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MISSING

The Canadian Engineer

WEEKLY

ESTABLISHED 1893

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The Canadian Engineer

ESTABLISHED 1893.

Issued Weekly in the interests of the

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

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Business Manager—JAMES J. SALMOND

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Address all communications to the Company and not to individuals.

Everything affecting the editorial department should be directed to the Editor.

NOTICE TO ADVERTISERS

Changes of advertisement copy should reach the Head Office by 10 a. m. Monday preceding the date of publication, except the first issue of the month for which changes of copy should be received at least two weeks prior to publication date.

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TORONTO, CANADA, SEPTEMBER 10, 1909.

CONTENTS OF THIS ISSUE.

Copy and cuts for changes of advertisements must be in our hands by the Monday preceding date of issue. If proofs are to be submitted, changes should be in our hands at least ten days before date of issue. When advertisers fail to comply with these conditions, the publishers cannot guarantee that the changes will be made.

THE CEMENT MERGER.

It is announced that the $30,000,000 Canadian cement merger has been successfully launched. The final negotiations and legal details have been completed. The companies coming into the new Canadian cement company have made their terms, have accepted the valuation offered them, the underwriters are busy on the security issue, and all that remains to make this new venture a success is to sell the cement manufactured next year at a profit.

We wonder will they, or is there to be repetition of this year's uncertainty in the cement market?

Press despatches state that a "leading official" of the new company placed the yearly output of their mills at 4,500,000 barrels—just one and a quarter million barrels more than the yearly consumption of cement in Canada.

Add to the proposed output of the new company the output of the mills in Canada not included in the merger and the prospective output for 1910 will be double the probable consumption during that period.

And this is not all. The amount of cement imported annually is on the increase. In 1908 it was almost half a million barrels. Because of the unusual conditions attending the cement trade in Canada during this year the imports for 1909 are likely to be larger. Where, then, is this 4,500,000 barrel plant to find its market, and by what means will they sell cement at a profit?

For some years past the consumption of cement in Canada has been on the increase, but we have no guarantee that this increase will long continue. In fact, unless new uses for cement are found there is every indication that the consumption will remain stationary.

The cement industry in Canada since its inception has had financial troubles all its own, and we do not see that this new venture will in any way ameliorate the difficulties under which it has been struggling.

CANADA'S TIMBER LOSS.

The Forestry Branch of the Interior Department, Ottawa, are doing a good service to Canada in making known the timber loss through forest fires. A knowledge of the loss will impress the necessity of great care with fire.

During the year 1908 835 forest fires of serious proportions occurred in the Dominion, upwards of 188,000 acres were burned over, causing destruction of over 56,000,000 feet, valued, including mills and improvements, at $25,500,000. Twenty-one lives were lost as a result of forest fires (all in British Columbia) and 2,404 persons were thrown out of employment.

Quebec Province headed the list with 250 fires, then British Columbia came second with 235. In Quebec, however, the value of the timber destroyed was very slight. In British Columbia 40,000,000 feet were destroyed at a loss of $25,000,000, or over 90 per cent. of the total loss by fire in Canada.

The destruction by fire in Manitoba and Alberta was very light. In Saskatchewan timber valued at over $20,000 was burned.

The heavy loss in British Columbia was due, of course, to the great fire in the Crow's Nest Pass country,

which destroyed Fernie and entailed a heavy loss of life. Fire on Vancouver Island, it is estimated, caused the destruction of 24,000,000 feet of timber.

Engineers appreciate the loss such fires cause. They should be among the first to show great concern and care, and thus educate those they come in close touch with.

EDITORIAL NOTE.

Ontario's railway mileage was increased during 1908 by 679 miles. There are now in that Province 8,399 miles of steam road and 119 separate systems.

PRECIPITATION FOR AUGUST.

