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The Canadian Engineer

ESTABLISHED 1893.

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FARM DRAINAGE.

The Ontario Department of Agriculture is just now giving very special attention to the matter of farm drainage. Demonstrations are being given in different centres throughout the Province, and those who are interested in the production from farm land, who do not already appreciate the value of a carefully planned system of underdrains are receiving valuable suggestions as to the necessity, the method of procedure and the monetary results to be obtained from such a system.

It is not to be expected that the department will have a staff large enough to meet all demands. Having educated public opinion and impressed upon the farmers the desirability for improvement along these lines, it will become the work of the engineer and surveyor, in touch with agricultural districts, to plan and carry out drainage schemes.

In the past the engineer has not been called in unless in the matter of large ditches reaching for miles into flat country. The farmer has recognized that in matters of this kind the engineer has been able to save him money. In this new work there is being opened up a new field, and we will expect to hear that farmers with even forty or fifty acres to be drained will call in a local engineer who can prepare a complete scheme for small districts; proportion the cost to be borne by each landowner, and, even if all the work may not be done in one year, it will be possible for the property-owners doing little year by year to work towards the general scheme.

It is very true that the departments are doing all they can to make it possible for the landowner to be his own engineer in these matters. There are cases where the landowner will be able to do very well, using the simple methods outlined in the various bulletins prepared by the Department, but, just as in the past the farmer has wasted money in erecting unsightly buildings in attempting to save architect's fees, so he will put down in some cases useless underdrains if he attempts to save the fees by working with poorly-adjusted instruments and along crudely-thought outlines.

The agriculturist to-day is as much a specialist in his department as the engineer. No vocation requires so much careful study as does agriculture, and if he attempts to add engineering to the long list of subjects in which he must now be familiar, the movement for better underdrains throughout the older agricultural districts will receive a serious setback.

TIMBER CONSERVATION IN BRITISH COLUMBIA.

The forests of British Columbia are at present the main source of timber supplies for large contract work throughout Canada. Any important step that the lumbermen of the West may take for the promotion of the proper conservation and use of timber will be of interest to Canadian contractors.

It is worth noting that the large sawmills on the Pacific slope of the United States have entered into an agreement to manufacture odd, as well as even, lengths in planing mill products.

Heretofore it has been customary to manufacture these products in even lengths only. From this out the waste in trimming will not be so great as under the old system. Considerable material was wasted in trimming and shaping. Anything that tends to lessen the waste will have the effect of lowering the cost and strengthening the supplies.

The latest official returns place the output of British Columbia for timber and lumber at 648,000 M. board feet at an average value of $14 per M., making the total output of British Columbia of over nine million dollars.

This does not include the million and a half dollars' worth of shingles and almost a quarter of a million dollars' worth of lath.

It is very true that the value of the output of British Columbia is less than half of the value of the output from Ontario, but the Ontario output is consumed more in the smaller contracts, and do not enter so largely into bridges, etc.

During the year 1908 the railways of Canada purchased about fourteen million cross ties, for which they paid over $5',000,000, at an average price of 40 cents per tie.

With such large consumption the reduction of waste is an important item, and it is hoped that the agreement now entered into by the large mills of the United States will be taken up by the mills of British Columbia, that the waste from British Columbia mills may be as small as possible.

BRITISH OUTPUT OF PIG IRON IN 1909.

The output of pig iron, being the basis of the iron and steel industry, is an indication of trade conditions. The secretary of the British Iron Trade Association has just published the figures for the pig iron output for 1909.

The total production of pig iron in the United Kingdom in the year 1909 was 9,664,287 tons, which compares with 9,289,840 tons in 1908, 9,923,856 tons in 1907, 10,149,388 tons in 1906, and 9,592,737 tons in 1905. In the year under review, therefore, the output was 374,447 tons more than in 1908, though still less by 259,569 tons than in 1907, and by 485,101 tons than the record production of 1906.

It will be noticed that the output of 1909 is not up to the output of 1906, but the output for the last half of 1909 was 232,000 tons greater than for the first half of the year.

The production of forge and foundry pig has remained about the same during the last two years.

QUESTION OF SALARIES.

We have noticed with considerable satisfaction the marked improvement in salaries being paid recently to newly-appointed city engineers. We have also noticed that rather than lose the men they have, a number of municipalities have increased the salary of their city engineers from twenty to thirty per cent.

There is no more room for improvement in the scheme of wages paid engineers engaged in municipal work.

Recently one of the large Canadian cities engaged a corporation counsel at an initial salary of ten thousand dollars per year. That this gentleman was well qualified and in every way suitable for the position has been granted on every side. Strange that the same city should limit the salary of their city engineer to about half that amount. The large questions that the corporation counsel will have to face are the very questions that the city engineer has been working on from year to year. The city engineer has in his hands very largely the making or the undoing of the case. If it is good policy to pay a man who has to get you out of trouble a large salary, surely it is a much better policy to pay a man who can keep you out of trouble a large salary. It is usually said that prevention is better than cure, and we think it would be a very wise policy on the part of municipalities to pay well the men who carry on the public works and local improvements of the city, expecting to secure the best men available, and to retain their services.

The city engineer is expected to know more about conditions in the municipality than the city council. From year to year he follows the trend of affairs, and he is familiar with details, which the city council, changing every few months, cannot grasp. He is a man who should be in a position to approach various problems with no preconceived ideas and without sectional prejudices, such as the ward alderman is very apt to have. If a man with the faculty of grasping and dealing with large problems, who can secure from private corporations remuneration far in advance to those which he may now receive from municipalities.

Recently in a report on the conditions of the city of Edmonton, Mr. Walter J. Francis, C.E., Montreal, recommended that they pay their city commissioner a salary of ten thousand dollars. Mr. Francis knows the salaries paid to men in large corporations who handle a volume of work and business similar to that which would be undertaken by the commissioner for a city like Edmonton. Taking that as a basis, he makes the suggestion that the municipality pay for the conducting of their work, salaries similar to those paid by men in private business. When consulting engineers throughout Canada take a similar stand in reports for municipalities, the salary of the engineers in municipal undertakings will shortly come up to the level of those paid the engineer in other branches of the profession, and the city engineer will be as well paid a body of men as the corporation counsels.

PRECIPITATION FOR APRIL.

The precipitation was below the usual quantity in many localities in British Columbia; very light in Alberta and Northern Saskatchewan, in most places less than half the average amount, but rather above the normal in Southern Saskatchewan and over Manitoba; less than the average in the Lake Superior District, and locally in a few other portions of Ontario; and above the average elsewhere in the Dominion. In the environs of Lake Ontario, including some little distance to the northward, also northwestward to the Georgian Bay, the rainfall was very heavy. Orangeville recorded 6 inches, Toronto 5.1 inches, and Grantham 5.8 inches. Lambton, Kent and Essex Counties also had much rain, Cottam receiving 4.9 inches. In Quebec the positive departure varied from half an inch in the western portion to a larger quantity in the Gaspé Peninsula; and in the Maritime Provinces from one-half to nearly five inches, the excessive departures occurring in New Brunswick and Western Nova Scotia. There was very little snow recorded during the month, the most noticeable fall being that which was experienced between the 15th and 17th, in a portion of Manitoba.

The table shows for fifteen stations included in the report of the Meteorological Office, Toronto, the total precipitation of these stations for April.

Ten inches of snow is calculated as being the equivalent of one inch of rain:—

Station.	Depth in inches.	Departure from the average of twenty years.
Calgary, Alta.	0.3	— 0.40
Edmonton, Alta.	0.4	— 0.45
Swift Current, Sask.	0.9	+ 0.15
Winnipeg, Man.	1.8	— 0.30
Port Stanley, Ont.	2.9	+ 0.30
Toronto, Ont.	5.1	+ 3.00
Parry Sound, Ont.	2.8	+ 0.65
Ottawa, Ont.	2.[illegible]	+ 0.10
Kingston, Ont.	2.8	+ 0.80
Montreal, Que.	2.8	+ 0.50
Quebec, Que.	2.9	+ 0.90
Chatham, N.B.	5.9	+ 3.15
Halifax, N.S.	8.2	+ 3.70
Victoria, B.C.	1.4	— 0.40
Kamloops, B.C.	0.1	— 0.37

PUTTING A CONCRETE JACKET ON A CRACKED CHIMNEY.

Two points of considerable engineering interest stand out from the facts of the work recently done by the Aberthaw Construction Company, of Boston, in putting a reinforced concrete jacket around a cracked and leaky chimney in the plant of the Winchester Repeating Arms Company, at New Haven, Conn. The job was of rather peculiar character, but the method by which it was done offers practical suggestions for handling work of different details.

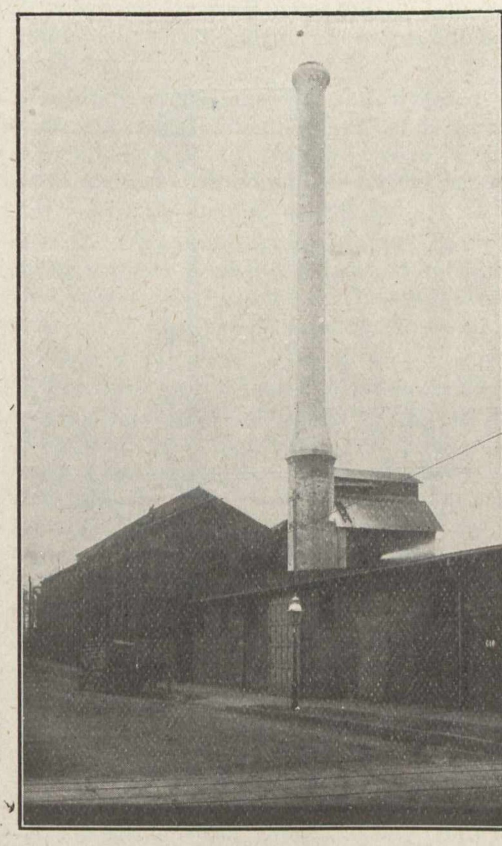
The original chimney was of reinforced concrete, but it had developed large vertical cracks which allowed the escape of smoke and at times the inflow of air—both of these actions being harmful to the efficiency of the draft. This chimney rested on a brick foundation which was part of the power house building. Above this foundation it was about 80 feet, spread to an outside diameter of 8 feet at the bottom, and 6 feet at the top; it was four feet in diameter, inside, and was unlined. The old concrete, forming a wall about four inches thick in the cylindrical part of the chimney, had proved seriously defective aside from developing cracks.

It had been laid as a stiff, dry mortar, without stone, and by the time the Aberthaw Company took hold of the job, the mortar had become so soft and "punky" that it crumbled easily under a blow and came away from the reinforcing metal with dangerous readiness.

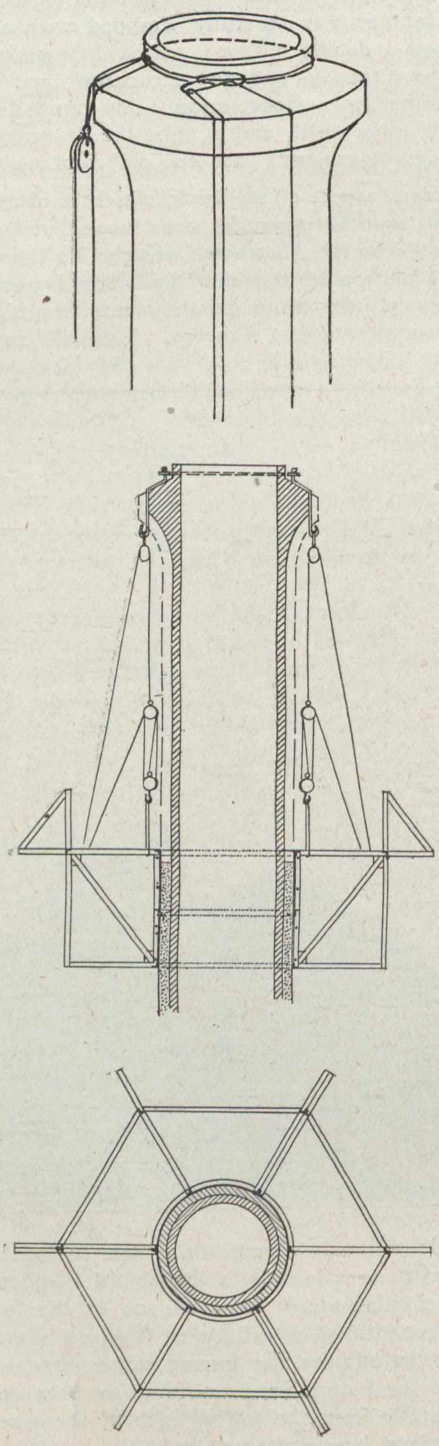
The new concrete jacket put about the old chimney by the Aberthaw Company was five inches thick over the whole surface of the old structure. The vertical reinforcement consisted of four sets of square twisted steel bars with 32 in each set, equally spaced, and with the ends of the successive sets lapped. The lowest set of bars, ⅝ inch thick and 30 feet long, were upset at their lower ends to ¾ inch diameter, and were screwed into an anchor ring 4 inches wide by ½ inch thick sunk in the brick work at the base of the chimney. The other three sets of vertical bars were ½ inch square and 24 feet, 22 feet, and 20 feet long respectively. Outside this system of lapped vertical bars were placed a series of horizontal hoops of 3.8 inch square twisted steel, spaced 6 inches. The concrete of the shell was mixed 1:2:4 with the stone small.

Before the first section of the concrete jacket was applied the old chimney was carefully wrapped with asbestos felt. This served a double purpose, acting first as an expansion joint between the old and new structures, and serving also to protect the green jacket against too rapid drying by the heat of the inner shell, and against the drawing of moisture from the green concrete into the old chimney.

The other aspect of the work, which is of especial practical value, was the ingenious construction and operation of the form used by the Aberthaw Construction Company on the cylindrical portion of the chimney. The form proper consisted of a cylinder of 16 gauge iron 5 feet high, with an inside diameter of 5 feet 8 inches. This was made in three



equal sections divided vertically. The horizontal framing consisted of three 2 inch by 2 inch by ¼ inch angles rolled to a true circular arc. Each section of the form proper, therefore, constituted a cylindrical surface of 120 degrees braced horizontally by the curved angle bars, one at the top, one at the bottom, and one midway between. Extending horizontally from the top of each of these sections was built a platform braced diagonally to the bottom of the form section with 2 inch by 2 inch by ¼ inch angles, and resting on horizontal angle bars running to the upper corners of each section of the form. These three sections of form and staging combined were fastened together by bolts running through angle bars on the vertical edges of each section of the form and through the pairs of adjacent angle iron supports under the platform. The form and the working platform were suspended by heavy ropes from three 12-inch single blocks, which were themselves hung from a heavy ring set on top of the overhang of the chimney. The cylindrical portion of the jacket, in which the form was involved, was made in the following manner. The asbestos having been applied over a height of about 5 feet from the top of the cylindrical form, the form was then raised, and concrete was filled into the space between the form and the chimney, and closely tamped about the reinforcing steel. The next forenoon the



Vertical section of chimney, jacket, and cylindrical iron form with staging.

asbestos and steel were extended farther up the chimney, and the form was hoisted a distance of 4 feet 10 inches leaving a lap of 2 inches on the concrete placed the day before. The concrete of the second day's work was placed in the afternoon, and was allowed to set until the next morning, when the form was again raised 4 feet 10 inches, and a new ring of concrete was placed that afternoon. The form and platform were prepared for hoisting by loosening the bolts in the facing angle bars which formed the three joints. This allowed the form to swing a little free of the new concrete and allowed of easy movement.

An interesting feature of the preparatory work was the method by which the steeple-jack reached the top of the chimney. One of the largest cracks in the old structure ran from top to bottom, and this furnished a good place for driving in stout hooks. At the start, the steeple-jack climbed up a ladder resting on the roof of the power house, and reaching up on the chimney drove a stout hook into the big crack. From this hook he then hung a small block carrying a rope. This combination made it possible to hoist a second ladder, which was allowed to lap on the first ladder, to which it was lashed. Climbing to the top of the second ladder, the steeple-jack drove a second hook into the crack in the chimney, reaching up as far as possible. Putting a block and line on this second hook, he was able, after getting down to the power house roof, to raise another ladder, which was lashed to the second ladder. From the top of this third ladder he drove a third hook into the crack, and so extended his track another space upward, and so on. The ladders had hooks at the ends, which held them away from the chimney. They were held firmly in one direction by lashings to the hooks, and the combination was stayed by ropes carried round the chimney every fifteen feet. The ladders were taken down by reversing the process of erection.

RECENT DEVELOPMENTS IN ELECTRIC LIGHTING AND HEATING OF RAILWAY CARRIAGES.

A very complete and elaborate electric lighting and heating equipment has just been fitted on a luxuriously appointed saloon recently built by the Metropolitan Amalgamated Railway Carriage & Wagon Company, and presented by them to the President of the Argentine Republic.

The electrical installation is on the latest "Stone" system, the system in use in practically every country in the world, in which the dynamo is driven from the axle, and a storage battery, carried under the coach, provides for the light when at rest. This has been developed in the present instance into a most comprehensive scheme to provide light, ventilation, air circulation, and heat for cooking and various other purposes; two large size "Stone" dynamos are fitted, and a double battery of exceptionally large capacity (giving 2,400 ampere hours storage). The saloon is brilliantly lighted by metallic filament lamps, mounted in fittings specially designed for this car, and arranged in the various compartments with beautiful effect. In addition to the lamps there are a number of independent and separately controllable electric ventilating fans, and an electric exhauster is fitted in the kitchen, to take all the hot air and fumes from this compartment straight out through the roof. Radiators for heating, hair curling iron heaters for the bedrooms, and cigar lighters for the smoking rooms are provided so that everything has been done for the comfort and convenience of the occupants of the car, and it is, in fact, a luxurious miniature travelling hotel.

The saloon is to be exhibited at the Centenary Exhibition, opening next month at Buenos Ayres, and will be in every way an exceptionally fine example of English design and workmanship.

THE

Sanitary Review

SEWERAGE, SEWAGE DISPOSAL, WATER SUPPLY AND WATER PURIFICATION

FILTRATION OF WATER vs. SEWAGE DISPOSAL.

Mr. George C. Whipple, in a valuable address before the Undergraduate Society of Applied Science at McGill University recently on the subject of "Water Filtration," stated:—

"There are still some who believe that it is better to prevent the pollution of lakes and streams with sewage than to allow the streams and lakes to become foul and then spend money to purify them. The answer to this is that for ideal conditions both ought to be done, and in the future both will be done. To allow our naturally pure streams to become foul and unsanitary, as many of them are, is, indeed, a disgrace. Nevertheless, sanitary improvements, like all other improvements, cost money, and it is wisest to spend our money where it will go farthest. Now, the filtration of water is very much cheaper than the purification of sewage, and from the sanitary standpoint is more efficient."

Mr. Whipple, while laying stress on the importance of both propositions, places water purification in the position of primary importance.

We are inclined to think that Mr. Whipple's point of view is more applicable to many parts of the United States than it is to Canada generally.

The populated water sheds of the States have had over a century start of Canada in river pollution. River pollution is a settled and acknowledged factor in the States. River pollution in Canada is still, generally speaking, only in its birth, and is preventable in the first instance.

We can understand exactly the position of Mr. Whipple, or any other United States engineer, who may be called upon to advise upon the improvement of the quality of a water supply for any American city situated on the banks of any of the great rivers. The river in question may take the sewage from many cities, towns and villages for miles along its banks. To simply advise that all sewage discharging into the river above the city's supply be purified as a means of obtaining pure water would be simply impracticable.

Here there is no question of Filtration of Water vs. Sewage Disposal, and we doubt very much if any such question has any existence, in fact, anywhere.

Purification of water by filtration, preceded by sedimentation or coagulation, as the case may require, is acknowledged to be the most practicable and efficient method of treating more or less turbid waters. The method, however, if properly carried out and efficiently attended to, is more within the reach of fairly large communities than small.

Mr. Whipple's description of a "slow sand filtration plant," consisting of rectangular basins, with inverted groined arch floor, vertical side walls and groined arch roof, supported on piers a dozen feet or so apart, the whole being built of concrete, the interior height of the filter chamber about twelve feet, each filter provided with manholes, regulator houses, sedimentation basin, covered clear water basin, a court or series of sand bins for storing sand, sand-washers, and generally a building containing an office or laboratory, sounds very good for the city with a large assessment, but what about the small, struggling villages located below the thriving city, which may have to depend for their water supply upon the city's filtered water reconverted into raw sewage, and so handed on to them?

The tendency on the part of some water purification engineers to put water filtration first and sewage purification second, is apt to foster a spirit of individual selfishness in the large communities, and consequent carelessness towards their smaller neighbors.

Here is the argument: As long as we can afford the expensive luxury of a well-regulated filter plant and obtain good water, why trouble ourselves with repurifying this water—when converted into sewage—as we are finished with it?

In Western Canada typhoid is more common in the small hamlets and isolated communities than in the larger cities. Winnipeg and Regina enjoy almost sterilized underground water supplies. Regina discharges its disused water into the Wascana Creek, which flows into the Qu'Appelle. These streams are extremely small in summer time. Hundreds of farmers and small communities depend on these streams for their water supply. Which would be the most inexpensive and the most sanitary? To ask all the farmers and small hamlets to adopt slow sand filtration, or to demand that Regina purifies and sterilizes its sewage. Well, the Saskatchewan Bureau of Health are insisting on the latter course.

Mr. Whipple's statement that the filtration of water is very much cheaper than the purification of sewage we do not think has universal application. Take, for instance, the case of Toronto's water supply. Lake Ontario water, if unpolluted by sewage, is acknowledged to be pure, good drinking water, requiring no treatment.

The Sanitary Review, in its issue of March 18th last, stated under an article entitled, "Sterilization of Sewage Effluents and Toronto's Pure Water Supply Problem," as follows:—

"For a city of the size of Toronto the capitalized cost of installing, operating and maintaining a sewage disinfecting plant would not exceed $500,000.

"The capitalized cost for removing the sewage from Lake Ontario water by sand filtration is $1,100,000.

"It will cost more than twice the amount of money to remove the sewage bacteria from Lake Ontario water as it will cost to keep the sewage bacteria out of Lake Ontario water."

We have no quarrel with Mr. Whipple when he insists on the benefits resulting from water filtration in connection with surface-collected waters.

