THIS ISSUE CONTAINS { A Page of Costs
Hydraulic Engineering in the Yukon

Canadian Engineer

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For CIVIL, MECHANICAL, ELECTRICAL and STRUCTURAL ENGINEERS and CONTRACTORS

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Vol. 16. Toronto, Canada, February 19th, 1909. No. 8.

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For the Assistance of Engineers, Contractors and Purchasing Agents

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The Canadian Engineer

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TORONTO, CANADA, FEBRUARY 19, 1909.

CONTENTS OF THIS ISSUE.

COST KEEPING.

Recently we attempted to gather information in reference to the consumption of water and its cost in Canadian cities. After much correspondence and months of waiting the figures have been secured, but through it all one could not help noticing the lack of uniformity in methods of cost keeping, and, in some cases, the utter lack of method of record or reliable data as to water pumped and cost of pumping.

The Canadian Society of Civil Engineers is almost "committed" to death, and it is only at long intervals that we receive workable and valuable reports. We would like to suggest, however, one more committee, this one to report upon Uniform Municipal Cost Keeping. In these days of so much municipal ownership, with public-owned waterworks, street railways and lighting plants it would be very much to the advantage of not only the ratepayer and consulting engineer, but also the resident engineer, to be able to accurately compare costs.

It is not casting reflections upon the engineers in charge of municipal work to say that there is more "padding" in municipal costs systems than in any other system of bookkeeping. The initiative may be taken by the engineer, but the councils prune and finance, and it is apparent to everyone the schemes they adopt to increase the "uncontrolable" and decrease the "controlable" expenditure; to keep down the rate, but increase the assessment; to charge to capital account much that should be charged to current expenditure. All those little winning ways of some councils make it very difficult for the engineer to arrive at accurate figures in reference to costs, and make it doubly difficult for the engineer who properly charges expenditures to maintain his position. His results are compared with the returns from other municipalities, and frequently to his disadvantage.

Each department should have a distinct account and a system of bookkeeping that would show clearly its financial standing. The waterworks system should not be robbed to make the electric light plant pay, nor the roadways department used to prevent deficits on the street railway system. The taxpayer should have some means of knowing exactly the standing of each department and a basis for comparison with results in other municipalities.

The possibility of comparing results will have a double value. The taxpayer will take a greater interest in the undertaking, and will more readily assist in securing suitable equipment, and will stimulate employees to secure economical operation and careful management. It will have another value; it may show clearly that the larger the corporation, the more people to serve, the greater the cost; and it will also do very much to temper the remarks of many who fancy public ownership is the only method of securing service at reasonable cost.

It is not expected that a committee of engineers would work out an absolutely uniform system of bookkeeping, but working with a committee of accountants they might develop a system suitable of general application—a system that will bring out clearly the capital and operating or maintenance expenditures and unit costs. Conditions in Canada differ, costs vary, but it must surely be methods in bookkeeping which vary the cost of pumping water for city supply from 12.5 cents per 1,000

gallons in Manitoba to 0.011 cent per 1,000 gallons in Ontario.

It is not expected that a system so worked out would at once be adopted by all treasurers, but gradually, like standard specifications, it would be referred to until its use became universal.

PENNY WISE AND POUND FOOLISH.

Our Governments and our municipalities generally are very reluctant in spending money for preliminary surveys, experiments and researches. Some years ago, the Dominion Government did spend a little money on the electric furnace, but they could not be induced to follow up the work, and as a result several years have been lost, iron mines remain undeveloped, and, incidentally, Sweden, with its insignificant iron and steel possibilities, has solved the problem.

All over this great country there are particular problems to solve—problems peculiar to location, climate and population. The governing bodies can be induced to spend thousands upon construction, but to get even a couple of thousands to plan and survey for complete schemes is often impossible. As a result, many improvements consist of a patch here and there, and the finished work shows neither good workmanship nor good design. Usually, the engineer is not at fault. He may time and again place an amount for surveys in the estimate, but it is just as regularly eliminated.

It is a matter of slow growth, this ability to recognize the engineer as a man able to lessen expense when given an opportunity to prepare a complete scheme; and the engineer is the only one who can make known his value to the corporation. To be continually pointing out how mistakes in management are being made is not a pleasant task, yet it is frequently necessary. It is all very well for the council to assert that they are responsible. They are; but they have a way of accepting the responsibility when the scheme is a success and damning the engineer when it is a failure.

A little more publicity when the engineer launches his plan, a stronger fight for the entire scheme or none, and a clear, emphatic statement as to the necessity for preliminary reports would frequently save much misunderstanding and uncomfortable situations.

EDITORIAL NOTES.

Canada has not neglected her shipping interests. Since 1896 there has been spent on the wharves of Nova Scotia $2,318,828.52; of New Brunswick, $1,178,519.68; of British Columbia, $1,200,653.09—almost five million on three Provinces.

* * * *

The output of Canadian pig iron for 1908 was 563,672 tons, a decrease of only 3 per cent. from 1907. This is a much less decrease than was expected. The output for the first half-year was 307,074 tons, and the second half 256,598 tons.

* * * *

Regularly the Ontario Government receives deputations asking for amendments to the Good Roads Act, so that Government aid may be secured for bridge building as well as for road making. It is to be hoped the Government will not seriously entertain any such suggestion. We do not consider that the Good Roads Act was passed to assist rural municipalities, but rather to encourage and instruct in road-making. If Ontario roads were as good as Ontario bridges, rural highways in that Province would be very near the ideal.

Let the Government stand by their past policy of encouraging good roads. Good bridges are strictly local improvement schemes.

MR. ANDREW F. McCALLUM, B.A. Sc., has been appointed city engineer of Hamilton, Ont.

The Mexican Light & Power Company's earnings for January (Mexican currency):

	1909.	1908.
Gross	$556,297 84	$500,024 77
Expenses	146,891 59	213,519 37
Net	$409,406 25	$286,505 40
Fixed charges	207,414 00	165,770 44
Surplus	$201,992 25	$120,734 96
Expenses per cent. of gross earnings	26.40	42.70

COMING MEETINGS OF ENGINEERING SOCIETIES.

Association of Ontario Land Surveyors.—February 23, 24, 25, 1909, Annual Meeting, Parliament Buildings, Toronto Killaly Gamble, secretary-treasurer, 703 Temple Building, Toronto.

Canadian Cement and Concrete Association.—First Annual Convention and Exhibition, March 1-6, 1909, St. Lawrence Arena, Toronto. Secretary, A. E. Uren, 62 Church Street, Toronto. Manager of Exhibition, R. M. Jaffray, 1 Wellington Street West, Toronto.

Canadian Mining Institute.—March 3-5, 1909, annual general meeting, Windsor Hotel, Montreal. H. Mortimer-Lamb, secretary, Montreal.

Dominion Land Surveyors.—February 23, 24, 25, 1909, annual meeting, Ottawa, Ont. T. Nash secretary.

Northwestern Cement Products Association.—March 2-4, 1909, fifth annual convention, Minneapolis National Guard Armoury, Minneapolis, Minn.

Ontario Provincial Good Roads Association.—March 3, 4, 1909, Annual Meeting, County of York Municipal Hall, Adelaide Street, Toronto. J. E. Farewell, Secretary, Whitby, Ont.

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

RAILWAY EARNINGS AND STOCK QUOTATIONS

NAME OF COMPANY	Mileage Operated	Capital in Thousands	Par Value	EARNINGS Week ending Feb. 11		STOCK QUOTATIONS TORONTO				MONTREAL			
				1909	1908	Price Feb. 13 '08	Price Feb. 4 '09	Price Feb. 11 '09	Sales Week End'd Feb 11	Price Feb 13 '08	Price Feb. 4 '09	Price Feb. 11 '09	Sales Week End'd Feb 11
Canadian Pacific Railway	8,920.6	$150,000	$100	1,167,000	935,000	147½ 146	173½	175	95	145 144	173½ 173¼	174½ 173½	101
Canadian Northern Railway	2,986.9			120,700	116,900								
*Grand Trunk Railway	3,568.7	226,000	100	631,690	556,683		1st. pref.105, 3rd pref. 55½, ordinary 19						
T. & N. O.	305	(Gov. Road)		20,000	10 000								
Montreal Street Railway	138.3	18,000	100	70,904	63,744					175½ 175	207½ 206¾	208 207¾	533
Toronto Street Railway	114	8,000	100	68,008	63,635		120	120	291	97⅝ 97	120½ 120	120¼ 119½	389
Winnipeg Electric	70	6,000	100			138	168	170 169⅝	403		170 160	170 167½	

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

HYDRAULIC ENGINEERING IN THE YUKON.

R. E. W. Hagarty, B.A.Sc.

There are many factors which may enter into any great engineering work. Each of these will probably require the results of life-long study and experience in some well-defined "branch" of one of the departments included in the broad term "engineering." However, the market for special products, such as turbines, pumps, dynamos, steel work, etc., depends directly upon such things as the building of railroads, power installations and other commercial and municipal enterprises involving mass construction; and the greatness of such works is measured principally by magnitude and unit efficiency of results rather than by the scientific accuracy of constitutent parts.

It is evident, then, that the essential element in large engineering construction is organization; and the engineer in charge must be, above everything else, an organizer.

The subject of "Hydraulic Engineering in the Yukon" will be of interest partly from a purely hydraulic standpoint, but there are two other reasons for the writing of this article:—

First. While the writer wishes to devote special attention to the hydraulic and hydro-electric installation of the Yukon Gold Company, yet on account of the extent and completeness of this company's work, it is the intention to construct the whole article with a view to showing the organization features of such undertakings.

Second. There are several engineering conditions to be herein met with which are peculiar to the Yukon; and, since

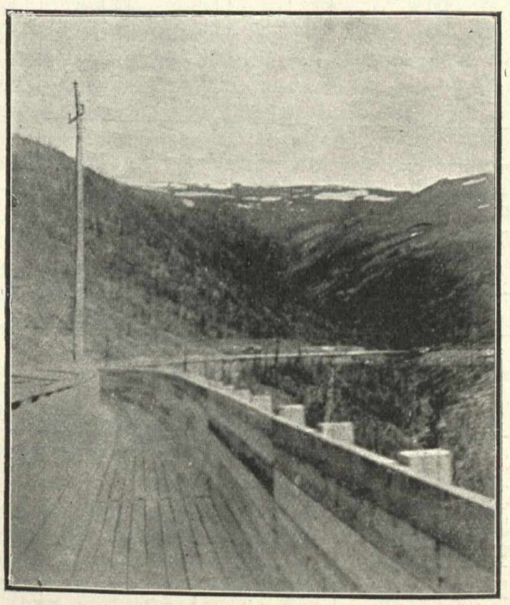


Fig. 2.—Open Timber Flume.

Canada's successful future will depend to a considerable degree upon the development of her vast northern unexplored territory, it is believed that all scientific information from the North will surely be of utmost importance.

A recapitulation of a previous article, entitled "Hydraulic Mining in the Yukon," * may throw light upon the discussion of the engineering equipment which has been installed for the purpose of meeting the requirements of the operations heretofore described.

Gold in the Yukon occurs principally in the free or placer state, and is usually found near bedrock depth, mixed with a yellow or black sand. Also, the ground, although surfaced by luxuriant vegetation, remains perpetually frozen nearly all the way up from bedrock. These are the two main conditions which effect the mining and engineering of the district.

At the present time mining of gold is the principal occupation in Alaska, U.S., and the Yukon, Canada. This

* The Canadian Engineer, Vol. XV., page 795.

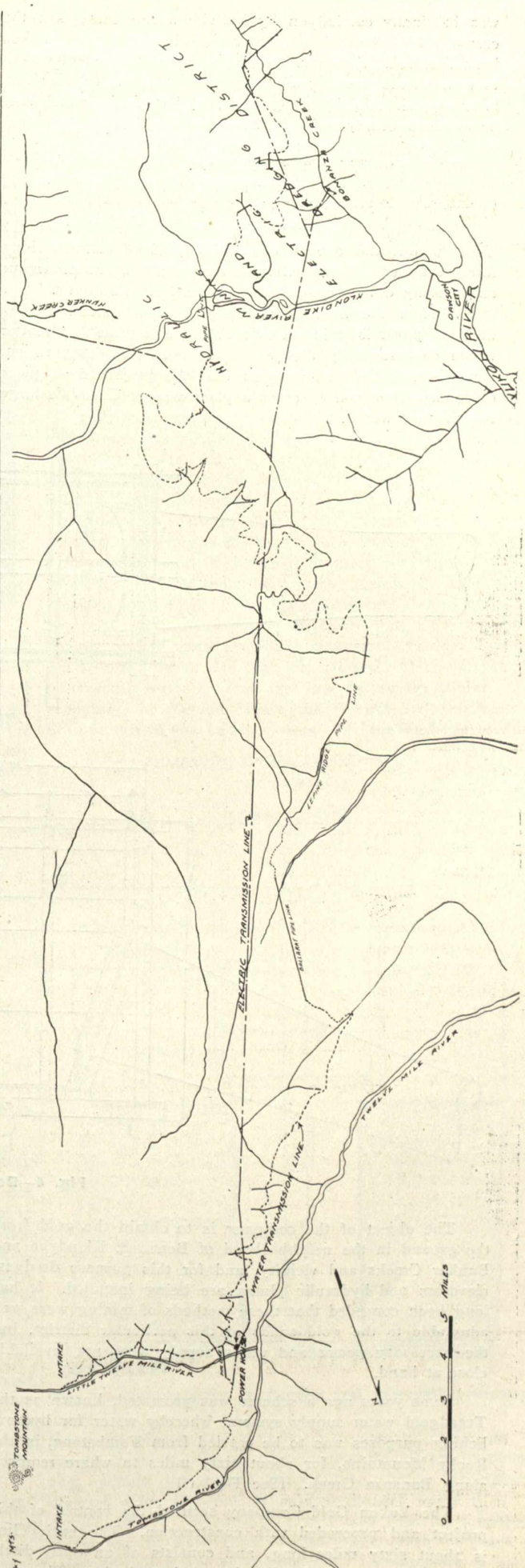


Fig. 1—Plan of Transmission and Pipe Line.

was originally carried on by individual interests; but the cream, as it were, of the discoveries already made has thus been removed. However, there still remains sufficient wealth to warrant the working of the ground on a large scale; that is to say, virtually by "large-company" methods, which may be outlined briefly as follows:—

(a) Dredging the creeks and valleys.

(b) Hydraulicking the hillsides.

(c) A combination of the above two, namely, the use of hydraulic and mechanical elevators.

There are many mining companies operating in the Yukon; but the one which probably is of all-absorbing interest under the present topic on account of its enormous engineering development is the Yukon Gold Company.

Whether the financial status of this organization as a dividend payer is or is not on a substantial basis is a matter which concerns only the stockholders of that corporation. Nevertheless, the fact remains that the project as a piece of construction well deserves a place among Canada's large engineering works.

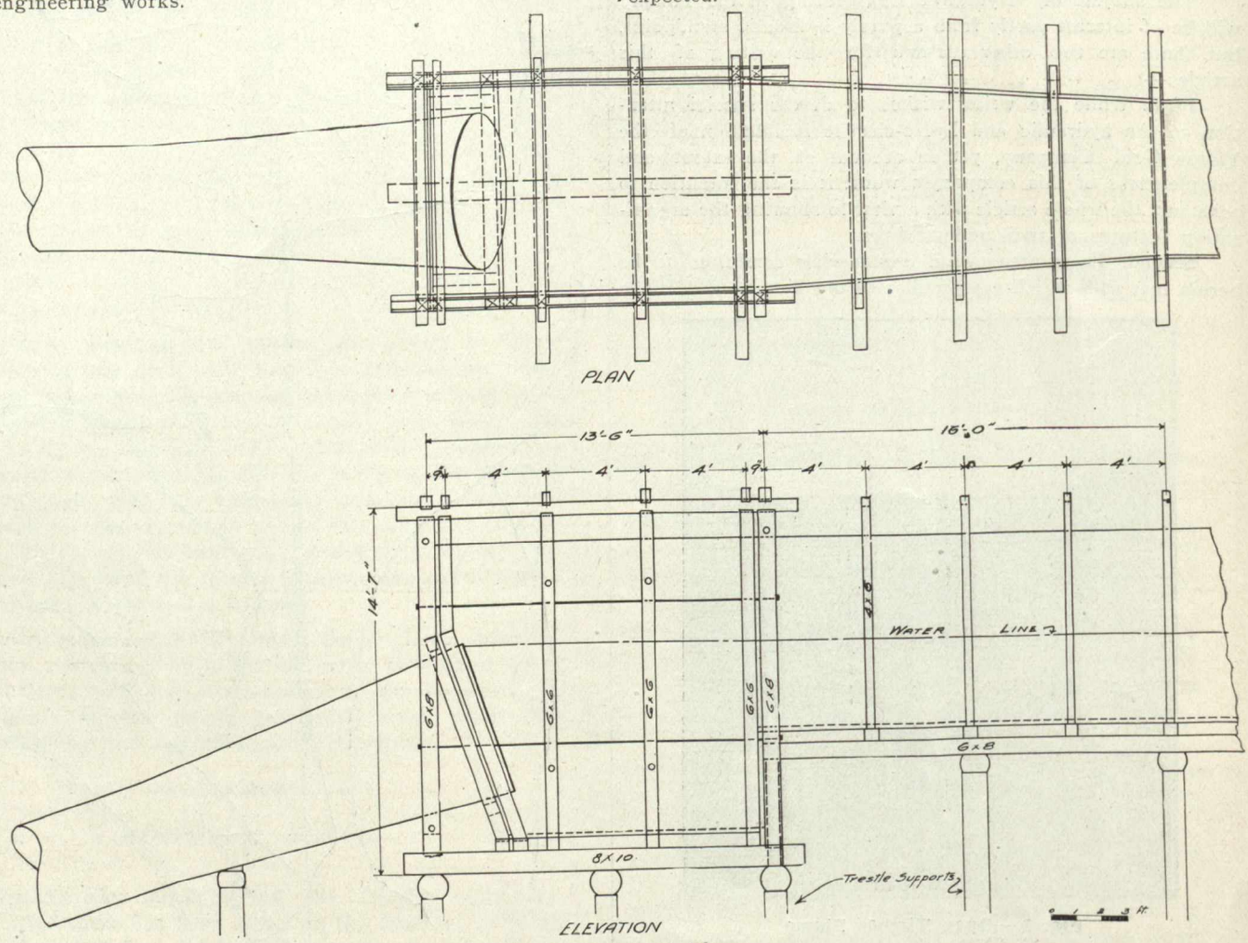


Fig. 4—Detail of Flume.

The object of the company is to obtain the gold from the ground in the neighborhood of Bonanza, Klondyke and Bunker Creeks and vicinity, and for this purpose dredges, elevators and hydraulic plants are being installed. It has long been conceded that these methods of mining were well adaptable to the gold sands of this particular district, but the necessary power and water supply were not available close at hand.

Some years ago a scheme was promoted, known as the Treadgold water supply system, whereby water for hydraulicking purposes was to be carried from Tombstone, in the Rocky Mountains, for about sixty miles to where required along Bonanza Creek. (See Fig. 1.)

The Yukon Gold Company secured the control of this project and proceeded with construction. The entire line is about sixty miles long, and consists of an open ditch, flume, wood-stave hydraulic pipe, and steel pipe. The open ditch follows the contour of the hills as far as possible on the same water shed. Then changing to the next shed, the intervening "gulch" is crossed by an inverted siphon. Fortunately, the line runs from the edge of the Rockies through the foothills; consequently a continuous down grade is easily maintained. In fact, the total drop throughout the line is sufficient to necessitate "killing" part of the available head. The company also develops their own power near the intake of the water line, and transmit for distribution also along the creeks in the mining district.

WATER TRANSMISSION LINE.

(a) The Intakes.

The capacity of the system is 10,000 miners' inches, or 15,000 cubic feet per minute. The source of supply consists of two intakes of 5,000 inches each, one on the Tombstone River and the other on the Little Twelve-mile River. Both intakes are in the neighborhood of Tombstone Mountain, around which the weather has the reputation of "raining once every day" during the four or five summer months; hence a constant supply may be expected.

The locations of the intakes are so chosen as to make their elevations more than one thousand feet above the elevations required for use along the creeks. The two streams from which the water is taken are mountain torrents, with glacial sources. The flow is supplemented by the evaporation and condensation in the form of rain of the mountain snow, which process continues throughout the greater part of the summer. The intakes in point of construction are merely tapered enlargements of the timber flume, yet to be described.

The Main Ditch.

For obvious reasons open ditch is used where possible. But it is in this portion of the line that the engineer finds himself closer to nature than in other portions of the construction, and, therefore, local climatic conditions are considerably more effective here than elsewhere.

In the winter months it is absolutely impossible to carry on any engineering work, partly on account of the frozen

ground and the severe climate, and also because of the long darkness of twenty hours per day throughout the coldest of the winter months. In the summer, however, the twenty hours of night is changed into day, and during the remaining four or more hours high twilight exists, which gives to the engineer a condition of practically perpetual daylight.

The hillsides are covered with thick moss and a wealth of vegetation, which in places is of almost tropical luxuri-

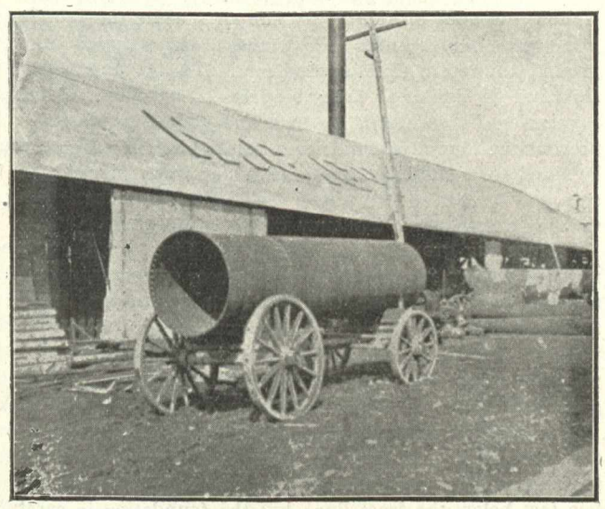


Fig. 4.—Steel Pipe in Dawson City.

ance. Underneath the moss there is usually found a foot or two of thawed soil, beneath which the ground under natural conditions remains frozen throughout all seasons. This condition exists from about the end of May until the end of September or middle of October, and renders any process of excavation uncertain, costly, and frequently dangerous.

In the first place, the ground must be thawed, and, in the case of open channels for conveying water, any mechanical process of softening the ground is too expensive; but if the moss is removed (see Fig. 5) the sun will act on the ground to a depth of six or eight feet, and if the melted water is once drained away the ground will probably not congeal again to the same extent. If possible, therefore, the moss is "stripped" off one summer previous to excavation.

After the thawing is done, if the soil is clean, sharp sand, ordinary steam shovel, scraper or other method of digging may be employed with little or no difficulty.

In case of clay, the usual difficulties in handling are met with, and also the process of thawing is much slower than in sand; but at least it can be said that a ditch in clay is satisfactory when finished.

However, there is another type of soil which, unfortunately, is frequently met with in the Yukon, known as "muck." It is frozen silt and loam, which melts easily, but invariably sloughs away. The difficulty of ditch-cutting in this material is apparent. There is still a worse condition often encountered when muck overlies a glacier and is sometimes part of it. Even if the glacier is surfaced with clay, when the water is turned into the ditch the effect is to honeycomb the ice, and in case of a side-hill excavation, the ground on the lower side is undermined and is in danger of sliding away.

In the map shown as Fig. 1 a considerable portion of the dotted line represents excavated ditch in the water transmission line. The cross-section would average five or six feet deep, seven or eight feet on bottom, with a one, or one and one-half to one slope. The grade is five to eight feet per mile.

The major part of the excavating was done with light steam shovels of Vulcan or Marion No. 20 type, burning wood, which is abundant.

Under best conditions of sand-digging a certain Marion No. 20 shovel averaged in the month of July as high as 100 cubic yards per hour. The entire camp included thirty-six men, working two shifts of ten hours each. The maximum rate of digging was 120 cubic yards per hour. In the month of June the same shovel averaged about 80 cubic yards per hour, the increase being probably due to improved organization of the gang by the foreman.

The operating cost for the month of July was 32 cents per yard, and the corresponding total cost about 50 cents per yard. The cost of handling glacial clay and muck by steam shovel in one case was $1.36 per yard. In another place where steam shovel could not be used the cost of handling by scrapers ran as high as $1.50 per yard. In general, the cost of excavation on work of this nature will probably run from 25 cents to $1.50 per cubic yard. However, it is to be remembered that any statements of cost for the Yukon are only of comparative value in view of the enormous freight rates on imported goods, and also the very high price of labor.

The Flume.

Even the excessive prices of excavation in glacial clay and muck still render the open ditch the cheapest way of conveying water, from a constructional standpoint. However, on account of the dangers of sloughing and honeycombing, it is often necessary to substitute for the ditch a continuous open timber flume (Fig. 3), supported by underpinning. The box is made of 2-inch dressed pine, 5 feet by 7 feet inside, and is designed to carry four feet of water. The details are indicated in the righthand side of the drawing of Fig. 3. It was originally intended to place the bents of underpinning 16 feet apart, but a more careful design placed these on 8-foot centres, according to which most of the flume has been constructed. It is not possible to transmit water through this line during the winter. Consequently, in the fall before the "freeze up" the water is drained out of the entire system. In long sections of flume

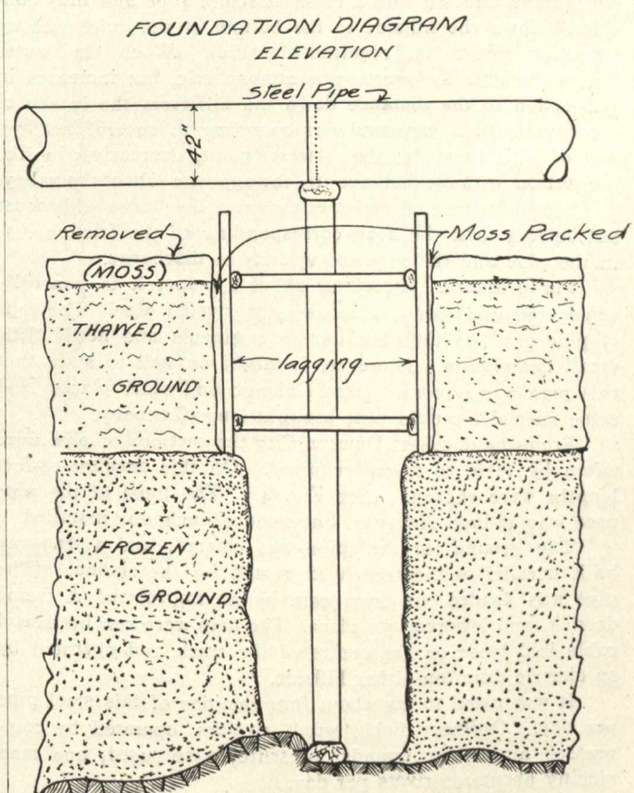


Fig. 5.—Cross-section of Ground and Foundation Diagram.

there are placed "turnouts," constructed according to the design shown in Fig. 4. One is operated simply by closing and opening the proper sluice-gates, whence the water is diverted a few hundred feet and discharged where it will be carried away. The same device is also used as a spillway, preventing the water from overflowing, in event of which the underpinning might be endangered. The question of underpinning will be dealt with under "Foundations."

The Inverted Steel Siphons.

By a reference to Fig. 1 it will be noticed that although the principal portion of the water transmission system consists of open ditch and flume following natural contours, yet at frequent intervals pipe lines are shown ranging from a few hundred feet in length on plan to more than three miles in one case. These pipe lines are known as "inverted siphons," which term is self-explanatory when the general application is known.

It is necessary, of course, to transfer the water in several places from water-shed to water-shed. To accomplish this

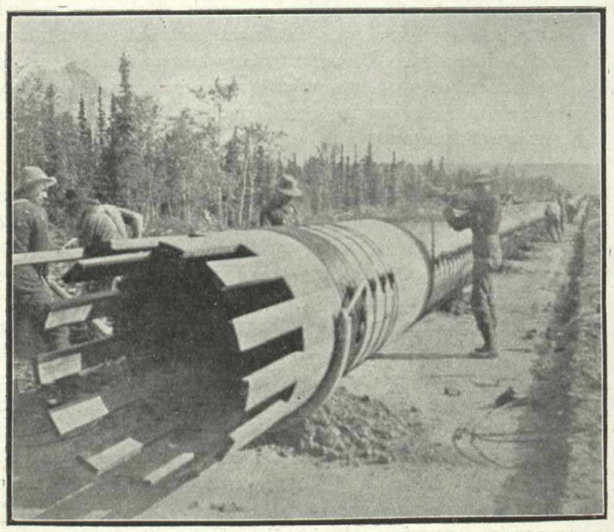


Fig. 6.—Wood-Stave Pipe.

the flow is directed into a closed circular pipe and thus conducted down the hillside to the bottom of the gulch and up the other side to the required elevation. When the water enters the pipe the pressure is atmospheric, but increases in proportion to the distance down the hill from the intake of the pipe until a pressure corresponding to several hundred feet of head exists at the lowest point, decreasing in like proportion with the distance up the opposite side of the valley.

The difference in elevation between discharge ends must not be less than the head corresponding to the friction loss in the pipe and the required velocity of discharge.

For pressures exceeding about 250 feet it is generally considered good practice to use steel-riveted pipe. The type of pipe used is that familiar to engineers and needs little detail description. However, it might be well to state that this pipe was imported from Chicago and other places, and some special lap-weld pipe brought from Germany.