The amount of precipitation which fell during August varied greatly with the district. In the southern parts of Vancouver Island and the Central Valleys of British Columbia, throughout Alberta, in most districts of Ontario and locally in Quebec and the Maritime Provinces the amount was much less than the usual quantity, whereas in some of the remaining portions of the Dominion, the positive departure was very marked, especially so in the eastern portion of Quebec, the extreme southwestern portion of the Peninsula of Ontario and also in portions of Prince Edward Island.

In British Columbia, a nearly normal temperature in the south decreased northwards to the Cariboo District, where there were negative departures of from 3° to 7°. In the Peninsula of Ontario, the Ottawa and Upper St. Lawrence Valleys and throughout the Maritime Provinces the average was just, or not quite reached. Elsewhere in the Dominion the average was generally exceeded. Positive departures of from 3° to 5° were recorded from Saskatchewan to northwestern Ontario.

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

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

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Calgary, Alta.	0.60	— 1.98
Edmonton, Alta.	0.90	— 1.06
Swift Current, Sask.	2.40	+ 0.62
Winnipeg, Man.	4.70	+ 2.16
Port Stanley, Ont.	4.20	+ 1.62
Toronto, Ont.	1.33	— 1.50
Parry Sound, Ont.	1.50	— 1.30
Ottawa, Ont.	3.20	+ 0.17
Kingston, Ont.	3.00	+ 0.55
Montreal, Que.	2.30	— 1.07
Quebec, Que.	5.20	+ 1.38
Chatham, N.B.	4.30	+ 0.29
Halifax, N.S.	3.40	— 0.93
Victoria, B.C.	0.50	— 0.11
Kamloops, B.C.	0.60	— 0.40

UNION OF NOVA SCOTIA MUNICIPALITIES.

The Union of Nova Scotia Municipalities met at Yarmouth, N.S., on Sept. 2nd, the report of the Committee on Resolutions was the first matter taken up. It made two recommendations, namely that voting by ratepayers in incorporated towns on extraordinary expenditures should be by ballot, and that the suggestions, as to improvements in the administration of justice as it affects towns and municipalities should be referred to the incoming executive. Both recommendations were adopted without dissent.

On motion of Arthur Roberts, of Bridgewater, and Mayor Richardson, of Sydney, the meeting decided that towns and municipalities should be given full control over the taxation, and the relicensing of all hawkers and pedlars within their respective limits, and that there should be no special or exceptional legislation in their behalf.

Mayor Stewart, of Bridgewater, read a highly interesting paper on "Municipal Assessment." He sharply criticised the present methods of assessment, mainly on the ground of under valuation, Warden Bishop, of Halifax, and Warden McMahon, of King's spoke upon the subject. On motion Dr. Stewart was cordially thanked for his paper.

The following officers were elected: President—Warden A. E. McMahon, Kings County.

Vice-President—Mayor W. A. Richardson, Sydney.

Secretary—A. Roberts, Bridgewater.

Treasurer—F. W. W. Doane, Halifax.

Executive Committee—T. S. Rogers, K. C., Amherst; Mayor Kelly, Yarmouth; Mayor Chisholm, Halifax; Mayor Murray, Truro; City Solicitor Finlay McDonald, Sydney; County Clerk W. Kerr Dimock, Windsor; County Stipendiary J. L. McDougall, Halifax.

Kentville was decided upon as the next place of meeting, and the convention adjourned.

ONTARIO MUNICIPAL ASSOCIATION.

The Ontario Municipal Association met in Toronto, Sept. 1st and 2nd, 1909. Forty of the townships, town and cities of Ontario were represented. In the absence of the president, Mayor W. Kennedy of Owen Sound, the first vice-president, George Geddes, Mayor of St. Thomas, occupied the chair, and made the opening address.

After pointing out that the association is prosperous financially and is holding its own in the matter of membership, he mentioned some of the matters which are to be discussed during the session. He said that a strong committee should be formed to watch, and, if necessary, aid in the amending of the Ontario Municipal Act. He suggested that serious consideration be given the question of federating the various Provincial associations.

Government by Commission.