We, however, beg to differ with him when he comes to Canada and appears to preach the utilitarian gospel of

"**No** matter how much you pollute your streams, you can purify your water supply cheaper than you can prevent the pollution."

To state that treatment at both ends is only ideal is simply to foster the creation of a nuisance in order to boos a method for its removal.

TORONTO'S CIVIC WATER AND SEWAGE POLICY.

Toronto's civic water and sewage policy is like a duck called the diver. The bird appears for the moment on the surface, then disappears, and we don't know where in the dickens he will reappear again.

To extend the intake pipe or not to extend the intake pipe, that is the question.

One moment the M.O.H. says extend it, and better water will result; the next moment he happens to take a few samples of water after an east wind storm and finds the water worse the further he proceeds into the lake.

If evidence in favor of an extended intake pipe is to be based on sample analysis, then samples must be taken from time to time under all conditions of wind, temperature, etc. The test period should include at least one year.

Isolated sample analyses of Lake Ontario water are of no value whatever.

If the extension of the intake pipe is to be rushed and not based upon absolute scientific data of average analyses taken over an extended period, then the extension of the intake pipe must be based upon the general proposition, **that the further and deeper you go, the purer you get.**

THE DISINFECTION OF SEWAGE AND SEWAGE FILTER EFFLUENTS.

Earle B. Phelps.

In a recent number of the Canadian Engineer, Mr. H. C. H. Shenton contributes an interesting discussion of an earlier paper by the writer upon the above subject. Mr. Shenton undertakes at great length to prove that the writer's statements regarding the relative efficiencies of electrolytic and commercial hypochlorites are in error. These statements are as follows: (P. 61) "Hypochlorites made electrolytically are slightly inferior to the market product, but this difference would probably be inappreciable in large-scale tests, where the conditions under which the hypochlorites are prepared are more nearly those of commercial practice."

This is surely not a very sweeping condemnation. Mr. Shenton's surmises in regard to the mode of preparation of these hypochlorites are correct, as is plainly stated. "In series II. comparison is made of free gaseous chlorine, potassium hypochlorite prepared from bleaching powder, and the same compound prepared by the recombination of the products of the electrolytic cell." Whether this compound shall be called electrolytic hypochlorite or not is purely a matter of personal preference. The purpose of the writer's investigation was to determine the cheapest source of germicidal power. All available data indicated that the most efficient method of producing hypochlorites through the agency of electrical energy was by first producing the electrolytic products, chlorine and caustic soda, in the cell, and later combining these products. The facts upon which this conclusion is based are fully set forth (pp. 67-69). To compare the efficiency of hypochlorite thus produced with the commercial product, upon a cost basis, was the sole object of the experiments quoted. For purpose of identification the former was called "electrolytic hypochlorite," and the latter "bleaching powder." The efficiency of the commercial product reckoned upon a cost basis is far above that of any other form of "available chlorine" that the writer has ever investigated. This does not mean that it is any more efficient per se, but merely that it costs less per pound. If any cost data are in existence which prove the reverse of this no one would appreciate their publication more than the writer.

The remainder of Mr. Shenton's discussion deals with a matter of chemistry which really boils down to a definition of "available chlorine." The questions involved are so elementary that apology is due for going into them in detail here. That some misconception evidently exists is apparent from Mr. Shenton's argument. Therefore, the following statements may help to clarify our views.

The writer defines this term as follows: "'Available chlorine' is the oxidizing power of a chlorine compound, measured against arsenious acid and expressed in terms of chlorine." If this be a correct definition then all the other contentions which the writer has made necessarily follow.

If the substance, sodium hypochlorite, $NaOCl$, could be obtained in a pure state and submitted to a chemist for analysis, he would report:

Total chlorine, 47.6%.
Available chlorine, 95.2%.

Furthermore, in a mixture of equal molecular quantities of the above substance and common salt, $NaCl$, our chemist would find:

Total chlorine, 53.4%.
Available chlorine, 53.4%.

Hence the statement made by the writer, "The available chlorine as ordinarily determined, of the products of reaction (1) ($NaOCl + NaCl$) is equivalent to twice the chlorine of the hypochlorite, or to the total chlorine present." Mr. Shenton objects to this statement on the ground "that it might induce non-chemical readers to suppose even that the chlorine existing as chloride were capable of exerting an oxidizing effect." The writer must confess to a fondness for scientifically accurate statements regardless of their effect upon non-technical readers. No other form of expression would state the full truth, as Mr. Shenton fully grants in his next paragraph: . . . . "for each univalent atom of chlorine existing as hypochlorite, one bivalent atom of oxygen is set at liberty under suitable conditions."

The final question to which this discussion leads is this. Given the reactions:

(1) $2NaOH + 2Cl = NaOCl + NaCl + H_2O$.

(2) $NaOH + Cl = NaOCl + H$.

Mr. Shenton believes the second expresses the facts upon the view expressed in an earlier paper that the first reaction would yield an electro-chemical efficiency of only 50% if completely carried out; "because the equation shows that half the chlorine liberated as a result of the electrolysis reverts to the state of chloride." The writer affirms the chemical accuracy of the first and the impossibility of the second. We must again ask the pardon of our non-chemical readers and apply some fundamental chemistry to this question, which is only apparently complicated. The electro-chemical equivalent of one ampere is 1.32 grams of chlorine per hour. Corresponding molecular quantities of sodium hydroxide and hydrogen are simultaneously produced. This chlorine is, of course, all "available." A simple calculation upon the basis of the two reactions will now show that reaction (1) will produce from 1.32 grams of chlorine, 1.39 grams of NaOCl having, as already shown, an "available chlorine" value of 95.2%. The "available chlorine" is, therefore, as in the beginning, 1.32 grams. Making the same calculations upon reaction (2) it is evident that from an initial chlorine value of 1.32 grams the hypochlorite produced would be 2.78 grams, with an "available chlorine" content of 2.64 grams. If this is not evident (without further proof), conceive the addition of hypochloric acid to the products of reaction (2):

$$NaOCl + 2HCl = NaCl + H_2O + 2Cl.$$

The process yields then twice the amount of chlorine with which is started or has an efficiency of 200% based upon electro-chemical equivalents.

As stated previously, the whole matter rests upon the definition of that very unsatisfactory term, "available chlorine," but accepting the common use of the term there can be no excuse for misunderstandings.

Of course hydrogen gas is copiously given off from the cell. The primary electrolytic reaction involves an evolution of hydrogen equivalent to the chlorine produced. If, after this reaction has taken place, reaction (2) should result between the products, then the total amount of hydrogen evolved would be double the amount of chlorine produced, and again the law of electro-chemical equivalents would have been violated.

The writer appreciates the candor of Mr. Shenton's discussion and makes this further explanation with the single purpose of establishing the true facts.

YORKTON COMPRESSED WATERWORKS SYSTEM.

Sir,—I notice in the issue of the Canadian Engineer of April 29th, a letter from "Municipal Engineer" suggesting that further information in connection with the Yorkton Waterworks System might be of some value.

The source from which Yorkton obtains its water supply is from two large wells 15 feet in diameter and from 35 to 40 feet in depth, and also from a number of points about 55 feet in depth which pierce a gravel strata below that which furnishes the water to the large wells. These wells are situated just at the rear of the pumping station.

The distribution system at present consists of 100 feet of 10-inch main; 2,600 feet of 8-inch main; 13,000 feet of 6-inch main; 12,000 feet of 4-inch main, and 46 fire hydrants.

The point was raised by "Municipal Engineer" that where pressure was supplied by mechanically compressed air instead of natural gravity, the actual cost of the pumping must necessarily be increased by the extra machine employed. This is very true, but is a comparatively small item, and is more than counterbalanced by other advantages.

In order to secure the compressed air, it necessarily requires the installation of an air compressor, but very little mechanical energy is consumed by this machine after the storage tanks have once been charged.

The air compressor in Yorkton has not been in operation more than half a dozen times during the past twelve months, and then only for a few minutes each time.

The best possible way to compare the compressed air system with the stand pipe system is to take an example of a particular case, for instance;

The Yorkton Waterworks plant has two storage tanks which have a capacity of over 2,400 cubic feet each. Allowing the half of this capacity for the compressed air, and half for the water, will give a water capacity of 1,200 cubic feet in each tank or a combined water capacity of 2,400 cubic feet, or a little over 15,000 imperial gallons. The tanks are first filled with compressed air to a pressure of 30 pounds, then water pumped against this pressure until the tanks are half full when the pressure has risen to about 65 pounds; we then have the use of 15,000 gallons of water between the pressures of 30 and 65 pounds (as we are able to make use of every drop of water in the tanks without the pressure going below 30 pounds.)

Take another example of a stand pipe located at the pump house. Merely for the sake of comparison, assume the inside diameter of the stand pipe to be 6 ft. 3 inches. This stand pipe would have to be 150 feet high in order to produce a pressure of 65 pounds per square inch when full to the top. The water would have to be pumped to a height of 70 feet before a pressure of 30 pounds per square inch could be reached, and consequently this column of water could not be made use of above the pressure of 30 pounds, and the remaining 80 feet would hold the same amount of water as the two compressed air tanks spoken of above, namely, 15,000 gallons.

I am not prepared to say off-hand the amount the above stand pipe would cost, but it would be in the neighborhood of $6,000.00 at least in this country, while the two storage tanks would not cost, at most, over $2,500.00 installed and ready for use. This shows a decided advantage from the one point of first cost, not to mention the elimination of the ice difficulty, the supply of water to the mains at a more even temperature throughout the whole year, and the compactness and appearance of the plant, which was dealt with in your issue of April 13th.

One will readily see the value of a compressed air system in a locality where the water supply is limited, as every gallon of water which can be secured can be supplied to the mains under pressure.

I might say that our system in Yorkton is rated as first-class by the underwriters.

I trust this will explain the points referred to by "Municipal Engineer," but I will be pleased to give any further information at my disposal regarding the compressed air system to any one who might enquire.

Yours truly,
F. T. McArthur,
Town Engineer.

THE PROBLEMS OF WINTER NAVIGATION ON THE ST. LAWRENCE RIVER.

By H. T. Barnes, D.Sc., F.R.S.C., Macdonald Professor of Physics and Director of the Physical Laboratories, McGill University.

In all northern countries, where the average winter temperature is below the freezing point, the water becomes frozen and attempts to continue navigation are made with great difficulty. As population increases and demands for cheaper and more effective communication grow, the question arises as to the feasibility of preserving the waterways. Hitherto, in Canada, this matter has not been found to be of very serious moment, except in one or two instances. Winter navigation has been maintained for many years across the

*The "Urimak" has recently had the bow propeller removed as it is of little use in the Arctic ice.

Northumberland Straits between Prince Edward Island and the mainland, and similar communication has been carried on to Newfoundland. It is only a question of time, however, before it will be found necessary to keep the St. Lawrence River open between Montreal and the sea. When commerce demands it, the means will be found. At the present time, it is found easier to land freight at the winter ports of St. John, N.B., and Halifax, N.S., and transport by rail for eight hundred miles. When the volume of trade grows, there can be no question as to the needs of cheaper methods of transit by water, thus keeping open the port of Montreal all the year round.

In Russia, winter navigation has been found to be commercially feasible, and many ports on the Kara Sea require ice-breakers in summer to reach Northern Siberia.

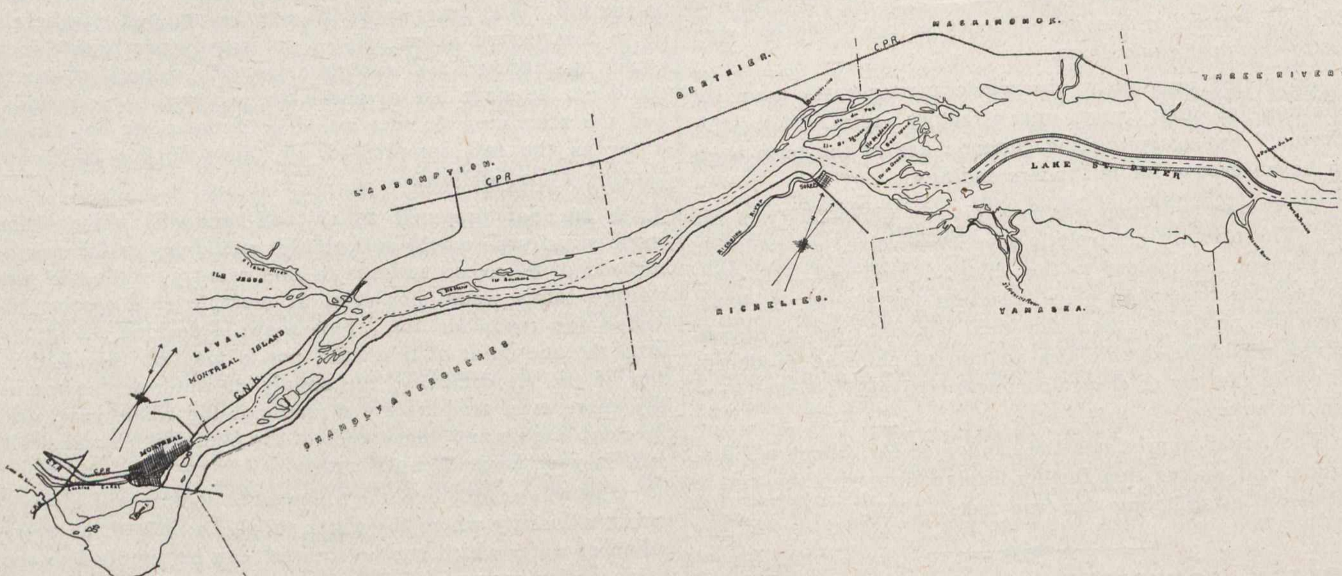
Two powerful ice-breakers were built by the Russian Government; one, the "Yermak," 305 feet long, 71 feet beam, 8,000 tons, and 8,000 h.p., with a speed of 15 knots, was placed in the Baltic to run between Baltic and Cronstadt, and St. Petersburg; the other, the "Urimak," a sister ship of 10,000 horse-power, to navigate through forty-five miles of ice to Vladivostock. These boats are equipped with triple screws—two on the stern and one in the bow—so protected, by being recessed in the body of the ship, as to be unaffected by the heaviest ice.* Another powerful ship, the "Neva," recently constructed, is without the bow propeller. She is of the same size as the "Urimak."

Captain C. H. Webb, R.N.R., who for three years was navigating officer in the waters of Vladivostock, informs me that in the worst weather, ships are escorted to their berth bv the ice-breakers, where they are allowed to freeze in until they are ready to sail, when the ice-breaker brings them out again. It frequently happens that a ship will freeze in so securely during a single night as to enable them to discharge their cargo the next morning on the ice. In the face of all these difficulties (if they are real difficulties), it is found to be commercially feasible to navigate in the coldest weather and, what is most important, to receive a favorable rating at Lloyds.

Canada possesses a considerable fleet of ice-breakers. The largest and most powerful was added this year, for the Northumberland Straits. The "Earl Grey" is 250 feet long, 47½ feet beam, 3,400 tons, and 6,985 h.p., with a speed of 18 knots. She does not possess the ice-fighting qualities of the "Yermak" or "Urimak," either in equipment or power—lacking the bow propeller—but she has accomplished splendid work during the past winter in maintaining navigation between Pictou, N.S., and Charlottetown, P.E.I., and has demonstrated what can be done by increasing the size and strength of the boat.

The "Stanley" is a single screw steel steamer, built in 1888, length 207 feet 9 inches, beam 32 feet, depth 17 feet 9 inches, net tonnage 395, and gross tonnage 914; indicated horse-power, 2,540.

At the beginning of the winter up to this year, the "Stanley" was performing mail service and carrying passengers between Georgetown and Pictou, and making tri-weekly trips. The service was continued on this route until May, when the steamer was transferred to the Charlottetown-Pictou route and continued on that route until the end of the month when the Charlottetown Steam Navigation Company commence running their boats.



St. Lawrence River from Montreal to Quebec.

The "Minto" is a single screw steamer, built in 1899, length 225 feet, beam 32 feet 7 inches, depth of hold 18 feet, net tonnage 372, gross tonnage 1,090, indicated horse-power, 3,150.

At the beginning of the winter, the steamer was on the Georgetown-Pictou route making tri-weekly trips until about May 4th. She then went on the Charlottetown-Pictou route, where she plied until about May 21st, when the summer service was resumed by the Charlottetown Steam Navigation Company.

The "Montcalm" is a twin screw steel vessel, length 245 feet, beam 40 feet 6 inches, depth of hold 15 feet 7 inches, net tonnage 3,508, gross tonnage 550. Indicated horse-power, 4,350.

She assisted incoming vessels through the ice, and furnishes valuable information to shipping through the Marconi Wireless Telegraph as to location, state, movement and direction of the ice, etc.

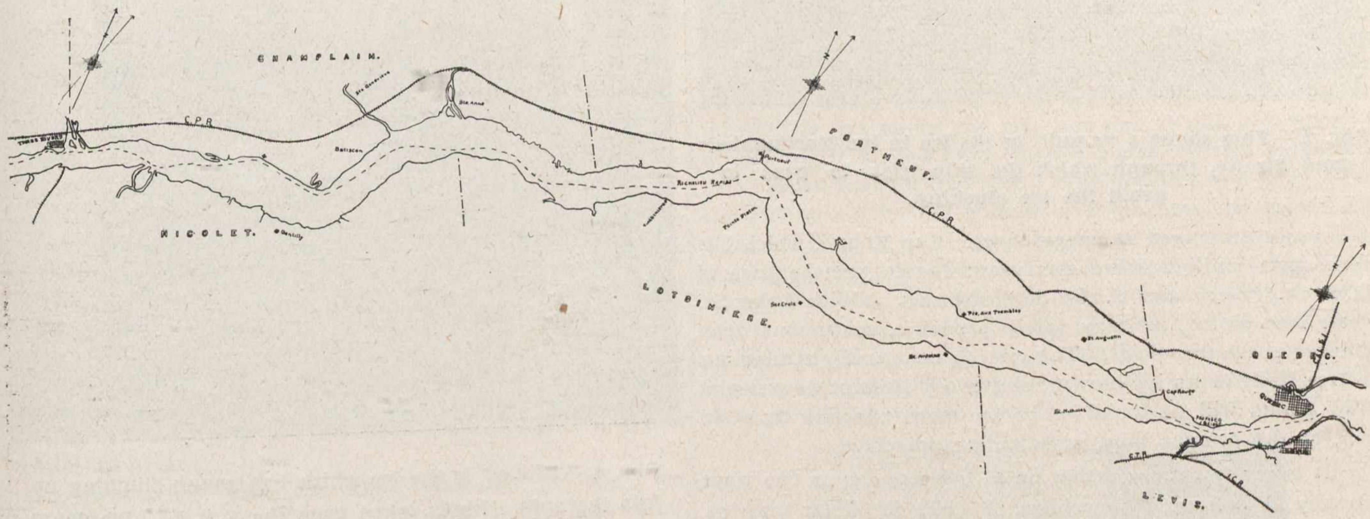
The vessel was employed for nearly two months transferring mails to and from ocean vessels off North Sydney; she then went to Pictou to take down the necessary supplies and Marconi operators with equipment for opening of Marconi wireless telegraph stations on the south and north coasts of the Gulf of St. Lawrence, Straits of Belle Isle, as well as off

Cape Race. She then returned to Quebec, and resumed her lighthouse work. She was placed at Quebec last winter and the present one to handle the ice at Cap Rouge.

The "Lady Grey" is a twin screw, steel vessel, built at Barrow, G.B., in 1906. She is 172 feet long, 32.2 feet wide, 15.9 deep; 65 net, 733 gross tonnage, and of 353 nominal h.p. Next to the "Earl Grey," she is the newest ice breaker in the fleet, and was designed more for river work. She was stationed this year at Quebec to assist the "Montcalm" in keeping the river clear at Cap Rouge.

Winter navigation has been maintained for many years on the Great Lakes. At the Straits of Mackinaw, in Lake Michigan, and the City of Duluth, on Lake Superior, winter ice-crushing ferries are operated through three or four feet of solid ice for a distance of fifty or sixty miles. These break the ice down chiefly through the action of the bow propeller. They successfully attack floating ice in the lake from five to ten feet thick. It was at Port Huron in 1890 that the value of the bow propeller was first discovered. Capt. Houghton when stopped in his attempts to force his privately operated ferry through the ice turned his boat around and backed into the ice, finding out by this means how rapidly the wave created by the screw broke the ice and sucked it down out of his way. He therefore had built a ferry with a bow propeller. The Russians copied this design to great advantage. Up to the present time, none of the St. Lawrence River ice-breakers have been built in this way, although it is of special assistance in an ice pack.

The Royal Commission appointed to study the formation of ice on the St. Lawrence River, as it affected the winter and spring floods, completed their report in 1886. As a result of their work, they recommend keeping the river open in winter from Montreal to tide water, in order to offer a free runway for the ice. They recommend the use of ice-breakers, and reported that winter navigation on the St. Lawrence was perfectly feasible. They distinctly stated that this offered the best means of keeping the river from flooding. In spite of their suggestion, however, no determined attempts have been made to keep the river clear of ice. This year, ice-breakers have been placed at Quebec by the Government in order to prevent the formation of the ice-bridge at Cap Rouge. This ice-bridge, which usually forms early in the winter, effectually stops the channels and lasts long into the spring. During last winter (1908-09), it was attacked by the ice-breaker "Montcalm" after it had formed and securely packed. Nearly the entire winter was spent in cutting a channel through it, Fig. 1, but the result was satisfactory, and navigation opened nearly two weeks earlier as a consequence. This year (1909-10), the "Montcalm" and "Lady Grey" have been stationed at Quebec, and no ice-bridge has been allowed to form. On three occasions it took, but the boats effectually cut it away in a few hours. The effect of this has been noticed on the upper reaches of the river, and at no time has the river been closed between Quebec and Three Rivers. The Royal Commission reported that if the ice-bridge at Lake St. Peter could be kept from forming, there was sufficient head of water between Lachine Rapids and there to effectually keep the channel open. As soon as the bridge forms it stops the floating ice, and the pack sets in at once, running back and covering the whole river. If the ship channel in Lake St. Peter and the Sorel Islands be kept open and Cap Rouge be free, all the ice would pass out to the sea. Mr. T. C. Keefer points out in his presidential address to Section Three of the Royal Society of Canada in 1897, the only difficulty is Lake St. Peter, where



St. Lawrence River from Montreal to Quebec.