From the docks at Dawson City the sections of pipe were taken by team to where required. On this account 18-feet lengths were chosen. (See Fig. 4.) The most of the pipe used was 42-inch diameter, but some 48-inch was installed.

The ground for the pipe was cleared, and a tramway built parallel to the trench excavated for the siphon. The pipe was loaded on tram cars by an improvised A frame derrick, and lowered into place. The cars were run by a steel cable laid loose on the centre of the track and operated by an electric drum on either hillside.

It was usual to lay about four sections of this steel pipe per day. Ordinary field "gun" riveters, operated by compressed air at 100 pounds pressure, were used, one man placing about 250 rivets per day.

The inclination of the siphon in many cases exceeded 45 degrees from the horizontal, so it was necessary to provide a means of anchoring. Steel wire rope was wound around the pipe just below a seam and crossed on top. The ends extended twenty-five or thirty feet, one on each side, where they were fastened to "deadmen" buried crosswise in the ground.

Foundations.

In connection with the steel pipe it is probably well to refer to foundations since they are of special importance in this connection.

At the bottom of the gulch the downward pressure of the pipe on both adjoining hillsides renders it necessary to support the siphon with considerable care. This is especially true of steel riveted pipe, which is designed according to an exact profile and any settlement would endanger the efficiency of the seams. Even after utmost care it was found that the riveted seams gave trouble upon turning in the water.

Fig. 5 shows a diagramatic sketch of the method of sinking the underpinning for the steel pipe. To save time the siphon was built on temporary supports while the foundation pits were being sunk. The moss was stripped and the ground allowed to thaw several feet. The ground below the frost line is similar in many respects to hardpan and merely requires to be excavated by pick and shovel or blasing. To prevent the thawed ground from "sloughing in" the pit must be lined to a sufficient depth with cut poles placed side by side and known as "lagging," behind which moss is packed to allay the thawing tendency of the atmosphere.

Since the ground lower than a few feet from the surface remains perpetually frozen it would seem unnecessary to sink all important foundations to bed rock. However, this is a fallacy, for it has been found that according to a well-known physical property concerning the "plasticity" of ice the pressure under any foundation support, such as a mud-sill, gradually melts the frozen ground and the sill slowly sinks.

In case of underpining for flumes, etc., however, where the pressure is not as great as in the case of steel siphon foundation, it is not customary to place the sill more than a few feet below the frost line; but the foundation is carefully packed with moss prior to refilling the pit.

In Fig. 5 the support for a steel pipe is shown. Bents are placed on twenty or twenty-five foot centres.

Wood-Stave Pipe.

In the case of inverted siphons, where the grade on the hillsides is not so great and where the depth of the valley is such that the pressure on the pipe crossing it will not exceed about 250 or 275 feet, it is considered economical to use in place of the steel-riveted pipe, continuous wood-stave hydraulic pipe of the same diameter.

Wood-stave pipe is probably the most novel feature of this transmission line and merits some special attention.

The pipe of two or three feet in diameter is made in sec-

Fig. 7.—Back Cinching.

tions, wrapped by galvanized steel wire and dipped in a hot bath of tar and refined asphalt.

The staves, which run lengthwise with the pipe, resemble somewhat the staves of a barrel. They are made of clear, kiln dried British Columbia Douglas Fir or California Redwood, and are dressed into perfectly true segments and beveled to suit the diameter. The spacing and size of the wire are adapted to the pressure under which the pipe is to serve. The interior of the pipe being perfectly smooth frictional loss is almost eliminated. The discharge of water is 10 to 15 per cent. greater than in case of metal pipe of equal dimensions.

On account of wood being a non-conductor the temperature of the water passing through wooden pipe is very uniform in winter and summer.

Freezing will not cause wood-stave pipe to burst like iron or steel. The wood expands and the steel wire or bands are merely embedded.

The cost of wood-stave pipe used under moderate head and average conditions is from 25 to 50 per cent. less than steel pipe.

The following are some of the advantages of this pipe claimed by manufacturers:

1. It is more durable than wrought iron or steel pipe.
2. It is cheaper than cast iron, wrought iron or steel pipe.
3. It has a greater carrying capacity than iron or steel pipe of many years' service.
4. Its carrying capacity is never decreased by rust.
5. It conveys water sweeter, more wholesome and cooler.
6. It is cheaply laid.
7. It is easily and safely tapped.
8. It needs no caulking.
9. It can be fitted to any connection.
10. No frost bursts.
11. No electrolysis.
12. No contraction.
13. No corrosion.
14. Freight saved.
15. Greater longevity.

This form of pipe is liberally used in British Columbia, California, and also in New Zealand and other parts of the world. In the Yukon it has been used wherever possible.

The pipe used in connection with the inverted siphons is 42-inch and 48-inch diameter, and is built continuous on the ground instead of in sections at the factory. The redwood staves were imported from California.

For pressures up to 196 feet the staves were one and five-eighths inches thick; and the iron bolts used as bands ½-inch round by 149¾ inches over all. For pressures above this the staves were two and one half inches thick and the bolts ⅝-inch round by 155¼ inches over all.

The following is a list of typical spacing distances for the iron bands:

42-inch Pipe.

Spacing in Inches.	Pressure in Feet of Head.
11	20
10	24
7	37
5	54
3¾	72
3⅛	86
2⅝	103
2¼	120
1¾	154
1½	180
1⅜	196

Size of Bolts Increased.

2	207
1⅞	220
1¾	236
1 1-16	245
1⅝	254

48-inch Pipe.

Spacing in Inches.	Pressure in Feet of Head.
10	20
6	41

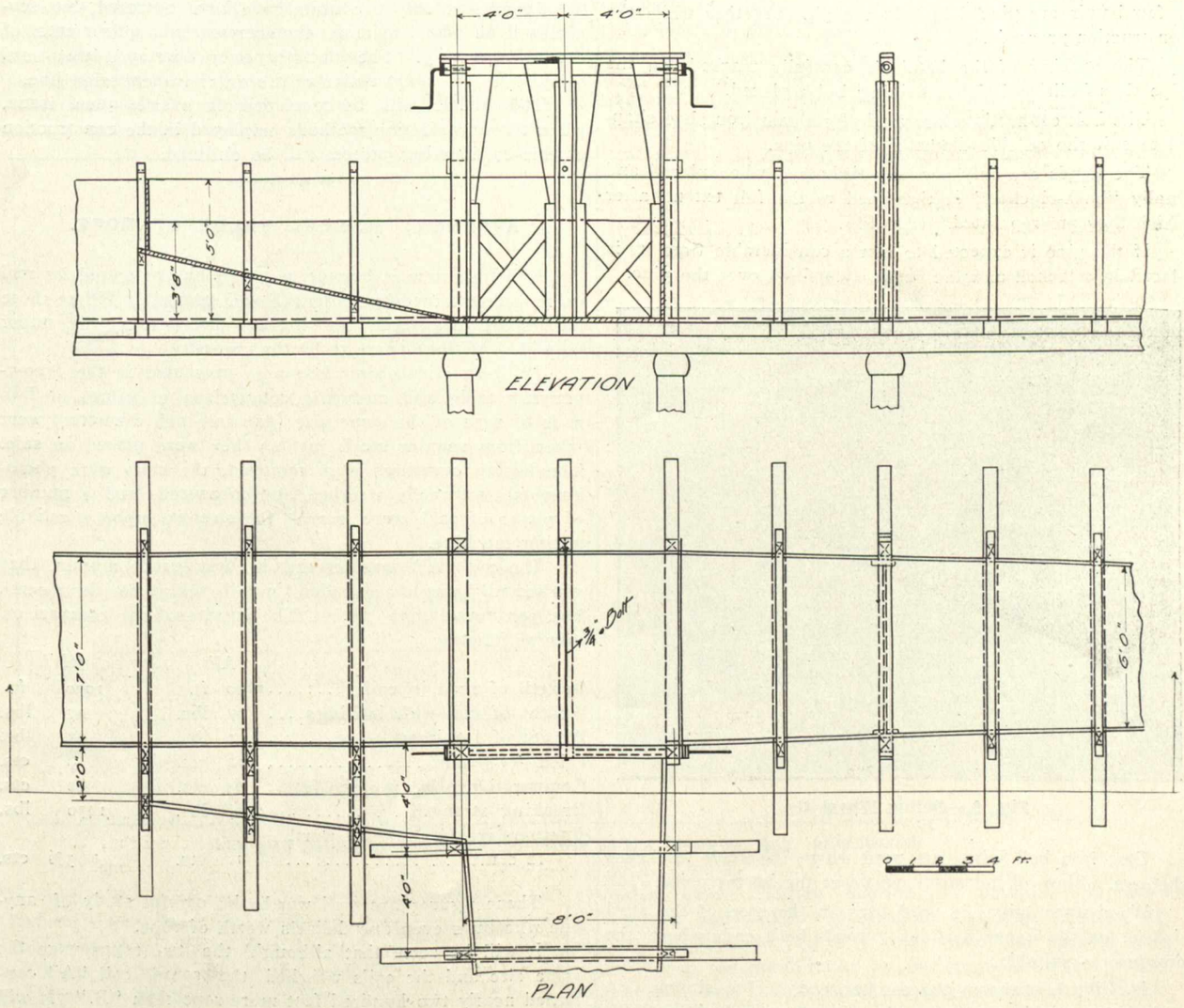


Fig. 3.—Turnout and Spillway.

4½	54
3¾	65
2⅞	85
2½	98
2 1-16	119
1 13-16	130

The material, consisting of the wood-staves and iron bolts, is delivered to a stock yard, from which it is distributed along the line as required. The bands are bent and painted in the stock yard.

The lower half of the pipe is built on a piece of lead pipe bent to the outside diameter of the siphon and the fourteen-foot staves allowed to project alternately thus producing the continuity of the pipe. (See Fig. 6.)

The top half is built around a wooden form placed inside the pipe and resting on the lower portion previously built. A few bands are placed to hold the pipe together while the construction proceeds.

The spacing of the bands is carefully marked on the pipe thus built and the remaining bolts placed.

The bolt connections are made by a cast iron shoe shaped to suit the outside diameter of the pipe.

The hands are only partially tightened when placed and finally "back-cinched" or tightened to the full extent, after which they are repainted. (See Fig. 7.)

If the pipe is expected to last a considerable time it is placed in a trench and the earth back filled over the pipe.

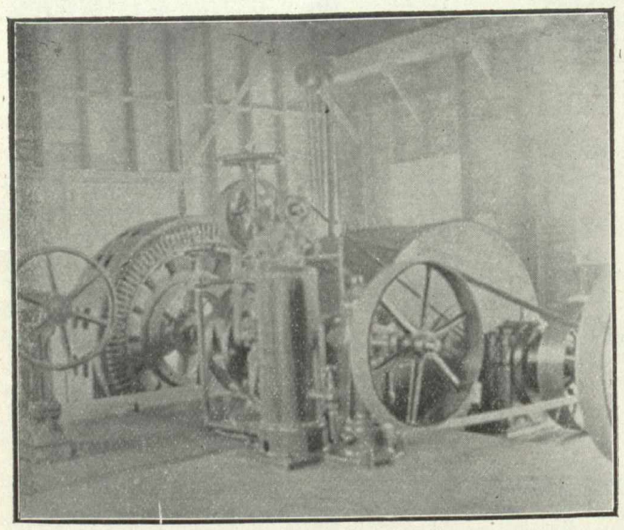


Fig. 9.—Pelton Wheel Unit.

Cast iron bell joints are used where the stave thickness changes. Blow-off holes are placed at the lowest point.

Wood-stave pipe is used even in the case of the steel siphon, on the upper portions towards both ends where the pressure is suitable.

In Fig. 8 is shown the discharge end of a siphon. A 16-foot taper joint expanding the pipe to 72-inch diameter is used for the purpose of decreasing the velocity of discharge in order to prevent undue eddying resulting in loss of water. The water is discharged into penstock box, where it returns to atmospheric pressure and continues in open flume for a greater or less distance before discharging into open ditch again.

Electric Development and Transmission Line.

The development of electric power is another important feature of the engineering work of the Yukon Gold Company.

In Fig. 1 it will be noticed that the power house is located close to the intakes of the water line, and a transmission line runs to the mining district.

Fig. 9 shows the one of the units in the interior of the power house.

The semi-circular casing shown encloses a four-foot diameter Pelton wheel. The head of water acting on the wheel is seven hundred and ten feet; and it was on this account a wheel was chosen in preference to turbine.

The feed pipe leading to the wheel under the floor of the power house is 14-inch diameter size; while nozzles used vary from 3¾-inch to 4¼-inch regular size, with a 2-inch nozzle for special use.

Connected directly to the shaft of the wheel is a 625 k.w. Canadian Westinghouse dynamo generating at 2,200 volts. The voltage is stepped up to 33,000 and sent out over a three phase transmission at 60 cycles.

In Fig. 2 the transmission line is seen crossing the open flume.

The governing apparatus for the Pelton wheels is shown in the foreground of Fig. 9. It was manufactured by the Sturgess Engineering Department of the Ludlow Valve Manufacturing Company, of Troy, N.Y. The speed of the wheel is regulated to 450 R.P.M.

At present only two units have been operated, but several will be added to meet the increasing requirements of dredge operating. The electric power developed was used to assist in the construction of the water transmission line.

This article will be concluded in a subsequent issue, when the organization methods employed in the construction of this engineering project will be outlined.

APPARENT vs. REAL VALUE OF ROPE.

Although rope is bought and sold by the pound its real value is determined by its length and strength. Where these factors are considered the highest priced rope will, under normal conditions prove to be the cheapest.

An instructive object lesson is presented in the accompanying table and authentic comparison of values. Two coils of rope of the same size (one-half-inch diameter) were taken from regular stock just as they were placed on sale. The burlap coverings were removed, the coils were photographed, accurately weighed and measured, and a number of pieces of each were tested for strength upon a reliable testing machine.

The coil "A" was of the highest grade manila, that marked "B" was of "so-called" manila selling for three cents less per pound than "A." The results of the comparison were as follows:

	"A"		"B"	
Length of rope in coil	1250	ft.	1070	ft.
Weight of coil with lashings	97	lbs.	97	lbs.
Weight of lashings	1	lb.	3	lbs.
Price per pound	12	cts.	9	cts.
Comparative price per 100 feet	93	cts.	82	cts.
Breaking strength	2907	lbs.	1450	lbs.
Comparative value ("A" worth 12 cents)	12	cts.	5⅔	cts.

These figures are well worth the careful study of anyone who buys even one dollar's worth of rope.

It will be seen that although the two ropes were the same size and the coils weighed the same, coil "A" contained nearly two hundred feet more rope than "B." It will also be seen that while rope like "B" can be bought at three cents per pound less than "A" the actual cost of 100 feet is only eleven cents less.

The difference is better shown when we consider the most important quality of these ropes—the strength.

The figures indicate that "B," although much heavier, was less than one-half as strong. Assuming the value of "A" to be 12 cents per pound, a simple calculation shows that, taking into consideration weight and strength, the comparative value of "B" is only 5⅔ cents per pound. Or, to return to the original proposition, when high grade rope like "A" can be bought for 12 cents per pound, every penny above 5⅔ cents per pound paid for rope like "B" is absolutely wasted. Of course the same proposition holds good with the price of "A" higher or lower.

Actual figures might vary in other cases, but the results are typical of those always obtained in buying low-grade rope.

THE GEORGIAN BAY SHIP CANAL.

By J. C. C. Kerry.*

The recent growth of population and industrial activity in the Canadian Provinces of Manitoba, Saskatchewan and Alberta has once more drawn the attention of the Canadian public to one of the oldest transportation routes on the continent, that which, following the Ottawa Valley, extends from sea level at Montreal, via the Ottawa and French Rivers, to the upper lake level at French Harbor, in the Georgian Bay. Historical evidence shows that this was, in common with most of our great traffic routes, an established and much-used pathway before the advent of European colonization in North America. The Georgian Bay route, as it is commonly called, was used by the first white man to reach the upper lakes, Samuel de Champlain; and it was, perhaps, fitting that the surveys for a modern waterway along the natural route that he followed should be completed, and their results announced, while the tercentenary of his settlement in Quebec was being celebrated with pomp and circumstance by the representatives of three great nations.

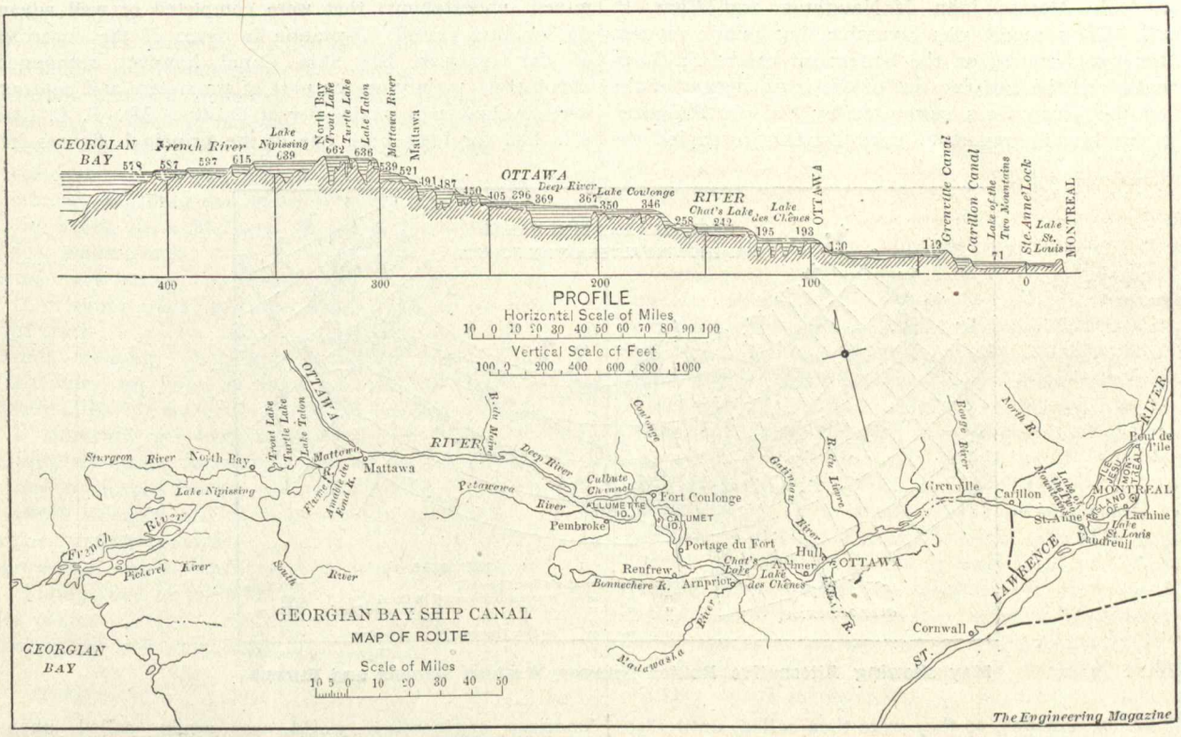
Champlain founded Quebec in 1608, and his followers immediately commenced working their way westward by way of the Ottawa River, choosing this route because that via the St. Lawrence River was barred by the hostile Iroquois from their settlements in what is now the State of New York; this accounts for the early use of the northern route just as at a later date the hostility of the United States to British interests accounted for the building of the Rideau Canal in preference to the opening up of the navigation of the St. Lawrence River. By 1613 Champlain had penetrated inland as far as the present town of Pembroke, and in 1615 he made his memorable journey to the Georgian Bay and thence via the Trent Canal route to Lake Ontario. To-day the canalization of the Trent waters, commenced by the British Government about 1835, and then abandoned on account of political disturbances in Canada, is rapidly approaching completion, and the canalization of the waters of the Ottawa and French Rivers is one of the major projects under consideration by the Canadian Government.

If any question is asked regarding the late date at which the improvement of natural routes of such evident importance is being undertaken, it can be readily answered. Until the present decade Canada has had no need of transportation facilities of the highest order between the upper lakes and the Atlantic; her north and her north-west have lain unoccupied save by the trapper and the fur trader, and practically no all-Canadian traffic has been afloat on her inland seas. At the same time the uncompromising commercial hostility of the United States has prevented its Western people from benefiting in any way by these great waterways, the American tariff laws making the handling of American import trade via Montreal a commercial impossibility.

The natural advantages of the Ottawa Valley and Trent Valley routes were recognized at an early date by the Canadian railways, and to-day the main line of the Canadian Pacific Railway follows Champlain's route up the Ottawa River, while the Grand Trunk Railway has for many years sent its Western grain traffic by the path which that explorer travelled from the Georgian Bay to the eastern end of Lake Ontario. The efficiency of the railway has materially delayed the advent of the canal.

Following Champlain to the West came the Jesuit missionaries, whose "Huron Mission" is, perhaps, the most picturesque and saddest incident in Canadian history. It is over two hundred and fifty years since that mission was wiped out in the annihilation by the Iroquois of the people to whom it was sent, but the writings of its members as recorded in the "Relations des Jesuits" made the Georgian Bay route familiar to western Europe centuries ago. It is worth noting that recently the main lines of the great lake and rail terminal which the Grand Trunk Railway is building at Tiffin, on the Georgian Bay, were deviated to avoid the ruins of the old headquarters of that pioneer mission.

By the same route came the Sieur de la Verendrye almost a century later on that expedition which brought him finally, as the discoverer of the far North-West, to the Rocky Mountains. Later, for a short time after the conclusion of the American War of Independence in 1783, Montreal became the centre of the fur trade and the Ottawa Valley and the French River its highroad. The short and savage struggle for the commercial mastery of the North-West between the North-Western Fur Trading Company of Montreal and the Hudson Bay Company brought the route into a prominence which ceased when the contract ended in the amalgamation of the two companies into that great corporation which for



Plan and Profile of the Projected Route of the Georgian Bay Ship Canal.

* Mr. Kerry, of Smith, Kerry & Chace, Toronto, Ont., prepared this article in the first instance for The Engineering Magazine, and through their kindness we are able to use it in this issue.

about half a century ruled over well nigh half the continent; from motives of policy that corporation closed up the route via the Ottawa River and sent all its traffic via Hudson's Bay in order that the North-West might be forgotten and the trade monopoly that had been created by King Charles II. perpetuated. The maps of the continent will, however, bear witness forever to the energy of the men of the North-West Company who named the lands by their own names, and who, as the pioneer Canadian engineers, were first to open Lake Superior to through traffic by their canal construction at Sault Ste. Marie.

After the conclusion of the War of 1812, the great future of the Western plains and the importance of the Great Lakes to their commercial development were recognized by both Briton and American. The State of New York, under the inspiration of De Witt Clinton, built the Erie Canal, and almost simultaneously the British Government built the canals along the lower Ottawa River and the Rideau and commenced work on the navigation of the Trent River. With the construction of the Rideau Canal began the rise into importance of the city of Ottawa, and in 1837 its merchants sent out the first expedition to study the possibilities of the Georgian Bay route for canal construction, the examination being made by Messrs. John McNaughton and Chas. P. Treadwell. Their report was favorable, but public interest at the time was centred on the betterment of the St. Lawrence route, and the carrying out of the improvement of the latter, on the broad lines suggested by Colonel Philpotts, R.E., in his historic report to Lord Durham, occupied the energies of the Canadas, as they were then called, until 1850.

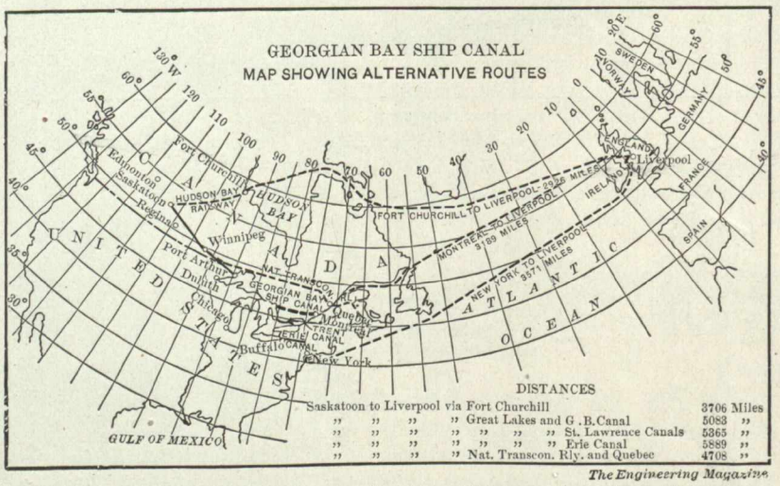
The following decade, 1850-1860, witnessed the first great era of railway building in Canada, but although the ablest and most farseeing of Canadian engineers had realized at that time, and were openly stating, that the day of the canal as a general system of transportation had passed, the public was agitating for further canal construction. As a result of this agitation Mr. Walter Shanly was commissioned by Parliament to make a report upon the construction of a canal by the Georgian Bay route. The result of his investigation was made public in 1858. There was then no Canadian traffic to be carried on such a waterway, and west of Pembroke there were but few people resident along the route. The absence of any commercial reason for the immediate construction of the canal, other than a hope of diverting American traffic from American routes, perhaps accounts for the fact that the appropriation made did not provide sufficient funds for the completion of the surveys, and Mr. Shanly's report, was, therefore, somewhat of the nature of an interim report. The estimated cost of construction of a ten-foot waterway was given by him at $24,600,000, the general principle of his design being the cutting of canals at all points not already navigable, in preference to the canalization and regulation of the rivers. The problem of the summit level was met by Mr. Shanly with the bold suggestion, worthy of his great reputation of an engineer, that the level of Lake Nipissing should be raised until that ample lake became the summit level, a reasonable proposal in times when there was neither settlement nor improvement on its now busy shores.

Mr. Shanly's work was continued and completed in 1860 by Mr. T. C. Clarke, who estimated the cost of construction of a twelve-foot waterway at $12,057,680, the decrease in the estimate being largely due to the adoption of considerably lower unit prices for the necessary excavation. Mr. Clarke favored, where possible, the use of canalized river in preference to canal. The feasibility of the project was now established beyond question; it remained only to demonstrate that there was a commercial need sufficiently great to justify the expenditure called for. No such need existed in 1860, and up to the present day the volume of traffic that will be carried by this waterway has been, and is, a matter of controversy.

From 1860 to 1890 the attention of the Canadian people was fully occupied with projects of national importance, the Confederation of the Dominion, the construction of the Intercolonial and Canadian Pacific Railways and the opening up of the fourteen-foot navigation from the Great Lakes to the Atlantic via the St. Lawrence River being the most prominent undertakings that were completed or well advanced during that period. Agitation in favor of the construction of the Georgian Bay Ship Canal, however, recommenced about 1890, mainly on the part of promoters and contractors with headquarters in the city of Ottawa. Mr. T. C. Clarke, who had for long been one of the principal figures in the American engineering world, was again called upon to report. In 1898 he recommended the adoption of a barge canal, with fourteen-foot depth on the lock sills, but questioned the practical utility of any such waterway in view of the small amount of Canadian traffic on the Great Lakes. He modified his earlier plans by abandoning the idea of raising the level of Lake Nipissing, thirty miles of the road-bed of the Canadian Pacific Railway and the town site of North Bay lying within the flood-line contour, and he proposed instead the lowering of the small summit lakes, Trout Lake and Turtle Lake, to the level of Lake Nipissing.

The idea of the navigation of the Great Lakes by ocean-going vessels has always been a most attractive one, and for over a century it has found many enthusiastic advocates both in Canada and in the United States. It was the basis of Colonel Phillpott's report in 1840, the raison d'être of the international "Deep Waterways Commission" of 1896 and the underlying principle of the early designs for the Georgian Bay Canal. In more recent proposals, however, it has been recognized that the conditions of navigation upon the ocean are so different from those which obtain on the Great Lakes that the same type of vessel cannot be economically used in both services. The purpose of the Georgian Bay Ship Canal as now projected is to bring the lake carrier to a point where she can trans-ship directly into the ocean liner. As a result

(Continued on page 277.)



The Engineering Magazine

May showing Alternative Routes between Western Canada and Europe.

A PAGE OF COSTS

ACTUAL, ESTIMATED and CONTRACTED

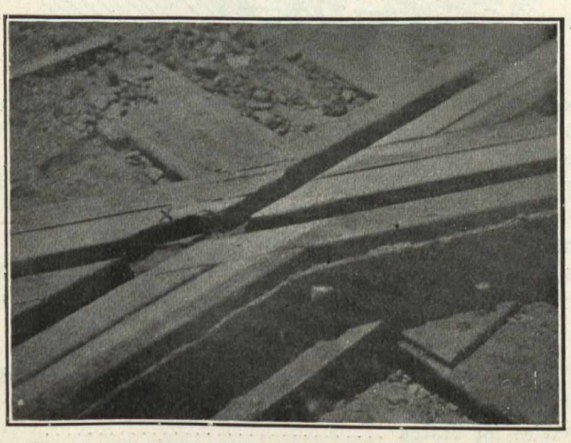
COST OF TRACK WORK.

At the last quarterly meeting of the Street Railway Association of the State of New York some very interesting figures were given relative to the cost per foot of track for the installations of Thermit welded joints and Clark joints.

The figures relating to the cost of Thermit joints were introduced by Mr. M. J. French, engineer of maintenance of way of the Utica & Mohawk Valley Railway Company, and itemized as follows:

The Itemized Labor Cost Per Foot of Single Track on Whitesboro' Street.