"Then, too," he said," "we want legislation allowing smaller cities and towns to choose government by a Board of Control or a commission without having to go through such elaborate stages as are at present necessary. What is just as important, too, is that municipalities should receive at least a portion of the liquor prosecution fines. We have all the trouble and expense of the prosecution."

A letter was read from the Council of Fort William, urging that a law be made preventing corporations from appointing special constables without notifying the municipal authorities or the chief of police of district. The matter was referred to the Committee on Resolutions.

The following resolutions were presented to the meeting and referred to the Committee on Resolutions.

That the legislature be requested to give municipalities the power to elect that the affairs of the community be conducted by a commission appointed by the people for three years and capable as a commission of initiating legislation for the people. Moved by W. C. Mikel of Belleville, and W. H. Ross of Dundas.

Assessment Matters.

That this association request the Legislature to amend the Municipal Act of 1904 by adding a clause declaring that the courts shall have power to consider the value of property for county purposes, which the assessors of individual municipalities cannot consider. Moved by A. J. Johnston and R. Bailey.

That the Registry Act be amended to provide that plans of sub-divisions of land within three miles of a city of over 25,000 population must be submitted for the approval of the Ontario Railway and Municipal Board before being registered. Moved by Mayor Hopewell of Ottawa, and seconded by Mayor Kyle of Brockville.

W. C. Mikel, K.C., of Belleville, wanted the association to back Winnipeg in asking the Ottawa Government for a grant towards the proposed Winnipeg Fair in 1912.

"You see," said Mr. Mikel, "while one or two million dollars seems a great deal to a young country like ours, still I think a great deal depends on the success of the Fair. It will be probably the greatest exposition Canada has ever had. I don't think anything could be of more benefit to the country."

The association passed the resolution supporting a "liberal" grant to Winnipeg.

"The lawyers in the House are our enemies," said City Solicitor W. B. Doherty of St. Thomas. "They oppose pretty nearly everything we want."

This came as the result of a discussion of the various failures that the association had been forced to record against itself at the hands of the Legislature. It was decided that another effort will be made to have the Municipal Act amended to limit the liability of municipalities for damages for accidents occurring on the highway.

The following officers were elected for 1909-10: President, Mayor George Geddes, St. Thomas; Vice-Presidents, Controller C. A. Hopewell, Ottawa; Controller W. S. Harrison, Toronto; Mayor Kyle, Brockville; County Clerk W. Lane, Huron; Mayor C. C. Hahn, Berlin; Secretary-Treasurer, County Clerk K. W. McKay, St. Thomas; Executive Committee, City Solicitor W. B. Doherty, St. Thomas; City Solicitor W. C. Chisholm, Toronto; City Clerk S. R. Armstrong, Peterboro; City Clerk S. H. Kent, Hamilton; Township Clerk, York; Alderman Jaffray, Galt, and City Solicitor F. R. Waddell, Hamilton.

NOVA SCOTIA SOCIETY OF ENGINEERS.

The third annual meeting of the Nova Scotia Society of engineers was held in New Glasgow on the 9th and 10th of September, 1909. The following papers were presented.

Some Memoranda on Land Surveying in Nova Scotia—R. R. McKenzie.

Forest Conservation—Prof. Sexton.

Forest Preservation—C. M. Odell.

Relation of Forests to Stream Flow—D. McD. Campbell.

The Timber Asset of Nova Scotia—A. R. McLeave.

On the second day of the Convention visits were made to the McNeil's bridge works and the Nova Scotia Steel Co.'s works. A trip was made down the river to inspect the dredge Northumberland.

President J. H. Winfield in presenting the report of the executive committee, makes the following suggestions:

"If the Society is to continue its existence, and to carry out its aims and objects as laid down in the Constitution, some definite work should be undertaken, and we would suggest the following:—

a. That a systematic effort be made to get together costs and data, and that they be printed and circulated among the members;

b. That if possible, one or two meetings each year should be held at other points outside of Halifax;

c. That the discussions and papers read at meetings should be reported, edited and printed;

d. That at the end of the year all the transactions of this Society be published in book form and delivered to the members.