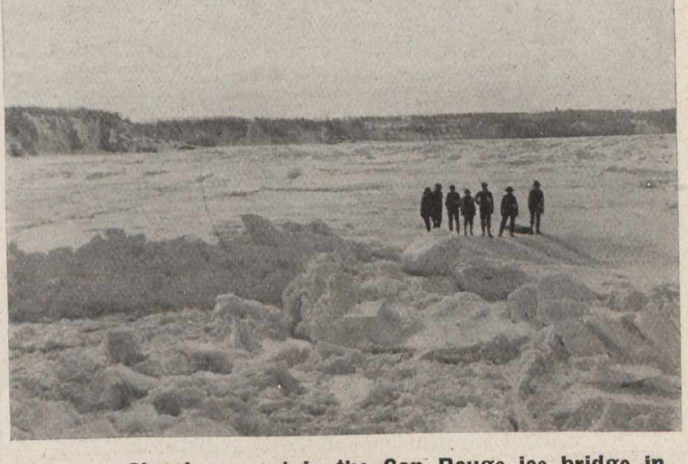


Fig 1.—Showing a cut in the Cap Rouge ice bridge in March, 1909. This is pack ice with frazil underneath. Photo taken from the "Montcalm."

the broken ice might be held in by strong winds. There is a current there of one mile per hour: through the channel, the lake would soon be emptied of ice if the channel were kept open. Thus, it appears from previous study of the river that there are three points where efforts would have to be made

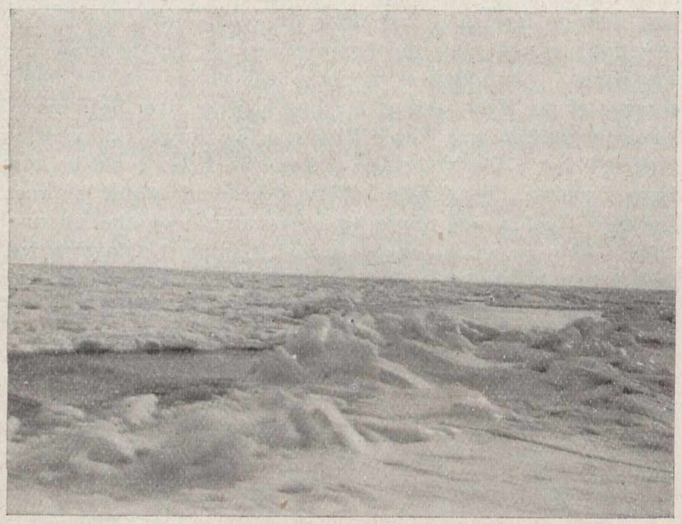


Fig. 2.—This shows a "Lead" in the ice in the Northumberland Straits, through which the ship tries to pass to avoid the ice crushing.

to prevent prolonged stoppage of ice. Cap Rouge, which has been successfully handled this year; Nicolet, at the base of Lake St. Peter; and at the Sorel Islands. With Lake St. Peter free of ice, we may safely predict a continuous open channel above that point. The river is continually struggling to free itself of its icy burden, and every attempt to assist at vital points will be found to be far more effective than we can, at the present time, sufficiently appreciate.

It is my intention further on to indicate one or two ways whereby, I believe, the problem of Lake St. Peter may be solved in a comparatively simple way.

Fig. 3.—Two floes coming together in opposite directions. Work at the Northumberland Straits.

Observations on the formation and action of salt water ice are of great interest. It is quite unlike fresh water ice, being so very variable in composition and different in appearance.

Prof. Otto Pettersson, of Stockholm, President of the International Commission for the Study of the Sea, has made an extended study of salt water ice. As a result of his inquiry, he finds that ocean water is divided on freezing, not into pure ice and a more or less concentrated solution of ordinary sea salt, but into two saliniferous parts, one liquid and one solid, which are of different chemical composition. It is found that the formation of sea ice is chemically a selective process. Some of the elements of the sea water are more fit than others to enter into the solid state by freezing: those that are rejected by the ice will preponderate in the brine, and vice versa. As a rule, the ice is richer in sulphates, the brine in chlorides. With time, the ice appears to give up more and more of its chlorides and to retain the sulphates. The general opinion has been that pure ice was formed on the freezing of sea water. The small impurities always present in sea ice were accounted for by adherent sea water, but it has been conclusively shown that the freezing of sea water

Fig. 4.—Nipped in the ice which has begun climbing up into the ship. Photo taken from the C.G.S. "Stanley."

involves a separation of its chemical constituents, of which one part enters into the composition of the solid, another into that part of the liquid water. The actual salinity of the ice is, of course, small, and was found to diminish with the age of the ice. Immediately after its formation, sea ice contains a noticeable quantity of salt—chlorides as well as sulphates, carbonates and other salts. Such ice is very different from fresh water ice in its physical properties. It melts below zero, and begins to show signs of melting by contraction of volume at temperature far below zero. Thus, ice which contained as much chlorine as 2.73 parts per thousand commenced to contract at -14° C. (6.8° F.), and continued to do so up to the melting point. Ice formed by freezing at low temperatures of Arctic sea water which contained 6.49 parts per thousand of chlorine began to contract its volume already at -18° C. (0° F.). This phenomenon is, however, a relative one, so far as any ice is concerned. Even fresh water ice contains small traces of impurities which cause a contraction of volume before the actual melting occurs. The purer the ice, the sharper is the change from solid to liquid differentiated. E. V. Drygalski has found, in his study of polar ice for the Berlin Geological Society, that the salinity of newly formed sea ice is from 4 to 5 parts of salt per thousand. He found, which is very important, that the salt is not confined, to the uppermost layer of the ice. The salt was found to be almost equally distributed in every layer of the sea ice, from the surface to 68.4 centimeters depth, where the salinity was 4 parts per thousand, but after two months the salinity in all layers decreased from 4 or 5 parts per thousand to 1 or 2 parts per thousand.

A very interesting characteristic of the thin layers of salt water ice is their great mobility. It is entirely different in appearance to fresh water ice, being white and the top layers seemingly full of mechanically suspended salt. Extreme brittleness, which characterizes the fresh water ice, is entirely wanting. A small wave set up in the water travels through it without breaking it, the thin layers rising and falling and exhibiting great plasticity.

Fig. 5.—Men cutting out the "Stanley."

It was clear that the chief factors in the ice conditions in the Straits are wind and tide. The temperature of the water remains very constant everywhere at 30° C. The severity of the air temperatures has an influence on the quantity of ice formed, but the greatest difficulties in ice-breaking were always experienced in the milder weather, especially after a period of intense cold. The frost appears to hold the shore ice, but this is afterwards set free by the milder weather and carried immense distances by wind and tide.

These "hard pans" of ice, as they are called, are carried by the wind through the Straits, and it sometimes happens that the ice formed in the Straits will be carried out by this means against the tide. If the tide is carrying in other floes, then the two meet, causing a tremendous ice jam. Should a ship be caught in such a jam, the squeezing and pinching is very great. In following a lead through the ice, see Fig. 2, a ship may be caught in this way, and is said to be "nipped." Fig. 3 shows two masses of ice coming together and piling up along the pressure ridge. Fig. 4 shows the ice pressing up on the ship and piling up, often on to the deck itself. As wonderful as the immense force of these jams is the quiet and silent way the ice disappears. When the tide turns, the ice is apparently drawn down and open water appears all around. One can hardly credit the vagaries played by the moving ice.

My assistant, Mr. J. B. Woodyatt, thus describes his experiences on board the C.G.S. "Stanley" during one of these ice jams:—

"The wind was from the S.S.E., and the sky was clear when we started out. As usual, we did not have much trouble with ice until we passed Cape Bear. We could see the 'Minto' had drifted to a point about half way between Cape Bear and Cape St. George, and was stuck solid. We passed along through leads until we passed the east end of Pictou Island, and were working west, about a mile off the south shore of the Island. We were in open water, running at full speed, and were making for a narrow bridge of ice (about 150 feet through) which separated us from open water, and the bow ran up on the ice, but did not break it, nor could she back off. From where we were to shore was solid ice, and the bridge we were on was holding back another big field, which was being pressed in by the wind, consequently it was very solid. After several attempts to move, we 'burned down.' About 12:00 o'clock there was a slight slackening in the ice, and the men started to 'cut her down' with slice-bars (or chisel-bars)—see Fig. 5. This operation consists of cutting away the ice for about six feet along one side of her, starting at the stern, and shoving the ice as cut back into the pond of open water created by the screw. The ice was opening up ahead, so that her bow was in open water. The instant enough ice was cut away to clear her, she moved for the open water, but the ice started to run, and before she could cover the hundred feet or so, the ice on the east side came in to fill in where it had been cut away and nipped us tight. It would seem as if the ice gained considerable momentum in travelling the six feet that it did, for when it nipped us, it nipped hard, started plates, twisted bulkheads, broke ports, and sheared bolts. And it didn't stop there. The ice coming on behind started to climb over the ice on our side, and piled up until it was coming in over the decks. With great groaning, it piled and squeezed and the ship shook under the strain. We were not quite broadside to it, however, and it was gradually passing to our stern, so that after about an hour of the squeezing we got another chance to cut down the ice and got under way before it closed in again. From there to Pictou was easy sailing, as there was lots of open water. The 'Minto' at that time was also stuck and drifted around for a number of hours."

Fig. 6.—The "Montcalm" stuck for 10 hours in the ice below the Richelieu Rapids. Observe the effect of the circulating water in removing the frazil.

The lolly ice met with in large quantities in the Straits is very difficult to force a ship through. There is no give to it and it squeezes up under the ship, forcing out the necessary water to float the ship. When any headway is made, this soft ice is carried along with the ship, rendering progress almost impossible. One of the great problems of the winter navigation of the Straits is the handling of the ship in the soft sponge-like lolly ice. It is formed chiefly over the surface with a high cold wind, and agglomerates, forming large masses, which attach themselves to the hard pans and make them very difficult to break. The lolly ice is really salt water frazil ice, and can be handled in the same way. I have recommended the use of steam or hot water around the ship to prevent the ice from adhering, and believe that such a method would very considerably assist navigation. Further on it will be seen what a great effect the circulation water from the pumps has on frazil ice.

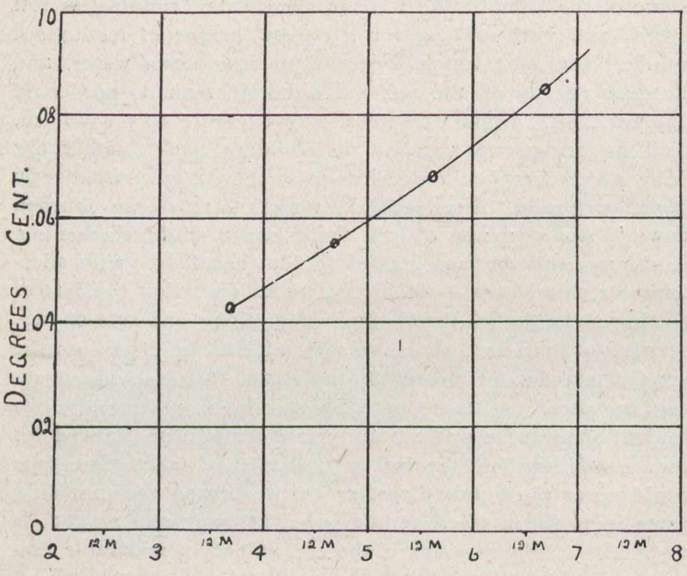


Fig. 7.—Curve showing rise of water temperature in the channel at St. Nicholas due to the open river and the sun.

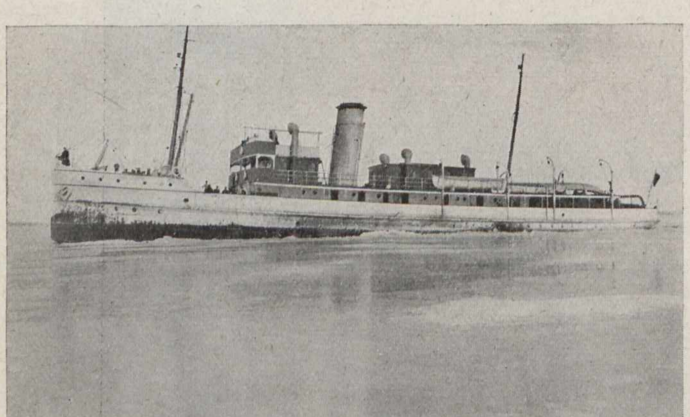


Fig 8.—C.C.S. "Lady Grey" at the end of a ram on the ice of Lake St. Peter. Engines are reversed in order to back off. Clear blue ice 18 inches thick.

Fresh Water Ice.

Surface Ice:—In fresh water, the surface ice is brittle, even in the thinnest layers. A wave set up in the water cracks it, and a ship plows through it with a hard rattling sound, totally wanting in salt water ice.

Sheet ice forms only when the surface is still, the water at or near the freezing point, and the air temperature below 32° F. The current must be small (one mile per hour or less) and all conditions must obtain before ice is able to spread. Wind waves will prevent surface ice from forming. Water temperatures above 32° F. will render ice possible only at air temperatures low in proportion to the slight elevation of the water temperature above the freezing point. Thus, for various air temperatures there are corresponding water temperatures, measured in hundredths of a degree, which will effectually prevent surface ice. It sometimes happens that open patches of water occur in a lake or river otherwise frozen over. These are due to warmer currents coming to the surface, either by the undercurrents being deflected upwards by a shoal, or by a warm spring of water in the lake. The first crystals of ice on still water form with the long axis (or principal axis) parallel to the surface. As soon, however, as these become cemented together the sheet thickens by conduction of heat through the ice from the water to the cold air. Such ice is always noticed to have its crystalline axis at right angles to the plane of freezing, and it is this that forms the clear hard ice. A surface sheet grows rapidly at first, but more and more slowly as it thickens. If the underwater is at 32° or a little below, as it sometimes is (a few thousandths of a degree), then there is no limit to the thickness of the ice. More frequently, a lake or river frozen over is a little above the freezing point, and hence a limiting thickness of ice results. This limiting thickness depends on the mean air temperature and water temperature elevation measured in hundredths of a degree. Thus the following table gives approximately the limiting thickness which ice will attain for various air and water temperatures. These data were obtained from observations made by my assistant, Mr. L. V. King, on the rate of growth of surface ice in the St. Louis Basin, at Quebec.

Table 1.—Limiting Thickness to Which Surface Ice Can Grow.

Limiting thickness.	Water temp. + .01° C.	Water temp. + .02° C.	Water temp. + .03° C.
2 inches	29.4° F.	25.2° F.	21.7° F.
1 foot	20.5° F.	9.3° F.	-2.2° F.
2 feet	11.1° F.	-9.8° F.	....

There is no doubt that surface ice prevents the formation of fine floating ice (frazil ice), but it also prevents access of the sun's heat to the water, and will retard the disintegration of ice in the spring. The effect of the sun in elevating the temperature of the water, even in the severest weather, is very remarkable, and has not been sufficiently appreciated. I am inclined to believe from recent observations that, on the whole, there would be less ice formed in a river kept continually open than in one which is allowed to freeze over.

Frazil Ice.

Wherever a river flows too swiftly to freeze, then surface contact of cold air produces fine needle crystals of ice, which are called "frazil ice." A rapid or water chute forms abundant surface action, and a correspondingly large amount of frazil. Whenever the cold is very great, the running water may be cooled a few thousandths of a degree below the freezin point, in consequence of which frazil production is rapid throughout the whole mass of water. These crystals grow and become cemented together into lumps. They are carried down by currents and stick to objects immersed in the water which are also supercooled. Frazil ice forms an obstacle to hydraulic development, but fortunately not now considered a serious one. The temperature effect is so small that objects may be kept immune from the ice by a small application of heat.

Anchor Ice.—This ice grows in situ on objects immersed in water and subjected to cooling by radiation at night. It also grows by the sticking down of frazil crystals. Anchor ice grows in weed-like forms, and when sufficiently thick often rises up under its own buoyancy and brings up stones, weeds and mud. The sun has a wonderful influence on this ice. No sooner have the sun beams penetrated to the bottom of a river than up comes the anchor ice, melted off by a minute temperature elevation, too small to be recorded except on the most sensitive electrical thermometer. Anchor ice is known as "ground ice" in many countries, and is found in

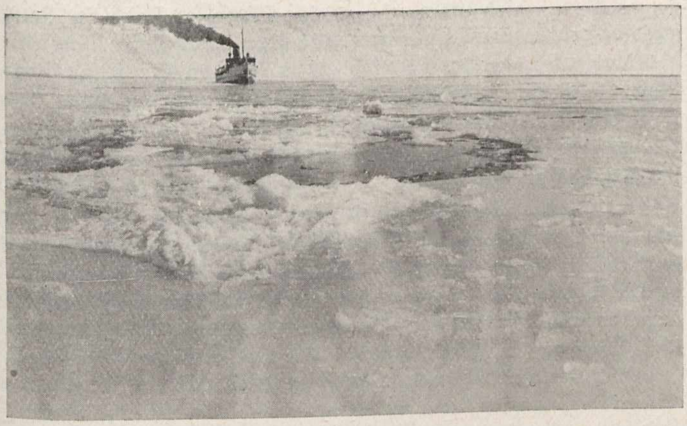


Fig. 9.—C.G.S. "Lady Grey" backed down the channel ready to come forward full speed into the ice. The V groove of the ship's prow may be seen in the foreground. The smoke of the "Montcalm" may be seen on the horizon.

an open channel not protected by surface ice. It may form at various depths, depending on the clearness of the water and the temperature of the bottom.

Open rivers, as a rule, thirty feet deep, are free from anchor ice, but in the sea it has been known to form seventy feet down.

Experiments at Cap Rouge.

An inspection of the map of the River St. Lawrence will show at once how narrow the River becomes at Cap Rouge, above Quebec. Here the river narrows down to something less than a mile wide. The taking of the ice-bridge at this point occurs practically every winter, early in January. Owing to high tides, immense pieces of shore ice are loosened up stream and float down with the current. These fields of ice are the result of the packing and freezing of loose floating ice carried by the wind and currents into the bays and shallow places along the shore. The "battures" (as they are called) are made up of a conglomeration of mixed ice—frazil, anchor ice, and broken pieces of surface ice—all cemented together in irregular masses. When these battures are broken away by the high tides, they come down, often a mile or two long and many hundred feet wide. It is the sticking of a batture in the Cap Rouge gorge that causes the beginning of an ice-bridge. The bridge soon grows by the packing in of floating surface ice, frazil and detached lumps of anchor ice. The packing increases with great rapidity, until the River is frozen up to Lake St. Peter. The ice-bridge becomes continually thicker, until it may be as much as fifty feet deep and fifteen feet above the surface. During the winter of 1909, the "Montcalm" was detailed by the Government to break up an ice-bridge that took on January 5th. On the 15th of the same month the ice-breaker set to work, and commenced, unaided, to cut it out. So thick had it become, however, that the progress was slow and the packing of the ice grew faster above the bridge than it could be cut away below. Seven hours of ebb tide per day was the working time during which the currents could carry away the pieces broken off. Slow, steady progress was made through the bridge and up through the pack, until on April 4th they had broken a channel completely through the ice-bridge, and it commenced to come away. On the 5th they succeeded in going up to a point about four miles below Pointe aux Trembles. Thus, from January 15th to April 5th the ship had only been able to cut out the bridge. On April 8th she reached the Richelieu Rapids, and on April 16th Three Rivers.

This year (1910) the "Montcalm" and "Lady Grey" were stationed at Quebec, in order to prevent the bridge from forming. As usual, it took in January, but the two boats immediately cut it away and cleared the Channel. Twice during the remainder of the winter it took, but both boats working together cut it away in a few hours. The two boats assist each other very much, preventing any serious sticking after ramming into the ice. A cross cut by one boat at once sets the other ship free, and great progress is made. The ordinary method of ice-breaking cannot be practiced on the batture ice or the ice at Cap Rouge. The masses of ice are of irregular structure and do not split. They are very thick and cannot be crushed down by the weight of the ship. Only by ramming can a cut be made and the pieces dislodged. When working alone, the "Montcalm" was many times stuck for several hours with her nose in the ice. Especially did this impede the progress of the ship in breaking ice under which there was much frazil ice. Just below the Richelieu Rapids, the "Montcalm" was stopped for ten hours,

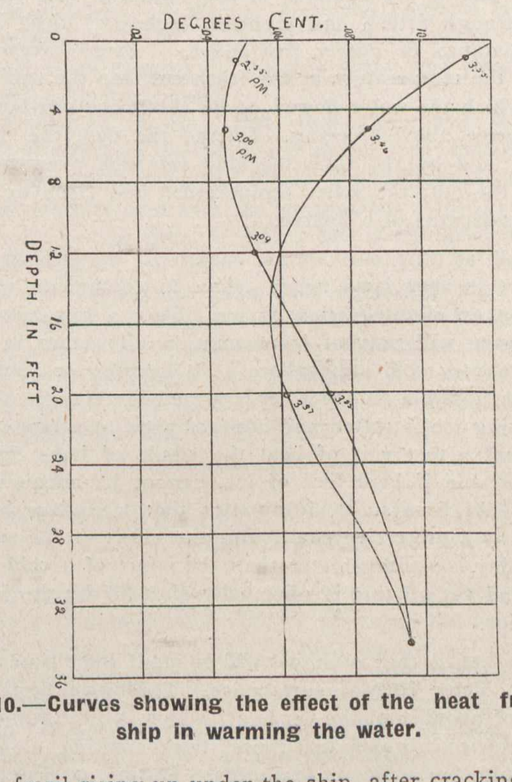


Fig. 10.—Curves showing the effect of the heat from the ship in warming the water.

by the frazil rising up under the ship, after cracking off the surface sheet. This ice squeezed out all the water and, in consequence, the ship was held firmly. Fig. 6 shows the side of the ship at that time, and illustrates, also, the remarkable effect of a very small amount of heat in disintegrating the frazil ice around the ship. Just where the circulating water from the pump comes out, all the frazil in a very short time was removed and carried away by the currents. Had this water been discharged at the bow of the ship, she would have been freed much sooner. An ice-breaker equipped with steam or hot water in the bow, would never be delayed by either frazil or lolly ice.

This year, the keeping of the channel open at Cap Rouge has had the effect of keeping the river clear all the way up to Three Rivers.