Placing and removing temporary track, per linear foot.	$0.31
Excavation, including hauling, per cubic yard, partly concrete, $1.05, or per foot on track	.46
Hauling away old materials, including old rails, wooden ties, scrap, old paving materials and cobbles, per foot of track	.03
Delivering track materials per foot of single track	.04
Track laying and surfacing per foot of single track	.19
Delivering concrete materials, including loading and hauling of sand 19 miles by work train, and breaking of old concrete and stone to use in new concrete, per foot of single track	.13
Concreting, including dry mixture under ties and under rail bases, per cubic yard, $1.51; or concreting per foot single track	.45
Placing track basins, two basins being located every 500 ft. of single track; price per basin $8.64, or per foot of track	.02
Thermit welding, including labor on molds and crucibles, per joint, $1.24; per foot of track	.04
Delivery of paving materials, including loading of blocks at storeyard, per foot single track	.11
Cleaning up street, including removal of unused materials, broken bricks, and regrading of lawns between sidewalk and curb, per foot of track	.06
Flagmen and switchmen	.01
Engineering, superintendence and inspection (not including time of foreman)	.09
Brick paving	.21
Timekeeping and watching	.05
Total cost	$2.19



The Cross Indicates Where Thermit Nickel Steel was to be Welded In.

Speaking of the Thermit joint, Mr. French said that in 1905, when relaying the track on Genesee Street, he had applied 700 Thermit welds. Welds had failed in both 1906 and 1907, but he thought that the later breaks were due to the running of heavier equipment. On a line laid in 1907, he put in 206 Thermit joints and the following spring found five breaks, a little less than 2 per cent. It was his belief that a railway company could well afford to have such a small percentage of failures, in view of the excellent bonding and fine riding track which the Thermit joint affords. At the same time, he was in favor of the Clark joint, because it did not have the line of recrystallization or reheating, which is the cause of most breaks in Thermit welds.

It might be explained here, for the benefit of those who may not be familiar with the Clark joint, that it consists of a fish-plate bolted to the rails by means of drive fit bolts driven into reamed holes passing through both plates and rails. A Thermit steel shoe is then welded about the base of the rails for the purpose of giving the joint high electrical conductivity. The joints which Mr. French installed were on 100-pound A.S.C.E. T-rail and consisted of the regular 36-inch angle plates with 13/16-inch holes spaced for drilling 2½ inches x 6 inches x 7 inches from the rail end to allow for tie clips. The lower flange of the joint was sheared off so as not to project beyond the rail base, and the plates were slotted to receive the steel tie clips. The 13/16-inch holes were reamed with Ludlow adjustable reamers operated by a Cleveland electric drilling machine.

The total cost of materials per single foot of track on a street on which Clark joints were installed was given by Mr. French as follows:

	Dollars.
Crushed stone, figured as all new stone	.285
All stone used was screened from excavated material.	
Concrete sand, labor only, given in labor items:	
Portland cement for concrete at $1.23 per barrel	.287
Steel ties complete, with clips and bolts, $1.66 each	.443
T-rail, 100-lb. A.S.C.E., $33.80 per gross ton, 60-ft. length	1.006
Clark joint plates, per pair, sheared and slotted, $1.45 each	.0483
Joint bolts, 1¼ in. x 4¾ in., each 9.53 cents	.0191
Tie-rods, ⅜ in. x 2 in. x 5 ft. 2 in., each 26.3 cents	.0351
Track inlets with connections, Syracuse type $8.75 each	.0360
Thermit, 8 pound per joint at 25 cents	.0667
Welding supplies, crucibles, thimbles, etc.	.005
Paving sand, 1 cu. yd. to 27 ft. of track at 63 cents	.0233
Paving blocks 42 per sq. yd., price $25.50 per M	1.146
Portland cement, for grouting and flushing, mixed (1:2 covers 20 linear ft.)	.0615
Total cost of materials per foot of track	3.4620
Add 10 per cent. for use of tools and power	.346
Total cost for materials and power	3.808
The actual labor cost per foot of track was:	
Excavation, while cars were operating, 0.365 cu. yd.	0.1455
Hauling old materials to storeyard	0.0797
Delivery of track materials	0.0398
Track laying, including drilling for and placing tie rods	.1379
Delivery of concrete materials, including loading of sand at Little Falls bed and hauling 15 miles	.1141
Concreting track to pavement grade, 0.233 cu. yd.	.3509
Placing track inlets, per basin $1.04	.0034
Placing Clark joints, reaming and bolting up	.0230
(Cost per joint, 68 cents; if holes had been reamed by electric power, cost would have been 35 cents.)	
Welding joints, including making of molds and crucibles	.0325
(Cost per joint, 97 cents, including four combination joints.)	
Delivery of paving materials, sand, cement and blocks	.1297
Street paving, pounding, grouting and rail batter	.2607
(or .2356 per sq. yd.).	

Cleaning up street, including hauling of surplus screened stone and fine screenings, grading lawns, adjusting sidewalks, etc.	.1101
Watching and timekeeping	.0380
Flagmen and switchmen	.1050
(Two flagmen from transportation department at 24 cents per hour, and one switchman at 15 cents per hour, 20 hours a day.)	
Superintendence, engineering and inspection	.0357
Total cost of labor per foot of single track	1.06060

It should be stated in connection with the above that, on this particular work, the bolt holes had to be reamed by hand instead of by electricity, which brought the total cost of reaming each hole to about 6½ cents instead of about 1 cent, which is the usual cost.

It is to be hoped that by the time the next meeting of this association is called to order, it will be possible to present some accurate figures as to the cost and endurance of the new Thermit joint (shown for the first time at the September meeting of the American Street and Interurban Railway Association at Atlantic City, and described in the Third Quarter of Reactions.) These joints have already been installed in New York and are giving satisfactory results under the severest possible service conditions.

COST OF SETTING WATER METERS AND LAYING SERVICE PIPES.

By W. H. Shillinglaw.*

The cost of setting water meters during 1908 by the city of Brandon Waterworks Department, Brandon, Manitoba, was as follows:

	⅝-inch	¾-inch	1-inch	1½-inch
Crown meters				
No. of meters set	499	20	5	2
Cost of labor	$295.85	$20.55	$5.97	$2.60
Average cost per meter	.593	1.02	1.20	1.30
Cost of materials	145.73	10.24	1.84	.....
Average cost per meter	.282	.51	.37	.....
Total average cost per meter	.875	1.53	1.57	.....

These meters were all set in basements by day labor by city employees. The cost for ⅝-inch meters varied from 20 cents to $2.00 for labor. A large number of these meters were installed on old services and entailed considerable alteration in service pipes and additional expense. The cost of setting meters on new services varied from 20 cents to 50 cents for labor.

The cost of laying water service pipes during 1908 was as follows:

	½-inch	¾-inch
Number of services	92	7
Number of feet laid	3,051	290
Cost of labor	$1,030.73	$96.69
Average cost per foot	.34	.333
Average cost per service	11.38	13.81
Cost of supplies	857.38	121.90
Average cost per service	9.32	17.41
Average length of service	33 ft.	41 ft.

These services were laid in 10 ft. trenches in sand, gravel, clay, some dry and a considerable number very wet, and requiring pumping. Refilling well rammed.

Cost of labor includes making up service, tapping main, etc.

All work done by day labor by city employees. The cost of labor varied from 26 to 50 cents per lin. ft.

The ¾-inch services were all made up for 2½-inch branches to serve two premises.

WINNIPEG.—The City Council passed a by-law to provide for an issue of half a million pounds sterling in bonds on the London market, the money to be used for local improvements and municipal power plant.

CITY ENGINEER'S OFFICE.

Brandon,.....**June 9**.....**1908.**

I beg to report the following labor and material used in installing.....**New Service**.....for Premises No.....**6th**.....Street, for Mr.....**Evans**.....Ser. No....**1149**... Installed by .....**Huxley**.....

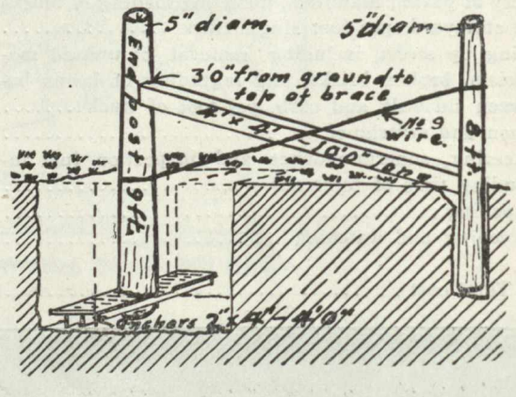
Labor	12½ hrs. at 25		$ 3.12
	10 hrs. at 20		2.00
	27½ hrs. at 17½		4.81
Length of trench	44 ft.		
Materials:			
44 ft.	in.	lead pipe	6.16
ft.	in.	lead pipe	
ft.	in.	iron pipe	
ft.	in.	iron pipe	
1	½ in.	Corp'n Cocks	.99
1	½ in.	Kerb Cocks	1.85
1		ServiceBox	1.87
	in.	Unions	
	in.	Elbows	
	in.	Check Valve	
			$20.80

Signed .....**Wm. Smith**.....Foreman.

Blank for reporting cost of laying service pipe.

COST OF WIRE FENCE.

Wire fence is coming more into use. The increasing cost of lumber makes wire cheaper. The costs given herewith are for forty rods of fence, Frost & Wood woven wire pattern. It was a nine wire (52 inches high), and posts were



placed twenty feet centre. The posts were eight feet long, and the smallest posts were five inches in diameter at the small end. The two anchor posts were nine inches at the small end, nine feet long, and were set four and a half feet deep. The other posts were set three feet deep.

Material:

32 posts at 25 cents (delivered)	$ 8 00
2 end posts at 50 cents (delivered)	1 00
2 braces, 4 in. by 4 in.—12 ft., at 25 cents	50
2 anchors, boards and braces at 25 cents	50
40 rod woven wire at 47 cents	18 80
5 pounds staples at 3½ cents	17
Wire for braces	13
	$29 10

Or 72¾ cents per rod

Digging and Setting:

Post-hole augurs were used, the first foot and a half been taken off with a spade. For the anchor posts at each end the holes were dug with a spade all the way.

Digging:

12 hours at 25 cents per hour	$3 00

Setting:

5 hours at 25 cents per hour..... $1 25

Making a total of $4.25, or 12½ cents per hole for digging and setting.

Stringing Wire:

1 foreman—5 hours at 35 cents per hour.....	$1 75
1 laborer—5 hours at 20 cents per hour.....	1 00
	$2 75

Forty rods cost $2.75, or for stringing wire, 6.8¾ cents per rod.

Material cost	72¾ cents per rod
Labor cost	6 4-5 cents per rod
	79 11-20 cts. per rod

CONCRETE SIDEWALKS.*

The question of relative cost of hand-mixed and machine-mixed concrete is frequently discussed. We give here the work of three gangs, two gangs laying hand-mixed concrete and one machine-mixed.

Section A was hand-mixed, and was 300 feet long and 5 feet wide, comprising 166.6 square yards, and costing as follows:—

		Per sq. yard.	Per sq. foot.
1 foreman, 8 hours.... $53 20 15 laborers, 120 hours.....		$0 32	$0 03½
Material:			
Cement	86 00	51	05⅔
Gravel	34 08	20	02¼
Total cost	$173 28	$1 03	$0 11½

Section B was hand-mixed, and was 380 feet long and 5 feet wide, comprising 211 square yards, and costing as follows:—

		Per sq. yard.	Per sq. foot.
Labor:			
1 foreman, 8 hours..... $59 10 18 laborers, 144 hours.....		$0 28	$0 3
Material:			
Cement	109 20	51	05⅔
Gravel	49 70	23	02½
Total cost	$218 00	$1 02	$0 11 2-5

Section C was machine-mixed, and was 575 feet long and 6 feet wide, together with an approach 27 feet by 2¾ feet—altogether, 391.5 square yards, and cost as follows:—

		Per sq. yard.	Per sq. foot.
Labor:			
1 foreman, 8 hours... $ 55 70 23 laborers, 184 hours.....		$0 14	$0 01½
Material:			
Cement	202 80	51	05⅔
Gravel	92 30	23	02½
Total cost	$350 80	$0 88	$0 9 9-10

These sidewalks were six inches thick. No allowance has been made for use of tools or machine.

Comparing the costs per square foot, it will be found that the material cost the same in each case, but that the cost of machine mixing was about two-thirds less than hand-mixing.

* From information furnished by H. J. Warwick, Superintendent of Works, Victoria, B.C.

THE LONDON STREET RAILWAY.

Annual Report.

The London Street Railway Company was incorporated in 1875. The company operate 33.25 miles of car line, comprising the street railway system of the city of London, Ont. They have a monopoly of surface street railways in the city until 1925, with a five year renewal clause. Authorized capital, $750,000.

The following statistical table which is an abstract taken from the report presented at the annual meeting on February 3rd, contains valuable information as to cost per car mile and revenue received.

Statistical Statement.

Years Ended Dec. 31.	1896.	1899. (Strike).	1903.	1907.	1908.
Gross Earnings	$94,194.19	$59,947.58	$172,084.53	$232,376.59	$235,032.40
Operating Expenses..	$54,171.18	$66,872.16	$109,493.15	$168,024.88	$167,566.72
Expenses, Per Cent. of Earnings	57.5	111.5	63.0	72.3	71.3
Net Earnings	$40,023.01	$*6,924.58	$ 62,591.38	$ 64,351.71	$ 67,465.68
Net Income, Per Cent. of Capital	10.11	*7.25	7.91	6.88	7.10
Passengers Carried .	2,432,416	1,463,182	4,305,975	6,321,994	6,442,998
Car Earnings, per Revenue Pass ..	3.83c	3.86c	3.83c	3.63c	3.64c
Total Passengers ..	2,803,443	1,662,896	5,047,456	7,361,356	7,505,304
Car Earnings per Passenger	3.32c	3.39c	3.27c	3.07c	3.07c
Car Mileage	854,604	972,651	1,286,263	1,435,993	1,427,353
Gross Earnings per Car Mile	11.02c	6.16c	13.38c	16.18c	16.47
Operating Expenses per Car Mile ...	6.34c	6.88c	8.51c	11.70c	11.74c
Net Earnings per Car Mile	4.68c	*.72c	4.87c	4.48c	4.73c
Number of Miles of Track	23.61	28.26	29.97	33.25	33.25
Gross Earnings per Mile of Track ..	$3,989.58	$2,121.28	$5,741.89	$6,988.77	$7,068.64
Population (City Estimate)	34,855	38,575	39,265	47,769	49,431

Taxes included in Operating Expenses, commencing year 1905.
*Deficit.

TRADE INQUIRIES.

The following were among the inquiries relating to Canadian trade received at the office of the High Commissioner for Canada, 17 Victoria Street, London, S.W., during the week ending January 1st, 1909:—

Asbestos.—A New Brunswick firm interested in the development of an asbestos property in the Province of Quebec, wishes to hear from a firm in the United Kingdom who could assist in obtaining capital.

Building Materials.—A Montreal firm dealing in building materials is seeking a few additional agencies of English and Scotch manufacturers. A representative is about to visit England with a view to arranging same.

Cycles.—A Birmingham firm wishes to open up business connections with Canada in rustless metal cycle rims.

Coal.—A British Columbia correspondent wishes to hear from likely buyers in the United Kingdom of a developed coal property in that Province.

Inspecting.—A correspondent in Belgium wishes to get into touch with Canadian engineers and merchants who might require the services of an inspecting engineer or buying agent on the Continent.

Paints.—A Vancouver (B.C.) firm reporting a good demand in British Columbia for paints desires to secure the agency of some United Kingdom manufacturers.

Paint.—Inquiry has been received from a London firm manufacturing paint and varnish specialties respecting the appointment of active and responsible agents in Canada.

Ropes.—Inquiry has been received from a firm in Scotland manufacturing all kinds of twine, ropes, sailcloth, canvases, etc., for the names of parties in Western Canada and British Columbia open to represent them.

Wire.—A London firm wishes to get into touch with Canadian importers of wire, glazed wall tiles, enamel ware, picture mouldings, etc.

A manufacturers' agent at Halifax, N.S., wishes to get into touch with United Kingdom firms requiring representation in the Maritime Provinces.

FACTORS DETERMINING THE EFFICIENCY OF TROLLEY WIRE.

Carl F. Woods.*

No department of electric railroading has received less attention than the transmission line and particularly the trolley wire. In the construction and maintenance of an electric railroad, no expense is spared to obtain power station equipment of the highest efficiency while the trolley wire, which is just as essential for operation is generally purchased with no restrictions on the quality of material.

The entire development of electric traction has taken place within the past twenty-five years, and this short period of time has witnessed an almost fabulous advance in the improvement of power station and rolling stock. Higher voltages, greatly increased electrical output, heavier and more efficient cars capable of increased speeds have been noticeable on all lines. The increasing demands of traffic and the necessity of economical operation have forced the development of machinery of high efficiency. In spite of the great advance along all other lines, the trolley wire of to-day is not essentially different from that at first installed.

At the present time there are over 25,000 miles of electric lines in the United States; calculating the value of the trolley wire in use, at the current price and assuming the average weight per mile as 2,000 lbs., shows a total investment of $8,000,000. This wire is the main artery of the entire system and any injury to it cripples the operation of the road and decreases thereby the efficiency of the expensive generating equipment, and yet an examination of the records of roads operating many hundred miles of track show that a broken trolley wire is almost a daily occurrence.

Numerous attempts have been made to specify the necessary characteristics of trolley wire, some of which have failed because of an incomplete understanding of the demands upon the material and many more on account of ignorance of the processes of manufacture, and the defects inherent to these processes. The determination of the qualities necessary to an efficient material must always be preceded by a thorough understanding of the conditions which it must meet and by a careful study of the material itself and the limitations imposed by manufacturing processes.

The trolley wire in general use in the United States is made from hard drawn copper, the sizes and shape varying considerably, but circular wire having a diameter of 0.364 inches, which corresponds to No. 2-0 on the Brown & Sharpe Gauge is perhaps the most common form of construction. Ordinary soft copper does not have sufficient strength for this service so that reliance has had to be placed upon either steel, bronze or hard drawn copper; while steel wire has the requisite strength it is subject to severe corrosion from the weather and has vastly greater electrical resistance. The silicon, phosphorus and other bronzes of a similar nature possess great strength but all have the serious effect of much lessened conductivity. Soft copper wire has a strength of about 34,000 lbs. per sq. inch, while hard drawn wire can be made having a strength of as high as 67,000 lbs. per sq. inch. Hard drawn wire although possessing some serious defects has therefore been accepted as being much better than the other materials available for the purpose.

In standard construction, trolley wire is suspended in spans of 100 feet on straight lines and in shorter spans on curves, the distance depending upon the radius of the curve, local conditions, etc. These spans are supported by ears which vary in construction but for the most part depend upon a fixed mechanical grip of the wire. In the earlier construction, ears were soldered to the wire, a process which annealed the hard drawn copper with the consequent reduction in tensile strength, but this practice is now rapidly becoming obsolete. The wire, therefore, is subjected to the pull of its own weight, to the extraordinary stresses of ice and snow and to severe pounding from the trolley wheel. In addition the wheel passing along the wire gives to it a wave motion which proceeds along the wire until an ear or other fixed support is reached where the wave is suddenly checked with a consequent sharp upward bend, followed by a series of bending stresses diminishing in force as the wave motion dies out. On a busy line where cars are operated on a small headway, the wire is subjected to practically a continuous effect of this nature, and in addition to this must be capable of carrying a large amount of power in order to diminish the outlay in feed wire.

To give efficient service under the conditions above noted, trolley wire must possess the following qualities:—

First:—Conductivity.
Second:—Tensile strength.
Third:—Flexibility.
Fourth:—Homogeneity.
Fifth:—Toughness.

Each of these qualities is essential and no one of them can be increased beyond a certain point without a proportionate reduction in one or more of the others. For example, certain wires have been made from an alloy of copper and tin which have high tensile strength, great toughness and homogeneity, but are lacking in flexibility and have a conductivity only half that of pure copper. On the other hand, by proper drawing, wire can be made very homogeneous, flexible and tough, but lacking in tensile strength, the conductivity being unimpaired. To recapitulate, high conductivity is necessary for economical operations; tensile strength to withstand the abnormal loads; flexibility to enable stringing and to allow the wire to adjust itself under strains and blows; homogeneity that the stresses may be uniformly distributed along the wire and toughness to withstand kinking, wrenching and slow distortion, without giving way.

Attention naturally turns next to the methods of determining to what extent wire possesses these essential properties. The determination of conductivity is very readily and accurately made with a Wheatstone Bridge or one of the several appliances based upon the same principles which are especially adapted for trolley wire. Tensile strength may be determined in a testing machine of suitable capacity, but owing to the nature of copper the elastic limit cannot be determined by a drop of the beam, as the metal apparently yields quite steadily up to the breaking point. Numerous conflicting figures are in print regarding the yield point of copper but as a stress and strain diagram shows a nearly perfect curve, the actual elastic limit can only be accurately determined by applying increasing loads for a definite length of time and measuring the permanent set in each case. Such a procedure is obviously too complicated for commercial testing, so that the elasticity of the wire has to be judged by other means. Under ordinary circumstances, power to resist the effects of twisting is not necessary for conducting wire, but the torsional strength measures indirectly but accurately two of the most important mechanical properties that a wire can possess, namely, homogeneity and toughness. In a tensile strength test the maximum tensile load is largely a factor of the cross-sectional area and the amount of work which has been put into the hardening of the surface. This test will detect inferior drawing or inherent weakness of the copper but it gives no idea of the power of the wire to resist distortion, nor of defects such as oxide seams which run lengthwise of the wire, and do not have a cross sectional area of sufficient sizes to affect the breaking strength. Under a torsional strain, however, such defects are quickly noted. If the wire contains an oxide seam as above spoken of, the twisting will open it up and at once weaken the strength of the wire. If the wire is of unequal hardness, the twists will tend to bunch up in the softest portion and very noticeably show this spot. Inferior copper not only shows a very low number of turns but splinters and slivers of metal appear on the surface which in very bad wires fall off to such an extent that a paper held beneath the sample during torsion will show a considerable collection of copper fragments. Non-homogeneous copper, due either to impure metal or uneven drawing, will show a great difference in the

*Of the Arthur D. Little Laboratory, Boston, Mass., a paper read before the Division of Industrial Chemists and Chemical Engineers of the American Chemical Society.

number of turns which different specimens will stand without breaking, while high-grade metal which has been carefully drawn, twists unevenly and uniformly, with no slivering and shows little difference in the number of turns on different specimens. It is, therefore, desirable to make at least three torsion tests, whereas one tensile strength test is sufficient to obtain an accurate measure of the strength.

In the appended Table No. 1 are given a series of tests which clearly illustrate the four general divisions into which the trolley wire of commerce may be divided by reason of difference in physical qualities. Specimens A—B—C having tensile strengths of 5,500 lbs. or higher, and torsion tests averaging about 13 represent wire lacking toughness, which has been given a high tensile strength by drawing. Specimens D—E—F having tensile strengths around 5,300 lbs. and torsion tests of about 15 are wires lacking both toughness and surface hardness. Specimens G—H—I having tensile strengths of about 5,100, but torsion tests of approximately 23, are typical wires in which the torsion has been obtained at the expense of tensile strength, while specimens X—Y—Z with tensile strengths over 5,400 lbs. together with torsion tests of 26 and even higher represent the best trolley wire which can be made at a reasonable price.

Of these four classes there is again a distinction in that the first two represent copper of an inferior grade which cannot be made the equal of the wires of the last two classes by any treatment in the rod mill. On the other hand, wires of the last two classes are both made from excellent copper, although specimens X—Y—Z are wires greatly superior in all respects to the preceding three. It is interesting to note that all of these wires have practically the same conductivity which shows clearly the fallacy of attempting to value trolley wire by conductivity and tensile strength alone as is so frequently done.

It is therefore, necessary not only to obtain high-grade copper, but also to secure the proper balance between tensile strength and torsion, as these two properties are correlated and increase in one, beyond a certain point, results in a proportionate decrease of the other.

The preceding remarks have shown the conditions under which wire must work and the qualities which are necessary to successfully meet these conditions. Attention must now be turned to the process of manufacture to determine how these qualities may be obtained and what defects of such processes injure the finished wire. For this purpose a brief review of the industry is necessary.

In the refining furnace the copper which is already at least 96 per cent. pure from the blister furnace is oxidized by air until a large part of the impurities have been removed and copper oxide is formed in considerable excess. Cuprous oxide is readily soluble in molten copper and acts as a powerful oxidizing agent by giving up its oxygen to any metallic bases present, so that an excess of oxide insures the presence of all metallic impurities in the oxide form. The excess cuprous oxide is then removed by burying a piece of green wood in the molten mass and covering the surface with charcoal. This process must be stopped within very narrow limits as over-reduction will throw the impurities back into the metallic state.

The influence of cuprous oxide has been studied by Mr. Patch, of the Detroit Copper Company; Dr. Edward D. Peters, Jr., who is without doubt one of the best authorities on the metal in this country, and by the well-known German authority, W. Hampe, among many others. Many of the impurities of copper have been found to be much more injurious when present in the metallic state than when in the form of oxides, and one effect of the cuprous oxide, as above mentioned is to convert these impurities into the comparatively inert and harmless form and so improve the quality of the metal. In large quantities, however, it is known to harden copper while at the same time causing it to become short or brittle and according to Hampe the presence of 1 per cent. produces a diminution in toughness.

It is therefore possible to so treat low-grade metal that it will have high conductivity although the large amount of cuprous oxide present greatly reduces the toughness. In purchasing copper for drawing trolley wire the manufacturer insists upon conductivity, but as a rule cares little for the other physical qualities, as he can obtain sufficient tensile strength by drawing. Lake copper possesses both high conductivity and excellent mechanical qualities, but this kind of copper costs from ⅛c. to ¾c. per lb. more than electrolytic. Why the latter should be inferior to lake is difficult of explanation, but experience shows that the general run of commercial electrolytic copper is by no means uniform in physical qualities and as a general thing is distinctly inferior to lake for wire drawing purposes. The cheaper price of electrolytic results in its use by many manufacturers although they frequently understand that the wire will be inferior.

The refined copper comes to the rod mill in bars weighing about 200 lbs. each, approximately ten of which are used in the manufacture of a mile of wire. These bars frequently have ridges along the sides, due to faults in casting and the surface is often covered with a layer of oxide. These bars are heated in the furnace until sufficiently soft for rolling and are passed through a series of rolls diminishing in size until a rod of the proper diameter is obtained. The rod is then cooled and drawn through dies, the rods being connected by brazing. The dies give the wire a dense hard exterior coating which increases its tenacity. As the strength obtainable is almost a direct factor of the work expended upon the wire, the smaller the size, the greater the tensile strength per square inch, so that the strength of the trolley wire is readily varied by changing the size of the rod and the number of dies.

One of the most serious defects occurring to wire at this point is from ridged bars as above described. Ordinarily the bar will not be sufficiently heated to dissolve the copper oxide on the surface, so that as the softened bar enters the first passes of the rolls the ridges are lapped over, enclosing the oxide scale. The subsequent passes and the drawing through the dies obscure this flaw almost entirely, but it remains a serious menace to the toughness and resistance to wear of the copper, as has been previously shown in remarks on the torsion test.

A second cause of trouble arises at the same point by overheating the copper in the furnace, in which case copper oxide is formed on the surface and quickly dissolved through the entire bar, thereby increasing the oxide content and tending toward the production of brittleness. Both of these dangers can be avoided by careful selection of the bars and by proper regulating of the temperature of the softening furnace.

As the production of the hard surface from drawing is at best a rather delicate operation, careless handling, uneven welding of the rods and unequal temperature of the wire while passing through the dies will all produce noticeable effects in the quality of the finished wire, so that care throughout the mill is absolutely necessary for the best results.

It therefore appears that the most efficient wire must possess not only high conductivity, but the maximum torsion and tensile strength possible in commercial copper and that to obtain this it is necessary first, to use high-grade copper and to prevent an excess of cuprous oxide entering it at any stage of the manufacture, and secondly, to select as perfect bars as possible and to observe extreme care in every treatment through which they pass. The question at once arises, can such wire be purchased at a commercial price? The writer must admit that this high-grade wire can not be obtained at the ordinary market price, but requires the payment of a premium of ½c. per pound. To produce wire of this grade, consistently the wire manufacturer must use the higher-priced Lake Copper and observe unusual care in its treatment so that he is justified in demanding a higher price. Experience in the use of this wire has shown conclusively that it is well worth the additional cost.

The appended Table No. 2 gives the results obtained upon 13 consecutive miles of trolley wire made from selected bars of Lake Copper. The tests were made upon each mile of the wire and the results show the great uniformity obtainable by proper care. It should be said in this connection that this

wire was not made as an experiment, but was drawn by a certain wire company as a part of a regular business contract.

The point must be kept clearly in mind, however, that even the best of wire is of little value if improperly used, and the consumer must realize that the same degree of care which he insists upon from the manufacturer, is essential in the handling and stringing of the finished wire.

The study of copper wire and the demands made upon it show the great need of a more thorough knowledge of this material. Owing to the minute quantity of impurities which exert a marked effect upon the qualities of copper, a chemical analysis is too difficult for technical purposes. The iron and steel industry is largely controlled to-day by micro-chemistry, and, in the same way, there is a future for this same practice in the copper industry. Of first importance, is the careful working out of the copper-cuprous oxide system with the determination of the number of phases occurring and the physical properties incident to different alloys. Doubtless much of this information is already in the hands of the copper refiners, but it remains for chemical engineers and chemists interested in industrial materials to verify and complete the work for the consumer.