This together with a small remuneration for the Secretary, would of course, necessitate considerable additional expense, certainly not less than $500.00. With a prospective revenue this year, of say $250.00, it is absolutely out of the question for the Society to undertake this work, and it would appear that something should be done towards obtaining an increased revenue. It has been suggested that the annual dues be increased. This, however, is a matter for the members to decide, and as according to the Constitution, no alteration can be made without at least one month's notice, and no such change can be made at this meeting. Your Council would suggest that this matter be given a very full and free discussion, so that some plan can be formulated

losses of condensation, besides the trouble caused by expansion and contraction of piping, water hammer, etc., the necessity of providing arrangements for trapping or disposing of the water of condensation, and, in spite of all precautions, the frequent stoppage for repairs entailed. Each steam operated machine, therefore, must have its own boiler and all appurtenances, its own supply of fuel and water. Such isolated and intermittently operated machines, taking the day through, cost in coal actually consumed at least 30 pounds, and often much more, per horse-power hour of work actually done, or about twice as much as the coal cost of the air operated machine.

With the air driven machine, when the air is piped to it, that end sit, and the operator has only to manipulate the throttle and attend to the lubrication. With the steam driven machine there is not only the cost of the coal actually consumed, but there is also the bringing of the coal to the machine, the supplying of the water, the firing and caring for the boiler, with all which that implies, so that there is for each machine the labor of a man, or at least the equivalent of one man's labor, to be added to the cost of operating.

The equivalent in coal cost of a man's labor is worth considerable. Say that coal costs at the machine $4 per short ton. Then if the man's wages is $2 per day, that will be 1,000 pounds of coal, or 100 pounds per hour, and for 10 horse-power, which is a big allowance for a hoisting engine, this would be 10 additional pounds of coal cost per horse-power hour.

So far, then, as the actual cost of the power used is concerned there is evidently a great saving in the employment of air instead of steam, and on this account alone it is no wonder that the knowing ones choose the air transmission, even that there are no special conditions, as in mining, tunnelling, subaqueous work, etc., compelling them to do so.

In addition to the saving in coal cost there are other advantages which air carries with it. In the use of steam there is the time taken to fire up and get the pressures before work commences, there is the warming up process and the working of the water out of the pipes and cylinders every time the machine is started up after standing, none of which delays occur with the air, so that in constant readiness and instant realization of power to the utmost limit required, the air will every day put in from 10 to 25 per cent. more actual work per day. Stuffing boxes will give no trouble; water will not knock out cylinder heads; pipe joints will not be giving out, there will be no chance of low water in the boiler, no burning of flues or crown sheet, no possible blow up. The cost and repairs of maintenance will be much less and the certainty of continuous readiness for work will be much greater. While, as was said, the air-driven machines are identical with the steam-driven type, the individual boilers and their appurtenances are dispensed with, the cost of them, as far as it goes, helping to offset the larger cost of the compressed air installation as a whole. The saving in repairs and maintenance, with the reduction in the cost of the air operated machines by dispensing with their boilers, may go to offset the fixed charges entailed in the larger cost of the compressors and piping.

The installation and operation of a complete, economical and reliable compressed air plant calls for no extraordinary reach of knowledge or skill, but it does demand thorough and conscientious engineering. The things which are worth while and which will guarantee satisfactory results are to be insisted upon. Excellent apparatus is provided by the makers of that class of machinery, if demanded. In mechanical lines there are no more creditable records than those of modern air compressors employed in the larger and more responsible engineering works.