Battures have formed, but these have come away early, not being held in place by the ice pack, and on March 20th, during the trip of the "Montcalm" from Quebec to Three Rivers, no ice was met with, the whole river being practically as clear as in summer. The effect of keeping an open channel has been to produce less ice than was expected. Open water allows the free entrance of the sun's heat, and during the month of March the water flowing past Quebec steadily rose. Fig. 7 shows the rise of water temperatures during a period of several bright clear days, with the temperature at or a little below the freezing point. The effect of surface ice would have been to prevent the rise of water temperature. Thus, the action of ice already formed is to refrigerate the water and really delay the disintegration of the river ice.

During the passage of the "Lady Grey" up the river from Quebec to Three Rivers to commence operations on the ice of Lake St. Peter, on March 16th, temperature measurements were made in the water at intervals. This was found to drop slowly at first and more rapidly up to the edge of the border ice on Lake St. Peter, where the temperature was found to be almost exactly at the freezing point. A most remarkable example of the effect of the sun in warming the water was observed on March 21st, during the time of the opening of a part of the channel in Lake St. Peter. See Figs. 8 and 9. A channel several hundred feet wide was made through fifteen and eighteen inches of clear lake ice for a distance of nearly five miles. Every measurement showed the temperature at the fresh cut into the surface ice, out of which the water flowed, to be about one one-hundredth of a degree above freezing. During the day, the sun was shining, and by the time the ship returned over the lower part of the cut, the water temperature had risen by two or three hundredths of a degree.

Small as this rise seems, measured by ordinary standards, it is very large when taken in connection with the formation or disintegration of ice. Only a few hundredths of a degree will prevent ice formation altogether in water, even in a very cold atmosphere. No freezing or sticking of the ice is possible on the river, warmed to this amount, and the existing ice is rotted and honeycombed to a large extent. How great a reservoir of heat the whole of Lake St. Peter would become if kept free of ice, cannot be adequately estimated. At first sight, it appears that a surface layer of ice acts as a protective coat. But the effect of the sun during the day is much greater than the effect of a cold atmosphere, and yet all this is effectually shut off by the layer of surface ice.

It is hoped that attempts will be made some time to keep Lake St. Peter free of surface ice. Through it there runs a current of about one mile per hour, which is quite sufficient to clear it of ice if broken up. Small tugs creating a powerful wash would be sufficient to do this. During an easterly blizzard, the tugs could not work, but if set at the ice directly after much could be accomplished. It seems wrong to allow the ice time to grow to its present thickness, and then spend time and money breaking it up. The channel, at least, should be kept open during the winter, to allow of a free runway for the ice. It is very likely that the open lake would to a large extent react on the lower parts of the river, and make the problem at Cap Rouge much easier.

Results of the Work of the Flood Commission

As early as 1886, the Royal Commission appointed to study the St. Lawrence River, with a view of finding some remedy for the winter and spring floods, issued a very elaborate and valuable report, giving a careful survey of the river above and below Montreal. The result of their study showed that the floods were occasioned by the winter packing of the ice, and that all this could be avoided by keeping the channel open to tide water. The St. Lawrence is not subject to floods such as affect many of the American rivers; its flow is more uniform. The winter and spring floods are entirely due to ice jams. Floods may last for a few hours, or a week or more. The one of 1858 lasted two weeks. There are certain critical spots in the river, where the ice forms first, which starts the pack. Thus, at Lake St. Peter the ice-bridge causes the water to rise behind it. The winter level of Lake St. Peter itself is four or five feet higher than the summer level while the river is open, but when that is closed it rises seven or eight feet.

Mr. T. C. Keefer, C.M.G., one of the greatest authorities on the ice conditions of the St. Lawrence, describes, in his address already referred to the taking of the ice over the St. Lawrence in 1886, when he studied the question as a member of the Flood Commission. In that year, the ice-bridge took at Nicolet, the lower end of Lake St. Peter, on December 4th, and the lake was covered to Stone Island, twenty miles above, in thirty hours. The ice then reached Sorel, seven miles further on, in fourteen hours after. It reached Vercheres, twenty-three miles above, in seventy-eight hours. After five days' thaw, it reached Verennes, going nine miles in seven days. The upward march to Longue Point (seven miles) was made in two days of cold weather. The whole of the river channel for fifty-five miles above Lake St. Peter to Lachine Rapids was covered in about three weeks. At the St. Mary's Current, ice shoves are most frequent. Sometimes, the water rises as rapidly as a foot in less than two minutes. During the great flood of 1886, the water in Montreal Hărbor rose twenty-seven feet above the summer level, by an ice jam below Hochelaga. This gave way suddenly, before the pressure caused by this head, and the ice-laden wave (starting at twenty-seven feet) was precipitated down the river. It dropped in amplitude only three feet in the first mile and was twenty feet high at Longue Point, which elevation it maintained for a distance of thirty miles. It finally reached Sorel, with a height of sixteen feet above summer level, in ten hours going at the rate of four and one-half miles per hour.

Flood Commissioners on Winter Navigation

The Flood Commissioners, after very careful deliberation came to the conclusion that there would be a great deal to be gained by keeping the St. Lawrence clear of ice, from Montreal to tide water, in order to avoid the winter and spring floods. They recommended a boom to be thrown across the base of Lake St. Louis, to keep back the lake ice. This was estimated to cost about $70,000.00, but was never carried out. Ice-breakers for the harbor of Montreal were authorized in 1885, but were likewise never put in operation. Experiments on explosives to break up the ice jams were tried, but were found to be of little use in the masses of packed ice. Moreover, they were very expensive, quite apart from any value in moving the jams.

They stated that the prevention of the ice-bridge at Lake St. Peter would result in an open channel up to the Lachine Rapids. The current, under a head of one-fifth of an inch per mile, was found to be effective in other parts of the river in keeping the surface clear of ice. As it is now, the ice-bridge at the lake stops the floating ice, which would otherwise pass out to tide water.

The result of all the Government's work during the past winter is to show how much can be accomplished by keeping open the channel at Cap Rouge. This has, without doubt, maintained an open channel up to Three Rivers, and this year stands out in striking contrast to last winter, when the bridge took and the winter's pack rendered the river between these points impassable. The Department of Marine and Fisheries is to be highly praised for the broad and determined effort to improve the ice conditions which has been so successful during the past winter.

The writer feels sure however, that much greater good could be accomplished by keeping the ice-bridge broken up at the foot of Lake St Peter and at the Sorel Islands. The lake itself could be kept nearly free of ice by having a boat like the "Lady Grey" making daily trips over the ship channel at full speed. The great wave generated by the propellers would be very effective in breaking up the thin surface ice that forms there. In addition, it might be necessary to have perhaps two strong harbor tugs to sail over other parts of the lake to break up the ice nearer to the north and south shores. It is the writer's belief that one ice-breaker could keep the river clear at the Sorel Islands as well as at Port St. Francis, and that this, together with one powerful ice-breaker at Quebec, would effectively keep the ship channel open. The hardest work would be in December and January, which may be termed the two "ice months." In February, the sun becomes stronger and assists very much the work of clearance. In March, practically no new ice is formed of any size. In the spring, instead of thick, hard, clear ice on the lake, which is difficult to break and retards the opening of the river above that point, we should find a surface of water practically free of ice. No floods would result, and the ships could begin running to the port of Montreal early in April, if not in March. If a serious attempt was made, as it will have to be sometime, to navigate all the year round, it will be found to be of great advantage to wall in the channel through Lake St. Peter. Such a canal has been successfully built through Lake St. Clair, at Port Huron. The influence of this canal would be to outline the channel, and produce sufficient current to prevent freezing. The ice on the rest of the lake would be held in and allowed to disintegrate in the spring without moving down to block the channel. The canal thus formed would be easy to navigate in the dark, and might in itself prove to be sufficient to maintain an open channel throughout the rest of the river. The canal could be built wide enough to give a suitable artificial navigable river and could be deepened very easily. In the map of the river reproduced at the end of this paper, the outline of such a canal is shown. To regulate the current in the canal, gates could be built at the mouth and a part only of the volume of water allowed to enter. It might, at first sight, be thought that the boats employed in the lake to keep the ice broken might become frozen in and helpless. Such boats could be supplied with pipes in order to blow steam into the water around them. The effect of such a small amount of heat in this way would effectually prevent a boat freezing in. In Fig. 10 is shown a diagram illustrating the effect of a ship like the "Lady Grey" in warming the water immediately surrounding it. Temperature measurements were made at different depths as soon as the boat had tied up in the St. Louis Basin at Quebec. The temperatures going down gradually increased with the depth, to thirty-six feet. On drawing the thermometer up, however, the temperature was found to have risen considerably. The rise commenced most markedly at fourteen feet from the surface, which is just the draft of the "Lady Grey." It is noticed that even in the coldest weather a ship like the "Lady Grey" never freezes in, but the ice is loose and disintegrated all round the ship from the natural heat of the ship and the effect of the circulating water. This could be increased very much by the use of special steam pipes in the water. A case has been recorded where a pond in which a dredge was working was kept open for a month with the air temperature at thirty below zero Fahrenheit, by blowing steam from an old 60 h.p. boiler, burning waste stumps, into the water under the dredge. At the end of this time the operations were stopped only by the inability to work the machinery of the dredge in the intense cold. Under normal conditions, the pond would freeze solid to the bottom. This is but one example of many which could be cited to show the wonderful effect of a small amount of heat in preventing ice formation. A thin surface layer a few hundredths of a degree above the freezing point will effectually protect the water from ice.

Any plan which may be carried out for the purpose of winter navigation on the St. Lawrence must include as is now contemplated by the Government, the placing of piers at suitable spots along the shore below Three Rivers, where the tide frequently sets loose the heavy battures from the bays and shallow places. These piers would effectually pin the ice and prevent it from moving out. No ship could run the risk of being shoved out of the channel by one of these great masses of floating ice. Wherever such piers are now found in the river above Quebec, the battures are prevented from moving. Much of the heavy floating ice met with in the Gulf could be prevented in this way. The navigation of the Gulf is a problem in itself, but with the use of ice-breakers patrolling the waters, with the Marconi System, and with suitable signal stations along the shore, no boat need run any risk of this kind. It would be necessary to fit every boat coming up the river with an iron or wooden apron over the bow. A boat so equipped becomes in itself an ice-breaker of no mean ability. Such an outfit is now used on all boats running to Russian ports, and adequately protects the ship from harm.

In conclusion, I feel sure that time will see the fulfilment of our hope for Montreal as the great distributing centre for the products of the West. Its natural advantages make this possible, and with the ice problem solved, nothing can prevent our city from becoming one of the greatest seaports in the world.

I desire to express my great indebtedness to Hon. L. P. Brodeur, Minister of Marine and Fisheries, for having permitted ice studies to be made by my assistants during the time that the ice breakers were working. Also to Mr. G. J. Desbarats, the Deputy Minister, for his unfailing interest and kind encouragement in the work.

WORKMEN'S COMPENSATION IN QUEBEC.

The Monetary Times.

On January 1st, as the result of the passing of a Workmen's Compensation Act in Quebec, the insurance companies raised their rates in that province. The law was generally thought to be severe upon the employer and the risk assumed on his behalf by the insurance company was, therefore, greater. Mr. F. P. Walton, Dean of the Faculty of Law, of McGill University, has performed an admirable service to employers, employees and underwriting companies interested by the publication of the Act, together with his commentary thereupon. The principle of the Act has been accepted in so many countries that its adoption here, he thinks, can occasion no surprise. Very few of the witnesses, who were heard by a Quebec Government commission in 1908, appeared to be satisfied with the law as it then stood. The employers complained that they were held liable for the least error committed by any of their employees, and that the law fixed no maximum limit of their liability. They also alleged that trials by jury were prejudicial to them, because the jurors allowed themselves to be guided by sentimental considerations instead of impartially weighing the evidence. They complained further that they were exposed to vexatious lawsuits for amounts altogether out of proportion with the damage suffered, and that, even when they succeeded in having these actions dismissed, they still had to pay their own costs, which were generally very high.

The workmen, on their part, contended that the law as it stood was unfair to them in obliging them to prove the fault of the employer, or of those for whom he was responsible, especially as in many cases the only available evidence was that of their fellow-workmen, who were thus called to testify against their employer. They also maintained that statistics showed that in nearly fifty cases out of a hundred, accidents were due to fortuitous causes, to superior force, or to undeterminable causes, and that in all such accidents the law allowed the workmen no indemnity. They further complained that their limited resources did not allow them to follow the employer through the numerous appeals from one court to another, and that it often happened that a final judgment was not arrived at before several years after the institution of the action.

Mr. Walton gives one instance of the length to which juries would sometimes go under the old law in finding liability established. The workman, a man of twenty-two years of age, had been warned by the foreman not to touch a machine, but in spite of this prohibition did so and received an injury. The fact that the foreman was aware that his order had been disobeyed, and had not taken the means to enforce obedience of it, was held enough to render the employer liable. The verdict, awarding reduced damages, was sustained by the Court of Appeal on the ground that the jury were entitled to judge as to the questions of fact, and that, although the verdict might not commend itself to the Court, it was nevertheless one which twelve reasonable men were entitled to find.

The Quebec Workmen's Compensation Act, Mr. Walton thinks, is a frank acceptance of the new principle of "professional risk," a theory which has been the subject of much discussion during the past twenty-five years in almost all the countries of Europe. It rests upon the simple idea that every workman is entitled to compensation for injury caused to him by an accident in the course of his work, quite apart from the consideration whether the accident was caused by fault on the part of the employer.

Experience has shown that, in the conditions of modern industry, a large number of accidents to workmen inevitably occur, and, upon this theory, the cost of making compensation for them—so far as it is possible to compensate such losses in money—ought to be a charge upon the industry, just as much as the cost of the machinery or the fuel.

Mr. Walton traces briefly the practical considerations which have induced the legislatures of so many countries to accept such a principle. The evolution of society, he says, has been upon the same general lines in all the great manufacturing and commercial centres. All alike have become vast, noisy workshops, full of whizzing wheels, of live wires, and of dangerous chemicals and explosives.

Before the days of steam and electricity, and dynamite, he continues, the workman could, as a general rule, protect himself by the exercise of ordinary care. His tools were few and simple. None of them moved except when he handled them, and no one was in a hurry. It is, therefore, not to be wondered at that the old law gave the workman no claim for damages unless some fault, at least of omission, could be clearly brought home to the employer. But the situation has completely changed. Under modern conditions millions of workmen pass their lives in continual danger. They have to deal at close quarters with complicated machines, to handle terrible explosives, to run the risk of coming in contact with "live wires"; in a word, to face a thousand perils. Even the strictest care cannot save them. A boiler may burst or some other accident occur, the precise cause of which can never be discovered. Hundreds of lives have been lost by this terrible accident anonyme, as it has been called. In many kinds of employment the workman knows that he is exposed to mysterious and sudden danger. He has to take the risk. It is inherent in the nature of the occupation. The master may have the best and newest plant. He may spare no expense and no vigilance in adopting every means for protecting his men. The workman may always be on the watch. But all this cannot prevent the accident. Is it fair that the workman should bear this professional risk? His employer may not be negligent, but, at any rate, the work is being carried on for his profit. It is idle to say that the workman is paid at a higher rate because his work is dangerous. The iron law of supply and demand compels him to take such wages as he can get in the state of the market. Mr. Walton's commentary will be perused with much interest.

GRADE SEPARATION.

W.H. Breithaupe, M. Inst. C.E., M. Can. Soc. C.E.

Two bodies cannot occupy the same space. Of two intersecting lines of traffic on the same plane neither can be continuous, each must be intermittent, must stop, or change direction, while the other passes. And while each line may be naturally intermittent, may consist of detached units, if its units pass at variable and unrelated intervals liability for two units, one on each line, to meet at the point of intersection remains unchecked. If either line is fixed in direction, as on a railway, and cannot turn aside, the danger of interference increases; and increases more if both lines are so fixed.

The fact that the only safe crossing of street or highwav and railway, or of railway and railway, is in placing one above the other and thus giving each a free and unobstructed course is also an axiom. It has become an axiom. No so-called protected crossing—a grade crossing with gates, signals, derails and other appliances, or any of them, operated by attendants or automatically—has been found to be ultimately safe. Separation of grades has, in addition to safety, the further great advantage of elimination of delay and of maintenance and operating cost.

This paper aims to give existing conditions governing the practicability of grade separation.

The physical laws for grade separation are summed up in two:

1. The structure carrying the upper line of traffic must be sufficiently high above the lower traffic way to clear all objects passing on the latter.

2. The grade on either traffic way, approching the crossing, must be practicable for the traffic thereon.

The maximum height of loaded vehicles and any objects thereon on city streets or country highways has been accepted as 14 feet. This height is also sufficient to clear regular street railway traffic. While higher objects are moved along roads (streets or highways) occasionally it is properly not considered necessary to endanger the practicability of crossings under railways to accommodate them. With the railway on moderate embankment undercrossings of roads, subways, as they are called, become readily practicable. In many cases it is possible to sufficiently change the grade both of railway and road to meet requirements for a subway. Sometimes a deviation of the road, or change of location for a short distance, is practicable, and greatly simplifies the desired grade separation.

The vertical clearance, top of rail to bridge, called for over railway tracks is in most cases much higher than over roads, and this constitutes, in the great majority of cases, the insurmountable obstacle to grade separation. The highest fixed projection on an ordinary railway train is the locomotive smoke stack, and passenger cars project higher than the great bulk of freight cars; but some, comparatively few, extremely few, special freight cars are higher than either passenger cars or locomotive stacks. The extreme clearance requirement is for height, top of rail to running board, of highest car, height of brakeman added thereto, and a further allowance for contingencies, among which may be height of load of light material on an open car exceeding maximum box car height.

There are, at the present time, on the railways of standard gauge in the United States, Canada and Mexico,* about 2,377,282 freight cars of all kinds. They classify as to height, rail to running board, as follows:

Under 12 ft. including flat, gondola and tank cars.	63.1%
12 ft. to 12 ft.	23.4%
13 ft. to 13 ft. 6 in. inclusive........................	11.9%
13 ft. 6 in. to 14 ft. "	0.65%
Over 14 ft.	0.95%

Of the total number of freight cars 98.4 per cent. are 13½ ft. high or under, and only 1.6 per cent. are higher than 13½ ft; and less than one per cent. higher than 14 ft.

Considering main trunk lines, the Pennsylvania Railroad, Baltimore and Ohio, Erie, Lehigh Valley, Great Northern, and a number of others as far as known, i.e., with a small percentage of cars having dimensions not ascertained, among them the Grand Trunk and Canadian Pacific Railways, have either none or less than one quarter of one per cent. of freight cars over 13½ ft. to running board.

The Master Car Builders' Association, whose rules and standards are adopted by railways on the North American continent generally, and recognized by the Board of Railway Commissioners for Canada, although it has not fixed a standard for box car dimensions, adopted in 1904, as recommended practice, a height of 12 ft. ¾ in. to eaes, equivalent to less than 13 ft. height to running board. High standard cars are such as the Grand Trunk Pacific Series 300000-310824, 13 ft. 4 in., and the Canadian Pacific new steel frame box cars Series 130000-132998, 13 ft. 4¾ in. The highest regular Canadian Pacific freight cars are 13 ft. 6 in. to running board and this may be said of most of the main trunk lines of railways. The highest Pennsylvania Railroad freight cars are 13 ft. 4 in.

Limits of car dimensions are fixed by clearance outlines on the various railways. A composite clearance limit diagram for ninety railways*, including all Canadian trunk lines, has height of 14 ft. 6 in., limiting "overall" height of cars to this figure and practically limiting height to top of running board of freight cars to 14 ft. In the St. Clair tunnel, Grand Trunk Railway, the clearance height at width of 3 ft. is 14 ft. It is true that on many divisions or branches of the lines considered the clearance is somewhat greater than shown in the composite diagram referred to; on the other hand, it is less on a number of main lines and on many branch lines.

An empty freight car 14 ft. high will on 5 ft. (out to out of rails) transverse base not resist a 30 lb. wind pressure when standing alone.

The limit of grade, approaching crossings, can, for railways, be taken as between 5/10 of one per cent. and one per cent. For city streets a grade of 5 per cent. is in most cases extreme and should be for main country highways, and it should be short at that. A preferable maximum grade for roads is 4 per cent., and 3 per cent. is materially better. This works out as follows:

5% grade 20 x 2 = 40 ft. length of approaches for every vertical foot of clearance.

4% grade 25 x 2 = 50 ft. length of approaches for every vertical foot of clearance.

3% grade 33 ft. 4 in. x 2 = 66 ft. 8 in. length of approaches for every vertical foot of clearance.

Any gain, by curtailment of vertical clearance requirement, or by change of railway grade, or by both, means corresponding shortening of road approaches, and at their high ends. Such a gain of one foot may greatly reduce the cost of a given grade separation, may make it practicable while otherwise it would not be; a vertical gain of two feet would mean a very large addition to the number of practicable grade separations.

As to brakeman on car 7 ft. must be accepted as the extreme allowance that should be made. 6 ft. 6 in. will clear any brakeman unless he should be over 6 ft. tall, and 6 ft. brakemen are not common, to say the least. What is to be said for the contention, seriously made, that the brakeman, on running board of highest known car, should be allowed room to swing his lantern over his head? The necessity for brakemen on tops of cars is becoming less and less, and has in many cases disappeared, rules and regulations of railway companies to the contrary notwithstanding. The air brake is now universally used in train control. In Canada orders of the Board of Railway Commissioners in force since December, 1908, provide that no regular freight train shall be allowed to proceed on its journey unless at least three quarters of the cars comprising it shall be equipped with air brakes in good working order, and that every freight car shall be equipped with air brakes and with operating levers on both sides of the end.

A stage arrives in the increase of traffic of railways when grade crossings become intolerable, and when the risk and interruption due to them becomes more expensive than their elimination. In Europe grade crossings in any considerable centres of population are the exception and this may soon be said also of main trunk line railways in the older of the United States. The Pennsylvania Railroad makes it a rule to avoid all grade crossings on new work and has within the last nine or ten years eliminated over 50 per cent. of its grade crossings on main lines. To do this clearance must be made as low as possible. Overhead bridges are as low as 16 ft. 6 in. above top of rail. Many are 18 ft. 6 in. and less. Twenty-one feet, the standard for signal bridges, is recognized as the highest clearance for which there can be any need. In New York many overhead bridges throughout the state are only 18 ft. above top of rail, and this is the case also in Massachusetts and in other States. The New York Central and Hudson River Railroad has asked for 16 ft. or

*Official Railway Equipment Register..