Table No. 1.

Number.	Diameter Inches.	Torsion Turns in 10″	Tensile Load Lbs.	Conductivity %
A	0.365	14	5,650	98.4
		12		
		9		
		Av. 12		
B	0.364	11	5,550	98.6
		12		
		11		
		Av. 11		
C	0.362	18	5,500	98.2
		14		
		16		
		Av. 16		
D	0.365	18	5,260	98.6
		16		
		18		
		Av. 17		
E	0.365	14	5,270	98.7
		15		
		16		
		Av. 15		
F	0.364	14	5,370	98.7
		13		
		14		
		Av. 14		
	0.364	21	5,070	98.9
		23		
		22		
		Av. 22		
H	0.364	22	5,110	98.4
		25		
		21		
		Av. 23		
I	0.365	24	5,210	98.4
		25		
		24		
		Av. 24		
X	0.364	27	5,400	98.3
		30		
		28		
		Av. 28		
Y	0.364	25	5,490	98.4
		27		
		26		
		Av. 26		
Z	0.364	25	5,590	98.2
		28		
		25		
		Av. 26		

Table No. 2.

Number.	Diameter Inches.	Torsion Turns in 10″	Tensile Load Lbs.	Conductivity %
1	0.363	22½	5,470	99
		24¾		
		22½		
		Av. 23½		
2	0.364	23	5,490	98.7
		25		
		23		
		Av. 23½		
3	0.363	19¾	5,400	97.8
		25½		
		17½		
		Av. 21½		
4	0.363	23½	5,470	98.8
		25½		
		23½		
		Av. 24		
5	0.363	22½	5,450	97.8
		21¾		
		24		
		Av. 22¾		
6	0.363	24	5,500	98.6
		20		
		24¼		
		Av. 22¾		
7	0.363	22½	5,420	97.8
		24		
		23¾		
		Av. 23½		
8	0.365	23	5,510	98.5
		24		
		20		
		Av. 22		
9	0.363	24	5,540	98
		19½		
		23½		
		Av. 22		
10	0.363	21	5,470	98.8
		23		
		21		
		Av. 21½		
11	0.363	22	5,490	98.8
		22½		
		23		
		Av. 22½		
12	0.363	26½	5,500	98.5
		26½		
		23½		
		Av. 25½		
13	0.363	23	5,450	98.7
		20½		
		24		
		Av. 22½		

CORRESPONDENCE

[This department is a meeting-place for ideas. If you have any suggestions as to new methods or successful methods, let us hear from you. You may not be accustomed to write for publication, but do not hesitate. It is ideas we want. Your suggestion will help another. Ed.]

THE TRAINING OF THE ENGINEER.

Sir,—I have carefully read the paper by Charles A. Bowman, in your journal of the 22nd ult., on the systematic training of engineers, and it is in every detail to the point, every article in the paper is so thoroughly gone into that it is difficult to choose any particular point to discuss. I know personally of young men who have the gall, not having any training in machinery, but who have been invoice clerks in a machinery establishment, setting themselves up as engineers, and try to over-ride thorough practical engineers. I agree with the writer in young men going to college, but before going to college to have 4 or 5 years' experience in a first-class machine shop thoroughly up-to-date, when all the branches of engineering can be fully gone into. I was bound seven years to my trade but never had a college education, but I do not care for any college-trained engineer in the Dominion of Canada. Theory is one thing and practice is another. My idea of the college engineer is this, They are no use to a practical machinist or engineer who has served five years' apprenticeship.

An Engineer.

Montreal, February 4th, 1909.

LAYING WATER PIPE.

Sir,—Looking over your journal of the 5th inst., I read an article in connection with the strength of cast-iron water pipe and jointing of the same. On the first of November, 1908, I was called to St. Albans, Vermont, U.S.A., to arrange difficulties in connection with an emergency plant in re shortage of water for the supply of the city. The job was rushed to its utmost and in 39 hours 10,760 feet of 6-inch cast-iron pipe was laid ready for water, and connected to the main. A test of 368 pounds equal to 800 feet head was put on the pipe, and not one joint gave out nor pipe burst. The pump is a compound double acting steam pump, 18-inch low pressure, 12-inch high pressure, 7-inch plungers, and 18-inch stroke. Pump has run all winter under 310 pounds water pressure over 700 feet head, and not a single joint has blown out, there were a few leaks, but of no detriment to the work. My experience in laying cast-iron pipe for water works service is this; If the faucets are strong enough, 250 pounds water pressure, 579 feet head can safely be carried for fire service. There are cast-iron pipes imported from England and Scotland, the faucets of which are so light that caulking will burst them. But where faucets are made from R. D. Wood & Company Pattern, 250 pound pressure is o.k. The laying of the pipe was done under the superintendence of E. H. Fortin, the Superintendent of Waterworks in St. Albans. The number of men employed at pipe laying was 9. This is good work. Part of the pipe is above ground and covered with snow.

This letter shows what can be done when the right material is used. Pipe before shipment was tested under 300 pounds' pressure and hammered.

Yours truly,

William Perry, C. and H.E.

Montreal, February, 1909.

SEWERS AND SEWAGE.

Sir,—One of the greatest authorities on sewer ventilation has said:—"The question of the ventilation of public sewers is not one of diluting the sewer air before it enters the street so that it may be safely inhaled. It is the question of the propagation of zymotic diseases which do not depend upon the number of infectious microbes taken into the human body but on the condition (in health of that body) favorable to their growth. It has been shown that the smallest particle of the infection, even a single microbe, may multiply itself so rapidly that the mere quantity taken into the system, in the first instance, is of minor importance. Therefore the question of the emission of sewer air into the streets is not one of di'ution at all but one of absolute exclusion."

Yet, here in Winnipeg, we are discharging these sewer gases, neither diluted nor treated in any way but absolutely raw, out of every manhole, which only average about 100 yards apart, and this discharge is taking place at manhole lid level, that is below the breathing level of a person in the street. It therefore follows that every person passing along these streets or living in the buildings abutting on them is hourly taking into his or her body those infectious microbes which propagate zymotic diseases (even though they do not experience the direct smell of the sewer gas) and that their only safeguard against typhoid and its kindred diseases is that their bodily health at the moment is not favorable to the growth of those microbes.

There are two main ways of drawing off the sewer gases from the street sewers: Firstly, by the ventilating shafts discharging the gases above the roofs of the surrounding buildings. In this case the shaft should be attached to the highest building nearby; the top or outlet should be not less than six feet above the eaves or four feet above the highest opening in the building (whichever may be the higher) and should be not less than 12 feet away from the nearest opening in any building or the same distance away from the nearest chimney shaft. Secondly, by the ventilating shaft terminating in some system which disinfects the sewer gases such as the Webb or other pattern lamp, chemical spray, etc.

But in either case, whichever may be adopted, there is the absolute necessity for dividing up the sewers into distinct lengths by means of disconnecting manholes, each of which would contain a disconnecting trap and without this arrangement all attempts to properly ventilate the sewers will be a failure. It is simply waste of time and money to attempt to ventilate any long sewer at once throughout its whole length. The exact positions of the disconnecting manhole would have to be carefully gone into as they would depend upon the size of the sewer, the flow of sewage and local conditions, but roughly they would require to be about 1,500 feet apart. Each disconnecting manhole would have a fresh air inlet formed as a small side pit with an opening in one side of it connecting with the manhole, the bottom of the side pit being formed to catch any dirt which sifted through the open grating with which it was covered for the admission of fresh air. The fresh air would thus be admitted at the very lowest point in any length into which the sewer was divided. Immediately behind each disconnecting trap the ventilating shaft conection would be taken off, that is at the very highest point in the particular length of sewer. We would thus get the length of sewer ventilated from extreme end to extreme end by a flow of fresh air travelling in an opposite direction to the flow of the sewage. The covers of the disconnecting manholes and all intermediate manholes should be self-sealing covers. There would thus be no openings into the sewers at street level which were not closed except the fresh air inlets

at the disconnecting manholes, and there the flow of air would always be inwards; no sewer gas could escape at them.

Having seen how the ventilation of the street sewers could be successfully accomplished let us consider briefly what should take place afterwards to purify the Assiniboine and Red Rivers. The city should provide a sewage works at the end of the pipe where all the sewage can be treated by bacteria process and only the purified effluent should be discharged into the rivers. It should be one of the first acts of the Dominion Government to pass a law that no sewage containing more than 1 per cent. of suspended matter should be discharged into any free flowing river. It might be urged that one sewage works for all Winnipeg would be impracticable as the sewers discharge at so many different points, but that objection could be immediately dealt with by an arrangement of sewage pumping stations.

In any case the adding on of a new sewer here and a new sewer there which has been going on for some years is, of the best, only a patchwork job, and it is high time that the whole question of the city's sewerage system was thoroughly gone into and a definite scheme, allowing for future extensions, was arranged, and then the question of all outfalls concentrating at the sewage works could be adequately dealt with.

There is absolutely no need to place the sewage works miles away as some of the residents here seem to think. Only a year or two ago I was the resident engineer of the sewage works belonging to one of the largest cities in England, and my house was situated on the works; in fact the nearest bacteria bed was less than 50 yards away and the central sewage pumping station only 200 yards away from the house. Friends have come to visit me and after having been in the house some considerable time have asked where the works were situated and when I have taken them to the door and shown them their proximity they have marvelled at the absence of smell. And at this particular works I also had an incinerator burning over 60 tons of refuse per 24 hours adjoining the pumping station. The incinerator here should be run in conjunction with the sewage works and all power required to operate the sewage works, including the electric lighting of the works, could be obtained from the latent heat contained in the refuse destroyed by the incinerator if the incinerator was of the proper design. I am fully acquainted with the calorific values of the refuse here, summer and winter, and I have no hesitation in saying that one pound of water should be evaporated for every pound of refuse consumed, and as the cost of operating the incinerator should not exceed 50 cents per ton this would leave a good balance as the value of the steam thus produced and incidentally reduce the cost of operating the sewage works.

H. P. Tanner, C.E., M.E.

Winnipeg, February, 1909.

INCREASE OF RAILWAY ACCIDENTS.

According to the statistics gathered by the Board of Railway Commissioners for the fiscal year ended March, 1908, 64 passengers were killed and 326 injured on Canada's railroads during the year as compared with 42 killed and 210 injured in 1907. During the same period, 246 employees were killed and 866 injured, as against 212 killed and 317 injured in 1907. Including people killed on tracks and in other ways the total number of killed was 529, and injured 1,309, as against 460 killed and 603 injured during the previous fiscal year. On the C.P.R. 283 people were killed and 314 injured, as against 218 killed and 140 injured in 1907. On the Grand Trunk 165 were killed and 321 injured, as against 160 killed and 303 injured in 1907. On the Canadian Northern the killed numbered 19, and the injured 123, as compared with 42 killed and 210 injured in 1907. On the Michigan Central, 25 were killed and 72 injured, as against 29 killed and 13 injured in 1907.

The following is a record of railway accidents in Canada for several years past:—

Year.	Passengers.		Employees.		others.		Total.		Passengers.	
	Killed.	Injured.	Killed.	Injured.	Killed.	Injured.	Killed.	Injured	One killed in every	One injured in every
1888...	20	70	107	619	104	86	213	775	534,931	152,837
1889..	37	103	89	637	84	135	210	875	328,408	117,971
1890...	11	52	83	682	124	101	218	835	1,165,569	246,562
1891...	13	105	65	582	118	131	193	818	1,617,120	125,929
1892..	14	43	110	697	109	139	233	879	966,672	314,730
1893..	11	57	72	331	133	120	216	708	1,238.002	238.912
1894...	12	64	67	521	132	107	211	694	1,205,208	225,976
1895...	9	47	51	489	127	122	187	558	1,554.175	297,608
1896...	11	62	46	446	104	111	161	619	1,346,400	238,877
1897..	7	70	76	579	130	158	213	807	2,310,191	231,019
1898...	5	72	98	862	167	163	270	1 097	3,688 809	256,167
1899...	20	119	139	882	145	184	284	1,185	956.668	160,784
1900..	7	131	123	941	195	245	325	1,317	3,071,453	164 123
1901...	16	134	118	970	183	213	317	1,317	1,149.108	137,207
1902...	19	177	146	930	165	221	330	1,328	1,088.419	116,836
1903...	53	258	186	956	181	239	420	1,453	417,900	85,848
1904...	25	232	192	214	178	259	395	705	945,630	101,899
1905...	35	244	206	920	227	193	468	1,357	722,535	103,642
1906...	16	231	139	893	206	241	361	1,365	1,749,361	121,168
1907...	70	352	249	1,126	258	220	587	1,698	459,104	91,299

ORDER OF THE RAILWAY COMMISSIONERS OF CANADA.

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

6084—January 14—Directing that the C.P.R. be required to stop its trains opposite the platform of the C.N.R. at St. Jerome, P.Q., and rescinding order of the board No. 5189.

6085—January 20—Granting leave to the Toronto Electric Light Company, to lay at its own expense, twelve underground tile ducts under and across the tracks of the G.T.R. and C.P.R. for the purpose of carrying power and electric wires under and across the said tracks.

6086—January 19—Authorizing the Bell Telephone Company to cross with its aerial wires the tracks of the C.P.R. at public crossing, Beeton station, Ont.

6087—January 18—Approving Standard Freight Tariffs C.R.C. No. 2, C.R.C. No. 3, C.R.C. No. 4 of the Grand Trunk Pacific Railway.

6088—January 19—Directing the Ingersoll Electric Light & Power Company to erect and maintain its wires across the Port Burwell branch of the C.P.R. at least 25 feet above the rails, and rescinding order of the board No. 3900.

6089—January 19—Directing the Ingersoll Electric Light & Power Company to erect and maintain its wires across the tracks of the Ingersoll branch of the C.P.R. at least 25 feet above the rails, and rescinding order of the board No. 3904.

6090—January 27—Dismissing the application of Crawshaw Brothers, Scotch Block, Ont., for order directing the G.T.R. to provide and construct a siding to and from their quarry.

6091—January 19—Directing the Ingersoll Electric Light & Power Company to erect and maintain its wires across the C.P.R. to the premises of the St. Charles Condensing Company, Ingersoll, Ont., at least 25 feet above tne rails, and rescinding order of the board No. 3903.

6092—January 22—Ordering that the Express "Tariff and rules in existence prior to January 1st, 1909," referred to in order No. 6020, be construed by all the express companies to be the ratings, tariffs, and rules embodied in "Classification and Tables of Graduated Charges" No. 16, revised to August 1st, 1905, and "Exceptions" thereto for use in Canada, which were in force on the 31st December, 1908; and ordering that the figure 9 be substituted for the figure 8 in the 9th line of the operative part of the said order No. 6020.

6093—January 21—Ordering that, pending the final determination by the board of the tariffs of tolls which the Bell Company shall be authorized to charge, and the form of agreement with other companies to be approved by the board, certain agreements of the company be temporarily approved.

6094—January 22—Authorizing the Q.M. & S. Railway to construct a spur to the property of the Imperial Oil Company, Iberville, P.Q.

6095—January 18—Amending order No. 1428 re Fairville, N.B., crossing by ordering the municipality and the St. John Railway Company to pay to the C.P.R. within one month of the date of this order, one-third of the wages of the said day and night watchman, directed to be provided by order of the board, dated 7th July, 1905, from the 1st July, 1906, to 18th January, 1909.

6096—January 12—Dismissing application of Hyde & Webster, Montreal, for a less rate on brick between Casselman and Montreal.

6097—January 18—Dismissing complaint of the Board of Trade of the city of St. John, N.B., against the increase by the Dominion Atlantic Railway Company of its passenger fare on its steamship line between St. John, N.B., and Digby, N.S., from $1.50 to $1.75 per capita.

6098—January 18—Dismissing complaint of I. R. Todd, St. Stephen, N.B., against the rate charged by the C.P.R. on shipments of pulp-wood from St. Stephen to Milltown, N.B.

6099—January 18—Dismissing complaint of the Board of Trade of St. John, N.B., against the C.P.R. charge of 50c. per short ton shunting charges on goods from steamers from West St. John to East St. John.

6100—January 23—Approving location of the C.N.O. Railway through the Township of Mowat and the Henvey Indian Reserve, district of Parry Sound, Ont., mileage 275.7 to 293.

6101—January 25—Authorizing the G.T.R. and the Napierville Junction Railway Company to operate their trains on the lines or tracks over, upon, or through the connection near Lacolle, P.Q., authorized by order No. 5264.

6102—January 25—Directing that the time for the installation of the interlocker of the G.T.P. Railway where the same crosses the C.P.R. (Pembina branch) at Oak Point Junction, near Winnipeg, Man., provided for in order No. 5417, and required by order No. 5573 to be installed not later than January 31st, 1909, be extended until the 31st March, 1909.

6103—January 8—Granting leave to the Niagara, St. Catharines & Toronto Railway Company to construct its railway, at rail level, upon, along and across the roads and highways in the Township of Thorold, County of Welland, Ont.

6104—January 22—Amending order No. 5943, dated 16th December, 1908, by striking out the words "City of St. Johns," where they occur in the recital and operative parts of the said order and substituting therefor the words "Town of Iberville."

6105—January 23—Directing the Town of Orillia, Ont., to remove certain electric power wires across the tracks of the G.T.R. at public road allowance, between Concession 5 and 6, east of Orillia, within 30 days of the date of this order, and that failing to comply with the provisions thereof, it shall be liable to a penalty of $25 a day for every day it shall be in default.

6106—January 22—Approving revised location of the Crow's Nest Pass branch of the C.P.R. through Province of Alberta, from Lethbridge to McLeod, mileage 0.0 to 31.4.

6107—January 23—Confirming and ratifying orders Nos. 4733, dated May 19th, 1908, 4733, dated May 27th, 1908, and 3058, issued by the board in connection with the V.W. & Y. railway spur from False Creek to Burrard Inlet at Vancouver, B.C., as applied in the name of the V.W. & Y. Railway & N. Company who has acquired the rights of the V.W. & Y. Railway Company.

6108—Approving the construction and maintenance of Walkerton & Lucknow Railway bridge over the Saugeen River, opposite Lot 71, north of Wellington Street, Walkerton, Ont., subject to terms and conditions of agreement between the C.P.R. and the town of Walkerton, dated the 30th December, 1908.

6109—January 25—Authorizing the Kaministiquia Power Company, Limited, to erect, place and maintain its wires across the tracks of the C.P.R. and C.N.R. at Heath Street, West Fort William, Ont.

6110—January 12—Authorizing the National Transcontinental Railway to construct its railway across the public highway running along the St. John River, between Edmundston and Connors (at rail level), in the County of Madawaska, N.B., at a point about 46.62 miles, measured westwardly from a point 2½ miles west of Grand Falls, N.B., and also to permanently divert such highway and construct another highway in lieu thereof.

6111—January 26—Authorizing the Rat Portage Lumber Company to erect, place and maintain its wires across the tracks of the C.P.R. at Harrison's Mills station, B.C., as per agreement between the Lumber Company and the C.P.R., dated 1st January, 1908.

6112—January 26—Approving Standard Freight Tariff C.R.C. No. 1 of the Grand Valley Railway Company.

6113—January 26—Authorizing the St. Lawrence & Adirondack Railway Company to reconstruct bridges as follows: Nos. 40 and 41, over Oak Creek, 8 miles north of Athelston station; No. 46, 1.3 miles north of Huntingdon station, County of Huntingdon; No. 71, 1.1 miles north of St. Stanislas station, County of Beauharnois, and No. 74, 2 miles north of St. Stanislas, County of Beauharnois, P.Q.

6114—January 26—Authorizing the G.T.R. and Hamilton Street Railway Company to operate their trains over the crossing of the Hamilton Street Railway by the G.T.R. additional track on Barton Street, Hamilton, Ont., at the intersection with Ferguson Avenue.

6115—January 27—Approving revised location of the C.P.R. as lesse of the Manitoba & Northwestern Railway from Bredenbury to a point on the Pheasant Hills branch of the C.P.R. at Esterhazy, Sask., mileage 0. to 20.2.

6116—January 27—Approving location of the C.P.R. (Lanigan-Prince Albert branch) from a point on the northern boundary of the southeast ¼ of Section 5, Township 35, Range 22, west 2nd meridian, to a point on the Regina, Saskatoon & North Saskatchewan Railway, in the northwest ¼ Section 26, Township 42, Range 28, west of the 2nd meridian, mileage 8.7 to 82.4.

6117—January 26—Dismissing application of the Council of the Municipality of the village of Upton, Quebec, for authority to continue Grand Trunk Street across the right-of-way and tracks of the Grand Trunk Railway at Upton, Quebec.

6118—January 8—Authorizing the Canadian Pacific Railway to construct a spur to the premises of John R. Arbuthnot Company, Limited, Winnipeg, Man.

6119—January 8—Authorizing the Canadian Pacific Railway Company to construct a spur to the premises of Woods & Company, Winnipeg, Man.

6120—January 8—Authorizing the Canadian Pacific Railway Company to construct a spur to the premises of Nichols & Shepherd, Winnipeg, Man.

6121—January 8—Authorizing the Canadian Pacific Railway Company to construct a spur to the premises of Hargrave & Company, Winnipeg, Man.

6122—January 8—Authorizing the Canadian Pacific Railway Company to construct a spur to the premises of H. Leadly, Winnipeg, Man.

6123—January 8—Authorizing the Canadian Pacific Railway Company to construct a spur to the premises of Christie Bros., Winnipeg, Man.

6124—January 8—Authorizing the Canadian Pacific Railway Company to construct a spur to the premises of Kelly Bros., Winnipeg, Man.

6125—January 8—Authorizing the Canadian Pacific Railway Company to construct a spur to the premises of the Prairie City Oil Company, Winnipeg, Man.

6126—January 8—Authorizing the Canadian Pacific Railway Company to construct a spur to the premises of F. C. Bell, Winnipeg, Man.

6127—January 27—Directing the Canadian Northern Quebec Railway Company to re-model its plant in the tower at the crossing of the Canadian Northern Quebec Railway, and

Montreal Street Railway near the intersection of Valois Avenue and Ontario Street, Montreal, Quebec; that they provide for the interlocking of derails with home signals, by 15th May, 1909, and providing a penalty of $25 a day on the Canadian Northern Quebec Railway, if in default in complying with the requirements of this Order.

6128—January 26—Directing that the Canadian Northern Railway Company construct a new plant in the tower house, or remodel the old plant at the crossing of the Canadian Pacific Railway at a point near Emerson Station, Manitoba, to enable the semaphores to be relocked. Said work to be completed June 15th, 1909, and placing a penalty of $25 per day for every day after June 15th, the C.N.R. shall be in default in complying with the provisions of this Order.

6129—January 12—Ordering Canadian Northern Ontario Railway Company to pay to the Grand Trunk Railway Company for the user of the Union Station and yards at Toronto, the amount agreed upon between the companies, November 7th, 1906, up to and including the day of the date of this Order, and directing the Canadian Northern Railway to make an arrangement, if possible, for the user of said station and yards, which will be satisfactory to the C.P.R., and G.T.R. companies. Said arrangement to take effect from the date of this Order. Also ordering that in the event of failure of the companies to make a satisfactory agreement upon the terms on which the C.N.R. shall use the Toronto terminals, the same shall be fixed by the Board.

6130—January 8—Authorizing the Canadian Pacific Railway Company to construct a spur to the premises of the Western Coal Company, Winnipeg, Man.

6131—January 29—Authorizing Clark Vanderburg, Nelles Corners, Ont., to lay and hereafter maintain across the lands and in the culvert under the track of the G.T.R., where the same crosses at a point 870 feet east of the first side road, east of East Nelles Corners Station, and on Lot 48, in the Township of Cayuga, a gas pipe, or main, for the conveyance of natural gas to his house.

6132—January 8—Authorizing the Canadian Pacific Railway Company to construct a spur to the premises of F. J. Wellwood, Winnipeg, Man.

6133—January 8—Authorizing the Canadian Pacific Railway Company to construct a spur to the premises of the Anchor Elevator and Warehousing Company, Winnipeg, Man.

6134—January 29—Approving location of the British Columbia Southern Railway Company., Michel Branch from mile 1.7 to mile 30, British Columbia.

6135—January 29—Rescinding Order 5760, dated December 3rd, 1908, which dismissed application of the Ingersoll Telephone Company, for authority to erect telephone cables across the tracks of the Tillsonburg, Lake Erie & Pacific Railway Company, at Ingersoll.

6136—January 29—File 7880; Case 3527; Order 6136, dated 29th January, 1909, authorizing the city of Winnipeg to erect and maintain transmission wires across the tracks of the C.P.R. Company, at Gomez and Carter Streets, Winnipeg; and amending Order 5777, December 3rd, 1908.

6137—January 8—Authorizing the Canadian Pacific Railway Company to construct a spur to the premises of Messrs. Oldfield, Kirby and Gardner, Winnipeg, Man.

6138—January 21—Temporarily approving of various contracts of the Bell Telephone Company with other telephone companies.

6139—January 27—Authorizing the Canadian Pacific Railway Company to cross by its Sudbury-Kleinburg Branch certain highways in the town of Vespra, Ont.

6140—January 27—Dismissing application of George F. Stiles, for an Order directing the Canadian Pacific Railway Company to construct a suitable farm crossing and directing the railway company to provide an under-crossing twelve feet high and twelve feet wide, as originally provided and as required by an agreement between George F. Stiles and the railway company.

6141—January 27—Dismissing complaint of F. B. Stevens & Company, Chatham, Ontario, alleging unjustly discriminative rates on shipments of corn from intermediate Canadian points as against those from Detroit, Mich., to Montreal and points east.

6142—January 27—Dismissing complaint of J. B. Stringer, Chatham, Ontario, alleging unjustly discriminative freight rates on corn from intermediate Canadian points as against those from Detroit, Michigan, to Montreal, and points east.

6143—January 27—Dismissing application of the Canadian Pacific Railway Company for authority to divert the present highway where it crosses the Canadian Pacific Railway Company's railway at Kleinburg, in the Township of Vaughan.

6144—January 27—Directing the Toronto, Hamilton and Buffalo Railway Company to provide and construct a suitable highway bridge over track of the company at the intersection of its line at Garth Street, Hamilton, and ordering that the railway company submit to the Board a copy or copies of any agreement or agreements between it and the Canadian Pacific Railway Company, or any other railway company in respect to the use and maintenance of the track of the Toronto, Hamilton and Buffalo Railway, at this point.

6145—January 12—Approving location of the Toronto and Niagara Power Company's lines from its transformer house in the County of Welland, at Niagara Falls, through the Township of Stamford.

6146—February 1—Authorizing the Canadian Pacific Railway Company, to construct a spur to the premises of the Manitoba Linseed Oil Mills, Winnipeg, Man.

6147—January 21—Disallowing charge of one cent per hundred pounds imposed by the C.P.R. at Cartier, Ont., on Western grain and grain products in carloads, consigned to Cartier, "For Orders," and by the G.T.R. at Sarnia Tunnel, on grain and grain products, in carloads, destined to points in Eastern Canada, and routed via Chicago, Chicago Junction or Milwaukee, to Sarnia Tunnel, "For Orders" and directing that a "Stop-over" charge of 25 cents per car per day for the first forty-eight hours, and the Car Service Toll, therefore, be substituted thereafter. This to become effective not later than February 15th, 1909.

6148—January 21—Disallowing charge of one cent per hundred pounds imposed by G.T.R. at Sarnia Tunnel, Ont., on lumber, shingles, timber and other forest products, in carloads, originating in British Columbia, destined to points in Eastern Canada, and consigned to Sarnia Tunnel, "For Orders," and directing that a "Stop-over" charge of 25 cents per car per day for the first forty-eight hours and the Car Service Toll therefor, be substituted thereafter. This to become effective not later than February 15th, 1909.

6149—January 29—Dismissing application of the Government of the Province of Alberta for authority to carry telephone wires across the tracks of the Alberta Railway and Irrigation Company at Experimental Farm, Lethbridge, Alta.

6150—February 2—Authorizing the C.P.R. to use and operate Bridge No. 43.8 Montreal Terminals, Eastern Division.

6151—February 2—Approving plan of a concrete wall built in connection with the C.P.R. Company's South Bank Branch, under crossing of the G.T.R. at St. Henri.

6152—February 2—Approving location of the C.N.O. from Sellwood Junction toward Port Arthur, through the Townships of Hutton and Creelman, Sudbury Mining Division.

6153—February 2—Authorizing the C.P.R. to construct its railway across highway between Keewatin and Kenora, at mile 1.75 and mile 3.15.

6154—January 26—Amending Order No. 5667, dated 24th November, 1908, authorizing the Brantford and Hamilton Electric Railway to open for traffic its railway from Alfred Street to Market Street, Brantford, Ontario, by striking out the provision by which speed of cars was limited over that line of railway.

6155—January 27—Approving diamond and interlocking semaphores installed at crossing of the C.N.R. and C.P.R. near Homefield Station, Man., and authorizing railway com-

panies to operate their railway trains over the crossing without being brought to a stop.

6156—February 3—Approving deviation of C.P.R. main line of railway near Kincorth Station, Sask., from mile 96 to mile 97.5.

6157—February 3—Approving deviation of branch lines or sidings of the G.T.R. extending from a point on the main line in the Township of Meaford, Ontario, and crossing Boucher and Gersham Streets to the premises of the Meaford Manufacturing Company, Limited, and the Meaford Wheelbarrow Company, Limited.