*Railroad Age Gazette.

16½ feet clearance for all overhead bridges within the electric zone, extending 16 miles from the Grand Central Station, in the city of New York.

Electric traction within limits for such large centres of traffic as Montreal and Toronto, with hydro-electric energy abundant or soon to be, is easily within the range of probability in the not distant future. Smoke abatement alone points in this direction. With accompanying cutting down of vertical clearance requirement to 17 ft. or less, or even if 18 ft., this would at once put an entirely different aspect on the vexed question of grade separation.

It is submitted that with conditions as they are, and the more so with regard to the future, 20 ft., 13½ ft. for car and 6½ ft. for man, is a reasonable vertical clearance. It has been shown that 13½ ft. covers the height to running board of all but a very small percentage of freight cars now in use and that cars higher than 14 ft. to running board, i.e., higher than 14 ft. 6 in. "over all" or top of brake rod, can only, to a limited extent, traverse beyond their home railways. That higher cars will be economical or practicable is as little probable as that the gauge of railways will be widened or their entire structure changed. For a vertical clearance requirement greater than 21 ft. (14 ft. plus 7 ft.), there can, in any event, be no conceivable rational need.

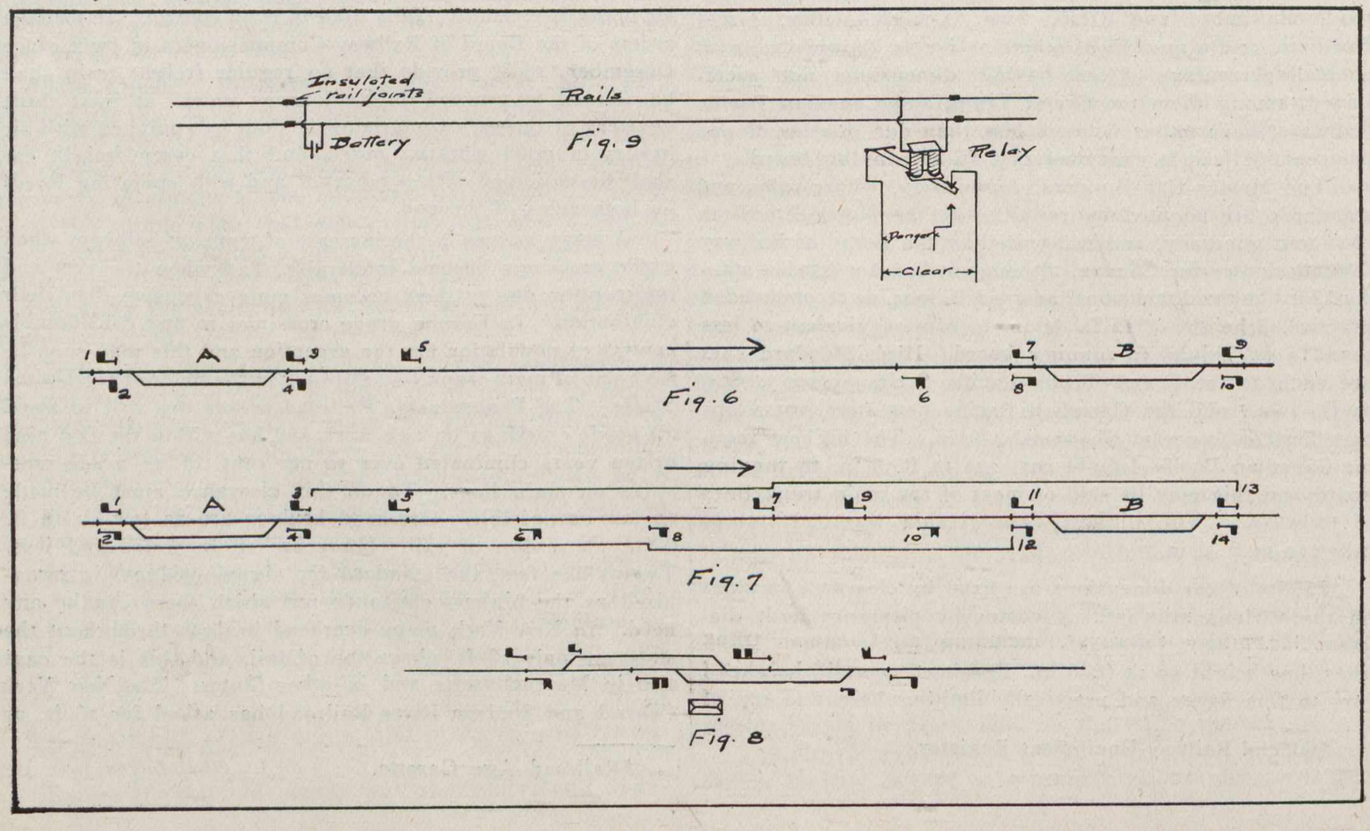
In the United States there is no federal law fixing vertical clearance for bridges over railways. A number of States deal with the question. In Massachusetts there is a special Grade Crossing Commission. The minimum clearance required by this commission is in general 18 ft. Connecticut and Rhode Island also specify 18 ft. In New York the Public Service Commission has charge of grade crossing regulation. While this commission requires 21 ft. clearance where practically many lower bridges are built throughout of the State, some as low as 16½ ft., as partly already spoken of, New Hampshire, Ohio, and Indiana requires 21 ft. The only States requiring more are Illinois and Vermont where 22 ft. is specified and exception made where this height is not practicable. In all other states there is no statute or regulation as far as has been ascertained, and height is not practicable. In all other States there is no 22 ft.

In Canada the Dominion Railway Act of 1904 specifies a minimum clearance of 22 ft. 6 in. above rail level for bridges over railways, with no deviation except by leave of the Board of Railway Commissioners. The board has allowed that the term "rail level" may be interpreted "base of rail," but has allowed no further deviation in any case.

RAILWAY SIGNALLING.*

Prof. V. J. Smart, McGill University.
Formerly Signal Engineer for the Chicago and Eastern Illinois Railway.

On single track, as we have seen above, the block stations will correspond to the passing track locations, there is no good reason why there should be any intermediate stations, as should two trains meet at an intermediate block station one or other of these trains must back up. In the location of Automatic signals on single track, the blocks would still be determined by the passing tracks, the only necessity for any intermediate locations would be to provide for following movements. Diagram No. 6 shows the location of signals, not providing for a following movement. Signal No. 4 blocks through to signal No. 8, No. 7 to No. 3. A train moving in the direction of the arrow from A, would set signal No. 7 at stop when it reached a spot somewhere in advance of No. 4, and hold it against any trains moving in the opposite direction, until it had reached the passing track at B, signal No. 4 going to the stop position when it had



passed it. In this way no train could leave B if a train had left, or was about to leave A. If now it is desired to provide for following trains to leave A closer together than the distance between the passing tracks, four additional signals must be located between these two passing tracks. Diagram 7 shows the new arrangement, signals 6, 7, 8, 9, have been added to provide for a possible following movement, with the objectionable feature added that two trains might leave the passing points one from A and one from B, which would not be caught until one of the trains had reached signal No. 8 and the other signal No. 7. Here one of the trains would have to back to the passing track. In order to provide for such a movement 33.3% has been added to the initial cost, and to the cost of maintainence and operation.

Mr. Alfred Beamer, superintendent of the Northern Pacific Railway, at Spokane, has devised a system of moving trains, which dispite the fact that it has a number of objections to it, is based on the correct principles, and has resulted in giving extremely satisfactory results. This system is known as the A. B. C. rules for train operation. It is simply the staff system, with the safe guards of staff left out, the application of existing apparatus would make this system complete. The instructions issued when this system was put in service will explain fully its operation.

"All time-card trains (both passenger and freight) previously shown on time table are annulled. All the running rights that a train has at any time are conferred upon it through the medium of a block card issued by the train dispatcher.

"A block is the section of main line extending from the signal at one telegraph office to the signal at the next telegraph office in advance.

"Train or enginemen are prohibited from accepting or running on a card purpoting to authorize them to pass an open telegraph office.

"No train will, except under flag protection, be allowed to leave a terminal or pass a telegraph office, no matter what may be the position of the semiphore, without both the conductor and engineer first securing a block card authorizing the train to use the block in advance.

"Immediately following the departure of a train from a telegraph office the operator will report its departure to the dispatcher and to the operator at the next telegraph office, in advance of the train.

"Immediately upon receipt of this report the operator at the office in advance will assure himself whether the block in advance from his office is clear, and if so, he will at once ask the dispatcher, in the form provided, for the block in advance for the approaching train. If his record shows the block in advance is occupied by another train, he will hold his signal against the approaching train until advised that the block in advance is clear.

"Having secured the block card from the dispatcher, he will at once secure from the operator at the next office in advance, a pledge of the block for the train for which the dispatcher has authorized the block card. After this has been accomplished, he will place his signal in the clear position and deliver a copy of the card to the engineer and another to the conductor as the train passes his office.

"Trains approaching telegraph offices and finding the signal at clear will understand from this that the block ahead is clear, and will pass the telegraph office without reducing speed, catching the block card as they pass. If, however, for any cause the cards should not be secured, the train will be brought to an immediate stop and will not proceed until the cards are secured.

"Conductors and engineers will immediately examine the block card, following its receipt by them, and make sure it is correctly made out. They will follow implicitly all instructions given them thereon. If directed to take siding at a station, they will do so disregarding a signal to come down the main line. The rights conferred on the train by a block card can not be extended by a signal, but may be restricted by one.

"When taking a siding to meet an opposing train or to pass by a following train, trains will head in at the first switch at all points where lap sidings (see Fig. 8) are provided.

"All exceptions, and the name of the telegraph office in advance must be repeated to the dispatcher by the receiving operator. A card bearing no exceptions is not repeated.

"When necessary to change instructions on cards that have already been put out by the dispatcher, he will invariably do so by annulling the card containing the instructions which it is desired to change. Dispatchers will, when making a change in meeting or passing points, invariably use the words "instead of."

"All trains will be designated by the number of the engine pulling them.

STREET RAILWAYS FOR CITIES COMMERCIALLY CONSIDERED.

T. W. Sheffield, A. M. Inst. E. E.

Electric Railways unquestionably confer great benefits upon the public, and bring many advantages to a city which cannot be obtained by any other system of locomotion. The rapid growth of street railways in the East has been the means of linking up outlying districts, allowing citizens and artisans to live away from congested centres, thus giving healthier and better conditions for living than prevailed before their adoption.

They also play a most important part in the commercial development and social life of the cities. The city of Regina is admirably laid out for a street car system, there being ample room in its well laid out streets to give a good service without impeding other means of traffic, which is one of the most important features in any system, as it minimizes accidents and permits a rapid service from one section of the city to the other.

The fact of the streets being so level is also a great factor in favor of the system, as the current consumption per car mile is kept practically constant, due to the motors not being called upon to take up heavy current loads on steep gradients. An important feature in any city's progress is to avoid overcrowding and congestion at the outset; when this is done the mortality per annum is reduced to a minimum; this can only be achieved by the early adoption of a system giving cheap and rapid facilities for transportation.

The writer was for several years connected with the General Electric Company of the United States, which gave him opportunities for gauging the advantages following electrical traction both in large and small cities, and without exception he observed that it brought increased business prosperity and progress: no city having ambitions for its future greatness can ever expect to lift itself beyond restricted expansion without a well-regulated street railway system. There are many cases where towns have become stunted in their growth owing to the fact that they have not been able to focus the outlying population and outskirts into the city for ordinary industrial social advancement, progress, and buying facilities.

Cost of Living Reduced

Apart from the foregoing advantages, there is the vital question of bringing in fresh food supplies from the outlying districts, this being a very important matter to any city seeking industrial development, being one of the chief items that have to be considered by artisans and skilled laborers coming from other centres of industry; facilities for cheap living being a great factor in the choice of localities for work.

With an ever increasing population, the question of cheap living becomes more acute every day, and there is no doubt the street railway system will materially reduce the present high prices prevailing.

The supply of fresh milk is also a highly important matter for the city—the very fact of cows having to be kept by citizens proves conclusively the urgent need for cheap and rapid transportation of this every-day commodity. The ideal scheme would be to have a series of collecting centres for farm produce such as milk, vegetables, poultry and fruit, conveying the same direct to a central market for general distribution. Apart from this it would save the farmers' time as there would be no long, tedious journeys to make, consequently giving better opportunities for cultivating and supplying such produce as the city demands.

The advantages following the adoption of a street railway service are many and varied. Excursions can be arranged at an hour's notice; parties can be taken to any part of the system; visitors can make the circuit of the city with a minimum waste of time. What a field they open up for the citizens, who, after a busy day in the crowded centre of the city, desire a quiet run to the lake, or further afield as the city grows.

But the street railway systems have far more important functions than mere excursions; they are the main and foremost means of solving the housing question. By their aid the worker is enabled to reside a few miles away from his work with ample land for growing all his vegetables, etc., which is a very important element in a city with an ever increasing laboring population.

Having in view the rapid and ever-growing progress of the city and the immediate expansion actually required for its present population together with the other advantages briefly alluded to, every endeavor should be made to have street railways adopted—whether they are run under a franchise or the city's administration, this is another question.

I have refrained from all technicalities in an endeavor to bring out a few of the general advantages accruing to the community from a street car service. There are many side issues omitted; the arguments advanced, however, may in some little measure assist a few of the citizens in their decision to support street railways, thus adding one of the strongest links in the city's chain of progress for its commercial advancement and prosperity.

ELECTRIC RAILWAYS OF CANADA.

Transportation is the great problem of to-day in Canada. The electric railways are doing something to assist and the information furnished by J. L. Payne, Comptroller of Statistics, in a report for the year ending June 30th, 1909, is of value as well as interest. According to Mr. Payne the total mileage of electric railways in Canada in 1909 may be put at 988.97. This would show a decrease of 3.06 miles, as compared with 1908; but there was actually an increase. There has all along been confusion on the part of reporting lines as to the proper method of computing mileage, due almost wholly to the lack of a specific classification on the subject. That difficulty has been removed, and hereafter the facts in relation to mileage will be returned on a uniform basis. The mileage of 988.97 for 1909, following the analogy of steam railways, refers to first main track. The details with respect to mileage are as follows:—

Length of first main track	988.970
Length of second main track	215.057
Total length of main track	1,204.027
Length of sidings and turnouts	83.624
Total, computed as single track	1,287.651

It is not possible to turn back and revise the returns for preceding years, and the figures as reported are used in the following summary relating to mileage:—

1901	674.58*
1904	766.50
1908	992.03
1909	988.97

*Improperly included double track and sidings.

Capital Liability

The paid-up capital on June 30th, 1909, aggregated $91,604,989, as against $87,409,885 in 1908. The increase was therefore $4,195,104.

Earnings and Operating Expenses

The gross earnings for the year 1909 were $14,824,936.55, showing a gain of $817,887 over the preceding year.

The following is a comparison of earnings for the years 1907, 1908 and 1909:—

	1907.	1908.	1909.
Passenger	$12,013,421	$13,233,724	$14,080,755
Freight	344,367	346,021	386,092
Mails and express	41,951	54,883	110,452
Other earnings..	233,190	372,421	34,185
Total	$12,630,430	$14,007,049	$14,611,484

The decrease in "other earnings" for 1909 is accounted for by a change of classification, which limited this item to "other car earnings," and transferred sums previously credited under this head to "miscellaneous income," which forms part of the account dealing with net income.

The balance sheet for the year 1909, prepared in accordance with the new form shows a net income of $4,716,308.75.

It must be remembered, of course, that the operating expenses include $246,192.77 of net loss by certain railways.

The above net income was equal to 5.13 per cent. on the electric railway capitalization of $91,604,989.

The operating expenses for 1909 were $8,884,690.71.

The above operating expenses were equal to 59.93 of the gross earnings. In 1908 the proportion was 62.08.

Public Service

The electric railways of Canada carried 314,026,671 fare passengers in 1909, and 81,670,945 transfer passengers—making 395,697,616 in the aggregate.

Employees

The number of employees in 1909 was 10,557—a gain of 603 over 1908. The aggregate of salaries and wages paid to this staff was $6,761,281.12. This sum was equal to 77.84 per cent. of the total operating expenses.

Accidents

The return of accidents for 1909 shows 68 persons killed and 2,139 injured—an increase over 1908 of one in the number killed and 256 in the number injured.

These accidents were divided up as follows:—

	Killed.	Injured.
Passengers	11	1,303
Employees	7	218
Others	50	618
Total	68	2,139

ENGINEERING SOCIETIES.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—413 Dorchester Street West, Montreal. President, Col. H. N. Ruttan; Secretary, Professor C. H. McLeod.

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—
96 King Street West, Toronto. Chairman, A. W. Campbell; Secretary, P. Gillespie, Engineering Building, Toronto University, Toronto. Meets last Thursday of the month.

MANITOBA BRANCH—
Chairman, J. E. Schwitzer; Secretary, E. Brydone Jack. Meets first and third Fridays of each month, October to April, in University of Manitoba, Winnipeg.

VANCOUVER BRANCH—
Chairman, Geo. H. Webster; Secretary, H. K. Dutcher, 40-41 Flack Block, Vancouver. Meets in Engineering Department, University

OTTAWA BRANCH—
Chairman, W. J. Stewart, Ottawa; S. J. Chapleau, Resident Engineer's Office, Department of Public Works.

MUNICIPAL ASSOCIATIONS.

ONTARIO MUNICIPAL ASSOCIATION.—President, Mr. George Geddes, Mayor, St. Thomas, Ont.; Secretary-Treasurer, Mr. K. W. McKay, County Clerk, St. Thomas, Ontario.

UNION OF ALBERTA MUNICIPALITIES.—President, H. H. Gaetz, Red Deer, Alta.; Secretary-Treasurer, John T. Hall, Medicine Hat, Alta.

UNION OF NOVA SCOTIA MUNICIPALITIES.—President, Mr. A. E. McMahon, Warden, King s Co., Kentville, N.S.; Secretary, A. Roberts, Bridgewater, N.S.

UNION OF SASKATCHEWAN MUNICIPALITIES.—President, Mayor Hopkins, Saskatoon; Secretary, Mr. J. Kelso Hunter, City Clerk, Regina, Sask.

CANADIAN TECHNICAL SOCIETIES.

ALBERTA ASSOCIATION OF ARCHITECTS.—President, E. C. Hopkins, Edmonton; Secretary, H. M. Widdington, Strathcona, Alberta.

ASSOCIATION OF SASKATCHEWAN LAND SURVEYORS.—President, J. L. R. Parsons, Regina; Secretary-Treasurer, M. B. Weeks, Regina

ASTRONOMICAL SOCIETY OF SASKATCHEWAN.—President, N. McMurchy; Secretary, Mr. McClung, Regina.

BRITISH COLUMBIA LAND SURVEYORS' ASSOCIATION.—President, W. S. Drewry, Nelson, B.C.; Secretary-Treasurer, S. A. Roberts, Victoria, B.C.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.—President, Charles Kelly, Chatham, Ont.; Secretary, W. A. Crockett, Mount Hamilton, Ont.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Vice-President, Gustave Kahn, Toronto; Secretary-Treasurer, R. E. W. Hagarty, 662 Euclid Ave., Toronto.

CANADIAN CLAY PRODUCTS' MANUFACTURERS' ASSOCIATION.—President, W. McCredie; Secretary-Treasurer, D. O. McKinnon, Toronto.

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

CANADIAN FORESTRY ASSOCIATION.—President, Thomas Southworth, Toronto; Secretary, James Lawler, 11 Queen's Park, Toronto.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President, Dr. Frank D. Adams, McGill University, Montreal; Secretary, H. Mortimer-Lamb, Montreal.

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

CANADIAN STREET RAILWAY ASSOCIATION.—President, D. McDonald, Manager, Montreal Street Railway; Secretary, Acton Burrows, 157 Bay Street, Toronto.

CANADIAN SOCIETY OF FOREST ENGINEERS.—President, Dr. Fernow, Toronto; Secretary, F. W. H. Jacombe, Ottawa.

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto, President, J. Duguid; Secretary, C. L. Worth, 409 Union Station. Meets third Tuesday each month except June, July, August.

DOMINION LAND SURVEYORS.—President, Thos. Fawcett, Niagara Falls; Secretary-Treasurer, A. W. Ashton, Ottawa.

EDMONTON ENGINEERING SOCIETY.—President, Dr. Martin Murphy; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alberta.

ENGINEERING SOCIETY, TORONTO UNIVERSITY.—President, A. D. Campbell; Corresponding Secretary, A. H. Munroe.

ENGINEER'S CLUB OF TORONTO.—96 King Street West. President, C. M. Canniff; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

INSTITUTION OF ELECTRICAL ENGINEERS.—President, Dr. G. Kapp; Secretary, P. F. Rowell, 92 Victoria Street, London, S.W.; Hon. Secretary-Treasurer for Canada, Lawford Grant, Power Building, Montreal, Que.

INSTITUTION OF MINING AND METALLURGY.—President, Edgar Taylor; Secretary, C. McDermid, London, England. Canadian Members of Council:—Prof. F. D. Adams, J. B. Porter, H. E. T. Haultain, and W. H. Miller, and Messrs. W. H. Trewartha-James and J. B. Tyrrell.

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

NOVA SCOTIA MINING SOCIETY.—President, T. J. Brown, Sydney Mines, C.B.; Secretary, A. A. Hayward.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, S. Fenn; Secretary, J. Lorne Allan, 15 Victoria Road, Halifax, N.S.

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, W. H. Pugsley, Richmond Hill, Ont.; Secretary, J. E. Farewell, Whitby, Ont.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, H. W. Selby; Secretary, Killaly Gamble, 703 Temple Building, Toronto.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—President, F. S. Baker, F.R.I.B.A., Toronto, Ont.; Hon. Secretary, Alcide Chausse, No. 5 Beaver Hall Square, Montreal, Que.

ROYAL ASTRONOMICAL SOCIETY.—President, Prof. Alfred T. de Lury, Toronto; Secretary, J. R. Collins, Toronto.

UNDERGRADUATE SOCIETY OF APPLIED SCIENCE, McGILL UNIVERSITY.—President, H. P. Ray; Secretary, J. P. McRae.

WESTERN CANADA RAILWAY CLUB.—President, Grant Hall; Secretary, W. H. Rosevear, 199 Chestnut Street, Winnipeg, Man. Second Monday, except June, July and August, at Winnipeg.

AMERICAN TECHNICAL SOCIETIES.

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

AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION.—President, John P. Canty, Fitchburg, Mass.; Secretary, T. F. Patterson, Boston & Maine Railway, Concord, N.H.

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE OF WAY ASSOCIATION.—President, L. C. Fritch, Chief Engineer, Chicago G. W. Railway; Secretary, E. H. Fritch, 962-3 Monadnock Block, Chicago, Ill.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—Secretary, C. W. Hunt, 220 West 57th Street, New York, N.Y. First and third Wednesday, except July and August, at New York.

AMERICAN SOCIETY OF ENGINEERING-CONTRACTORS.—President, George W. Jackson, contractor, Chicago; Secretary, Daniel J. Hauer, Park Row Building, New York.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—29 West 39th Street, New York. President, Jesse M. Smith; Secretary, Calvin W. Rice.

WESTERN SOCIETY OF ENGINEERS.—1735 Monadnock Block, Chicago, Ill. J. W. Alvord, President; J. H. Warder, Secretary.

COMING MEETINGS.

CANADIAN ELECTRICAL ASSOCIATION.—July 6-7-8. Annual convention at Royal Muskoka Hotel, Muskoka Lakes, Ont. Secretary, T. S. Young, Confederation Life Building, Toronto, Ont.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS.—May 16-20. Annual meeting at Los Angeles, Cal. Secretary, P. W. Drew, Room 306, 135 Adams St., Chicago, Ill.

NATIONAL FIRE PROTECTION ASSOCIATION.—May 17-19. Annual meeting at Chicago, Ill. Secretary, Franklin H. Wentworth, 87 Milk St., Boston, Mass.

AMERICAN RAILWAY ASSOCIATION.—May 18. Annual meeting at New York City. Secretary, W. F. Allen, 24 Park Pl., New York City.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS.—May 19-20. Semi-annual meeting at Cincinnati, Ohio. Secretary, F. E. Sanborn, Ohio State University, Columbus, Ohio.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—May 23-26. Annual meeting at Chicago, Ill. Secretary, D. B. Sebastian, 327 La Salle Station, Chicago, Ill.

NATIONAL ELECTRIC LIGHT ASSOCIATION.—May 23-28. Annual meeting at St. Louis, Mo. Secretary, T. C. Martin, 29 West 39th St., New York City.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—May 31-June 3. Spring meeting at Atlantic City, N.J. Secretary, Calvin W. Rice, 29 West 39th St., New York City.

ENGINEERS' SOCIETY OF PENNSYLVANIA.—June 1-3. Annual convention at Harrisburg, Pa. Secretary, E. R. Dasher, Gilbert Bldg., Harrisburg, Pa.

MASTER CAR BUILDERS' ASSOCIATION.—June 15-17. Annual convention at Atlantic City, N.J. Secretary, Jos. W. Taylor, 390 Old Colony Bldg., Chicago, Ill.

AMERICAN FOUNDRYMEN'S ASSOCIATION.—June 7-9. Annual convention at Detroit, Mich. Secretary, Richard Moldenke, Watchung, N.J.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION.—June 20-22. Annual convention at Atlantic City, N.J. Secretary, Jos. W. Taylor, 390 Old Colony Bldg., Chicago, Ill.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—June 21-24. Annual convention at Chicago, Ill. Secretary, Chas. W. Hunt, 220 West 57th St., New York City.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS.—June 22-24. Semi-annual meeting at Niagara Falls, N.Y. Secretary, J. C. Olsen, Polytechnic Institute, Brooklyn, N.Y.

TORONTO, CANADA, MAY 13, 1910.

CONTENTS OF THIS ISSUE.

Editorials:

Leading Articles:

Sanitary Review:

RAILWAY EARNINGS; STOCK QUOTATIONS.

Figures for the Past Week and from Beginning of Year, with Comparisons and Stock Quotations.

Stock quotations on Toronto, Montreal and London exchanges, and other information relating to the companies affected are appended:—

Company.	Capital. 000's Omitted.	Par Value	Price May 6 1909.	Price Apl. 28 1910.	Price May 5 1910.	Sales last week.
C. P. R.	$150,000	$100	180-179¾	182-180	185¾	165
G. T. R.	226,000	100	1st pref. 110;	3rd pref. 64¾;	ord. 29½	
Montreal St.	18,000	100	211-209	245-244⅞	243⅞-¾	1010
Toronto St.	8,000	100	124-123	....	120	180
Halifax Electric	1,400	100	115	124-123	....	8

The following table gives the latest traffic returns it is possible to obtain at the time of going to press:—

Road.	Week Ended.	1910.	Previous Week.	1909.
C. P. R.	May 7	$1,855,000	**$2,265,000	$1,329,000
G. T. R.	Apr. 30	**1,103,199	823,325	**955,171
C. N. R.	May 7	295,400	**397,600	159,500
T. & N. O.	Apr. 30	35,871	25,740	40,006
Mont. St.	May 7	79,121	78,632	71,030
Halfx. St.	Apr. 30	**4,996	3,814	**4,493

**April 22nd to 30th (inclusive).

Figures showing the earnings of Canadian roads since January 1st, this year and last, are appended:—

Road.	Mileage.	Jan. 1st to	1910.	1909.
C. P. R.	10,276	May 7	$29,218,000	$24,561,000
G. T. R.	3,536	Apr. 30	13,859,154	11,484,016
C. N. R.	3,180	May 7	3,797,600	2,774,200
T. & N. O.	264.74	Apr. 30	383,728	303,712
Montreal St.	141.79	May 7	1,428,852	1,225,080
Toronto St.	114	Mar. 31	975,806	804,631
Halfx. Elec.	13.3	Apr. 30	61,608	53,368
London St.		Mar. 31	55,237	51,446

MONTREAL STREET RAILWAY.

In the appended table are given the increases and percentages of change in earnings and expenses of the Montreal Street Railway Company for February, March, and the six months ended March 31st last:—

	—Feb.—		—March—		—Six mos.—	
	Inc.	P. C.	Inc.	P. C.	Inc.	P. C.
Gross	$19,887	7.00	$37,469	12.54	$178,894	9.80
Op. exps.	7,343	3.73	16,958	8.32	67,401	5.86
Net	$12,544	14.39	$20,511	21.61	$111,493	16.80
Chgs.	4,838	13.81	4,167	10.71	16,936	8.55
Surp.	$7,706	14.78	$16,344	29.19	$94,557	20.30

Since the beginning of the current fiscal period the company has been operating more economically than in the year previous. In March the ratio of operating expenses to gross revenues was but 65.67 per cent., as compared with 68.23 per cent. for the same month of 1909, a decrease of 2.56 per cent. An equally favorable reduction was also scored in the operating ratio for the half-year, the percentage of expenses to gross revenues having been 61.09 per cent., as against 63.40 per cent. in the year previous, a saving of 2.31 per cent.

During the past few years the company has enjoyed a period of progression in the matter of revenues. For instance, in 1905, gross earnings totalled about $2,700,000, which compares with more than $3,800,000 for the 1909 fiscal period. The 1905 net was approximately $1,000,000, contrasted with over $1,600,000 for the 12 months ended September 30th last. The number of passengers carried in 1905 was about 66,600,000, as against over 95,300,000 last year; number of transfers issued 19,800,000, compared with 127,661,000 in 1909, but the rate received per passenger had dropped from 3.09c. to 2.96c. in the late fiscal period. According to interests thoroughly familiar with the situation, the outlook is favorable for future operations of the company.

GRAND TRUNK SYSTEM.

Increases in All Branches—Grand Trunk of Canada March Net $799,097 Against $679,850.

The roads in the Grand Trunk System of Canada report earnings for the month of March and three months ended March 31st, 1910, compared as follows:—

Grand Trunk of Canada.

	1910.	1909.	1908.	1907.
March gross	$2,887,294	$2,433,030	$2,271,196	$2,720,860
Expenses	2,088,215	1,753,180	1,686,243	1,946,113
Mar. net	799,079	679,850	584,953	774,747
3 mos. gross	7,520,688	6,388,074	6,143,956	7,311,915
Expenses	6,016,940	5,142,250	5,242,681	5,575,062
3 mos. net	1,503,748	1,245,824	901,275	1,736,853

Grand Trunk Western.

March gross	$528,520	$489,083	$527,502	$544,561
Expenses	399,540	364,501	382,967	445,285
March net	182,980	124,582	144,535	99,276
3 mos. gross	1,508,614	1,257,503	1,306,142	1,414,204
Expenses	1,152,387	1,020,505	1,049,191	1,245,823
3 mos. net	356,227	236,998	256,951	168,381

Detroit, Grand Haven & Milwaukee.

March gross	$158,161	$126,042	$105,603	$160,107
Expenses	122,636	109,253	130,422	126,529
Mar net	35,525	16,789	*24,819	33,578
3 mos. gross	456,964	352,334	354,766	431,657
Expenses	375,207	312,186	350,873	365,473
3 mos. net	81,757	40,148	3,893	61,184

*Deficit.

Canada Atlantic.

March gross	$164,974	$128,962	$110,956	$145,508
Expenses	125,069	127,502	119,716	137,722
Mar. net	39,905	1,460	*7,760	7,786
3 mos. gross	535,358	348,441	335,301	394,672
Expenses	366,448	371,314	406,738	417,058
3 mos. net	57,910	*22,873	*71,437	*22,386

*Deficit.

CALGARY STREET RAILWAY.

Earnings and expenses of the Calgary Street Railway, since January 1st, compare as follows:—

1910.	Earnings.	Expenses.	Profits.
January	$11,564.60	$8,762.02	$2,802.58
February	11,353.05	8,396.23	2,956.82
March	13,257.65	7,862.62	5,395.03
April	14,613.20	7,227.47	7,385.73

Four months' profits $18,540.16

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 PENDING.

In addition to those in this issue.

Place of Work.	Tenders Close.	Issue of.	Page.
Ottawa, Ont., steel steamer	May 31.	Apr. 15.	367
Vancouver, B.C., garbage destructor plant	May 31.	Apr. 22.	50
Winnipeg, Man., electrical distribution	May 16.	Apr. 22.	50
Grimsby, Ont., High school	May 30.	Apr. 22.	398
Sault Ste. Marie, Ont., railway construction	May 16.	Apr. 29.	52
Ottawa, Ont., extensions and repairs to wharf	May 20.	Apr. 29.	427
Toronto, Ont., centrifugal pumps and electric motors	May 17.	May 6.	64
Niagara Falls, Ont., boulevard construction	May 17.	May 6.	64
Bridgeburg, Ont., sewer construction	May 16.	May 6.	52
Leamington. Ont., marsh drainage system	May 28.	May 6.	48
Ottawa, Ont., power house equipment	May 25.	May 6.	48
Toronto, Ont., reinforced concrete footbridge	May 17.	May 6.	48
Brantford, Ont., bridge abutments	May 26.	May 6.	457
Lindsay, Ont., school	May 16.	May 6.	457
Orillia, Ont., sewage sedimentation tanks	May 16.	May 6.	457
Toronto, Ont., coal supply	May 17.	May 6.	457
Toronto, Ont., lumber supply	May 17.	May 6.	457
Winnipeg, Ont., railway bridge work	June 28.	May 6.	457

TENDERS.

St. John, N.B.—Tenders will be received for renewal pipes of water mains and sewers. Wm. Murdoch, City Engineer.

St. John, N.B.—Tenders will be received until May 31st for the installation of a sprinkler system in Sand Point Warehouses. Wm. Murdock, City Engineer.

St. John, N.B.—Tenders will be invited for permanent paving work. Wm. Murdock, City Engineer.

Montreal, Que.—Tenders will be received until May 17th for supply and delivery of 70 tons of chloride of lime. L. O. David, City Clerk.

Outremont, Que.—Tenders will be received until May 18th for the construction of approximately 5,000 feet of trunk sewers. J. Kruse, secretary-treasurer.

Montreal, Que.—Tenders will be received until May 12th for the laying of permanent pavements and sidewalks. L. O. David, City Clerk, City Hall.

Montreal, Que.—Tenders will be received until May 18th for the construction of sewers. John R. Barlow, City Surveyor.

Quebec, Que.—Tenders will be received until 18th May for one year's coal and wood supply. W. D. Baillange, city engineer.

Montreal, Que.—Time for receiving tenders for permanent pavement and sidewalk construction to cost one and a half million has been extended to May 19th. L. O. David, city clerk.

Ottawa, Ont.—Tenders will be received until June 2nd for the construction of a wharf and warehouse at Arichat, Richmond county, N.S. Plans may be seen at the offices of C. E. W. Dodwell, District engineer, Halifax, N.S.; E. G. Millidge, District Engineer, Antigonish, N.S., and on application to the postmaster at Arichat, N.S. Napoleon Tessier, secretary, Department of Public Works.

Fort Frances, Ont.—Tenders will be received until May 26th for vitrified tile pipe and junctions, cast-iron manhole covers, catch-basin covers and flap valves, and labor required in the construction of sewer extensions here. W. H. Elliott, Town Clerk.

Berlin, Ont.—Tenders will be received until Tuesday, May 19th, for the construction of a 35-foot concrete arch near New Dundee and a concrete bridge floor near Ayr, as per plans prepared by Bowman & Connor, consulting engineers, Toronto. H. J. Bowman, C.E., County Clerk.

Walkerville, Ont.—Tenders will be received until May 17th for the construction of concrete pavements and brick sewers. Cecil H. Robinson, Town Clerk; Owen McKay, C.E.

St. Catharines, Ont.—Tenders will be received until May 12th for sewer construction. D. Benzie, City Engineer.

Colchester, Ont.—Tenders will be received until June 3rd for the construction of an extension to the pier. Napoleon Tessier, secretary, Department of Public Works, Ottawa. H. J. Lamb, District Engineer at London, Ont., and J. G. Sing, of Toronto, have plans.

Port Arthur, Ont.—Tenders will be received until May 25th for the construction of transformer station building steel superstructure. Hon. Adam Beck, chairman, Hydro-Electric Power Commission, Continental Life Building, Toronto.

Newmarket, Ont.—Tenders will be received until May 23rd for the construction of a reinforced concrete arch bridge of 60-foot span, over the Holland River. Barber & Young, Consulting Engineers, Toronto. (Advertisement in the Canadian Engineer.)

Ottawa, Ont.—Tenders will be received until May 17th for a supply of coal. John Henderson, City Clerk.

Ottawa, Ont.—Tenders will be received until May 31st for supplying ten 42-inch cast-iron flexible joints for waterworks intake pipe. Newton J. Ker, City Engineer.

Alexandria, Ont.—Tenders will be received until May 16th for macadamizing approximately 4,745 square yards of road. E. H. Tiffany, Town Clerk.

Prescott, Ont.—Tenders will be received until May 21st for the construction of sewers, septic tank and outlet. Plans may be seen at the office of the Town Clerk, or at the office of Morris & Moore, Pembroke. F. W. Elliott, Chairman, Sewerage Committee.

Toronto, Ont.—Tenders will be received until May 23rd for the supply of coal and wood. H. F. McNaughten, Secretary, Department of Public Works.

St. Thomas, Ont.—The public improvement committee of the county council decided a erect a concrete arch bridge over Kettle Creek, on the town line, at a cost of about $3,000. The bridge will be 23 feet wide.

Toronto, Ont.—Tenders will be received until Tuesday, May 17, for supply and erection of a 50,000 gallon steel tank. (See advertisement on another page.) A. J. McGee, Secy.-Treas., T. & N. O. Ry., Toronto.

Southampton, Ont.—Tenders will be received until May 18th for the erection of a brick town hall. This is an extension of time. J. C. Eckford, town clerk.

Peterborough, Ont.—Tenders will shortly be invited for sewer construction.

Winnipeg, Man.—Tenders will be received until May 16th for the erection of sub-station. M. Peterson, secretary, Board of Control.

Winnipeg, Man.—Tenders will be received until May 19th for asphalt pavement construction. M. Peterson, secretary, Board of Control.

Canora, Sask.—Tenders will be received until May 16th for the erection of a brick hotel for N. Cohen. J. H. Bossons, architect, Dauphin, Man.

Prince Albert, Sask.—Tenders will be received until May 14th for the construction of extensions to the water and sewerage systems. C. O. Davidson, City Clrk.

Regina, Sask.—Tenders will be received until May 30th for the construction of storm water and sanitary trunk sewers and disposal works. A. E. Chivers, City Clerk. (Advertisement in the Canadian Engineer.)

Francis, Sask.—Tenders are invited for the construction of fifteen and three-quarter miles of rural telephone system. Colin Wells, secretary-treasurer, Rural Telephone Co.

Wetaskiwin, Alta.—Tenders will be received until May 16th for the erection of a Roman Catholic Church. L. C. Walravens, priest.

Victoria, B.C.—Tenders will be received until May 16th for the laying out of grounds for the new hospital at Coquitlam. F. C. Gamble, Public Works Engineer, Department of Public Works.

Victoria, B.C.—Tenders will be received until May 16th for furnishing 4,000 tile letters; also for 100 street signs. Wm. W. Northcott, purchasing agent, City Hall.

Nanaimo, B.C.—Tenders will be received for the construction of from four to eight miles of concrete sidewalks. Allan Waters, City Engineer.

Victoria, B.C.—Pending the preparation of specifications, the invitation for pavement tenders has been postponed. Angus Smith, City Engineer.

CONTRACTS AWARDED.

Sydney, C.B.—The Dominion Iron and Steel Company has placed the contract for a new mill with the Morgan Construction Company, of Worcester, Mass., who built the billet mill as well as the rod mill now operated by the Steel Company. The new mill will be known as the bar and rod mill, and will be of the semi-continuous type, using 1¾ inch and 2½ inch square billets supplied by the present billet mill.

St. John, N.B.—Contracts have been awarded as follows: 1,000 barrels coal tar at $3.50, Carritte-Paterson Co.; 95 tons Trinidad Lake asphalt at $23.50, Robt. Reford Co.; 600 loads bank sand at $1.25 a load of 40 cu. feet., H. E. Creighton; 40 cords birch and maple wood at $7.14 a load of 160 cu. feet, Geo. Dick. No bids were received for 6,000 square yards of heart wood spruce paving blocks, 7 in. x 6 in. x 3 in., the standard required being considered too high. Other bids on tar, $3.60; asphalt, $24.75 and $25.00; wood, $8.00.

Montreal, Que.—The contract for the construction of the last section of Sherbrooke Street sewer was awarded to M. Dineen, his tender of $37,072 being the lowest. There were nine tenders, ranging from $51,510. The contract for the construction of the new bath in Ste. Cunegonde was awarded to Mr. Langevin, at $24,500, the lowest.

Campbellford, Ont.—The Bishop Construction Co., of Montreal, have been awarded the contract for section 6 of the Trent Valley Canal.

Chatham, Ont.—Smart-Turner Machine Company, Limited, of Hamilton, were given the contract for a new pump required at the waterworks. Contract price, $1,318.40 f.o.b. Chatham.

London, Ont.—The Waterous Engine Works Company, of Brantford, were awarded the contract for a 15-ton, $3,000, steam road roller.

Orillia, Ont.—The contract for the new Roman Catholic church has been let to John Bigue, of Peterborough, at $50,500. The building will be of Longford stone, on the site of the present church.

Peterboro', Ont.—The Dickson Bridge Company, of Campbellford, Ont., were awarded the contract for the steel superstructure of a bridge over Nogey's Creek, near Bobcaygeon, at $1,574.

Guelph, Ont.—Wm. Panton, county clerk, Milton, Ont., recently invited tenders for the construction of a reinforced concrete arch and viaduct. The contract was not awarded, nor was it decided whether the bridge would be built. A special meeting will consider the question shortly.

Ottawa, Ont.—Some of the contracts awarded for two new schools were as follows: Hopewell Avenue School—Masonry, brickwork and concrete, A. Garvock, $25,000; steel boiler (Webster), Currie & Livock, $4,175; ventilation, Sheldons, Ltd., Galt, Ont.; (Multivane fan), $1,100; the total cost of this school will be $48,548.75. Breeze Hill Avenue School—Masonry, etc., A. Garvock, $25,500; Johnson system steel boiler, Currie & Livock, $4,415; 5 h.p. fan, Canadian Buffalo Forge Co., Montreal, $992.

Woodstock, Ont.—The county of Oxford called for tenders for the construction of a 125-foot steel bridge with concrete abutments. The contract was given to the Hunter Bridge and Boiler Works Co., Kincardine, Ont. Contract prices were: Superstructure and floor, $3,200; abutments, $776. A contract was awarded to M. M. Hiles, of Attwood, for a 30-foot reinforced arch of $898.

Port Arthur, Ont.—Following tenders were received for 50,000 square yards pavement construction: Sheet asphalt—National Paving and Contracting Company, Winnipeg, $189,305.75. Sheet asphalt—Stewart & Hewitson, Port Arthur, $197,100.75. Asphalt block—Stewart & Hewitson, Port Arthur, $191,684.25. Sheet asphalt—The Warren Bituminous Paving Company, Toronto, $213,103.05. Block asphalt—The Warren Bituminous Paving Company, Toronto, $201,790.50.

Brandon, Man.—John Forbes was given the contract to build the new Knox Church here.

Brandon, Man.—Chas. Hall, of Brandon, was given a contract for building a $25,000 addition to the Empire Hotel here.

Minnedosa, Man.—The contract for building the dam on the Little Saskatchewan River here was awarded to Snyder Bros., of Portage la Prairie, their tender being $40,528. The work will be commenced at once.

Selkirk, Man.—Western Pavers, Ltd., of Winnipeg, have been awarded a contract for the construction of concrete walks, to cost $8,000.

Winnipeg, Man.—The Canadian General Electric Company were awarded the contract for arc lamps and regulators at $9,190, as well as a contract for a switchboard and instruments, at $3,450. The Northern Electric and Mfg. Co. were given a contract for line wire at $2,010.75, and another for most arm posts at $258.21. An order for coal required at the asphalt plant went to the Western Coal Co., at $6.18 a ton. Contracts amounting to over $100,000 for street pavements were awarded to the city engineer.