6158 to 6163—February 3 and 4—Authorizing the Manitoba Government Telephones to erect their wires across the tracks of the C.P.R. at:—

¼ mile east of Sinclair Station.
1½ miles west of Manitou Station.
¼ mile west of Brookdale Station.
¼ mile west of Treherne Station.
1½ miles west of Newdale Station.
½ mile east of Basswood Station.

6164—February 3—Authorizing the C.P.R. to open for traffic that portion of the double tracks of its Smiths' Falls Section between Kemptville Junction and Mountain, Ont.

6165—January 12—Dismissing application of the city of Peterboro for an Order amending Order No. 5132, 27th March, 1908, authorizing the G.T.R. to construct and operate two branch lines of railway or spurs, crossing Bethune St., Peterboro, Ont.

6166—January 13—Directing that the rates charged by the C.P.R., G.T.R., and K. & P. Railway, on western grain arriving at Kingston by vessel and destined to points in Maritime Provinces be made on the basis of seven cents per hundred pounds from Kingston to Montreal, and that the proportional or arbitrary rates from Montreal to the said points in Quebec and the Maritime Provinces to be added to the said rate of seven cents per hundred pounds from Kingston to Montreal, do not exceed the proportional or arbitrary rates from Montreal now in force concurrently on western grain transfers at Lake Huron ports. Such rates to become effective not later than February 18th, 1909.

6167—February 4—Directing express companies under the jurisdiction of the Board, to carry acetylene gas under the rules and regulations prescribed in Official Express Classification No. 18.

6168—February 3—Directing the G.T.R. Company to reduce its rates on coal in carloads from Suspension Bridge, Black Rock, and Buffalo to Lindsay, Ont., to $1.15 per ton of two thousand pounds, subject to s.s. 5 of Sec. 315 of the Railway Act.

6169—February 2—Dismissing complaint of Owen Davidson, Almonte, Ont., re excessive whistling of C.P.R. engines in town of Almonte, Ont.

6170—February 4—Dismissing application of T. N. & Western Railway Company for approval of location of its line from village of Burlington to the city of Hamilton, through the Township of Nelson, County of Halton, Ont., and the Tp. of West Flamboro, County of Wentworth, Ont.

6171—February 4—Permitting the W. E. and L. S. Railway Company to operate a mixed train service on its line, using; a trailer or trailers on the rear end for passengers, provided each trailer and all freight cars between locomotive and trailer are equipped with automatic air brakes, subject, to the condition that they will not handle freight cars in mixed trains within the limits of the town of Windsor, nor between the town switch and the company's power-house at Kingsville.

6172—February 4—Authorizing the N. St. C. & T. R. Co. to cross with its track and wires the wires of the Hamilton Cataract Power, Light & Traction Company at station 247+01 and Station 282+94, main line, and Station 280+40, T. H. & B. connection, Lot 27, Con. 5 and 6, Township of Crowlan, County of Welland, Ont.

6173—February 3—Authorizing the Galetta Electric Power & Milling Co. to place its wires across the track of the G.T.R. at public road west of Galetta station, Ont.

6174—February 3—Authorizing the Galetta Electric Power and Milling Company to place its wires across the track of the G.T.R. at public road on Lot No. 2, Concession 14, Township McNab, near Arnprior, Ont.

6175—February 6—Authorizing the Manitoba Government Telephones to place its wires across the C.N.R. tracks 200 yards west of Grays Station, Man.

6176—February 6—Authorizing the Bell Telephone Company to place its wires across the tracks of the G.T.R. 100 yards south-east of Glen Williams Siding, Ont.

6177—February 6—Authorizing the Chatham Gas Company, Limited, to lay a gas main under the G.T.R. tracks on Lacroix Street, Chatham, Ont.

6178—February 6—Approving deviation of the C.N.R. Company's Montreal Road, in the Township of Cumberland, Russell County, Ont., subject to the condition that the diverted road, with approaches and ditches, be put in and maintained in as good order and condition as the existing road, including the approaches and ditches.

6179—February 6—Granting leave to the W. E. & L. S. R. Railway Company to construct its line along and across the highways in the Township of Gosfield South, across the highways in the Township of Mersea, and along Erie Street, Leamington, Ont.

6180—February 2—Dismissing application of Dominion Concrete Company for an Order authorizing the C.P.R. Company to refund to them $196.52, the amount paid the railway company on account of a siding built to its right-of-way, to connect with private siding to the complainant's industry at Kemptville, Ont.

6181—February 1—Dismissing resolution of Order of Railway Conductors, the Brotherhood of Locomotive Engineers, etc., relative to reduction of section gangs, the "Cross" snow plow, and re Terminal Clearance.

6182—February 1—Dismissing complaint of Swan River Board of Trade alleging failure of the Canadian Northern Railway Company to furnish cars for prompt and efficient movement from that point.

6183—February 1—Dismissing application of W. R. Ritchie, Winnipeg, Man., for an Order compelling the C.N.R. to either to proceed to arbitration or withdraw the registration of its location plans where the same effect the property of the applicant, being Lots 33 and 34, Block 8, D. G. S. 30, St. Boniface, Man.

6184—February 1—Dismissing application of Mrs. J. E. Collings, of failure of the Canadian Northern Railway Company to settle her claim against the railway company for right of way over S.W. 32-27-29.

6185—February 1—Dismissing complaint of the Hanbury Manufacturing Company, Brandon, Man., alleging discrimination in favor of Winnipeg on shipments to points on the Regina Branch of the C.N.R., via Regina, from Brandon and Winnipeg.

6186—February 1—Directing that where shippers in the Prvince of Manitoba, Saskatchewan, and Alberta, are conpelled to furnish car doors to enable cars to be used for traffic, allowance shall be made upon the following basis:—(1) Lower car door, one dollar; (2) upper car door, fifty cents.

6187—February 2—Authorizing the C.P.R. Company to construct a branch line of railway at Beausejour to the premises of J. L. Turner, on the north-east Quarter Section 35, Township 12, R. 7, east.

6188—February 2—Dismissing application of the Kemp Manufacturing Company and Winnipeg Ceiling & Roofing Company for an Order directing the railway companies to equalize their freight rates on metallic sidings from eastern points to points in Manitoba, Saskatchewan, and Alberta, as against freight rates charged on the manufactured product.

6189—February 1—Dismissing complaint of the Winnipeg Elevator Company respecting certain charges made by the C.P.R. for drawing plans, etc.

6190—January 25—Directing every railway company subject to the authority of the Board, operating a railway by steam power, to equip each and every car with one of the

following systems of lighting, namely, the Pintsch Compressed Oil-Gas System, or the Commercial Acetylene System; and rescinding Order No. 5690, 17th November, 1908.

6191—February 6—Directing the G.T.R. Company to keep a night-watchman at the crossing of the Montreal Road, Kingston Junction, with the G.T.R., pending the construction of the subway.

6192—February 4—Dismissing application of the C.N.O. Railway Company for an Order to vary Order No. 5869, dated December 16th, 1908, granting the C.N.O. Company authority to place its track across Bay View Avenue, on Lot 20, Concession 2, Township York, Ont.

6193—February 4—Dismissing the application of the Toronto Electric Light Company for leave to place its underground ducts below the C.P.R. Company's tracks on Christie Street, North Toronto, Ont.

6194—February 4—Authorizing the C.N.O. and C.P.R. companies to operate their trains over the crossing east of Lorette, in Parish of St. Sauveur, Que., as authorized by Order No. 4862, of the 2nd June, 1908.

6195—February 3—Dismissing application of C.P.R. Company for an Order amending Order No. 3242, authorizing the Commissioners of the Transcontinental Railway to cross the C.P.R. track at a point near St. Bazile Station, Que.

6196—February 8—Directing that sleeping car and parlor or chair-car tariffs filed with the Board be printed on sheets uniform in size, namely, 11 inches by 11 inches, and be specifically numbered by each company beginning with C.R.C. No. S 1, and that subsequent tariffs be numbered consecutively with the prefix C.R.C. No. S—; and further directing that said tariffs be filed under filing devices similar to those used for the filing of passenger tariffs.

6197—February 8—Approving application of C.P.R. Company for approval of plan B-1-95-1, and 3 showing spans at each end of bridge No. 0.72, Fraser River, on the Mission Branch of the C.P.R., British Columbia.

6198—February 8—Authorizing the Qu'Appelle, L. Lake and Sask. Ry. and Steamboat Company to construct spur lines on Smith Street, and in the lane between Smith and McIntyre Streets, Regina, Sask., and that such spur lines be completed within 2 years from the date of this Order.

6199—February 8—Authorizing the C.P.R. Company to open for traffic that portion of the Mountain Section of its line from mile 99.17 to mile 100.4, known as the Rogers Pass Diversion, British Columbia.

6200—February 8—Authorizing the C.P.R. Company to construct a branch line of railway in the town of Tilsonburg, Ont., to and into the premises of the Tilsonburg Packing Company, and that such branch be completed within 2 years from the date of this order.

6201—February 8—Authorizing the G.T.R. Company to construct branch lines from a point on its railway at Donald, on part of Lot 6, Concession 2, Township Dysart, to the premises of the Woods Products Company, Limited, and that such branch lines be completed within 2 years from the date of this order.

6202—February 8—Directing the Toronto, Hamilton & Buffalo Railway Company to make certain improvements in the crossing of its railway with the Lee Mountain Road, in the Township of Saltfleet, Wentworth County, Ont.

6203 to 6212—February 9—Authorizing Okanagan Telephone Company to cross tracks of the C.P.R. with wires at ten different points in British Columbia.

6213—February 9—Approving of plan showing pier of Cornwall bridge draw span; Ottawa and New York Railway.

6214—Febrsuary 9—Authorizing the Chatham, Wallaceburg and Lake Erie Railway Company to open to the carriage of traffic that portion of its line of railway running from the crossing of the Michigan Central at Charing Cross to Erie Beach Park, Ont.

6215—February 9—Authorizing the Provincial Natural Gas & Fuel Company, of Ontario, Limited, to lay a gas pipe or main under the tracks of the G.T.R., Lot No. 74, Township of Stamford, County of Welland, Ontario.

6216—February 6—Authorizing the C.P.R. to use and operate the bridge crossing the canal at the Canada Sugar Refinery, on the South Bank Branch of the G.T.R. at the same point.

6217—February 9—Authorizing the Okanagan Telephone Company to cross the tracks of the C.P.R. 223 feet east of the 35th mile post.

6218—February 9—Authorizing the G.T.R. to construct, maintain and operate a branch line of railway from a point on its Lachine Canal Bank Branch immediately west of the draw span at the entrance to the dry dock into the premises of G. A. Grier & Sons, Montreal.

6219—February 8—Authorizing Hawthorn Hill Rural Telephone Company to erect and maintain its wires across the tracks of the G.T.R. on the second concession of the Township of Minto, Ont.

6220 to 6221—February 8—Authorizing the Okanagan Telephone Company to cross tracks of the C.P.R., with wires at 900 feet north of the 39th mile post; also at Lake Drive, Vernon, B.C.

6222—February 2—Authorizing the Georgian Bay & Seaboard Railway Company, (C.P.R.), to cross until November 1st, 1909, the tracks of the G.T.R., by means of the trestle over Hog's Bay, at or near Lots 13 and 14, Concession 5, Township of Tay, Ontario.

6223 to 6224—February 9—Authorizing Okanagan Telephone Company to cross tracks of the C.P.R., at Strand Hotel Level Crossing, and at Rosedale Avenue, Armstrong, B.C.

6225—February 9—Authorizing the Le Chemin de Fer de Colonisation du Nord to construct its railway across the highways and divert certain portions of the highways between Nominingue and a point ten miles northwesterly in the Province of Quebec.

6226—February 10—Authorizing the C.P.R. to open for carriage of traffic that portion of its Sheho Extension from Leslie, mileage 66.2 to Wynward, mileage 89.0, a distance of 22.8 miles.

6227 to 6228—February 10—Authorizing Dunnville Consolidated Telephone Company to cross the tracks of the G.T.R., at Forks Road, and Cedar Street, Dunneville, Ontario.

THE VALUE OF A WATER POWER.

C. T. Main.*

The value of an undeveloped constant water power is such a sum as when put at a proper rate of interest, say 10 per cent., will pay the difference in cost between steam and water power, items of cost being considered.

A power which is variable, and which cannot be depended upon throughout the year, has, of course, less value than that which is constant. In such a case the items for consideration are:—

The maximum, minimum, and average quantity of water, and length of time when there is no water; all the other items which enter into the value of a uniform power; necessity in nearly all cases for a supplementary steam plant, with the expense of maintenance and running for a portion or all of the time.

The value of an undeveloped variable power is little or nothing if its variation is great, unless it is to be supplemented by a steam plant. It is of value then only when the cost per horsepower for the double plant is less than the cost of steam power under the same conditions as mentioned for a permanent power, and its value can be represented in the same manner as the value of a permanent power has been represented.

To determine the market value of such a power which has been developed, it will be necessary to consider the power by itself, independent of the plant; that is, to determine first the value of the power as though it were undeveloped, and

*Mill Engineer and Architect, Boston, Mass.

then to determine the value of the improvements. The sum of both will represent the value of the power as developed.

It might happen in some cases that the value of the privilege would be a minus quantity, but that the value of the improvements more than offset that, thus making it of value in the developed state.

The cost of developing a power originally will not always represent the value of the improvements, except in so far as it relates to the character of the work done. Considering the work properly and substantially done, the value of that work immediately after completion may not be represented by its cost. A certain power may cost to develop twice as much as another of equal power, the difference in cost being due to difference in head or some other natural cause; but, all other things being equal, the one which cost double has no more value than the other, because it produces no more.

The value would depend largely, however, upon the character of the work done and the condition of the dam, canal, and wheel plant. If any portion required renewing soon, the value would be lessened; and if a general renewal of all the plant were necessary, the value would then be practically the same as though it were undeveloped.

The actual value of a plant would depend upon the amount of depreciation which had taken place; or, better, upon the number of years which it would run without renewing.

The value of the plant will be its cost, less depreciation, up to the point where the cost of water-power equals that of steam-power; for it would be justifiable to make an expenditure up to an amount which would give as good financial returns as any other source of power. Beyond this point, when water-power costs more than steam-power, the value of the improvements would not be represented by their cost.

SOCIETY NOTES.

British Columbia Land Surveyors.

The Corporation of British Columbia Land Surveyors commenced their annual convention at the offices of Gore & McGregor, Chancery Chambers, with the retiring president, J. H. McGregor, in the chair. There were present about fifteen members from Vancouver and the mainland points, in addition to those resident in the city, and much interest was taken in the proceedings. The following officers were elected for the coming year:—President, W. S. Drewry, of Nelson; vice-president, W. S. Gore, of Victoria; secretary, S. A. Roberts, of Victoria (re-elected). Board of management, J. Herrick McGregor and J. H. Grey, of Victoria, and E. A. Cleveland, G. H. Dawson, and E. B. Herman, of Vancouver.

Canadian Clay Manufacturers.

The Canadian Clay Products Manufacturers brought their convention at Brantford to a close. An effort will be made to have the Government erect a technical school for the clay-making industry, following the plan of those in the United States. New Officers were elected as follows:—President, H. Janes, Delaware; vice-presidents, James Cornhill, Chatham; T. Mulligan, Ottawa; W. H. Freeborn, Brantford; secretary-treasurer, D. O. McKinnon, Toronto; executive, J. B. Miller, Toronto; George Close, Stratford; George Crain, Beamsville; O. Baird, Parkhill; S. J. Fox, M.P.P., Lindsay; W. McCredie, Lyon; James Irwin, Norwich; J. W. Ball, Mimico; John Wardle, Blenheim; and J. C. O'Dell, Ottawa.

Canadian Street Railway Association.

The quarterly meeting of the executive committee of the Canadian Street Railway Association, was held last Saturday. Mr. J. F. Hutcheson, superintendent of the Ottawa Electric Railway Company, presided. Others who took part were:—Acton Burrows, secretary of the Association; Duncan Macdonald and P. Dube, of the Montreal Electric Railway; E. A. Evans, of Quebec; William Hopper, of St. John, N.B.; C. B. King, London; W. McCrea, Toronto, and James Anderson, Windsor. Details of several matters dealt with by the Association in Ottawa a few months ago were disposed of and some arrangements made for the annual meeting, which takes place in Winnipeg in midsummer.

OZONE IN THE PUBLIC HEALTH.*

T. J. McKavanagh.

We all fully realize it is essential that we have pure air and pure water.

In the city, the problem of the Public Health is particularly prominent because of the prevalence of epidemic, the possibilities of infection, and the difficulty in obtaining hygienic conditions in congested districts.

In buildings, overcrowded, or lacking good ventilation, the anemia, weakness, and general depression we experience is good argument for the necessity of pure air, and did we fully estimate the possibilities of contagion from the inhalation of vitiated air, we would realize a most important factor in the spread of consumption, pneumonia, and many fevers. Persons afflicted with disease infect the atmosphere by the bacteria exhaled in forced respiration, as, in coughing, sneezing, or talking, and in a vitiated atmosphere we are predisposed to infection from such bacteria.

Fortunately, the pathogenic, or harmful bacteria, readily succumb to light and oxygen, both of which we have in the atmosphere about us, but the congestion in the town and city, smoke, and other conditions of present day life, make it imperative that we supplement the slower purifying processes of nature.

Oxygen being only about 20 per cent. by volume of the air; in large or over-crowded buildings, it is difficult to provide sufficient quantities of fresh air by artificial ventilation, and at the same time to avoid disagreeable draughts and lowering of temperature.

Ozone, O_3, is a concentrated form of oxygen and, as we might expect, and as practice has shown, it is eminent as an air-refresher, and also is a powerful oxidising agent, deoderiser, and disinfectant.

Most of us are familiar with the Induction, or Rumdorff coil, now in general use for ignition purposes in motor cars and motor boats. Should we gradually increase the distance between the discharging points, or knobs, the discharge changes from a well defined noisy spark to a faint brush display, and upon further increase we must darken the room to observe the very faint, silent, violet-colored glow now obtained. Ultra-violet rays are now present and their action on the oxygen of the air results in the production of an allotropic form of oxygen—ozone.

In the commercial production of ozone, the necessary high tension currents are obtained from transformers and the silent discharge between plates or combinations of points and plates. The discharge must not be of the nature of a spark or arc. Sparks and arcs produce nitrogen oxides which are corrosive. The air treated by the silent discharge must be dry, otherwise, we have hydrogen peroxide. The air is dried by passing through calcium chloride, or pumice and sulphuric acid.

Small portable ozonisers, light enough to be easily carried from room to room, consisting of transformer, plates and fan, and with flexible wire and plug for attachment to the ordinary lamp socket, are in considerable use in theatres, offices, hospitals, etc., and are very efficacious in the home treatment of consumption, whooping cough, and anemia.

In Paris, the gas is used to disinfect and bleach the linen in hospitals. Ozone is in use in many flour mills for the bleaching of wheat and flour. Ozonised air of suitable strength passing at the rate of 100 cubic feet per minute will sterilise and bleach to a beautiful whiteness three tons of flour per hour. The treatment reduces the number of micro-organisms in wheat flour from 540 to 170 per gram and the flour can be stored for longer periods without deterioration.

Bleaching and refining petroleum, purifying beer-kegs and the ageing of wines and spirits, are some of the many successful applications of ozone. But, ozone's most important use the sterilising of potable water and sewage,

* Read before the Nova Scotia Society of Engineers, Halifax, N.S.

In Canada, many of our towns and cities are at present favored with water from what are, generally speaking, good sources, while others have natural advantages which slightly offset the risks from suspicious sources and they are not anxious, at present, to incur the cost of filters. With increased demand for water and increased risks of pollution, with a denser population, we will take our water from less wholesome sources and must consider the problems of water purification. We draw water from lakes and rivers that are, for the most part, above suspicion, but dead animals and the excreta of man and the higher animals are possibilities to be thought of in connection with water supply contamination. Typhoid fever is generally associated with water pollution. Spring epidemics are common, owing to the harmful bacteria from surface waters during times of melting snow and heavy rains. Wherever the drinking-water has been sterilized by ozone, the falling-off in mortality from typhoid fever has been most marked.

Ozone is particularly the enemy of harmful bacteria. Its action on bacteria is purely chemical, the bacteria being reduced to the simpler metals or elements. Color, due to humus substances, and the very unpleasant odors and the taste in water, due to vegetable decay, readily yield to ozone, and, in the water sterilising plant in Philadelphia, the effect of ozone in turbidity is easily seen, as the muddy-looking water passes through a glass tower and is instantly cleared on meeting the gas.

In the ozone process of water sterilisation, the water, if containing much matter in suspension, is first passed through rough or rapid filter beds to remove the grosser matter. The water so strained is raised to the top of towers, about sixteen feet high, and it either trickles down through layers of large pebbles or, is broken up into spray by baffle-plates; or, other device to ensure thorough mixing with the ascending gas forced in near the bottom of the tower. The gas is usually supplied in excess of ordinary requirements to meet the possibility of an excess of bacteria or oxidisable matter, and the excess of gas passing out to the open air is an indication of the purity, or otherwise, of the raw water.

Small ozonisers, guaranteed to sterilise sixty gallons of very impure water per hour, have been in considerable demand and the author recently had opportunity of seeing a very successful "Otto" ozoniser of this type. Over one thousand "Otto" small household ozonisers are in use in Paris alone, and there the system is considered indispensable. Recent tests of this apparatus in London were very satisfactory. Samples of London Main water, having an average of 870 organisms per cubic centimeter, were perfectly sterile after treatment. And water, infected with Bacillus Coli, and showing 5,400 organisms per c.c., was also readily sterilised. In this type of ozoniser, a small box, containing a transformer and plates, is placed above the water tap and a small pipe is carried down to a point just below the water valve. Opening the water valve automatically switches on the current to the transformer and the water in passing through the valve sucks down ozonised air through the small pipe, and intimate contact between the gas and water is in future assured by means of a swirling or mixing chamber which is part of the tap casting. The water drawn off smells strongly ozone, but, the gas passes off almost instantly and the water is then absolutely tasteless, that is, it retains its natural taste. The cost of treatment is nominal; the current required being about the same as for a 16 c.p. lamp.

We hear much, though not enough, of "Death From The Cup," an apt title to emphasize the danger of drinking from the public school or fountain cup. Common sense, without statistics, brings home to us the need of a remedy for existing conditions in schools and other places where the drinking cup transmits from mouth to mouth the most loathsome diseases.

Considerable attention has been given to this in the United States and it is impossible to over-estimate the good already done by those intrusted with the work of investigation and prevention. Dr. Forbes, of Rochester, reported, that an epidemic of diptheria, bringing suffering to twenty-four persons, was traced to a common drinking cup which all had used. Virulent diptheria germs were found in nearly five per cent. of a large number of apparently healthy school children in Philadelphia.

Dr. Davidson, of Lafayette College, found on a cup, which had been in use only nine days in a school, over twenty thousand human cells, or bits of dead skin. Between the cells, were thousands of germs, and every square inch of glass had on its surface at least one hundred thousand bacteria. We cannot afford to ignore the warning given by the above figures, and we might look at the matter in this way, that if we are not humane enough to protect others, we should at least be selfish enough to protect ourselves.

The small ozonisers, already spoken of, afford an excellent remedy, for, besides sterilising the water from the mains, the ozone present, either in solution or in excess, as free gas, effectively sterilizes the drink glass. The simplicity and economy of the process almost mark its apparent power as a bactericide, for we are accustomed to fighting disease with more costly and cumbersome methods. There is now no doubt as to the commercial success of the sterilisation of water by ozone. In America, we have a very successful plant at Philadelphia (Vosmaer process) treating about one million gallons per day of very polluted Schukyll River water at a cost of from three to seven dollars per million gallons. The water is rough filtered. The figures cover all charges, as interest, depreciation, salaries, etc. These figures compare favorably with the cost of eight dollars per million gallons obtained from good sand-filtering plants and the estimated cost of ten dollars per million gallons for the sand filters at Pittsburg. And, the relative sizes of the plants is striking. The Philadelphia plant takes up but a small space in the heart of the city, while the Pittsburg plant covers an area of 170 acres and is distant about eight miles.

Vosmaer plants are in operation near Amsterdam, treating 5,000 to 8,000 gallons per hour of surface water of poor quality.

The Otto & Marmier-Abraham processes exploited by the General Ozone Company, of Paris, etc., have met with considerable success on the continent of Europe. The system has been officially recognized by the French Government, and has carried off all honours wherever exhibited since first obtaining the Grand Prize at Paris in 1900. Plants treating from 100,000 to 5,000,000 gallons daily have been installed by the company at Paris, Nice, Dinard, Indret, Chartres, St. Servain, Chantenay, Avranches, Cosne, Sulina, and many others are now in the course of erection.

Effort is now being made to apply the Otto process in the treatment of sewage in conjunction with "Dibden" Slate Beds. "The sewage is poured over a series of plates which are laid one on top of the other with a 2-inch space between them. The sewage is then allowed to remain stagnant for two hours, when it is drawn off slowly, the sludge being left behind on the slates and being exposed to the air. Here it is immediately attacked by numberless animalcula. The filter is allowed to remain empty for about one hour, when it is gradually filled again. The sludge deposits, while it is allowed to remain for two hours, when the bed is again emptied. The result is that the whole of the organic matter in the sewage is digested by the worms and other living creatures and converted into humus. Periodically this humus is washed off (escapes). It has absolutely no smell whatever. This new departure is of the greatest value, permitting sewage schemes to be carried out much closer to houses than was formerly possible." The slate bed takes the place of the septic tank and produces sludge which is quite inodorous. The effluent from the beds is treated by ozone, the treatment removing the last trace of the oxodisable matter and killing off all bacteria.

WINNIPEG.—Tenders addressed to the chairman, Board of Control, for supply of ten ton macadam roller for the Street Commissioner's Department, will be received at the office of the undersigned up to 11 a.m. on Monday, March 1st, 1909. Delivery called for 1st May, 1909. M. Peterson, secretary, Board of Control office.

SOCIETY NOTES.—Continued.

Ontario Land Surveyors.

The seventeenth annual meeting of the Ontario Land Surveyors will be held at Toronto, February 23rd, 24th, and 25th, 1909, and the meetings, except the Tuesday evening meeting, will be held in the Parliament Buildings.

Tuesday morning will be taken up with the receiving of reports of committees. In the afternoon Mr. A. J. Van Nostrand will give his presidential address, and the following papers will be read:—"Topographical Surveys," B. J. Saunders; "The Mill Lot, Township of Plantagenet," E. T. Wilkie; "Grade Crossings of Railways," F. L. Somerville.

Tuesday evening, Mr. Elihu Stewart will give an illustrated lecture at the Engineers' Club, 96 King Street West, on "Down the Mackenzie River and up the Yukon."

Wednesday morning the following papers will be taken up:—"The Sewerage System, Hamilton, Ontario," E. G. Barrow; "Hudson Bay, a National Asset," J. W. Tyrrell; "The Road Surface," W. A. McLean; "Local Improvements," George Ross; "The Seigniority of Longueil," E. T. Wilkie.

Wednesday afternoon:—"The Future of Surveyors in Northern Ontario," J. F. Whitson; "Equipment and Management of a Party on Township Outlines," T. B. Speight; "Professional Status," B. J. Saunders; "Gravity," Otto Klotz; "Determining Azimuth by the Polar Star," L. B. Stewart.

Wednesday evening, dinner at McConkey's.

Thursday morning, paper on "Iron Ore Mining,—Belle Island, Newfoundland," W. B. Ford.

Report of committees and election of officers.

Canadian Forestry Association.

The annual meeting of the Canadian Forestry Association was held in the Convocation Hall, University of Toronto, on February 11th and 12th, 1909. The attendance was large and representative. The president, Mr. W. B. Snowball, presided.

Earl Grey was present and gave an interesting address. He referred to the great loss a country sustained by deforestation, not only because of timber waste, but the loss to agriculture. "The teaching of the people how to care for their forests is becoming the first object of the American Government," said His Excellency. "I hope it will also become the first object of the Canadian people. The forest area in the Dominion is 354,000,000 acres. By far the greater part of this is still Crown land, or in other words, belongs to the people. The question for you to determine appears to me to be this:—Shall this great inheritance, of which you are the trustees, be handed over to uncontrolled individuals to be misused, without regard to the interests of posterity, or shall it be managed under careful and well considered regulations on lines which will increase the public revenues, at the same time that they will ensure a steady advance in capital value."

Hon. J. M. Gibson spoke very briefly. Effective fire ranging was necessary to protect the forests, he said, and very important steps had been taken along that line. When he was Minister of Crown Lands there was selected and set apart many forest areas, and these could be found in Ontario areas, no good for agriculture, on which second-growth timber was coming, which was set apart and held held sacred and protected as forest reserves for all time.

Hon. W. C. H. Grimmer, Surveyor-General of New Brunswick, said he believed in the absolute preservation of the forests. He referred to the work done by the Government of New Brunswick. The exportation of pulp, he said, was a serious question in the eastern province. Great precautions had been taken to prevent fire in New Brunswick forests, and a new departure had been made by getting the correct scales of timber cut.

Mr. Frank Hawkins, Secretary of the Canadian Lumbermen's Association, said all lumbermen were intensely interested in the question of the protection of the forests. He thought that lands which had been denuded of timber should be utilized in some way.

Prof. McClement, of Queen's University, said it was time that Ontario was taking measures to conserve the water supply. The Province was lacking in coal supply and would suffer in the near future if the water supply was not conserved. In all the instruction at Queen's, he said, he would point out the necessity of every man subordinating his own private interests to those of the public and the future, and in some extent sow the seeds of public opinion which would prevent the exploitation of the forests in a wasteful mnner.

"General Forestry Conditions and Forestry Education" was the subject of a paper read by Mr. R. B. Miller, of the Department of Forestry of the University of New Brunswick, who was of the opinion that education was the best way to preserve the forests.

The convention closed with a banquet given at the National Club on Friday evening, at which the chair was occupied by the President of the Board of Trade, Mr. J. P. Watson, and the chief guest was His Excellency Earl Grey. Among those also present were His Honor the Lieutenant-Governor of Ontario, Sir James Whitney, President Falconer, Mr. Leveson-Gower, Hon. Frank Cochrane, Hon. W. C. H. Grimmer, Hon. Colonel Matheson, Mr. J. B. Miller, Major J. F. Macdonald, Mr. W. J. Gage, Mr. W. B. Snowball, Hon. J. S. Duff, Mayor Oliver, Dr. B. E. Fernow, Mr. A. H Campbell, Mr. Thomas Southworth, Mr. A. H. D. Ross, Mr. R. S. Gourlay, and Mr. G. H. Gooderham, M.P.P.

Institute of Engineers.

At the Institution of Engineers and Shipbuilders in Glasgow, Mr. A. S. Biggart described several of the most important bridges constructed within recent years by Sir William Arrol and Company, under his supervision. The first bridge described was that for the Caledonian Railway Company over the Clyde at Glasgow, which has accommodation for 13 railway tracks at the north end. As the main girders are underneath the deck of the bridge there is ample provision for rearrangement of lines or crossings. The piers of concrete hearting faced with granite were built on rectangular steel caissons sunk to a depth of 50 feet below the bed of the river, and filled with concrete. These caissons were built on a timber staging erected across the river, and were lowered to the river bed by hydraulic jacks. The next bridge noticed was that across the River Barrow, in the south of Ireland, serving the railway between Rosslare Harbor and Waterford. This bridge is 213 feet long, and consists of 13 fixed spans, each of a clear width of 140 feet, and a swing span giving two clear openings of 80 feet. The main girders are of lattice type, and carry the railway floor from the bottom booms. The chief difficulty encountered in the work was the exceptional depth reached by some of the pier cylinders. This depth (in one case 120 feet below high water), necessitated special arrangements to ensure reduction of pressure and to prevent illness among the workmen.

The new bridge over the River Wear, at Sunderland, was the next described. It carries a double line of railway for the North-Eastern Company, a roadway of 26 feet wide and two 7 feet footpaths. The bridge measures 1,220 feet between the principal abutments, and consists of one main river span 330 feet long and 85 feet above high water, and three land spans each 200 feet long. The main piers are of granite, and are built on concrete foundations. A steel caisson was adopted for the north river pier.

The new road bridges over the River Nile at Cairo were designed by Sir William Arrol and Company, and supervised by Mr. Biggart. The largest bridge is 1,755 feet long, and the smaller bridges are 272 feet and 220 feet respectively. The chief difficulty encountered was the extremely high level to which the River Nile rose every autumn, and which necessitated staging stronger than is generally used for such work. The Walney bridge, which connects Barrow-in-

Furness and the Isle of Walney, and the widening of Blackfriars bridge over the Thames were also described.

American Society of Mechanical Engineers.

The next monthly meeting of the American Society of Mechanical Engineers will be held on February 23rd, the fourth Tuesday of the month, instead of the second Tuesday as usual. The subject of the evening's discussion will be Safety Valves, introduced by a brief paper by Mr. Frederic M. Whyte, General Mechanical Engineer of the New York Central Lines.

Mr. Whyte will discuss the principles of the application of safety valves to steam boilers with special reference to locomotive practice, including questions of design and construction, and the requirements and limitations of valves. His paper will be followed by a general discussion covering marine and stationery practice and conditions existing in connection with low-pressure heating boilers.

Engineering Society, McGill.

The regular meeting of the Undergraduate Society of Applied Science was held in the Chemistry Building on the 3rd inst. The attendance was unusually large, due no doubt, to the fact that the address by Mr. C. B. Smith which had been stated for the December meeting, but unavoidably postponed until this had been talked of with considerable expectancy, and many who had followed the career of Mr. Smith as a Professor in the University, and as a consulting engineer throughout Canada, were very glad to have an opportunity of listening to him, as his opinions are accepted as of unusual weight.

Mr. Smith in selecting his subject chose a general topic rather than a technical one, since, as he expressed it, students in the University receive as much technical training as can be thoroughly digested, while on general matters pertaining to the advancement of the Engineering Profession, little or no attention is given, and the young engineer in starting on his life's work usually goes away poorly equipped to contend with business men on business problems. Citing his own case, he instanced that on leaving the college when quite young, without the knowledge of men and affairs, which is so desirable for successful handling of commercial projects during the first fourteen years from the nature of his work he came very little in contact with men of the highest standing in the nation. He accordingly strongly advised the undergraduates to make the most of all opportunities for culture while in the University, emphasizing the importance of taking a personal interest in all societies and to identify themselves with as much of the social life as possible. He also advised graduates to take interest in the civic affairs of the community in which they were located, stating that reticence and aloofness would not give any permanent standing, and only by assisting in administration could the engineer secure those rights which are undoubtedly his. Mr. Smith stated that from the nature of the training of an engineer he should be peculiarly adapted for executive positions in large or small industries, and although this method of filling such positions was not largely adopted in Canada up to the present time it would seem that by comparison with the United States and Europe this condition would prevail within the next decade. Although the Society has been favored with some very excellent addresses, yet Mr. Smith in this paper touched on some ideas of pre-eminent importance to the graduating year, and it is safe to say that this section of the Undergraduates will long remember Mr. Smith's address as one of the most valuable heard in their college course.—W. H. Powell.

Western Canada Railway Club.

A railway club of western Canada has been organized with headquarters in Winnipeg, Man. The following officers have been elected:—Hon. President, William Whyte; Hon. Vice-Presidents, M. H. McLeod, G. J. Bury, G. W. Caye and Wilford Phillips; President, Grant Hall; First Vice-President, L. B. Merriman; Secretary, W. H. Roseberry; Treasurer, T. Humphries; Secretary of Committee, E. W. DuVal; Executive Committee, R. J. Hungerford, C. W. Cooper, J. McKenzie, W. Smith, R. McNeil and L. O. Moody. The club will meet on the second Monday of each month, excepting June, July, and August.

ENGINEERING SOCIETIES.

ALBERTA ASSOCIATION OF ARCHITECTS.—President, R. Percy Barnes, Edmonton; Secretary, H. M. Widdington, Strathcona, Alberta.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS (TORONTO BRANCH).—W. H. Eisenbeis, Secretary, 1207 Traders Bank Building.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—29 West 39th Street, New York. President, H. L. Holman; Secretary, Calvin W. Rice.

ARCHITECTURAL INSTITUTE OF CANADA.—President, A. F. Dunlop, R.C.A., Montreal, Que.; Secretary, Alcide Chaussé, P.O. Box 259, Montreal, Que.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Vice-President, C. F. Pulfer, London, Ont.; Secretary-Treasurer, Alfred E. Uren, 62 Church Street, Toronto.

CANADIAN ELECTRICAL ASSOCIATION.—President, N. W. Ryerson, Niagara Falls; Secretary, T. S. Young, Canadian Electrical News, Toronto.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, J. F. Demers, M.D., Levis, Que.; Secretary, F. Page Wilson, Toronto.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President, W. G. Miller, Toronto; Secretary, H. Mortimer-Lamb, Montreal.

CANADIAN RAILWAY CLUB.—President, L. R. Johnson; Secretary, James Powell, P.O. Box 7, St. Lambert, near Montreal, P.Q.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—413 Dorchester Street West, Montreal. President, Geo. A. Mountain; Secretary, Prof. C. H. McLeod. Meetings will be held at Society Rooms each Thursday until May 1st, 1909.

QUEBEC BRANCH OF THE CANADIAN SOCIETY OF CIVIL ENGINEERS.—Chairman, L. A. Vallee; Secretary, Hugh O'Donnell, P.O. Box 115, Quebec. Meetings held twice a month at Room 40, City Hall.

TORONTO BRANCH OF THE CANADIAN SOCIETY OF CIVIL ENGINEERS.—96 King Street West, Toronto. Chairman, C. H. Mitchell; Secretary, T. C. Irving, Jr., Traders Bank Building.

MANITOBA BRANCH OF THE CANADIAN SOCIETY OF CIVIL ENGINEERS.—Chairman, H. N. Ruttan; Secretary, E. Brydone Jack. Meets first and third Friday of each month, October to April, in University of Manitoba.

CANADIAN STREET RAILWAY ASSOCIATION.—President, J. E. Hutcheson, Ottawa; Secretary, Acton Burrows, 157 Bay Street, Toronto.

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto. President, C. A. Jeffers; Secretary, C. L. Worth.

DOMINION LAND SURVEYORS.—Ottawa, Ont. Secretary, T. Nash.

ENGINEERS' CLUB OF TORONTO.—96 King Street West. President, A. B. Barry; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

MANITOBA LAND SURVEYORS.—President, Geo. McPhillips; Secretary-Treasurer, C. C. Chataway, Winnipeg, Man.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, J. H. Winfield; Secretary, S. Fenn, Bedford Row, Halifax, N.S.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, A. F. VanNostrand; Secretary, Killaly Gamble, 703 Temple Building, Toronto.

WESTERN CANADA RAILWAY CLUB.—President, Grant Hall; Secretary, W. H. Roseberry, Winnipeg, Man.

WESTERN SOCIETY OF ENGINEERS, 1735 Monadnock Block, Chicago, Ill.—Andrew Allen, President.

(Continued from page 260.)

of steady agitation a complete survey for such a project was authorized by the Canadian Government in 1904 and an interim report on the survey was laid before the Houses of Parliament in July of last year. It is probable that the final report giving in detail all results of the surveys will be ready for presentation during the coming session of Parliament.

It will be well before proceeding further to review, very briefly, the physical characteristics of the route of this proposed waterway. A glance at the accompanying maps and profile will show both its directness and the singular chain of deep lakes and rivers lying along it. The late A. M. Wellington, who was for years one of the most enthusiastic advocates of this route, has described it as "the finest place on the globe for a deep-water canal." Long reaches of navigable water occur, which need no improvement whatever. In fact the existing waterway is a succession of deep, almost currentless pools connected together by short streams broken by rapids and waterfalls. For this reason the water level does not fluctuate with great rapidity, seldom rising more than three inches in twenty-four hours for any considerable number of days in succession.

Geologically and topographically, the character of the surrounding country is broadly divided at a point close to the city of Ottawa. To the westward lies an Archæan region, composed mostly of diorite, gneiss and granite, abrupt, broken and bare, and with well-defined and deep valleys; in this section are occasional large patches of level-lying and fertile Cambro-Silurian country. To the eastward is a Cambro-Silurian region bordered close to the north shore of the Ottawa River by Archæan; this region is generally level-lying, but it is divided by well-defined outcrops, which form the natural dams that hold back the long deep-water reaches of the lower river. Permanent raising of the water levels will not be objectionable in the western section, where the channels are narrow and deep, but in the eastern section the river shores are flat, low and well-cultivated, and flooding is, therefore, an economic impossibility.

As in the case of all northern canals, the climatic conditions, which will limit the period of navigation to approximately seven months, are the most serious drawbacks to the efficient working of the route. It is estimated by the engineers that the waterway will be open, on an average, for 210 days in the year, this estimate agreeing closely with the figures for Lake Nipissing given by the Deep Waterways Commission in 1896. It was estimated at that time that Lake Nipissing would be closed by ice from November 29th to May 3rd, a period of 155 days. That climate will place the Georgian Bay Ship Canal at a disadvantage when compared with the existing St. Lawrence Canals can be readily seen from the following dates of the opening and closing of navigation taken from the report of the Deep Waterways Commission—

Place.	Average date of closing.	Average date of opening.
Port Arthur	December 21st	May 1st
Sault Ste. Marie	December 2nd	April 30th
Welland Canal	December 10th	April 17th
Lake Nipissing	November 19th	May 3rd
Lachine Canal (Montreal)	December 2nd	April 30th

It is hardly possible from these dates to avoid the conclusion that the northern waterway will have a navigation season nearly a fortnight shorter than that which can be obtained for the proposed enlarged canals on the St. Lawrence route.

A mental picture of the route, then, will show between Montreal and Ottawa, or, say, one-fourth of the length, a broad, placid river, broken by three groups of rapids and flowing between fertile and well-cultivated shores. This section has been navigable for nearly eighty years, and the present enterprise will merely enlarge the scale of the navigation. For 190 miles further to the westward the route still follows the Ottawa River. This section has been long the highway of the lumberman, but has remained little known to general commerce. The broad, placid pools and well-settled banks are still found, but the river is broken more frequently, more roughly and for longer distances by the rapids, the character of the valley changing swiftly with the change in its geology and islands of great size becoming a feature of the river. Old and well-established towns are on the banks, but settlement is by no means dense. It is hardly thirty years since the Canadian Pacific Railway reached Mattawa, the western end of the section. The building of the ship canal would give to this part of the river opportunities for development which it has never yet had, all through navigation now terminating at Ottawa.

The third section from the Ottawa River to the Georgian Bay runs through a succession of pools, with high, rocky banks. It is a much-broken region, with its streams sometimes divided into two or three parallel branches, its areas little settled and less cultivated, and, like most Archæan country, it is not attractive to the agriculturist. It was unopened to commerce in any effective way until the Canadian Pacific Railway was built through it twenty-five years ago.

The surveys, which have been under the general direction of Mr. E. Lafleur, Chief Engineer of the Department of Public Works, and Mr. A. St. Laurent, Engineer-in-Charge of the Georgian Bay Canal Survey, have been carried through with great thoroughness, the work done including general surveys, precision levels, borings, soundings, establishment of water levels at the various stages, studies of river regulation, hydrographic surveys of tributary watersheds, studies of power development, of the requirements of modern navigation, of the handling of large freighters, and of the details of lock construction. No plans have as yet been made public, and the drawings accompanying this article are prepared from the results of earlier surveys; in major detail the design can be but little altered, the natural features being so well marked and on so grand a scale.

The interim report places the length of the waterway at 440 miles, and for over 410 miles it will not be canal, but lake or canalized river. The general route has already been sufficiently described. The stretches of canal are found near the summit and near Montreal, but it is questionable whether the latter sections will ever be built or whether the locality does not justify a much bolder scheme of river improvement in spite of the expense entailed. The cut across the divide between the waters of the French and Ottawa Rivers is 3½ miles long, and a stretch of three miles of canal is projected in the valley of the Mattawa River, where the fall is comparatively rapid. These are the longest sections of actual canal except the section near Montreal. From the foot of the Lake of Two Mountains, out of which the Ottawa flows to its final discharge into the St. Lawrence in four separate branches, two routes are projected, the one following Lake St. Louis and the St. Lawrence River to Montreal, and the other the valley of the Back River or Rivière des Prairies. The Back River is the main stream of the Ottawa, and flows at the back of the Island of Montreal, discharging into the St. Lawrence at Bout de l'Ile, a point about seventeen miles east of the centre of Montreal harbor. Owing to the expense of right-of-way and the artificial obstacles that are necessarily found in the environs of a great city, about five miles of actual canal have been recommended on the first route and about eleven miles on the second.

In the natural waterways about 332 miles require no improvement whatsoever, for an additional fourteen miles a broad waterway can be secured by the cutting off of a few small shoals, and there will be about 66 miles of channel or submerged canal to be built. Locks of the ordinary type are to be used, the dimensions of the lock chambers being given as 650 feet by 65 feet by 22 feet on the mitre sills. It is not considered that there will be any lake vessels designed in the immediate future to draw more than 20 feet of water. It is true that the St. Mary River channel is being deepened to 25 feet and that the Canadian lake terminals are being dredged to the same standard, but the extra five feet are considered necessary to provide for the free movement of vessels drawing 20 feet, and also for those sudden falls in the lake levels which occasionally occur as a result of severe wind storms. Twenty-foot navigation at all stages is still

to be secured in the channels connecting the Great Lakes, and only the most important harbors can dock vessels of this draught. It will be noted that the locks are designed to handle self-propelling vessels rather than tows; and in their proportions they are in marked contrast to the St. Lawrence River locks, which were designed by the Canal Commission of 1870. The latter are 270 feet by 45 feet in plan, and Mr. T. C. Keefer has suggested that they were especially intended to provide for Noah's Ark, no other vessel of his knowledge having the same relative dimensions.

Forty-five main dams will be required in all, not including those that may be built for regulating the discharge of tributary streams. Where the river flow is abundant it is proposed to adopt the rock-fill type of dam, but the economic value of power has been advancing so rapidly during the last fifteen years that it is questionable whether the use of so wasteful a device will be permitted. The regulated water levels in the pools will be maintained by the use of stop logs as is customary in Canadian practice. In a few places the Stony patent sluices may be introduced.

Both from the standpoint of navigation and for the development of power the regulation of the discharge of the Ottawa River is most desirable. The units involved in its control are startling. The records show that the minimum discharge near Ottawa in recent years has not been much greater than 10,000 cubic feet per second, and that maxima as high as 250,000 cubic feet per second have been reached. It is hoped that the discharge may be so effectively controlled that it will never be less at this point than 90,000 cubic feet per second and never more than 120,000 cubic feet per second. The economic value of this regulation is effectively set forth in the interim report by the remark that the potential low-water horse-power on the two main rivers will be increased by it from about 150,000 horse-power to nearly 1,000,000 horse-power.

It is not easy at this date to grasp the fact that the watershed of the Ottawa River is an almost unknown and uninhabited land. It is mainly in the Province of Quebec and far to the north of the river itself, which in reality skirts its southern edge; its northern boundary is the height of land between Hudson's Bay and the St. Lawrence River waters. For at least three generations this district has been given over to the lumberman, and few and limited in area are the farm clearings in it. Engineering data for the design of the regulating works on the tributaries of the main river are. therefore, not in existence, and exhaustive surveys such as are needed to secure these data cannot now be conducted at reasonable expense except, perhaps, in the depth of winter. This difficulty will, however, be very greatly reduced when the National Transcontinental Railway, now building, is opened to traffic, as its location crosses the head waters of nearly all the principal tributaries of the Ottawa. It will provide a convenient base for the carrying out of a hydrographic and topographic survey of the upper watershed.

Much attention has already been given to the general hydrography of the river, and it is estimated that at a cost of less than $500,000 the well-known lakes, Temiscamingue, Keepawa, Quinze, Barrière, Kinejiskaskatic, Turn Back, Askikwaj and Grand Lake Victoria, might be converted into storage reservoirs, and a storage of, perhaps, 150 billion cubic feet of water obtained. The regulative effect of these great storage basins and the ease with which the discharge of the waters from them can be controlled are too obvious to call for comment. A more picturesque suggestion has been made for the control of the flood discharge, based on the fact that the head waters of the Ottawa itself lie far to the eastward, where the stream flows in a bed of high elevation between the two great ridges which form the height of land between the St. Lawrence River and Hudson's Bay. It is suggested that a large portion of the flood waters should be diverted across the height of land and into the streams discharging into Hudson's Bay. Pending the opening up and further survey of the watershed such a proposal may be regarded as an interesting speculation.

Settlement and investment have rendered impracticable here the bold projects of the earlier engineers, and it is not now proposed to make any material change in the existing hydrography. The study of the engineers has instead been directed to the estimation of the available water supply in the summit watershed and to the possible means of supplementing it. The district with its large forest areas, its severe climate and late spring, and its feeble evaporation, is well suited to a conservation of the natural rainfall and in this respect the location is most advantageous. It is intended to make a deep-water summit reach by flooding the series of small lakes, Troutt, Talon, and Turtle, that lie at the headwaters of the Mattawa River, and to design the summit locks so that this reach can be drawn down 6 ft. below normal level without interference with navigation. It is estimated that the watershed tributary to these lakes will furnish a supply sufficient to allow 24 lockages to be made daily through the summit reach. This should be ample to handle all the traffic for many years to come, provided that some arrangement is made for an economical locking of the smaller craft that are sure in season to throng such a waterway.

When the demand of the traffic is such that the existing watershed cannot provide for the lockages, the flow of the Amable du Fond River will be diverted into the summit reach. The Amable du Fond is a small stream lying to the south of the canal, and it is estimated that its discharge will more than double the supply available for the summit reach; at present it empties well to the eastward into the Mattawa waters. The generally unsettled and undeveloped condition of the district makes such a diversion possible without the legal conflicts and costly compensations that would be necessary in older countries.

The total lockage from the Georgian Bay up to the summit level is 99 feet and the lockage down to Montreal 659 feet, 27 locks in all being required if the Lake St. Louis location is adopted; the lock lifts will vary from 5 to 50 feet. As has already been stated the locks will be of the usual type, but unusual care has been taken to secure the most advantageous locations for them. The estimates are made for locks with chambers 650 by 65 by 22 feet, but the possibility of an increase both in length and width has been discussed. Where possible and as a measure both of safety and of economy the locks are placed in rock cuttings, and the character of the rock encountered is such that little more than a facing of the sides with concrete will be necessary. The locks will be provided with two pairs of steel gates at each end, so that the waters of the upper reach cannot break loose if by any accident a vessel should chance to run into one pair of gates. With modern power machinery there will be little difficulty in operating the two pairs of gates simultaneously. The locks are also by preference located so that the necessary water may be drawn directly from and discharged into the main river near the centre of the lock. All culverts and sluices and valves in the vicinity of the gates are avoided as far as possible. Guide piers for incoming vessels will be run far out on one side, and on the line of the lock, so as to avoid all difficulty at entrance. The rivers will provide abundant power for the lighting and working of the whole plant.

No provision has been made in the estimates for terminals at either end. The intention of the canal being to avoid transhipment until Montreal is reached, no provision other than a protection harbour is requisite at the western entrance; and at the eastern end there is already Montreal with its wharves, sheds, elevators, tracks, and machinery for handling bulk freight. Two routes have been surveyed near Montreal, but if the teachings of history are to be regarded, the route by Lake St. Louis, which enables all existing facilities and the sites of the manufacturing and trading companies to be reached to the best advantage, will unquestionably be adopted. The Back River may subsequently be opened up to furnish facilities and accommodation for manufacturing concerns of great magnitude that may in the future desire to establish themselves near this commercial centre.

The canal location near Montreal is necessarily affected by the greater engineering problems of the city, of which

perhaps the most important is the regulation of the St. Lawrence River, in the immediate vicinity, with the consequent increase of available power and the lessening of the floods and ice shoves which make the construction of terminal facilities in the harbor so costly an undertaking. This problem was studied exhaustively in 1889 by the Montreal Flood Commission, of which Mr. T. C. Keefer was chairman, and a report was submitted. It was pointed out that the local difficulties arose almost entirely from enormous accumulations of "frazil" or "slush" ice, which was formed throughout the winter in the open waters of the Lachine Rapids. The remedy recommended was the creation, in so far as possible, of an ice cap over the water surface. If the construction of the Georgian Bay Ship Canal is undertaken by the Canadian Government it is hardly likely that so great an opportunity to carry out the ideas of the Flood Commission will be allowed to pass. If the regulation of the St. Lawrence River between Montreal Harbour and Lake St. Louis be successfully accomplished no canal construction near Montreal will be necessary and the available harbour frontage will be very greatly increased. This matter is not dealt with in the interim report, probably because the cost is not fairly chargeable to the canal scheme, but rather to the general development of Montreal as a commercial centre. Among the many problems suggested by or involved in the canal scheme there is probably not another equal in engineering interest or economic importance to this question of flooding out the Lachine Rapids, where the total fall of the river is about 50 feet, and the minimum flow nearly 250,000 cubic feet per second.

It should be noted that although this canal scheme calls for an expenditure (according to the latest estimates) of $100,000,000, it is to be regarded as a fairly simple piece of construction and as one that presents few problems that are not familiar to the profession. The works will be on a great scale, but there is no uncertainty about any of major considerations connected with the execution of the work; and the estimates should be very close and accurate, for the surveys have been very carefully made and the unit cost of the various classes of work proposed is well-known. Compared to such problems as the enlargement of the Erie Canal or the building of the Panama, it is a model of simplicity and certainty. The lessons learned in the Detroit and St. Mary's Rivers make the adjustment of the design to the needs of the proposed traffic almost a piece of routine work.

The real problem of the Georgian Bay Ship Canal is indeed not one of engineering, but of economics and finance. Will the improvement justify the outlay? This has been the question for fifty years past and it remains the question to-day.

In 1865, shortly after the publication of the Shanly & Clarke reports, Mr. William Kingsford, the Canadian historian, himself an engineer by training and occupation, wrote in his monograph on the Canadian Canals as follows: "The geographical situation of this navigation can only have in view the trade of Lake Michigan, for from the lakes east of those waters the nearest route is by the St. Lawrence;" and "for purposes of Canadian navigation the canal is utterly unnecessary."

No one will now question the thoroughness of Mr. Kingsford's grasp of the situation of the soundness of his conclusion at the time of writing. The canal would then have served American traffic only.

In 1891, Mr. A. M. Wellington, in his comments in Engineering News, practically endorsed Kingsford's opinion in the following words:—"Had the route lain in American territory it would have been built long ago, and probably at Government expense as a free highway of commerce, so great is the opportunity. Were the route to-day under American control it would not be two years before work on it would be under way, but with one country to reap the chief gain and another country to pay the chief price for it, the prospect for any immediate action is poor." It may be said again that at the time of writing this conclusion was true.

The time has now come, however, when the Canadian publicist has ceased to look to the United States as the source of the traffic which his works are to handle. The growth of the settlement along the north shores of the Great Lakes, the rapidly increasing output of the prairie Provinces, and the diminishing importance of the United States as an exporter of heavy food stuffs, have combined to create conditions in his present which his predecessors could only predict for the far future. He realizes that England is still the great purchasing market and that the returns to the Canadian farmer and shipper are determined by the prices ruling in Liverpool and London. Every reduction in the cost of transportation—and it should be remembered that it is a case of the transport of heavy material of low unit value over great distances—means therefore an increased price at the farm, and pending the growth of a local market, the Canadian West eagerly advocates every proposition that promises to reduce the cost of its export shipments. The West, however, has not been a very vehement advocate of the Georgian Bay Canal because the disability that is closest to it, and consequently most felt, has been the inability of the railroads to deliver its crops of the Great Lakes steamers at Fort William and Port Arthur before the close of navigation.

In my opinion there is little reason to-day why the West should advocate the construction of this waterway, for it is by no means clear that it would materially aid in the solution of the West's particular problem. The engineers in their report cannot find that the Georgian Bay Canal offers any advantages for grain shipments that cannot be obtained at a lesser cost by improving the St. Lawrence canals between Lake Erie and Montreal, and the climatic advantage of the St. Lawrence route has already been mentioned. Moreover, there are two great schemes, now more or less under way, to which the West looks with much interest and which affect it directly. The first of these is the National Transcontinental Railway, now building from Winnipeg to Quebec, with an east-bound grade of 0.4 per 100, and a very direct route; and the second is the Hudson's Bay Railway, from Saskatoon to Fort Churchill, which is to tap each of the great grain-gathering railway systems and to deliver its traffic to the problematical navigation of the Hudson Bay and Hudson's Straits. This railway is now under survey. It may be reasonably predicted that the next few years will see the St. Lawrence route much improved, the National Transcontinental Railway in operation and the Hudson Bay Railway also. Each of these will take some share of the grain traffic, which in itself will not for many years to come be sufficiently great to justify the investment called for in the Georgian Bay scheme, even if all the export grain were carried by that route.

The engineers have based their design upon a probable traffic of 20,000,000 tons per annum, and when we bear in mind the history of the traffic passing Sault Ste. Marie there is little reason to question the estimate. Conditions are changing and settlement is advancing so rapidly towards the north that estimates based on the facts of to-day are a little less valuable than guesses of the traffic that will exist twenty years from now. I am a profound believer in the wisdom of constructing a Georgian Bay Canal, although not necessarily of the dimensions now planned, and this even though I do not think that the grain traffic from Western Canada will be a predominating item in the traffic returns of the canal. The work is necessary to the development of the region through which the canal is projected, and of the wealth and possibilities of that region we have abundant evidence. The Sault Ste. Marie traffic has grown on the coal and iron south of the Great Lakes at a rate beyond all prediction; but who knows what wealth lies to the north of those waters? Sudbury is not much over twenty years old, and its nickel-copper industry, now not half developed, is the result of an accident of railway location, and was not in the minds of the men who built the Canadian Pacific Railway. Cobalt is not ten years old and might have lain unknown and undisturbed had not the Province of Ontario run a haphazard railway into the unopened north. Moose Mountain has not yet commenced to send out its iron, and no engineer will question the value

of cheap transportation in the development of these mineral resources which come from surely only a few of the treasure spots in the unknown north. There is also the possibility of building up along the great valley with its water powers, its varied mineral deposits, and its wealth of timber, a manufacturing region unequalled on the continent. To this valley, which has raw material in such abundance tributary to it, cheap power and cheap transportation are necessary, and with the advance in the demand for power for heavy manufacturing and the growth of the world demand for every staple, there seems little doubt that the Canadian people is economically justified in developing the Ottawa waterway. Its power supply will not be greatly in excess of the demand by the time that construction is complete, and the traffic of the Georgian Bay Canal, in my judgment, will be created mainly on or close to the canal, and will be of a volume to justify its construction. Holding such opinions, it is waste of words for me to discuss the statistics of quantity, distance, and cost of operation, which would ordinarily be the determining factors in such an undertaking. It is not necessary that a great public improvement shall earn interest on its cost. Neither the Intercolonial Railway nor the Canadian Canal system have as yet ever done so, but the wisdom of building both these great works at public expense, in spite of all the minor errors of planning and administration, has never been questioned. They were essential to the welfare of the country that built them, and in a minor measure the same is true of the projected Georgian Bay Ship Canal.