Winnipeg, Man.—Building operations, which will mean the expenditure of $275,000, have been commenced in St. Boniface by the Western Canada Flour Mills Company. Foundations are being laid for a grain storage system which will have a capacity of half a million bushels, and work will be commenced immediately on the construction of a barrel factory and cooperage shop. The general contract for the system of tubular cement bins has been awarded to G. H. Archibald and Company, and the work will be completed for the fall reception of wheat. The heavy foundations for the bins, of which there will be twenty-seven, are under way. Machinery has been purchased for a cereal mill, with a capacity of 300 barrels a day, and plans are now being prepared for this structure. Tenders will be called for shortly.

Saskatoon, Sask.—For the new Caswell Hill School a contract has been let to Shannon Bros. & Cassidy at $37,973. Other tenders were: Saskatchewan Building and Construction Co., $48,973; J. E. Farley, $41,700; Bigelow Bros., $36,000, and Walter Bennett, $36,250.

Moose Jaw, Sask.—The Kettle River Company, of Minneapolis, were awarded the contract for 33,300 square yards 3-inch creosote wood block pavement for the business streets of this city, at $106,064. A complete list of the tenders submitted was published on page 399, issue of April 22.

Indian Head, Sask.—The tender of the Western Pavers, Ltd., of Winnipeg, was accepted for the construction of granolithic pavement on Main Street. The figures submitted were 50c. per foot.

North Battleford, Sask.—A contract for the cast iron pipes for the waterworks extensions was awarded the Canada Iron Corporation, Ltd. The contracts for the hydrants and valves was awarded the Canada Foundry Co., Ltd. Wm. Newton & Co., Winnipeg, secured the contract for trenching, pipe laying and filling.

Vancouver, B.C.—The tender of T. R. Nickson for block-paving Robson Street, from Burrard Street to Bute Street, was accepted, his figures standing at $29,891. Palmer Bros. & Henning bid at $30,800, and M. P. Cotton at $33,857.

Victoria, B.C.—The contract for the supply of sand and gravel was awarded to the B.C. Sand and Gravel Company.

Vancouver, B.C.—The construction of the new school board offices will be begun at once. The Ferro Construction Co., of Vancouver, was awarded the contract for the building at $36,640; Samuel A. Wye was awarded the contract for the heating apparatus at $1,830. The total expenditure on the new offices will be $39,992.50.

RAILWAYS.

Sault Ste. Marie, Ont.—The O'Boyle Construction Company was awarded a contract for the construction of 31 miles of railroad from Hawk Lake to Hobon, which will connect the C.P.R. and A.C.R., so that direct connection along the Algoma Central main line to Winnipeg will be possible.

Ottawa, Ont.—The Canadian Pacific Railway Company have filed plans involving an outlay of about one million dollars for an underground line through the city connecting the Central Station near the foot of the Rideau Canal with the company's Union Station in the northwestern part of the city. The connection between the two stations is now made by a roundabout line across the Ottawa River and around the outskirts of Hull. The proposed new line will give the shortest route between the two stations, will enable all trains to be run through to the Central Station in the heart of the city, and will cut off several miles of the company's through line from Montreal to the West. The company proposes to acquire from the Dominion Government the bed of the Rideau Canal from the "deep cut" to Sapper's Bridge, a distance of about half a mile, and after diverting the water in the canal to the Rideau River, to run its railway line along the course of the waterway, paralleling the present railway entrance to a point opposite the new station. From there it is proposed to construct an underground tunnel from near the post-office under the same to a point on Wellington Street, near the waterworks aqueduct property, and thence on the street level to a connection with the C.P.R.'s present lines at the Union Station.

Port Arthur, Ont.—The new route laid out for the extension of the Canadian Northern Railway east from Port Arthur to Sudbury, on which engineers have been at work for several months, is proving to be much more favorable to railway construction than was hoped for. The divide between Port Arthur and Nepigon is crossed at an elevation of 220 feet lower than where it is crossed by the Canadian Pacific Railway. This insures a four-tenths grade. The line will probably skirt the shore for some distance along Thunder Bay.

Toronto, Ont.—It is reported that the Canadian Pacific Railway will commence early in June on extension to their yards at North Toronto. These include a subway and a new passenger station on Yonge Street, and extensive freight sheds. Another subway may be built at the Avenue Road crossing.

Toronto, Ont.—The Toronto Railway Company have submitted to the Ontario Railway and Municipal Board for approval the list of new street car lines the company agreed to construct, as follows:—Teraulay Street, from Queen to Agnes, west across University Avenue, Anderson and St. Patrick to Bathurst. Victoria Street, from Adelaide to Wilton east, across the new bridge to a point east of Broadview Avenue. Shuter Street from Yonge to Victoria. Harbord Street, from Spadina Avenue to Ossington Avenue. Single track on Louisa Street, Teraulay to James. Single track on James Street, Louisa to Queen.

Welland, Ont.—A street railway will probably be built here at an early date. The ratepayers will shortly vote.

London, Ont.—The C. P. R. has just taken over a piece of land in the east end of London, which will be used for a new roundhouse, station, shops, yards and office buildings. It is said that practically all repair work now being done in Toronto will be done here.

Camrose, Alta.—For the first time in the history of Alberta the lines of three transcontinental railroads were connected with one town when the steel of the Canadian Northern was laid into Camrose last week. The diamond crossing the Canadian Pacific Railway track is completed and the sidings in their yard are finished, and steel is being laid south toward the Battle River. The grade is connected about 40 miles south of Stettler, and the track laying will be pushed as far as possible. The telegraph crew is following closely and the poles are up as far as Camrose, while the wiring is finished to within five miles of Camrose.

Edmonton, Alta.—The contract for the first fifty miles of the C. N. R. main line west of Edmonton has been awarded to Malcolm McCrimmon, of Edmonton, who will start construction at once. Surveys of the main line have been completed through to the coast, and construction is now to be rushed with the object of reaching the coast in three years.

Vancouver, B.C.—The Western Canada Power Co. will shortly commence the construction of an eight-mile railway, which will be operated in conjunction with their new power plant at Stave Falls, from whence the first power will be delivered this week.

Philadelphia, Pa.—At the special meeting of the Lake Superior Corporation stockholders, in Camden, plans were approved for the extension of the Algoma Central-Hudson Bay Railroad from the end of the present line ninety miles to Hobon on the Canadian Pacific. Plans for financing the company were also approved. Under the terms of the land grants from the Canadian Government the work must be done at once. President Drummond announced that the cost of construction had been estimated at $3,162,000, and the officers estimated that the net earnings for the first year after completion would be $552,900 for the railroad, and $75,000 for the steamship line, a total of $627,000.

SEWERS, SEWAGE AND WATERWORKS.

Montreal, Que.—A new six-million-gallon turbine pump costing $30,000 will be among the items in the $375,000 bill for water extensions in different parts of the city. This is to supply high-level territory recently annexed to the North End, and the total cost of that particular task, with an $8,000 pump house and $126,000 worth of pipe, will be $173,000. For the new territory of Villeray and northern St. Denis no pumping is needed, and the piping will cost only $36,440; while that of Rosemount is a trifle of $6,910. For new mains in the old sections there is $45,000, and for new service pipes $35,000. The sum of $39,000 is for the third section of a new elevating main on Montigny Street. The high-level reservoir will cost $6,000 to make water-tight. Improvements to the low-level station cost $15,455.

Quebec, Que.—The Private Bills Committee sanctioned the addition of a new clause to Montreal's bill empowering the city to raise by by-law an additional loan of five million dollars, in order to establish a water filtration plant; to further enlarge the waterworks; to put down mains, and to provide a water supply for the newly annexed districts, and also to construct sewers in the new wards.

Chatham, Ont.—Water commissioners have decided to meter the water supplied to factories, stores, hotels, etc. Meters may either be purchased direct from manufacturers or through the city.

St. Thomas, Ont.—Hazen & Whipple, who were engaged to report on waterworks extensions here, have recommended improvements to cost $32,000. They include: Construction of a coagulating basin (at $7,500), and aerator (at $1,000), on side hill near the pumping station, at distance of about 500 feet, $8,500; connections to and from this basin to the pumps to consist of 80-inch cast iron pipe, $3,000; installation of two electrically-driven centrifugal pumps to be installed in the present station, taking water from the reservoir and lifting it to the aerator above coagulating basin, $1,500; the construction of a pure water reservoir of covered concrete, reinforced with steel, with fire equipment and a capacity of 600,000 gallons, near present station below level of filters connecting piping from present filters to this basin, $8,500; installation new coagulating apparatus and controllers on discharge lines to regulate the flow of the filter, $2,500; installation of proper loss of head gauges, $2,500. The cost of engineering in connection with this was estimated at $4,200, making a total of $32,200. The consulting engineers agreed with most of the details of a report prepared previously by City Engineer Jas. A. Bell.

Vancouver, B.C.—Board of Works have decided on a general sewerage scheme for Mount Pleasant and Fairview. The work will cost over a hundred thousand dollars, and tenders will shortly be invited.

Victoria, B.C.—H. M. Burwell, consulting engineer, of Vancouver, has been engaged to report on the Sooke Lake water scheme.

BY-LAWS AND FINANCE.

Bowmanville, Ont.—On 31st May ratepayers will vote on a by-law to purchase the electric light plant for $12,000.

Ingersoll, Ont.—Council have passed by-laws to take over the electric light at $39,800 and for waterworks extension to cost $55,000.

New Hamburg, Ont.—Ratepayers will vote on a by-law to purchase J. Morley's electric light plant and operate it as a public utility in view of the Ontario Hydro-Electric Power Co.'s proposition.

Ottawa, Ont.—The $12,000 Eastview School by-law passed its third reading.

Niagara Falls South, Ont.—Tenders will be received up to May 21st for $12,000 Public school debentures of the township of Stamford. J. E. Jones, Township Clerk.

Foxwarren, Man.—A by-law authorizing the council to borrow $5,000 to build a bridge over the Assiniboine River at Lazare was passed on May 5th in the Ellice municipality.

Regina, Sask.—Ratepayers sanctioned the following money by-laws: Sidewalks, $10,000; pavements, $115,000; trunk sewer, $280,000; collegiate, $26,500; isolation hospital, $18,000; Children's Shelter, $10,000; Hospital, $25,000; total, $484,500. The street railway franchise by-law was defeated.

Saskatoon, Sask.—School Board decided to issue $62,000 debentures and build a new school.

Calgary, Alta.—By-laws are being prepared for street paving, boulevards and sidewalks.

Medicine Hat, Alta.—A by-law to raise $57,000 for the installation of an electric light plant will shortly be introduced.

Medicine Hat, Alta.—A by-law for the construction of a $70,000 municipal electric power and light plant, may shortly be submitted. A report and detailed plans will first be obtained.

Fernie, B.C.—Votes taken on by-laws for the extension of the light and water plants, and for building a new school house, for surface drainage and for street improvements, calling for the issue of $103,000 in debentures, resulted in the ratification of all except that for the extension of the sewerage system, which lacked one vote of the necessary three-fifths. The total amount of debentures authorized is $62,000.

Kamloops, B.C.—A $40,000 by-law will be introduced for the construction of waterworks extensions. (Mentioned in previous issues.)

South Vancouver, B.C.—Ratepayers carried road improvement and sidewalk construction by-laws.

LIGHT, HEAT, AND POWER

Brockville, Ont.—C. H. and P. H. Mitchell, consulting engineers, Toronto, are preparing plans for electric light plant extensions here.

Portage la Prairie, Man.—The Reese Engineering Company's offer for the supply of power to this city is being considered by the officials. (Previously mentioned.)

New Westminster, B.C.—City Engineer S. W. Blackman is preparing a report on the possibility of developing power at a waterfall near Harrison.

MISCELLANEOUS.

Londonderry, N.S.—The steel castings plant recently designed by F. Smallwood, who was formerly construction engineer for the Canadian Iron Corporation, is now in operation. The plant which is a basic open hearth installation, fully equipped with modern appliances for moulding, cleaning and annealing steel castings is already working to capacity.

Sydney, N.S.—Council is considering the construction of a subway at McQuarrie's crossing.

St. John, N.B.—Works Board are considering the installation of an incinerator.

Montreal, Que.—In a report completed by the Board of Control, it is shown that, in addition to the million and a half which is to be spent on permanent works on the streets, no less a sum than half a million dollars is to be expended this summer in putting down permanent sidewalks.

Windsor, Ont.—The Peabody Company are building a large reinforced concrete factory in which the Kahn system of reinforcement will be used.

Winnipeg, Man.—The Regent Apartments which will cover a block of ground some 200,000 ft. square, will have reinforced concrete floors. The Kahn system will be used. Holmerman & Prain, Architects.

Winnipeg, Man.—Controller Waugh is advocating the construction of a new two-million-dollar city hall.

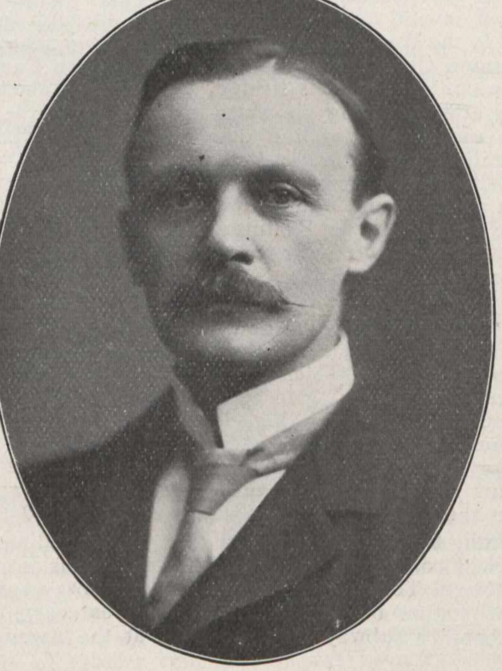
Moose Jaw, Sask.—T. M. Wilson, city engineer, is preparing a report on the feasibility of constructing a subway beneath the C.P.R. tracks.

Moose Jaw, Sask.—Messrs. B. Groves, of Regina, and H. Humber, of Moose Jaw, will probably erect a $35,000 theatre here.

Victoria, B.C.—The Warswick Asphalt Pavement Company are said to have decided on the erection of a $40,000 asphalt plant.

PERSONAL.

Dr. Chas. A. Hodgetts, Secretary of the Ontario Provincial Board of Health has been offered a position with the Canadian Commission of Conservation. It is expected that the position which Dr. Hodgetts will be called upon to fill will be one having in general to do with the conservation



Dr. Chas. A. Hodgetts

of human life in relation to health. This may include an oversight over stream pollution prevention and sewage dosposal systems, the prevention and cure of tuberculosis, etc. Dr. Hodgetts, who has been connected with the Provincial Board of Health of Ontario for some twelve years, succeeded Dr. Bryce when he joined the federal service.

Mr. A. S. B. Lucas, late assistant harbor engineer for the Grand Trunk Pacific Railway, at Prince Rupert, B.C., and Mr. L. F. Grant, formerly resident engineer for the same company, have opened an office in Prince Rupert, and will carry on a civil and mining engineering practice in that town, and in northern British Columbia.

Mr. J. Antonisen, A. M. Can. Soc. C. E., city engineer and commissioner of public utilities at Port Arthur, Ontario, has resigned that position, it is understood, to accept an appointment as city engineer at London, Ontario.

Mr. J. J. Scully who for several years has been district superintendent of the Canadian Pacific between Winnipeg and Fort William, will leave the division on May 8th, to assume the position of superintendent at Moose Jaw. This change is believed to be preparatory to the promotion of Mr. Scully to the position of general superintendent, with supervision over the immense new territory which is being created in the west through immigration and the construction of new lines. Mr. W. T. Uren, who is at present in Moose Jaw as superintendent, will go further west, and will take over the duties of the superintendency at Cranbrook, B.C. The position left vacant at Kenora will be filled by the transfer of Mr. J. H. Brownlee from Cranbrook.

Mr. Edward Duval, chief clerk to Mr. Bury at Winnipeg, has been appointed superintendent of terminals at Calgary, an office recently created.

CURRENT NEWS.

Ottawa, Ont.—After tests made simultaneously in Canada, the United States and England at the instance of the board of engineers who prepared plans for the superstructure of the Quebec bridge, the engineers have reported to Hon. George P. Graham, Minister of Railways and Canals, that the plans are satisfactory. The engineers came to the conclusion that the cantilever principle is better than suspension. The tests demonstrated that a suspension bridge might not be practicable. The engineers do not contend that other plans might not be as good or in some respects better, and they are open yet to consider other plans, but they claim that from the approved plans a safe bridge can be constructed. Mr. Graham states that tenders will be advertised for in a few days. The successful tenderer will have to accept full responsibility for the bridge.

Winnipeg, Man.—By an order-in-Council the board of examiners for architects in this province was appointed, in accordance with an Act passed at the last session of the legislature incorporating the architects of Manitoba. The board is as follows: Wm. Fingland and J. H. Russell, to act for four years, H. Matthews and W. Percy Over, to act for two years, and Prof. Brydone-Jack representing the university, who will act for two years. The Act does not interfere with a man drawing his own plans for a building, but hereafter no one can practise the profession without satisfying the board as to his qualifications.

Lethbridge, Alta.—The city council decided to purchase an automobile for the use of the mayor and the superintendent of the waterworks department.

Prince Rupert, B.C.—The first civic elections for mayor and aldermen for the city of Prince Rupert, will be held about 19th May, and after that date a city engineer will be required. Applications stating salary, etc., should be sent to the city clerk.

Vancouver, B.C. — Council is considering the appointment of a waterworks engineer.

OBITUARY.

Mr. Walter Craig Kerr, president of the Westinghouse Church, Kerr & Company, a well-known construction engineer, of Rochester, Minn., died on May 9th. Some of the greatest undertakings in the United States are a part of his work, the most notable being the Pennsylvania terminal, now in course of construction, in New York City. For nearly twenty years he has been a member of the Board of Trustees of Cornell, from which he was graduated in '79.

Mr. Herbert S. Fierneller, B.A., Sc., a graduate of the Faculty of Applied Science and Engineering, Toronto University, of the class of 1906, died at his home, Toronto, May 3rd, 1910. Since graduation, Mr. Fierheller has been a member of the staff of the Faculty of Applied Science, holding at the time of his death the position of demonstrator in electricity.

SOCIETY NOTES.

Ottawa Branch, C. S. C. E.—On Wednesday, May 18th, the Ottawa branch of the Canadian Society will discuss Mr. H. S. Hancock's paper on the "Fort William Water Supply."

Canadian Railway Club.—Mr. A. A. Maver, master mechanic of the Grand Trunk Railway, was elected president of the above club at the annual meeting held on Tuesday week at Montreal. Other officers are as follows:

Vice-president—A. A. Goodchild, auditor of stores accounts, C.P.R.

Second vice-president—James Coleman, superintendent of the car department, Grand Trunk.

Secretary—James Powell.

Treasurer—S. S. Underwood, chief draftsman of the Grand Trunk.

Executive Committee—Messrs. A. L. Grayburn, R. W. Burnett, H. C. Butler, C. Kyle, William McNab and F. Ditchfield.

Auditors—Messrs. H. A. White, J. S. Johnstone and G. L. Evans.

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ON PAGE 10.

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MARKET CONDITIONS.

Following the quotations of the various articles listed in the markets will be found in brackets numbers, thus (10). These numbers refer to the list number of advertisers on page 3 of this issue and will assist the reader to quickly find the name and address of a firm handling any particular article. Buyers not able to secure articles from these firms at the prices mentioned will confer a favor by letting us know.

Montreal, May 12th, 1910.

Notwithstanding the indications of a setback in the iron and steel trade of the United States, as contained in market reports, William E. Corey, president of the United States Steel Corporation, is very optimistic. He says: "There is nothing in the business situation that would warrant pessimism. Underlying conditions of the country in general are sound, and with fair average crops the current year should be one of the most prosperous in history.

"Recently there has been satisfactory improvement in the steel business and the steel mills of the country should be kept active for the rest of the year. Prices for steel are holding firm and from present indications we will obtain average prices, which will assure manufacturers a reasonable margin of profit."

This report receives considerable support from at least one of the leading metal papers of the United States. While admitting that production is being curtailed, it says that the rate was recently more than 31,000,000 tons of pig-iron a year, as against 25,500,000 tons in 1906-07, and that even with the reduction there is no likelihood that the production will be as low as it was during 1906-07, when previous records were established. It assumes that if the curtailment brings the production down to the rate of 29,000,000 tons it will have spent its force, and the latter half of the year should show an up-turn to at least the 30,000,000 tons' rate. In that case the production will be 30,000,000 tons of pig-iron, as against the previous high record of 26,000,000 tons. It allows that the trade may be entering a period of reduced profits, but claims that the country has been educated to expect too large profits. The railways have been large purchasers although their proportion of the whole is less than usual. This is not an unfavorable condition of affairs, as the consumption of bars, pipes, tin plate, wire, etc., gives rise to more industrial activity per ton than is the case in steel rails and cars, and much railway material. Consequently, the business of the country, as indicated by the conditions in the iron and steel trade, is better than it has ever been heretofore.

The only important new development is that after a dip to $11.50, Birmingham, for No. 2 Foundry Iron, there are signs of a slight reaction in the south. The tendency of prices in the north still seems to be downward; and, of course, it is the price prevailing in the competitive markets that establishes the furnace levels. There is very little buying of pig-iron and scarcely any inquiry. The pipe market is heavy. There is considerably less melting of pig-iron than previously, and this should begin to have an effect on prices before long.

Advices from England are not very encouraging. The situation there is showing the results of the slackening of the demand in the United States, and the lower range of prices, and now the death of the King will doubtless have its effect. The tendency of prices is downward.

In Canada, trade is unquestionably better, relatively, than in either of the other markets. Demand continues steady, although there is no special activity. Prices show the same range as previously.

Antimony.—The market is steady at 8c. to 8¼c. (111).

Bar Iron and Steel.—The market promises to advance shortly. Bar iron $1.90 per 100 pounds; best refined horseshoe, $2.15; forged iron, $2.05; mild steel, $1.90; sleigh shoe steel, $1.90 for 1 x ⅜-base; tire steel, $2.00 for 1 x ⅜-base; toe calk steel, $2.40; machine steel, iron finish, $1.95; imported, $2.20 (111, 119)

Building Paper.—Tar paper, 7, 10, or 16 ounces, $1.80 per 100 pounds; felt paper, $2.75 per 100 pounds; tar sheathing, 40c. per roll of 400 square feet; dry sheathing, No. 1, 30 to 40c. per roll of 400 square feet; tarred year will be the largest in the history of the country. Prices on foreign fibre, 55c. per roll; dry fibre, 45c. (See Roofing; also Tar and Pitch). (164).