EXPERIENCE OF CONTRACTOR vs. QUALITY OF WORK.

Leonard C. Wason.*

There is scarcely a field or building operations in which at first glance it seems simpler for the relatively inexperienced to do satisfactory work than in the use of concrete. Here are simple materials—sand, gravel and cement—mixed by crude labor, usually handled in a crude way, and frequently used only to obtain a relatively crude result in the form of foundations, walls, footings, and the like.

But even here experience counts for much, particularly in view of the fact that work improperly done, is often excessively expensive to remove and replace. With the rapid increase in the use of reinforced concrete the absolute necessity of practical experience and thorough technical supervision is daily becoming more apparent. With few exceptions the failures of concrete are traceable to ignorance on the part of the designer and the contractor—all too frequently to the latter.

Mr. Leonard C. Wason, president of the Aberthaw Construction Company, of Boston, Mass., one of the pioneers in the use of reinforced concrete in this country, points out with special emphasis some of the principal reasons why reinforced concrete should not be handled by unskilled labor. They are briefly:

1. Because the plans may be incorrectly read. Hence knowledge and experience are absolutely necessary.

2. Because the wrong reinforcement may be used. It is an easy matter to make an error of an eighth of an inch in the selection of bars—this may mean a decrease of 25 to 50 per cent. in strength. When made up frames are used error is equally liable in their selection.

3. Because the reinforcement may be wrongly placed. To the unskilled a matter of an inch or two difference in the level of a bar in floor or beam seems but a small matter. But in the case of a four-inch floor the placing of bars two inches instead of ¾ inches from the bottom may reduce the strength one-half. Bars in columns are easily mis-set with disastrous results.

4. Because materials for concrete may not be suitable, both in quality and relative size of the aggregates. The difference between concrete made with clean sharp sand and that with poor material may be equivalent to a loss of 50 per cent. in strength with the latter. Proper judgment—based on experience—is necessary in the use of different kinds of cement.

5. Because the concrete is improperly mixed and used. Errors are always liable to occur in the proportions used. The mixing may not be thorough, the batch may be too dry, it may not be properly tamped, the forms may be removed too soon.

Evidently the handling of reinforced concrete work is not such a simple matter after all. It is a work in which the experience of the contractor is the best evidence of the quality of the work.

* President of the Aberthaw Construction Company.

GAS TESTS.

The Department of Chemical Engineering at the University of Wisconsin, in charge of Professor Charles F. Burgess, has been carrying on an extensive series of tests of the various methods for measuring the heating values of gas, in order to enable the State Railroad Commission to determine a standard gas for fuel and illuminating purposes. The calorimeters of various types, made both in this country and abroad, and used to test the heating values of gas, have been thoroughly tested. It was discovered that one type of instrument extensively used and sold gave heating values from 10 to 20 per cent. higher than the gases measured actually contained, and that erronious results were being obtained in gas producer and gas engine work where these instruments were found in use.

One of the most marked defects in the calorimeter outfits was found due to inaccurate thermometers. The various users of gas calorimeters in Wisconsin may have these defects remedied by the university experts. The Department of Chemical Engineering has just made the announcement that it is in a position to calibrate accurately such calorimeter thermometers as may be sent to it by users in Wisconsin. The State Railroad Commission, through the co-operation of this department, offers this service free of charge to public service companies in this State.

Investigation work along this line is to be continued, and the Chemical Engineering Department is co-operating with the Railroad Commission and the Committee of the American Gas Institute in prosecuting this research work. Not only are the properties of gaseous fuels being studied at the university laboratories, but solid and liquid fuels are also receiving attention.

Wisconsin has the record of being the first State to perscribe a heating value as the standard for gas for fuel and illuminating purposes. Investigation showed that over ninety per cent. of the gas is used for the heat that it is capable of developing. The old candle-power standard is, therefore, wholly inadequate. It is predicted that the universal standard of the future will be that based upon heat unit. A recent report of the Public Utility Commission of New York suggests that an investigation is under way looking toward a change of standard in that State.

Professor Burgess has been assisted in his work by Professors J. L. Dickerman and O. L. Kowalke in co-operation with a committee appointed by the American Gas Institute, consisting of R. B. Brown, of Milwaukee; J. B. Klump, of Philadelphia, and Professor Burgess.

The Grand Trunk Pacific has so far this year placed orders for additional equipment as follows: Ten colonist cars, five parlor cafe cars, sixteen first-class coaches, eight sleeping cars, eight second-class coaches and three dining cars. This makes an aggregate of fifty new cars that will be placed in service in the coming summer on the new transcontinental line between Port Arthur and Edmonton.

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.

New Brunswick.

NEWCASTLE.—Tenders will be received by the undersigned until March 1st for the erection and completion of a stone addition to Harkins' Academy, Newcastle, Miramichi, N.B. J. E. T. Lindon, Secretary Board of School Trustees, Newcastle, N.B.

Ontario

BRANTFORD.—Tenders will be received until February 23rd, 1909, for cement, sewer pipe and paving brick. T. Harry Jones, City Engineer. (Advertised in The Canadian Engineer.)

OTTAWA.—Tenders addressed to the undersigned will be received until February 23rd, 1909, for the construction of two 60 cubic yards capacity centre hopper wooden dumping scows. Napoleon Tessier, Secretary, Department of Public Works, Ottawa.

OTTAWA.—Tenders will be received until noon of February 22nd for 144 cedar posts and 113,000 feet best quality spruce timber of various dimensions up to 6 in. x 6 in. and 27 feet long, to be supplied not later than April 8th, 1909. Address: W. W. Cory, Deputy of the Minister of the Interior.

OTTAWA.—Tenders for shops, will be received at the office of the Commissioners of the Transcontinental Railway at Ottawa, until 12 o'clock noon, of the 10th day of March, 1909, for the construction and erection complete, in accordance with the plans and specifications of the Commissioners, of shops east of Winnipeg. Plans, details and specifications may be seen at the office of Mr. Hugh D. Lumsden, chief engineer, Ottawa, Ont., and Mr. S. R. Poulin, district engineer, Winnipeg, Man. P. E. Ryan, Secretary.

OTTAWA.—Tenders for boundary monuments will be received at the Department of the Interior, Ottawa, up to noon of March 6th, 1909, for the supply of one hundred cast-iron monuments for use in marking the international boundary. W. W. Cory, Deputy Minister of the Interior.

OSHAWA.—Tenders will be received until March 4th, 1909, for the entire capital stock, save certain shares, of the Oshawa Electric Light Company, Limited. This company owns its own steam generating plant and water-power in the town of Oshawa. This company also owns the property and assets of the Bowmanville Electric Light Company, Limited, having steam and water-power generating plant and transmission system in the town of Bowmanville. E. R. C. Clarkson, 33 Scott Street, Toronto.

PORT ARTHUR.—At a meeting of the Electric Railway Commissioners, held last week, the secretary was authorized to call for tenders for rails, ties, bolts, etc., required to complete the double-tracking of the electric railway to the Fort William boundary.

SQUIRE.—Tenders will be received by the undersigned until 25th February, 1909, for 4,300 feet of rock elm plank, 3 in. by 16 ft. long (not to be less than 8 in. wide). To be delivered at Herriman's Bridge, Sydenham River, Derby, not later than the 15th day of April, 1909. Arthur Weaver, Squire, Ont.

TORONTO.—The Building Committee of the Western Hospital have instructed Mr. E. J. Lennox to prepare plans and call for tenders for the first large section of the new hospital to be erected on Bathurst Street. The building will be three stories high, with all the latest improvements. The first section will cost about $150,000, and will be followed by three or probably four other sections, each costing the same amount.

TORONTO.—Bulk tenders addressed to the undersigned will be received up to noon on Tuesday, February 23rd, for the various works required in the erection and completion of a Transportation Building on the Exhibition Grounds, Toronto. Joseph Oliver (Mayor), Chairman Board of Control, City Hall, Toronto.

TORONTO.—Tenders addressed to the undersigned will be received through registered post only up to noon on Tuesday, February 23rd, 1909, for the various works required in the erection and completion of a Transportation building on the Exhibition Grounds, Toronto. Joseph Oliver (Mayor), Chairman Board of Control.

WOODSTOCK.—The building committee of the municipality of Carleton will receive plans, specifications and cost of plans and estimates for the building of a brick Court House in the town of Woodstock during the summer 1909. Said tenders to be addressed to the undersigned. Tenders to be received up to February 20th, 1909. Henry A. Phillips.

Manitoba.

WINNIPEG.—Tenders will be received until February 22nd for 500 to 1,000 cords of cedar for block paving. Address M. Peterson, Secretary Board of Control, Winnipeg.

WINNIPEG.—Tenders will be received until February 22nd for 660 feet of 20-inch five-ply rubber belting for gravel conveyor. Address M. Peterson, Secretary Board of Control.

WINNIPEG.—Tenders will be received by the undersigned up to the 24th of February for the erection and completion of a three-storey and basement brick addition, 50 by 100 ft., to the Adelaide Block, on Osborne Street. Wm. Wallace Blair, Architect, 414-16 the Nanton Building.

WINNIPEG.—Tenders will be received by the undersigned up to the 27th of February for the several trades required in the erection of a five-storey and basement brick, stone and fireproof apartment block on the north-east corner of Roslyn Road and Osborne Street. Wm. Wallace Blair, Architect, 414-16 the Nanton Building.

WINNIPEG.—Tenders will be received by the undersigned up to the 27th of February for the several trades required in the erection of a six-storey and basement brick building, 50 by 120 ft., on Main Street South. Wm. Wallace Blair, Architect, 414-16 the Nanton Building.

WINNIPEG.—Tenders, addressed to the chairman of the Board of Control, for the supply of from 2,500 to 3,500 tons of asphalt for street paving for the city of Winnipeg, will be received until Wednesday, February 24th. M. Peterson, secretary, Board of Control office, Winnipeg.

WINNIPEG.—Tenders will be received until March 2nd, 1909, for the supply insulators, supply of material and erection of telephone line, erection of transmission line and certain repair shop equipment. M. Peterson, secretary, Board of Control. (Advertised in The Canadian Engineer.)

Saskatchewan.

SASKATOON.—Tenders addressed to the undersigned will be received until Friday, February 26th, for the construction of the post-office, customs and inland revenue fittings, etc., at Saskatoon. Napoleon Tessier, Secretary, Department of Public Works, Ottawa, Ont.

SASKATOON.—Tenders will be received until March 1st, 1909, for certain material for waterworks and sewerage works. For details see advertisement. Willis Chipman, C.E., chief engineer, 103 Bay Street, Toronto. (Advertised in The Canadian Engineer.)

SASKATOON.—Sealed tenders will be received by the municipality until February 24th, 1909, for a pumping engine with a capacity from 1,200 to 1,500 United States gallons per minute. J. H. Trusdale, Secretary-Treasurer; Willis Chipman, Chief Engineer. (Advertised in the Canadian Engineer).

LETHBRIDGE.—Tenders will be received until March 1st, 1909, for a Municipal Power Plant at Lethbridge. Fuller particulars will be found in the advertisement in The Canadian Engineer. George W. Robinson, Secretary.

Alberta.

CALGARY.—Tenders will be received until March 1st, 1909, for the supply of material and labor necessary for the construction of a coal and ash conveyor. H. E. Gillis, City Clerk. (Advertised in The Canadian Engineer.)

British Columbia.

VANCOUVER.—Tenders will be received until February 23rd for the supply for the current year of cement, sand, gravel and sewer pipe; also for the construction of wood-block pavements. The lowest or any tender not necessarily accepted. Wm. McQueen, City Clerk.

VICTORIA.—Tenders will be received until February 24th, 1909, for the erection and completion of a brick and reinforced concrete school building for the Board of School Trustees of Victoria, B.C. Hooper & Watkins, Architects.

ALBERNI.—Tenders will be received until February 22nd for the erection and completion of a lavatory, septic tank, etc., for the Government building at Alberni. Address F. C. Gamble, Public Works Engineer, Department of Works, Victoria, B.C.

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. Address, Engineer-in-Chief's Department, Adelaide, South Australia.

BRISBANE, AUSTRALIA.—Tenders will be received until March 29th for a supply of ironwork, insulators, and iron, bronze and covered wire. Address: Controller of Stores, General Post Office, Brisbane, Australia.

BRISBANE, AUSTRALIA.—Tenders will be received until May 31st for installing in the general post office a switchboard, consisting of one trunk line section, three subscribers sections, cable turning and string sections, frames, racks, power plant, etc. Address: Captain R. M. Collins, Australian Commonwealth Offices, 72 Victoria Street, Westminster, S.W., London, England.

GUAYAQUIL, ECUADOR.—Tenders will be received until May 1st for the execution of drainage, water supply, paving, asphalting and sanitary works at Guayaquil. Address: Junta de Canalizacion y Proveedora de Agua, Quayaquil, Ecuador.

LA PALOMA, URUGUAY.—Tenders addressed to the undersigned will be received until April 2nd, for the construction of a port. Ministerio de Obras Publicas, Monte Video.

MELBOURNE, AUSTRALIA.—Tenders will be received until March 23rd for the supply and erection of a power plant for the Central Telephone Exchange. Address: Commonwealth Offices, 72 Victoria Street, Westminster, S.W., London, England.

LEIPZIG, GERMANY.—Tenders addressed to the undersigned will be received until March 15th for a supply of pumps for the New Waterworks. Stadtverorducten, Leipzig.

CONTRACTS AWARDED.

Ontario.

HAMILTON.—The contract for laying an iron pipe down the side of the mountain, to connect sewer systems, was awarded to A. Mercer, whose price is $2,175.

HAMILTON.—At a meeting held last week contracts for supplies were awarded, and in nearly every case the prices showed a considerable slump. The secretary was instructed to figure out whether the prices quoted by the Hamilton and Toronto Sewer Pipe Co. or Sackville Hill were the lower. E. J. Guest and James Marshall will divide the lime contract at 16½ cents a bushel; the Hamilton Brick Co. got the brick contract at $8 a thousand, and the Gartshore-Thomson Co. the iron castings contract at $1.95 a hundred pounds.

Quebec.

MONTREAL.—The tenders for the additional contracts on the new Montreal jail have been opened, and that of Messrs. J. B. Pauzé & Co., who already secured the first contract, is the lowest, at about $800,000. The architects will send in their reports without delay, and it is expected that the new contract will be awarded to Messrs. Pauzé & Co. in a few days.

ST. LOUIS.—The tender of Laurin & Leitch was accepted for supplying flagstone for sidewalks for 1909.

Alberta.

EDMONTON.—Tenders for spruce lumber, required by the city during the year, were opened by the Commissioners. The tenders were based on the amount of spruce used last year, which totalled 828,000 feet. For the different sizes the tenders were: Edmonton Lumber Co., $20.40, $21.25, $20.40, $21.25; D. R. Fraser & Co., $20, $21, $20, $21; John Walter, $20.40, $21.25, $20.40, $21.25; McInnes Lumber Co.—On cars, 18.50, $19.50, $18.50, $18.50. Delivered from yards, $19.50, $20.50, $19.50, $19.50; Cushing Brothers Co., $19, $20, $21, $21; W. H. Clarke & Co., $20.40, $21.25, $20.40, $21.25; Alberta Lumber Co., $20, $21 to $23, $22, $21.50 to $23. The Commissioners recommend the acceptance of the Cushing Brothers Co., Limited, tender, that of the McInnis Lumber Co. being hedged by conditions with which the city cannot comply.

LIGHT, HEAT, AND POWER.

Ontario.

LONDON.—Plans and estimates are being prepared by Electrical Engineer Sifton in regard to Niagara power. Two estimates will be submitted, one on the cost of duplicating the present electric plant, and the other on the cost of a plant to distribute 5,000 horse-power, as outlined in his previous estimate to the committee when he named that amount as the probable sale at $35 per horse-power or less.

Saskatchewan.

McLEOD.—The Northern Electric and Manufacturing Co., Limited, have been awarded the contract for a Western electric 260 kw., 2,200 volt, 60 cycle, polyphase alternator and switchboard for the town.

PRINCE ALBERT.—The Prince Albert civic electric light plant shows a profit of $200 after paying the debenture indebtedness, interest and all operating expenses. The gross earnings of the plant for 1908 were $20,542.

RAILWAYS—STEAM AND ELECTRIC.

Ontario.

OTTAWA.—In reply to a question by Mr. McCarthy, Calgary, the Hon. G. P. Graham said it was not the intention of the Government to add at the present session to the obligations already incurred to aid the construction of railways. This means the Government does not intend to introduce new railway subsidies to Parliament this year.

TORONTO.—The Grand Trunk Railway have placed in commission a number of fast locomotives of the Atlantic type, with a seven-foot six-inch drive. They are being used on passenger trains between Toronto, London and Windsor.

Quebec.

MONTREAL.—The Canadian Northern Railway have ordered 30,000 tons of rails from the Dominion Steel Co.

QUEBEC.—The Great Northern Railway will erect freight sheds on St. Andrew Street in spring.

RIVIERE DU LOUP.—The Smart-Turner Machine Company, Limited, Hamilton, are supplying the Intercolonial Railway Company with an outside packed plunger pump, to be installed in the shops here.

Manitoba.

WINNIPEG.—Announcement is made by the C.P.R. that the telephone system will be installed almost immediately between this city and Brandon, to supersede the telegraph for train despatching. If the experiment proves successful extensions are contemplated.

Alberta.

MACLEOD.—The C.N.R. has purchased a site for terminals here, and assurances are given that the company will

be in here shortly. It is negotiating with the holders of the Macleod, Montana & Cardston charter.

British Columbia.

VANCOUVER.—President Elliot, of the Northern Pacific Railway, and L. P. Gilman, assistant to the president of the Great Northern, were at Vancouver recently with a party of officials to confer with the city authorities concerning he location of joint terminals in the East end of the city.

SEWERAGE AND WATERWORKS.

Ontario.

HAMILTON.—The Sewers Committee last week appointed Chairman Jutten and Ald. Allan to procure more land for the proposed west end sewage disposal works, and the Ontario Government will be asked to pay a share of establishing and maintaining the works.

FINANCING PUBLIC WORKS.

New Brunswick.

CHATHAM.—Tenders will be received by the town of Chatham until February 24th for $25,000 electric light debentures, bearing 4 per cent. interest. Address: Robert A. Logie, chairman, Finance Committee.

Ontario.

BARRIE.—Tenders will be received by the town of Barrie, for $12,000 20-year, 4½ per cent. electric light debentures. Address: E. Donnell, treasurer.

BLIND RIVER.—The town of Blind River is offering $17,000 to any transportation company which will construct a line of railway from Blind River to Lake Natininda thence to Lake Chiblow, a distance of seventeen mills. John Muncaster, Secretary of Board of Trade.

FORT WILLIAM.—Tenders will be received by the city of Fort William until February 22nd for $156,500 local improvement debentures. Address: Wm. Phillips, treasurer.

Saskatchewan.

MELVILLE.—The municipal council is soliciting offers for $6,000 debentures for grading streets and building sidewalks, repayable in fifteen years.

Alberta.

RED DEER.—Tenders will be received by the town of Red Deer until March 1st for $19,400 sewer local improvement debentures, bearing 6 per cent. interest. Address: A. T. Stephenson, commissioner.

WETASKIWIN.—On January 30th, the City Council sold the balance of the waterworks and sewerage bonds, amounting to $105,000, to the Ontario Securities Company, Limited, Toronto. The City Council will take immediate steps to complete the installation of waterworks and sewerage system.

TELEPHONY

Nova Scotia.

SYDNEY.—It is understood that F. A. Bowman, manager of the Eastern Telephone Co., will shortly remove to Halifax, where he will assume an important position with the Nova Scotia Telephone Co. Mr. Bowman was formerly in the electrical department of the Dominion Steel Co.

Manitoba.

WINNIPEG.—An item of particular interest and one which has figured for the first time in Manitoba's budget was the telephone statement. The income in this, the first year under Government operation, was $656,486.74. During the year there have been 408 miles of long distance 'phones constructed and 583 miles of farmers' telephones. During the fiscal year the number of telephone subscribers increased from 14,000 to 20,000.

MISCELLANEOUS.

Ontario.

HAMILTON.—At the Waldorf Hotel, Hamilton, this week was held an exhibition of hardware and builders' supplies. The management gave space on first, second and third floors to the following firms and their respective lines: Canada Wire Goods Manufacturing Company, Hamilton, all kinds of steel and iron jail work, entrance doors, steel wire guards, jail bunks, etc., plain wrought iron gates, wire binding for reinforcing concrete, sand and gravel screens, bank and office railings; Hamilton & Toronto Sewer Pipe Company, Limited, Hamilton, square and oval flues, terra cotta chimney tops and sewer pipe; Allith Manufacturing Company, Limited, Hamilton, door hangers, track and automatic fixtures; Taylor-Forbes Company, Limited, Quelph, Ont., hardware specialties, mowers, and woodware; F. W. Bird & Son, Hamilton, Ont., Paroid roofing. (This firm has recently supplied 770,000 square feet of their roofing to Messina, Italy.) Canadian Hart Wheels, Limited, Hamilton, power grinders; Pittsburgh Wire Fence Company, Pittsburgh and Canada fencing; E. C. Atkins & Company, Hamilton and Indianapolis, belt and strap punches, vest saws for cutting nails; S. F. Bowser & Company, Toronto, oil storage tanks.

HASTINGS.—Mr. Stevens, of Randolph, McDonald & Company., the contractors who have the contract for this section of the Trent Valley Canal, has returned to town and opened an office here. The contractors will commence the construction of their scows and boats shortly. Once the work on the dam and locks starts the river will be blocked, and no lockages made at this point, it is expected, for the balance of the season.

Manitoba.

BRANDON.—The City Council are advertising for a city engineer. Harry Brown, city clerk. (Advertised in The Canadian Engineer.)

Alberta.

EDMONTON.—The city will spend $120,000 this year on street paving. For this work the Bitulithic Paving Co. have made an offer of $3.10 per square yard, with a five-year guarantee.

British Columbia.

VICTORIA.—Tenders will be invited shortly for the construction of two stern-wheel steamers of the type of the steamer Distributor, built last year for the Grand Trunk Pacific Railroad Company. The two steamers will be similar in size and design to the steamer built by Alex. Watson of this city last year for the railroad company.

VICTORIA.—City Engineer Topp has suggested the following approximate amounts for street maintenance for the current year: Cleaning, $12,000; drains, $5,000; sprinkling, $7,000; horse and cart maintenance, $2,300; bridge repairs, $2,000; oiling pavements, $900; tools maintenance, $2,000; car fares, $100; new sprinkling, $1,500; four horses and carts, $1,600; surfacing streets, $20,000; plank sidewalks maintenance, $4,300; contingencies, $3,000; moving large crusher in quarry and bunkers et al to different points, not including land, $2,600; total, $64,300.

FERNIE.—At the last meeting of the City Council it was decided that tenders for the erection of the new municipal building should be called for at once. The structure is to be proceeded with immediately.

CURRENT NEWS.

Ontario.

OTTAWA.—The International Portland Cement Co. reports for the year ended November 30th, 1908, a profit from sales of 252,234, equal to 20.17 per cent. on the paid-up capital of $1,250,000. There is now $72,000 at the credit of depreciation account, and $68,227 profit and loss.

CHATHAM.—City Engineer Bell, of St. Thomas, who has recently designed a number of bridges for the county of Elgin, has been asked by the council of Kent county to prepare an estimate for a bridge over the Thames River, twelve miles below Chatham. It will be a swing bridge of 200 feet, with a fixed span of the same distance, and will be used for general traffic.

OTTAWA.—A new patrol steamer has been launched at the yards of Swan & Hunter, Newcastle-on-Tyne, for use by the Canadian Government in Georgian Bay waters in con-

nection with buoy and lighthouse work. The "Simcoe," as she is called, is 180 feet long by 35 feet beam, built of steel. She is being fitted with twin-screw triple-expansion engines.

Saskatchewan.

LANIGAN.—The C.P.R. line from here to Prince Albert will be commenced early in spring and pushed to completion, and the gap between Wynard will be removed, thus affording two direct lines to Winnipeg. The town has sold $13,000 debentures, and a town hall will be erected shortly.

REGINA.—Plans are being prepared for the erection of some important buildings during the coming season. Among others, a large structure for the Heintzman Piano Co. will be erected near the post-office.

British Columbia.

PRINCE RUPERT.—Last week five hundred men were laid off by G.T.P. contractors, owing to adverse weather conditions.

PERSONAL.

MR. HARRY D. BAYNE, Eastern manager of the Canadian Westinghouse Co., Limited, has handed in his resignation, which, it is understood, will take effect in a few weeks.

OBITUARY.

MR. JOHN STARR, the well-known senior member of the electrical engineering and contracting firm of John Starr, Son & Company, Limited, died on February 15th at Halifax, N.S. Mr. Starr was one of the best known business men in Nova Scotia. His early life was spent in the hardware trade, and he and his brother David carried on business in that line for many years, but as electricity came into general use electrical supplies were largely handled by the firm, and in 1883 the firm of John Starr, Son & Company, electrical contractors, was founded by Mr. Starr. It is now the oldest established electrical supply house in Canada. The business expanded and some years ago became John Starr, Son & Company, Limited. John Starr introduced the American system of arc lighting in Halifax, Charlottetown, Moncton, St. John's, Newfoundland, and other places. He spent two or three years in London, Paris and Marseilles, where he also introduced the street electric lighting system. Mr. Starr was in his eighty-first year. He leaves two sons, C. C. Starr, associated in business with his father, and David Starr, manager of the Electric Power Company in Glasgow, and four daughters.

MR. MAURICE PERRAULT, M.L.A. for Chambly county, one of the most prominent of the private members of the Quebec Legislature, and Vice-President of the Architectural Institute of Canada, died at his home in Longueil. Mr. Perrault had been chairman of the Private Bills Committee, the most important committee of the Quebec House, during the last session. The late Maurice Perrault, M.L.A., was born in Montreal, on June 12th, 1857. He was a son of Mr. H. M. Perrault. After studying at the Seminary, Montreal, he became an architect, many fine buildings testifying to his ability and originality. Mr. Perrault succeeded his father in business in 1877, and has since devoted himself largely to his profession. His time was taken up to a considerable extent with the planning of churches, convents and other large structures. From 1888 to 1892 he was official architect for the district of Montreal under the Hon. P. Garneau, then Minister of Public Works. From 1889 to 1895 he acted as expropriation commissioner for the city of Montreal and from 1889 to 1901 he was architect to the corporation of Montreal. He was one of the organizers and members of the Architects Association of the Province of Quebec, had been a member of the American Public Health Association since 1894, and a member of the Civil Engineers Society of Canada since 1898. He represented Chambly in the Quebec House of Assembly since 1900, when he was elected by acclamation, but at the two following general elections he was unsuccessfully opposed.

MARKET CONDITIONS.

Montreal, February 18th, 1909.

Cable reports from London show that prices of pig-iron in England continue practically unchanged, being up one week and down the next, but varying around the same point. Stocks are showing a slight increase, but this does not seem to affect the general situation. Exports continue very light and trade has been rather disappointing.

The market in Scotland is fairly firm but the expectation seems to be that there will be slightly lower figures on round lots. Home demand is good, however, and consumption is sufficient to absorb the most of the output. Export demand is only fair and apparently requires encouragement in the way of lower prices.

The market in the United States continues disappointing, the volume of business being rather lighter than was anticipated at this time of the year. Generally speaking, prices are well maintained, but there is little doubt that some concessions could be secured if it was desired to purchase in quantities of 1,000 tons or over. Demand for semi-finished and finished material is showing improvement, that for light structural material having developed very considerably during the last ten or fifteen days. The railway companies are also in the market for increased supplies of bridge material, steel castings, etc. Several good orders for rails and steel cars have been recently placed, this tending to strengthen the market generally.

Notwithstanding the disappointment in foreign markets, signs of a decided improvement are showing themselves in Canada. The demand for not only pig-iron, but iron and steel material, generally, is brightening up and it looks as though quite a satisfactory trade will be done during the next few months. Railways are placing large orders for steel rails and other material, and manufacturers and consumers are enquiring for and purchasing to cover their requirements till next June. Between quantities purchased and still under discussion, over 120,000 tons are involved. These orders will absorb large quantities of Canadian pig-iron, and will have a tendency to generally strengthen the market situation.

Prices for finished and semi-finished material show practically no change as yet, and dealers are anxious to see an improvement:—

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 ¾-base; tire steel, $1.95 for 1 x ¾-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.; 2¼-inch, 10c.; 3-inch, 11½c.; 3¼-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, 55c. 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 strength, 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 Head, $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: 1-4-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-inch, $27; 2-inch, $36; 2½-inch, $57.50; 3-inch, $75.50; 3½-inch, $95; 4-inch, $128

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 9 1-2c. 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.

Shingles.—See lumber, etc.

Spikes.—Railway spikes are in dull demand and prices are steady at $2.40 per 100 pounds, base of 5½ x 9-16. Ship spikes are also dull and steady at $3 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 and thicker; 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.)