Cement.—Canadian cement is quotable, as follows, in car lots, f.o.b., Montreal:—$1.30 to $1.40 per 350-lb. bbl., in 4 cotton bags, adding 10c. for each bag. Good bags re-purchased at 10c. each. Paper bags cost 2½ cents extra, or 10c. per bbl. weight. (26, 164).

Chain.—Prices have advanced considerably of late, being now as follows per 100 lbs.:—¼-inch, $5.10; 5-16-inch, $4.50; ⅜-inch, $3.70; 7-10-inch $3.45; ½-inch, $3.35; 9-16-inch, $3.25; ⅝-inch, $3.20; ¾, ⅞ ,and 1-inch, $3.15.

Coal and Coke.—Anthracite, egg, stove or chestnut coal, $6.75 per ton, net; furnace coal, $6.50, net. Bituminous or soft coal: Run of mine, Nova Scotia coal, carload lots, basis, Montreal, $3.85 to $4 per ton; cannel coal, $9 per ton; coke, single ton, $5; large lots, special rates, approximately $4 f.o.b., cars, Montreal

Copper.—Prices are strong at 13¾ to 14c.

Explosives and Accessories.—Dynamite, 50-lb. cases, 40 per cent. proof, 15c. 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; 6-ft. wires, $3.54; 8-ft. wires, $4.08; 10-ft. wires, $5.

Galvanized Iron.—The market is steady. Prices, basis, 28-gauge, are:—Queen's Head, $4.10; Colborne Crown, $3.85; Apollo, 10¾ oz., $4.05. 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. (111).

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

Iron.—First boats are now arriving at Montreal, and importers are quoting prices, ex-wharf, about $1 per ton under prices ex-store. Following are the prices, on cars, ex-wharf, Montreal:—No. 1 Summerlee, $20.50 to $20.75 per ton; selected Summerlee, $20 to $20.25; soft Summerlee, $19.50 to $19.75; Carron, special, $20 to $20.50; soft, $19.50 to $20; Clarence, $17.25 to $17.50; Cleveland, $17.25 to $17.50 per ton.

Laths.—See Lumber, etc.

Lead.—Prices are easier, at $3.35 to $3.45.

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 of $1.50. Red pine, mill culls out, $18 to $22 per 1,000 feet; white pine, mill culls, $16 to $17. Spruce, 1-in. by 4-in. and up, $15 to $17 per 1,000 ft.; mill culls, $12 to $14. Hemlock, log run, culls out, $13 to $15. 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 carring $1.50 freight rate to Montreal, $2 to $3. Shingles: Cedar shingles, same conditions as laths, X. $1.50; XX, 2.50; XXX, $3. (112).

Nails.—Demand for nails is better and prices are firmer, $2.40 per keg for cut, and $2.35 for wire, base prices. Wire roofing nails, 5c. lb.

Paints.—Roof, barn and fence paint, 90c. per gallon; girder, bridge, and structural paint for steel or iron—shop or field—$1.20 per gallon, in barrels; liquid red lead in gallon cans, $1.75 per gallon.

Pipe.Cast Iron.—The market shows a steady tone although demand is on the dull side. Prices are firm, and approximately as follows:—$32 for 6 and 8-inch pipe and larger; $33 for 3-inch and 4-inch at the foundry. Pipe, specials, $3 per 100 pounds. Gas pipe is quoted at about $1 more than the above. (74, 188).

Pipe.—Wrought and Galvanized.—Demand is about the same, and the tone is firm, though prices are steady, moderate-sized lots being: ¼-inch, $5.50 with 63 per cent. off for black, and 48 per cent. off for galvanized; ⅜-inch, $5.50, with 59 per cent. off for black and 44 per cent. off for galvanized; ½-inch, $8.50, with 69 per cent. off for black, and 59 per cent. off for galvanized. The discount on the following is 71½ per cent. off for black, and 61½ per cent. off for galvanized; 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, $108.

Plates and Sheets.—Steel.—The market is steady. Quotations are: $2.20 for 3-16; $2.30 for ⅛, and $2.10 for ¼ and thicker; 12-gauge being $2.30; 14-gauge, $2.15; and 16-gauge, $2.10. (111).

Rails.—Quotations on steel rails are necessarily only approximate and depend upon specification, quantity and delivery required. A range of $30.50 to $31 is given for 60-lb. and 70-lb.; 80-lb. and heavier, being $30; 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. (73).

Railway Ties.—See lumber, etc.

Roofing.—Ready roofing, two-ply, 70c. per roll; three-ply, 95c. per roll of 100 square feet. Roofing tin caps, 6c. lb.; wire roofing nails, 5c. lb. (See Building Paper; Tar and Pitch; Nails, Roofing). (164).

Rope.—Prices are steady, at 9c. per lb. for sisal, and 10½c. for Manila. Wire rope, crucible steel, six-strands, nineteen wires; ¼-in., $2.75; 5-16, $3.75; ⅜, $4.75; ½, $5.25; ⅝, $6.25; ¾, $8; ⅞, $10; 1-in., $12 per 100 feet. (132).

Spikes.—Railway spikes are firmer at $2.45 per 100 pounds, base of 5¼ x 9-16. Ship spikes are steady at $2.85 per 100 pounds, base of ⅝ x 10-inch, and ⅝ x 12-inch. (132).

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

Telegraph Poles.—See lumber, etc.

Tar and Pitch.—Coal tar, $3.50 per barrel of 40 gallons, weighing about 500 pounds; roofing pitch, No. 1, 70c. per 100 pounds; and No. 2, 55c. per 100 pounds; pine tar, $8.50 per barrel of 40 gallons, and $4.75 per half-barrel; refined coal tar, $4.50 per barrel; pine pitch, $4 per barrel of 180 to 200 pounds. (See building paper; also roofing).

Tin.—Prices are firm, at $34 to $34.50.

Zinc.—The tone is easy, at 5¾ to 6c.

CAMP SUPPLIES.

Beans.—Prime pea beans, $2 to $2.25 per bushel. (74).

Butter.—Fresh made creamery, 25 to 26c.

Canned Goods.—Per Dozen.—Corn, 80 to 85; peas, $1.05 to $1.15; beans, 85c.; tomatoes, 85 to 90c.; peaches, 2s, $1.65, and 3s, $2.65; pears, 2s, $1.60, and 3s, $2.30; salmon, best brands, 1-lb. talls, $1.87½, and flats, $2.02½; cheaper grades, 95c. to $1.65. (74).

Cheese.—Finest, colored, 12c. (74).

Coffee.—Mocha, 20 to 25c.; Santos, 15 to 18c.; Rio, 10 to 12c. (74).

Dried Fruits.—Currants, Filiatras, 5¾ to 6¼c.; choice, 8 to 9c.; dates, 4 to 5c.; raisins, Valentias, 5 to 6¼c.; California, seeded, 7½ to 9c.; Evaporated apples, prime, 8 to 8½c. (74).

Eggs.—New laid, 20 to 22c. (74).

Flour.—Manitoba, 1st patents, $5.60 per barrel; 2nd patents, $5.10; strong bakers, $4.90. (74).

Molasses and Syrup.—Molasses, New Orleans, 27 to 28c.; Barbadoes, 40 to 45c.; Porto Rico, 40 to 43c.; syrup, barrels, 3½c.; 2-lb. tins, 2 dozen to case, $2.50 per case. (74).

Potatoes.—Per 90 lbs., good quality, 45 to 50c. (74).

Rice and Tapioca.—Rice, grade B., in 100-lb. bags, $2.75 to $2.80; C.C., $2.65. Tapioca, medium pearl, 5½ to 6c. (74).

Rolled Oats.—Oatmeal, $2.20 per bag; rolled oats, $2, bags. (74).

Sugar.—Granulated, bags, $5.05; yellow, $4.65 to $5. Barrels 5c. above bag prices.

Tea.—Japans, 20 to 38c.; Ceylons, 20 to 40c.; Ceylon, greens, 19 to 25c.; China, green, 20 to 50c.; low-grades, down to 15c. (74).

Fish.—Salted.—Medium cod, $7 per bbl.; herring, $5.25 per bbl.; salmon, $15.50 per bbl., for red, and $14 for pink. Smoked fish.—Bloaters, $1.10 per large box; haddies, 7½c. per lb.; kippered herring, per box, $1.20 to 1.25. (74).

Provisions.—Salt Pork.—$27 to $34 per bbl.; beef, $18 per bbl.; smoked hams, 16 to 20c. per lb.; lard, 16½ to 17½c. for pure, and 12½ to 14c. per lb. for compound. (74).

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Toronto, May 12th, 1910.

For all building materials the demand is fairly steady. This applies to cement, bricks, tiling and other roofing, drain tiles, building paper and felt. Structural steel is also in request. Lumber is moving fairly well, large dimension stuff especially, and prices are maintained.

Advices from the Old Country respecting iron and steel show a good tone in the market; while in the States structural material is active at current prices. The ingot metals have been excited for some days; tin and copper are held higher.

Among camp supplies there are scarcely any changes in canned goods, and dried fruits are somewhat lower. Butter shows a decline, cheese a lesser one; eggs are also lower, lard and meats are unchanged.

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

Antimony.—A light improvement can be observed. Demand steady at 9c., but hardly active.

Axes.—Standard makes, double bitted, $8 to $10; single bitted, per dozen, $7 to $9. (217, 377).

Bar Iron.—$2.00 to $2.10, base, per 100 lbs., from stock to wholesale dealer. Market supply limited (332).

Bar Mild Steel.—Per 100 lbs., $2.10 to $2.20. (372).

Boiler Plates.—¼-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate. Tank plate, 3-16-inch, $2.40 per 100 pounds. (241, 362, 456).

Boiler Tubes.—Orders continue active. Lap-welded, steel, 1¼-inch, 10c.; 1½-inch, 9c. per 10 foot; 2-inch, $8.50; 2¼-inch, $10; 2½-inch, $10.60; 3-inch, $11 to $11.50; 3½-inch, $18 to $18.50; 4-inch, $19 to $20 per 100 feet. (514).

Building Paper.—Plain, 27c. per roll; tarred, 35c. per roll. Demand is moderate. (518).

Bricks.—In active movement, with very firm tone. Price at some yards $9 to $9.50, at others, $9.50 to $10 for common. Don Valley pressed brick are in request. Red and buff pressed are worth $18 delivered and $17 at works per 1,000. (518).

Broken Stone.—Lime stone, good hard, for roadways or concrete, f.o.b., Schaw station, C.P.R., 75c. until further notice, per ton of 2,000 lbs., 1-inch, 2-inch, or larger, price all the same. Rubble stone, 55c. per ton, Schaw station, and a good deal moving. Broken granite is selling at $3 per ton for good Oshawa. (518).

Cement.—Car lots, $1.75 per barrel, without bags. In 1,000 barrel lots $1.60. In smaller parcels $1.90 is asked by city dealers. Bags, 40c. extra. Demand good; in another week or two the movement by water will be active. (61, 518).

Coal.—The price of anthracite has dropped for the spring season, and opened at $6.75; pea, $5.75. From these prices a cash discount of 25c. per ton is given on any quantities purchased. In the United States there is an open market for bituminous coal and a great number of qualities exist. We quote: Youghiogheny lump coal on cars here, $3.75 to $3.80; mine run, $3.65 to $3.70; slack, $2.75 to $2.85; lump coal from other districts, $3.55 to $3.70; mine run 10c. less; slack, $2.60 to $2.70; cannel coal plentiful at $7.50 per ton; cook, Solvey foundry, which is largely used here, quotes at from $5.75 to $6.00; Reynoldsville, $4.90 to $5.10; Connellsville, 72-hour coke, $5.25. Soft coal and slack are slowly growing more plentiful, and the market may be called steady.

Copper Ingot.—There has been much excitement in the market for some days; feeling is upward, we quote 14c. firm.

Detonator Caps.—75c. to $1 per 100; case lots, 75c. per 100; broken quantities, $1. (212).

Dynamite, per pound, 21 to 25c., as to quantity. (212).

Felt Roofing.—The spring trade has opened very well at an unchanged price, which is $1.80 per 100 lbs. (518).

Fire Bricks.—English and Scotch, $30 to $35; American, $25 to $35 per 1,000. Fire clay, $8 to $12 per ton. (518).

Fuses.—Electric Blasting.—Double strength 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, per 100 count. Bennett's double tape fuse, $6 per 1,000 feet. (212, 217, 377).

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, per 100 lbs. (217, 377).

Iron Pipe.—A steady request at former prices:—Black, ¼-inch, $2.03; ⅜-inch, $2.25; ½-inch, $2.63; ¾-inch, $3.28; 1-inch, $4.70; 1¼-inch, $6.41; 1½-inch, $7.70; 2-inch, $10.26; 2½-inch, $16.39; 3-inch, $21.52; 3½-inch, 27.08; 4-inch, $30.78; 4½-inch, $35.75; 5-inch, $39.85; 6-inch, $51.70. Galvanized, ¼-inch, $2.86; ⅜-inch, $3.08; ½-inch, $3.48; ¾-inch, $4.43; 1-inch, $6.35; 1¼-inch, $8.66; 1½-inch, $10.40; 2-inch, $13.86, per 100 feet. (185).

Pig Iron.—We quote Clarence at $20.50, for No. 3; Cleveland, $20.50; Summerlee, $22; Hamilton quotes a little irregular, between $19 and $20. A fair quantity is moving, but the fresh inquiry is not large. (332, 372).

Lead.—Small movement at $3.75 to $3.85.

Lime.—Retail price in city 35c. per 100 lbs. f.o.b., car; in large lots at kilns outside city 22c. per 100 lbs. f.o.b. car without freight. Demand is moderate. (518).

Lumber.—Dimension stuff is in brisk demand, for present or later delivery. Prices are generally firm, especially in pine. We quote dressing pine $32.00 to $35.00 per M; common stock boards, $26 to $30; cull stocks, $20; cull sidings, $17.50; Southern pine dimension timber from $30 to $45, according to size and grade; finished Southern pine according to thickness and width, $30 to $40. Hemlock in car lots, $17 to $17.50; spruce flooring, car lots, $22 to $24; shingles, British Columbia, are steady, we quote $3.10, lath growing scarce and stiffening, No. 1, $4.40, white pine, 48-inch; No 2, $3.75; for 32-inch, $1.70. (333).

Nails.—Wire, $2.35 base; cut, $2.60; spikes, $2.85 per keg of 100 lbs. (217, 377).

Pitch and Tar.—Pitch, unchanged at 70c. per 100 lbs. Coal tar dull at $3.50 per barrel. (518).

Plaster of Paris.—Calcined, New Brunswick, hammer brand, car lots, $1.95; retail, $2.15 per barrel of 300 lbs. (518).

Putty.—In bladders, strictly pure, per 100 lbs., $2.25; in barrel lots, $2.10. Plasterer's, $2.15 per barrel of three bushels. (518).

Ready Roofing.—An active demand; prices are as per catalogue. (453).

Roofing Slate.—Most of the slate used in Canada comes now from Pennsylvania or Maine, the Canadian supply being slender and mostly from the Rockland quarries of the Eastern Townships in Quebec. There is a great variety of sizes and qualities, so that it is difficult to indicate prices. But No. 1 Bangor slate 10 x 16 may be quoted at $7 per square of 100 square feet, f.o.b., cars, Toronto; seconds, 50c. less. Mottled, $7.25; green, $7, with a prospect of advance. Dealers are fairly busy. (518).

Rope.—Sisal, 9½c. per lb.; pure Manila, 10½c. per lb., Base. (217, 377).

Sand.—Sharp, for cement or brick work, 90c. per ton f.o.b., cars, Toronto siding. (518).

Sewer Pipe.—

	4-in.	6-in.	9-in.	10-in.	12-in.	24-in.
Straight pipe per foot	$0.20	$0.30	$0.65	$0.75	$1.00	$3.25
Single junction, 1 or 2 ft. long	.90	1.35	2.70	3.40	4.50	14.65
Double junctions	1.50	2.50	5.00	....	8.50	.....
Increasers and reducers	....	1.50	2.50	....	4.00	.....
P. traps	2.00	3.50	7.50	....	15.00	.....
H. H. traps	2.50	4.00	8.00	....	15.00	.....

Business moderate; price, 73 per cent. off list at factory for car-load lots; 65 per cent. off list retail. (96, 211, 421).

Steel Beams and Channels.—Active.—We quote:—$2.75 per 100 lbs., according to size and quantity; if cut, $3 per 100 lbs.; angles, 1¼ by 3-16 and larger, $2.50; tees, $2.80 to $3 per 100 pounds. Extra for smaller sizes of angles and tees. (65, 77, 94, 241, 362, 363, 372, 454, 551).

Steel Rails.—Current price for rails at the Soo, $32 to $34 for weights 60 to 100 lbs.

Sheet Steel.—The market has advanced 10c.; American Bessemer, 10-gauge, $2.60; 12-gauge, $2.65; 14-gauge, $2.45; 17, 18, and 20-gauge, $2.55; 22 and 24-gauge, $2.60; 26-gauge, $2.75; 28-gauge, $2.95. (65, 77, 94, 241, 362, 363, 372, 454, 551).

Sheets Galvanized.—Apollo Brand.—Sheets 6 or 8 feet long, 30 or 36 inches wide; 10-gauge, $3.00; 12-14-gauge, $3.00; 16, 18, 20, $3.20; 22-24, $3.35; 26, $3.50; 28, $3.95; 29, $4.25; 10¾, $4.25 per 100 lbs. Fleur de Lis—28-gauge, $4.10; 26, $3.80 per 100 lbs. A very large tonnage of all sorts has been booked. An advance of 10c. is declared. (332).

Tank Plate.—3-16-inch, $2.40 per 100 lbs. (241, 362).

Tool Steel.—Jowett's special pink label, 10½c. Cammel-Laird, 16c. "H.R.D." high speed tool steel, 65c. (3, 372).

Tin.—The market has been excited for a day or two, with an upward trend. Price here, 35c. firm.

Wheelbarrows.—Navvy, steel wheel, Jewel pattern, knocked down, $21.60 per dozen; set up, $22.60. Pan Canadian, navvy, steel tray, steel wheel, $3.30 each; Pan American, steel tray, steel wheel, $4.25 each. (217, 377).

Zinc Spelter.—The market can no longer be described as lively; a steady but limited movement goes on at $5.65 to $5.90 per 100 lbs.

CAMP SUPPLIES.

Butter.—Dairy prints, 23 to 24c.; creamery prints, 27 to 28c.; the creamery output is now increasing every week, and prices must come down.

Canned Goods.—Peas, $1.10 to $1.50; tomatoes, 3s, 85c. to 95c.; pumpkins, 3s, 85 to 90c.; corn, 80 to 85c.; peaches, 2s, white, $1.50 to $1.60; yellow, $1.90 to $1.95; strawberries, 2s, heavy syrup, $1.50 to $1.85; raspberries, 2s, $1.50 to $1.95 (74).

Cheese.—Moderately firm; large, 12¾c.; twins, 13c. (74).

Coffee.—Rio, green, 11 to 12½c.; Mocha, 21 to 23c.; Java, 20 to 31c.; Santos, 11 to 15c. (74).

Dried Fruits.—Raisins, Valencia, 5¾ to 6¼c.; seeded, 1-lb. packets, fancy, 7½ to 8c.; 16-oz. packets, choice, 7 to 7½c.; 12-oz. packets, choice, 7c.; Sultanas, good, 5 to 6c.; fine, 6 to 7c.; choice, 7 to 8c.; fancy, 8 to 9c.; Filiatras currants, 6½ to 7c.; Vostizzas, 8½ to 9c.; uncleaned currants, ½c. lower than cleaned. California Dried Fruits.—Evaporated apricots, 14 to 15c. per lb.; prunes, 60s to 70s, 7½ to 8c.; 90s to 100s, 6c.; evaporated apples, 7c. (74).

Eggs.—New laid, coming in freely, are now quoted 19 to 20c. per dozen, case lots. (74).

Flour.—Manitoba Flour.—Quotations at Toronto are:—First patents, $5.60; second patents, $5.10; strong bakers', $4.90; 90 per cents., Glasgow freights, 28s. 6d. Ontario Flour.—Winter wheat patents, for export, $4.20 to $4.25, in buyers' sacks outside. (74).

Lard.—Tierces, 16¾c.; tubs, 17c.; pails, 17¼c.; market steady. (74).

Molasses.—Barbadoes, barrels, 37 to 45c.; West Indian, 27 to 30c.; New Orleans, 30 to 33c. for medium. (74).

Pork.—Market very firm, short cut $29 to $30 per barrel; mess, $27 to $28. (74).

Rice.—B. grade, 3½c. per lb.; Patna, 5 to 5¾c.; Japan, 5 to 6c. (74).

Salmon.—Fraser River, talls, $2; flats, $2; River Inlet, $1.55 to $1.75. (74).

Smoked and Dry Salt Meats.—Long clear bacon, 15 to 15½c. per lb., tons and cases; hams, large, 17 to 17½c.; small, 17½ to 18c.; rolls, 15 to 15½c.; breakfast bacon, 19 to 20c.; backs (plain), 20 to 21c.; backs (peameal), 21 to 22c.; shoulder hams, 13½c.; green meats out of pickle, 1c. less than smoked. A steady but small trade doing, people buying mostly from hand to mouth. (74).

Spices.—Allspice, 16 to 19c.; nutmegs, 30 to 75c.; cream tartar, 22 to 25c.; compound, 15 to 20c.; pepper, black, pure Singapore, 14 to 17c.; pepper, white, 20 to 30c. (74).

Sugar.—Granulated, $5.20 per 100 lbs., in barrels; Acadia, $5.10; yellow, $4.80; bags, 5c. lower. (74).

Syrup.—Corn syrup, special bright, 3½c. per lb. (74).

Teas.—Japans, 20 to 35c. per lb.; Young Hysons, 16 to 35c.; Ceylons, medium, 16 to 45c. (74).

Vegetables.—Beans, hand-picked, $2.35; prime, $2.25; stocks light, market firm; beets, 85c. a bag; carrots, 60 and 65c. a bag; onions, $1.25 a bag; potatoes, best, 65 and 70c. a bag; turnips, 45c. a bag. (38).