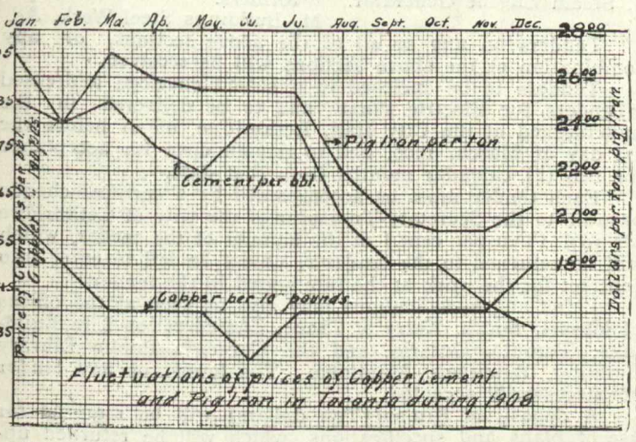
Tin.—Prices are 32c. to 32½c.

Zinc.—The market is steady at 5⅛ to 5¾c.

* * * *

Toronto, February 18th, 1909.

The outlook is improving. Among the signs of increased trade is the experience of a lumber traveller on the road who sold more car loads of lumber in South-western Ontario than in any week for months. He reports that many dealers have been buying from hand to mouth for half a year or more, and are now bare of stock. Orders have come in, too, for April shipment of building paper, sewer pipe, fire-bricks, and small quantities of cement. Architects have orders for more and better styles of buildings than this time last year, which gives hope for good employment by builders when spring opens.



No special activity appears, however, in metals or hardware at the moment; metals are especially dull this week. There are no immediate features of moment in foreign markets, and in the iron trade of Britain not much business is passing.

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

Antimony.—Partakes somewhat of the greater strength that characterizes all metals this week. Not much selling, however. Price as before, 9 3-4c.

Axes.—Standard makes, double bitted, $8 to $10; single bitted, per dozen, $7 to $9.

Boiler Plates.—1-4-inch and heavier, $2.40. Boiler heads 25c. per 100 pounds advance on plate.

Boiler Tubes.—Orders continue active. Lap-welded, steel, 1 1-4-inch, 10c.; 1 1-2-inch, 9c. per foot; 2-inch, $8.75; 2 1-4-inch, $10; 2 1-2-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.—Common structural, $9 per thousand, wholesale, and the demand moderately active. 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.—We do not change our quotation from 15c. to 15 1-2c. Matters have quieted down, and there is but slight movement at unchanged prices.

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.—Still quiet on account of coarse climatic conditions. 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 pounds. 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 are in very active request.

Iron Chain.—¼-inch, $5.75; 5-16-inch, $5.15; ⅜-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.

Iron Pipe.—Black, ¼-inch, $2.03; ⅜-inch, $2.25; ½-inch, $2.63; ¾-inch $3.56; 1-inch, $5.11; 1¼-inch, $6.97; 1½-inch, $8.37; 2-inch, $11.16; 2½-inch, $17.82; 3-inch, $23.40; 3½-inch, $29.45; 4-inch, $33.48; 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, $4.71; 1-inch, $6.76; 1¼-inch, $9.22; 1½-inch, $11.07; 2-inch, $14.76. Makers are holding prices stiff.

Lead.—Quiet and unchanged at $3.90 to $4.00 here. Excitement abroad quieted.

Lime.—In adequate supply and slow movement. Price for large **lots at kilns outside city 22c. per 100 lbs. f.o.b., cars; Toronto retail price 35c. per 100 lbs. f.o.b. car**

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 quoted at $22.00 in car lots. The season being practically** over for shingles, there is but little movement in them, but prices are suddenly strong at $3.20 for British Columbia. White pine lath are scarcer, No. 1 especially, and stiff in price. No. 1 are $4, and No. 2 $3.50. 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, $2.55 base; cut, $2.70; spikes, $3. There is a fair supply and no especial activity.

Pitch.—Demand is flat; price, 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, 9¼c. 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	$0.60	$0.75	$1.00	$3.25
Single junction, 1 or 2 feet long.	.90	1.35	2.70	3.40	4.50	14.63
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 24-gauge, $2.50; 26-gauge, $2 65; 28-gauge, $2.85.

Tool Steel.—Jowett's special pink label, 10½c. Cyclops, 16c.

Tin.—The tone of outside markets is firmer, some authorities still think the price must go up. The production has increased. No change in price here, 30 to 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 fairly active, market strong at $5.25 to $5.50, and more enquiry.

* * * *

Winnipeg, February 16th, 1909.

The local trade continues quiet and preparations are being made on all hands ordering supplies for the coming season, and dealers in many cases have already placed their spring orders.

The local architects are exceptionally busy just now as most of them have plans under way of large works to be done during the present year. No further rise in the price of lumber has taken place and new lists have not yet been compiled, although the list price in all probability will be changed instead of merely giving a smaller discount.

The Cement Block business is likely to have a good season's run as many of the architects are favorable to using a cement faced block. The price of cement is still quoted at an exceptionally low figure giving very little profit for the dealers.

This week the Annual Bonspiel is on in Winnipeg and many of the out-of-town merchants and business men are in the city and will take the

(Continued on Page 45)

A statement has been prepared for the Minister of Railways showing the circumstances of every level crossing fatality in the last five years. The total number of deaths is 270 and the returns show that in ninety-five per cent. of the cases the accident was due to carelessness or recklessness on the part of the individuals concerned.

TENDERS CALLED FOR

CITY OF WINNIPEG

POINT DU BOIS HYDRO-ELECTRIC DEVELOPMENT

Tenders for Construction and Equipment

Sealed tenders on prescribed forms, addressed to the Chairman of the Board of Control, Winnipeg, Canada, and marked on the envelope "Point du Bois Hydro-Electric Development, tender for....." (here add the particular item or items as below) will be received at the office of the undersigned up to 11 a.m. on Tuesday, 2nd of March, 1909, for the supply and delivery of Insulators, the supply and delivery of material for and the erection of a telephone line between Point du Bois and Winnipeg, the erection of a Transmission line between Point du Bois and Winnipeg, and the supply and delivery of certain repair shop equipment.

Copies of the instructions to bidders, Plans, Specifications, and Forms of Tender may be obtained at the Power Engineer's Office, Carnegie Library Building, Winnipeg, Manitoba.

These specifications, plans, etc., may also be seen at the offices of Smith, Kerry & Chace, Confederation Life Building, Toronto, Ontario.

Each tender must be accompanied by a certified cheque, payable to the order of the City Treasurer for the sum called for in the corresponding "Instructions to Bidders," which cheque will become forfeit to the Corporation in the event of the successful tenderer refusing or neglecting to sign a satisfactory contract when called upon to do so.

Individual tenders will be received for:—

16—Insulators.
*3—Telephone Line.
*14—Erection of Transmission Line.
28A—Repair Shop Equipment.

As a further alternative, tenderers may include or group together number 3 and 14 providing that they have also tendered for each individually.

The Board reserves the right to reject any or all tenders or to accept any bid which shall appear advantageous to the City of Winnipeg.

M. PETERSON, Secretary.

Office of the Board of Control,
Winnipeg, Man., Feb. 5th, 1909.

* The numbers are those of the different volumes of specifications.

TENDER

Tenders will be received up till noon March 1st, 1909, by the City Commissioners addressed to the undersigned for the supply of material and labor necessary for the construction of a Coal and Ash Conveyor for the City of Calgary.

Plans and specifications can be obtained at the City Engineer's Office.

The lowest or any tender not necessarily accepted.

H. E. GILLIS,
City Clerk.

Dated at Calgary, February 10th, 1909.

CITY OF LETHBRIDGE, ALBERTA, CANADA

Tenders for Municipal Power Plant

Specifications, drawings and form of tender may be obtained from the Secretary-Treasurer, City of Lethbridge, Alberta, on and after the Fifteenth day of January, 1909. The following are the sections issued:

A. Boilers and Accessories.
B. Economizer.
C. Feed Pumps.
D. Mechanical Draft.
E. Pipe work and Valves.
F. Steam Turbine Generator
G. Steam Engine Generator.
H. Re-erection of Steam Engines.
I. Condensing Sets.
J. Crane.
K. Switchboards, &c.
L. Motor Generators & Transformers.
M. Buildings Steel Work, &c.

Tenders on any or all of the above sections, or any combination of the above sections will be received.

Tenders to be enclosed in a sealed envelope addressed "Tenders for Electric Plant" and to be delivered to the undersigned at the City Hall, Lethbridge, on or before the 1st day of March, 1909, and to remain open for acceptance for two (2) calendar months from that date.

Each tender must be accompanied by a certified cheque payable to the Secretary-Treasurer of the City of Lethbridge for 10% (Ten per cent.) of the amount of the tender, which will be returned to the tenderer, unless he fail to enter into contract for the work at the rate stated in the tender.

Plans and specifications may also be seen at the offices of Messrs. Smith, Kerry & Chace, Confederation Life Buildings, Toronto, Ontario, and the Carnegie Public Library Building, Winnipeg, Manitoba. The lowest or any tender not necessarily accepted.

A deposit of $10.00 (Ten dollars) will be required for use of plans and specifications, which will be returned upon letting of contracts.

GEO. W. ROBINSON,
Secretary-Treasurer.

CITY OF BRANTFORD

Tenders for Cement, Sewer Pipe and Paving Brick

Sealed Tenders, addressed to John Moffat, Chairman of the Board of Works, in care of the City Clerk, Brantford, Ont., will be received till 12 o'clock noon on

TUESDAY, FEBRUARY 23rd, 1909

for the above supplies required by the City of Brantford, during 1909.

Specifications may be seen, and instructions to bidders and forms of tender obtained on application to the City Engineer.

Each tender must be accompanied by a marked cheque payable to the order of the City Treasurer for the amount called for in the form of tender.

The lowest or any tender not necessarily accepted.

T. HARRY JONES,
City Engineer.

City Hall, Brantford, February 8th, 1909.

ROLL THE HIGHWAYS.

The Town Board (Township Council), of the town of Canton, N.Y., is considering the advisability of having rollers constructed to roll the snow on the country roads. At the last meeting of the board a report was read from sections where it has been tried, showing that the plan was very successful. One roller was said to be sufficient to roll 25 miles of road, and the average cost of rolling where nine feet of snow fell on the average cost only about 60 cents a mile. A great advantage claimed for this method of treating the roads is that the sleighing remained good so long as there was snow anywhere, and where the roads were rolled they did not fill up as in other places, since the road was so smooth that the wind blew the snow off instead of piling it in drifts. The practice of rolling is largely followed in Vermont and Michigan, where the snow-fall is heavier than it is in Canton.

CANADIAN NORTHERN IN MANITOBA.

During 1908 the Canadian Northern discharged all fixed charges on the bonds of the company guaranteed by the province. In addition they made the following additions to track:

Rossburn branch—Graded to end of 1907, 109.75; graded 1908, 22.88; total grade, 132.63; steel to end of 1907, 92.64; steel laid 1908, 22.31; total steel, 114.95.

Oak Point branch—Graded to end of 1907, 63.75; graded 1908, 9.43; total grade, 73.18; steel end of 1907, 60.75; total steel, 60.75.

Hallboro' extension—Graded 1908, 48.89; total grade, 48.89.

Thunder Hill branch—Graded to end of 1907, 20.17; total grade, 20.17; steel end of 1907, 20.05; steel laid, .12; total steel, 20.17.

CONTRACTOR'S SUPPLIES

To know where to look for what you want, to know where to dispose of what you don't want is a great convenience. You require special equipment. This department will enable you to get in touch quickly with reliable men who wish to dispose of that which you require. Whether a buyer or a seller, you will find this department an aid to business.

RATES FOR THIS DEPARTMENT ARE VERY SPECIAL. BETTER SEND FOR THEM.

FOR SALE

HORIZONTAL ENGINES.

1 refitted 16" x 24" L.H. rocking valve.
1 refitted 11¼" x 14" L.H. slide valve.
1 nearly new 12" x 12" C.C. slide valve.
1 new 12" x 15" C.C. slide valve.
1 refitted 10½" x 14" C.C. slide valve.
1 refitted 10¼" x 16" R.H. slide valve.
1 new 10" x 15" C.C. slide valve.
1 refitted 11" x 11" C.C. rocking valve.
1 new 9" x 12" L.H. slide valve.
1 refitted 9" x 12" L.H. slide valve.
1 refitted 8¾" x 9" R.H. slide valve.
1 refitted 8" x 13" R.H. slide valve.

HORIZONTAL BOILERS.

1 refitted 66" x 14' 7" containing 106-3" tubes.
1 refitted 60" x 17' 6" containing 54-4" tubes.
1 refitted 63" x 14' containing 64-3½" tubes.
1 refitted 56" x 14' 4" containing 64-3" tubes.
1 nearly new 60" x 12' containing 82-3" tubes.
1 refitted 54" x 14' containing 70-3" tubes.
1 refitted 60" x 13' 6" containing 72-3" tubes.
1 refitted 50" x 14' containing 64-3" tubes.
1 refitted 54" x 12' containing 64-3" tubes.
1 refitted 52" x 11' containing 68-3" tubes.
1 refitted 44" x 10' containing 48-3" tubes.
1 refitted 36" x 11' 6" containing 32-3" tubes.

STEAM PUMPS.

1 refitted No. 6 pulsometer pump, 300 gals. per minute.
1 new 8" x 5" x 12" duplex, 224 gals. per minute.
2 refitted 7½" x 4½" x 10" duplex, 172 gals. per minute.
1 new 7½" x 4" x 8" duplex, 82 gals. per minute.
1 refitted 7" x 4½" x 8" duplex, 150 gals. per min.
4 new 6" x 4" x 7" duplex, 114 gals. per min.
2 refitted 6" x 4" x 7" duplex, 114 gals. per min.
1 refitted 5¼" x 3½" x 5" duplex, 100 gals. per min.
1 new 4½" x 2¾" x 6" duplex, 60 gals. per min.
10 new 4½" x 2¾" x 4" duplex, 40 gals. per min.
18 new 3" x 2" x 3" duplex, 20 gals. per min.

A copy of our supply catalogue or machinery stock list for the asking.

H. W. PETRIE, Ltd.
Toronto Montreal Vancouver

JARDINE UNIVERSAL CLAMP RATCHET DRILL

Indispensable for Machine Repairs, Factories, Machine Shops, Bridge Builders, Track Layers, Structural Metal Workers, have use for it. Send for description.

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547-548 Monadnock Block, CHICAGO.

FOR SALE

Rails—Newand second-hand
Locomotives—Standard and narrow gauge.
Contractor's Equipment.

JOHN J. GARTSHORE
58 Front Street, West, TORONTO

FOR SALE. Great Bargains if you act promptly in D.C.

MOTORS

1—500 volt, 15 Kilowatt. 900 R. 1—250 volt, 11 Kilowatt, 1150 R. 2—250 volt, 8 H.P. 1—250 volt, 10 H.P. 600 R. Built Specially for Hoisting Purposes.

All in First Class Order and no Reasonable Cash Offer refused.

WRITE, WIRE, OR CALL.

ELEVATOR SPECIALTY CO.
Cor. Lombard and Church Sts., TORONTO

NEW INCORPORATIONS.

(Continued from Page 7)

Ontario.—Boston Portage Cobalt Silver Mines, Limited, Cobalt, $40,000; Geo. Mitchell, Jas. Anderson, Wm. Graham. McBurney Lumber Co., Limited, Toronto, $50,000; Jas. McBurney, John Gray, C. H. Edwards. Gowganda Prince Silver Mines, Limited, Toronto, $1,000,000; Chas. G. Lache, D. R. Leask, A. H. Dowler. The John Black Mining Co., Limited, Toronto, $1,500,000; John Black, C. E. Lewis, Wm. Vass, all of Montreal. The Nasmith Baking Machine Co., Limited, Toronto, $100,000; John D. Nasmith, A. H. Rodgers, S. Turner. G. W. Dixon Engineers and Maps, Limited, Cobalt, $40,000; Heman H. Lang, T. C. Hare, J. J. Anderson. The Northern Dredging Co., Limited, Durham, $190,000; Richard H. McWilliams, C. R. Lavelle, W. A. Lavelle. Bartlett Mines, Limited, Toronto, $4,000,000; Walter M. Watson, G. P. Ridler, W. T. Stewart. The Lennox Telephone Co., Limited, Hog Bay, Ont., $4,000; Irvine Hambly, John J. Clark, P. Seeley.

A CEMENT EXHIBITION.

The first annual exhibition of Cement and Cements Products will be held in Toronto on the 1st to 6th March at the St. Lawrence market. The sale of space since the first announcement of the show has increased rapidly, and there are but few available now. It is expected that this, the initial exhibition, which is held under the auspices of the Cement Users Association will prove a success in every way. Not long ago it will be remembered this association was formed in Toronto with the object of furthering the use of cement as a building material and the various uses for which the product is adapted. Several prominent men identified themselves with the association, among them being T. L. Dates, of the Sun Portland Cement Co.; Gustave Kahn, J. M. Kilbourn, J. G.

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(Continued from Page 285.)

opportunity of placing their spring orders, and transacting other business. In conversation with a number of the out-of-town business men they seem to be, without exception, very confident about the coming year and state that the progress made last year will even be greater in the building line, and growth of small places, than it was during 1908.

The following quotations hold good for this week:—

Anvils.—Per pound, 10 to 12 1-2c.; Buckworth anvils, 80 lbs., and up, 10½c.; 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 1,000, three grades.

Cement.—$2.65 to $2.75 per barrel.

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; ¼-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., 4¾c.

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, $11.25; 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.

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CITY OF BRANDON, Manitoba

Applications for the position of City Engineer will be received by the undersigned up to Four o'Clock p.m., March 1st, 1909. Duties to commence April 1st, 1909. Applicants to state qualifications.

HARRY BROWN, City Clerk.

AMONG THE MANUFACTURERS

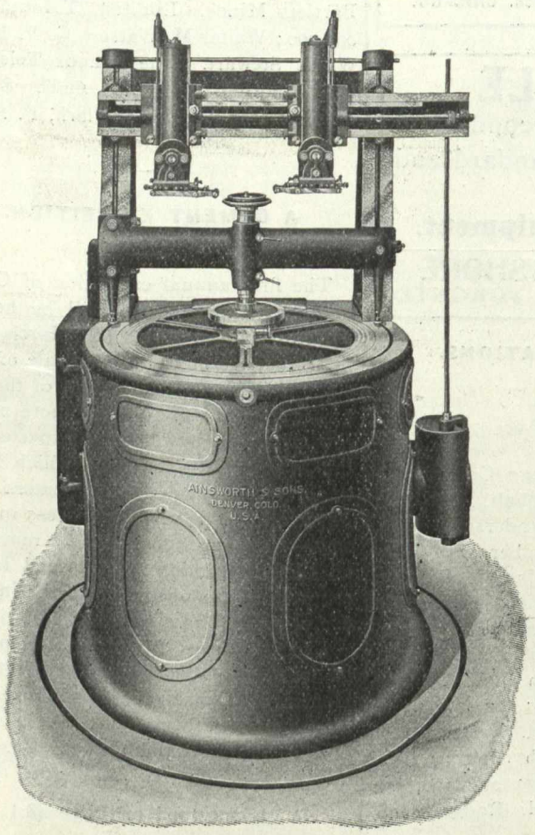
A department for the benefit of all readers to contain news from the manufacturer and inventor to the profession.

A NEW AUTOMATIC CIRCULAR DIVIDING ENGINE.

As along other lines there have been many improvements in engineering instruments and the special tools and machinery for their accurate and economical manufacture.

Wm. Ainsworth & Sons, the well-known instrument makers, of Denver, Colorado, U.S.A., have in many respects departed from the traditional instrument making practice, which, originating as it did in Europe, and until now closely followed by American makers, and advanced along the lines of the American watch-making industry, in the development of special and automatic machinery, tools and instruments for the production of engineering instruments with interchangeable parts.

We show herewith a new 30-inch automatic circular dividing engine, which has just been finished in the tool and experimental department of their factory, and which has many original features, making for increased accuracy and



speed in the graduation of the circles for engineering and astronomical instruments.

A most striking feature of this machine is its massiveness and its rigidity, for, while its heaviest work will be the ruling of lines .002-inch wide by .005-inch deep, its weight exceeds 2,000 pounds, and it is mounted on a concrete foundation that is entirely separate from the floor.

As far as possible all parts have been made of cast-iron, but the bearings throughout are of tool steel, hardened and ground, which insures durability and permanence of alignment for an indefinite period, and, while the difference in the expansion coefficients of the three materials used is .000001 per degree Farenheit, the construction is such that its alignment and operation are not perceptibly affected by a temperature variation of 30 degrees Farenheit, although the engine is located in an underground constant temperature building, with a temperature variation of but one degree Fahrenheit.

The worm wheel of cast-iron, and weighing 175 pounds, is well ribbed, and has embedded in its upper surface three platinum circles, on which the original and corrected circles have been divided, and from which the worm teeth are cut and corrected. Owing to the extreme rigidity of this machine errors as small as .00001-inch are readily determined by means of the high power microscopes used, and, as the worm wheel was seasoned for a period of two and one-half years before the final work was done on it, errors once determined and corrections made will remain constant for an indefinite period.

The worm wheel spindle is of cast-iron, with conical, hardened steel sleeves, which rest in hardened steel bearings carried by a cast-iron socket, a counter balanced roller bearing taking all but about ten pounds of the weight of the wheel and spindle off the bearings, this being sufficient to hold the spindle firmly in its bearings, a film of watch oil .00002-inch in thickness giving sufficient lubrication.

As may be seen from the illustration, this machine has double dividing heads operated through splined shafts and spiral gearing from a single mechanism on the base, which lifts the cutters, carries them forward, drops them, rules the lines and automatically varies the length of the single, fifth and tenth degree lines on two pieces of work simultaneously. Both dividing heads have independent vertical and horizontal adjustment, and either may be independently swivelled to any angle for flat, bevel or edge graduation, and both operated simultaneously.

The lower rail or bracket carries an auxiliary spindle or "quill," as it is called, which in turn carries the work. This bracket is adjustable in every direction, and the "proving plate" on the lower end of the quill facilitates its adjustment, together with that of the quill, and work to a position with its axis coincident with the axis of the worm wheel to within the limit of accuracy of the engine.

The application of the "quill" is one of the most important features of this machine, which makes for increased accuracy, besides facilitating the rapid handling of the work. The quills consist of hardened steel spindles carried in hardened steel sleeves, the outside of which are of uniform diameter and concentric with the axes of the spindles, and are nothing more or less than precision lathe spindles that are removable, and may be carried from one machine to another.

The parts to be divided are, after being previously roughed out and seasoned, attached to a quill, and all finishing operations, including facing off silver for dividing, dividing, engraving figures and turning graduated edge to gauge to fit verniers, before being removed, thereby insuring that each operation is true with every other operation performed on the quill and with the hole at the centre from which the work is located to within the error limits established for this work.

Owing to the advancement of astronomy and the increasing precision demanded of instruments for use in connection therewith, error limits that are permissible to-day must be decreased ten, twenty-five or fifty years hence, and in view of this a device is embodies in this machine by means of which original errors in the worm and worm wheel may be further reduced, together with any errors that may arise from wear.

By the use of this device corrections as small as one-tenth of a second (.000005-inch, measured on the periphery of the worm wheel), and even less may be made at any time without interfering with the operation of the machine.

The operation of the machine is entirely automatic, it only being necessary to place the work in the machine and start it. Upon completion of the work the machine stops automatically and calls the operators' attention to it by the ringing of a bell.

The makers state that, owing to the fact that they have a considerable amount invested in patterns, tools and fixtures for the production of this machine, they will probably construct to order similar machines under their patents.

(Continued from Page 45)

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.

Lumber.—No. 1 pine, spruce, tamarac, British Columbia fir and cedar—2 x 4, 2 x 6, 2 x 8, 8 to 16 feet, $27.25, 2 x 20 up to 32 feet, $38.

Nails.—$4 to $4.25 per 100. Wire base, $2.85; cut base, $2.90.

Tool Steel.—8½ to 15c. per pound.

Timber.—Rough, 8 x 2 to 14 x 16 up to 32 feet, $34; 6 x 20, 8 x 20 up to 32 feet, $38; dressed, $37.50 to $48.25.

Boards.—Common pine, 8-inch to 12-inch wide, $38 to $45; siding, No. 2 white pine, 6-inch, $55; cull red or white pine or spruce, 6-inch, $24; No. 1 clear cedar, 6-inch, 8 to 16 ft., $60; Nos. 1 and 2 British Columbia spruce, 6-inch, $55; No. 3, $45.

Flooring.—No. 2 red pine, 4-inch, $43; No. 3 red, 4-inch, $38; No. 4 red and white pine or spruce, 4-inch, $28; ceiling, No. 2 white pine, 4, 5, and 6-inch, $55; No. 3 red pine, $38.

Lath.—No. 1 red and white pine mixed, $5.50; No. 2, $4.75.

Shingles.—No. 1 British Columbia cedar, $4.25; No. 2, $3.75; band sawn, $6.

Rope.—Cotton, ¼ to ½-in. and larger, 23¼c. lb.; deep sea, 18c.; lath yarn, 9¼c.; pure Manila, per lb., 13¼c.; British Manila, 11¼c.; sisal, 10¼c.

(Continued from Page 45)

Murphy, Kennedy Stinson, C. H. Thompson, and Peter Gillespie, president. A programme is being arranged for the visitors to the exhibition.

The Hespeler Machinery Company, Limited, Hespeler, Ont., has been incorporated with a capital of $100,000. The incorporators are: W. G. Chater, Hespeler, Ont.; T. F. Campbell, M. A. Secord, A. Wilson, and others, all of Galt.

Heenan & Froude, Limited, engineers, of Manchester and Worcester, have been awarded a bronze medal by the Royal Sanitary Institute in connection with the model of a refuse destructor exhibited by them at the Health Exhibition, held at Cardiff July 1908.

The University of Pittsburg on Friday, February 12th, honored Mr. Edward G. Acheson, president of the International Acheson Graphite Company of Niagara Falls, N.Y., by conferring upon him the degree of Doctor of Science. The convocation was held in Carnegie Music Hall and was in commemoration of the birth of Abraham Lincoln and Charles Darwin. It was made memorable by the presence of James Schoolcraft Sherman, vice-president-elect. The degree of Doctor of Science was conferred upon Mr. Acheson because of the many successes he has scored as results of his scientific research. It was Mr. Acheson who gave to the world the abrasive known as Carborundum, also the product Siloxicon, as well as Artificial Graphite. His electric furnace work has given him prominence as the greatest electric furnace expert in the world. His work has added very materially to the world's wealth and will be of material assistance in the future conservation of our natural resources, particularly so in the case of lubricating oils, as his latest process for deflocculating graphite and applying it to lubrication is esteemed and appreciated as a factor destined to largely conserve the world's supply of lubricants. The extent to which his possible developments will reach is as yet unknown, but there can be no question as to the ultimate great general benefit.

WHERE TO BUY.

(Continued from page 2.)

Contractors
Cleveland Bridge & Engineering Co., Ltd., Darlington, England.
Metcalf Engineering Co., Ltd., Montreal, Que.

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

Conveyors
Babcock & Wilcox, Ltd., Montreal.

Cranes
Dominion Bridge Co., Ltd., Montreal.
Harpell-Stokes, Limited, Winnipeg and Toronto.
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,
Harpell-Stokes, Limited, Winnipeg and Toronto.
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.
Harpell-Stokes, Limited, Winnipeg 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
Harpell-Stokes, Limited, Winnipeg and Toronto.
Toronto & Hamilton Electric Co., Hamilton, Ont.

Economizers
Babcock & Wilcox, Ltd., Montreal.

Electric Apparatus
Harpell-Stokes, Limited, Winnipeg and Toronto.
Hill Electric Mfg. Co., Montreal, Que.
Toronto and Hamilton Electric Co., Hamilton, Ont.

Electrical Supplies
Harpell-Stokes, Limited, Winnipeg and Toronto.
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.
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
Harpell-Stokes, Limited, Winnipeg and Toronto.
Mussens Limited, Montreal, Que.

Generators, Alternating and Direct Current
Harpell-Stokes, Limited, Winnipeg and Toronto.
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
Harpell-Stokes, Limited, Winnipeg and Toronto.
Mussens Limited, Montreal, Que.
Toronto & Hamilton Electric Co., Hamilton, Ont.

Motors
Harpell-Stokes, Limited, Winnipeg and Toronto.
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.
Sterling, W. C. & Son Co., Monroe, Mich.

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

Preservatives
Carbolite Carbolineum Co., Toronto,

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

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

Pulleys
Harpell-Stokes, Limited, Winnipeg and Toronto.
Mussens Limited, Montreal, Que.

Pumps—Steam and Power.
Canadian Buffalo Forge Co., Montreal and Toronto.
Harpell-Stokes, Limited, Winnipeg and Toronto.
Mussens Limited, Montreal, Que.
Petrie, H. W., Ltd., Toronto, Montreal, Vancouver.
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.

Rock Crushers
Mussens Limited, Montreal, Que.

Rope, Manilla and Wire
Harpell-Stokes, Limited, Winnipeg and Toronto.
Mussens Limited, Montreal, Que.

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
Hamilton Brick Works Co., Ltd. Hamilton.
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.
Harpell-Stokes, Limited, Winnipeg and Toronto.
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.

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

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

Transformers
Harpell-Stokes, Limited, Winnipeg and Toronto.
Toronto and Hamilton Electric Co., Hamilton, Ont.

Transmission Machinery
Harpell-Stokes, Limited, Winnipeg and Toronto.
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.
Harpell-Stokes, Limited, Winnipeg and Toronto.
Mussens Limited, Montreal, Que.

Wire, Switchboard
Harpell-Stokes, Limited, Winnipeg and Toronto.