In driving the tunnels under the North and East Rivers, at New York, the compressors ran without interruption, maintaining constant air volume and pressure for months, the lives of men dependent upon their continuance, and they never failed. If good machines are selected, and they are properly installed and connected, there will be no cause for complaint or disappointment. The earlier employments of

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and also the condensed steam chokes the small and tortuous passages about the valves; also the lubricant which is used, when once it wets the surfaces of the air operated tool, remains a long time, while when steam is used in a drill for only a few minutes, so that it is thoroughly heated if the drill is taken apart and the surfaces supposed to have been lubricated examined, no trace of oil will be found in them, and they will usually be reported "as dry as a bone." The favorable experience with the rock drill, as to the use of air in preference to steam as the operating fluid, is repeated with all other styles of normally driven machines. The air operated machine is always and instantly ready and only the throttle requires to be manipulated or thought of.

In driving the tunnels of the Pennsylvania Railroad under the Hudson River at New York, it is not conceivable how the work could have been done without the constant aid of compressed air; but for the enormous excavation required for the passenger station of the same company, which was all outdoor work, the use of compressed air was not imperative, but still air was adopted for the work entirely upon its merits by men who knew, and the results have fully proved the wisdom of the choice.

The similar and even more extensive work of excavation for the new station of the New York Central in the heart of New York City, this also entirely outdoor work, is similarly being done entirely with compressed air as the power transmitter.

For engineering works of large extent and the completion of which will require months or years, so as to make the installation of a suitable plant worth while, compressed air is becoming more and more the favorite, where formerly only steam would have been thought of. Some of the largest stone quarries which have promise of permanence of output are now operated entirely from central air compressing plants. The compressed air installations on the Barge Canal at Crescent, at Vischer's Ferry and on the contracts in the western sections are fully warranted by successful engineering experience.

As has happened before in engineering matters and other things having to do with the world's progress, it has not been the scientific investigators, the official testers of efficiencies, those whose function it is to explain the why of things, who have been the leaders and promoters in this extension of general outdoor compressed air practice. For appreciation and opportunity compressed air is indebted almost entirely to the practical men who have been most closely in touch with it, and now the theorists can pat them on the back and patronizingly assure them that "they builded better than they knew." Perhaps so.

It is by no means difficult, after the practical man has established the practice, to find many cogent reasons which justify the extensive and permanent employment of compressed air. The general impression has been that, while compressed air has many things to recommend it in practice, it is still very wasteful of power, or that the amount of power ultimately realized at the extremities of the piping systems where the air is used is but a small fraction of that which is consumed in the initial compression of the air. The power losses in the use of compressed air have been harped upon until some persons have been able to think of nothing else in connection with it.

The truth is really in the other direction, when the use of air is compared with that of steam for the lines of work we are here considering. It is quite possible to show that the use of air compressed by steam at a central station, instead of using steam direct in the individual, widely distributed machines, effects a distinct saving at the coal pile and an enormous saving of operative labor in addition, besides securing the many accompanying minor advantages not generally enumerated and often not even thought of.

Of course it as an easy thing to cite cases showing how power is wasted by the employment of compressed air for power transmission. Some such occurred early in the compressed air experience of the writer himself. For nearly my first lesson, there was a straight-line, single-stage air

compressor running at normal speed and the entire air output of it was used to drive a steam pump down in a coal mine, the length of piping being not more than 1,000 feet, and the greatest efficiency I was able to figure out in the case, starting with the indicator card of the steam cylinder of the compressor, was 19 per cent. Of course, some of the loss here shown was chargeable to the pump itself, with its large clearance spaces to fill, and the use of the air entirely without expansion. Many cases where the too familiar steam pump is driven by compressed air would show results worse than this, while other types of apparatus so operated might show up somewhat better.

In another case I had a straight-line, single-stage compressor, with piping not exceeding 300 feet, to a small flywheel governor, slide-valve steam engine of suitable size. It was possible to adjust the work of the engine—the work was the driving of a fan—and the speed of the compressor so that the one would just supply the other, and each could be brought to a constant running speed. In this case the air passed through a heater by which its temperature was raised 150 degrees Fahr., and its volume correspondingly increased before it entered the engine. The best efficiency I could figure out in this case was 37 per cent.

All who have to do with compressed air can cite instances of power losses such as this, and they would seem to be conclusive against the use of the air, so far as power economy is concerned, were it not for the fact that a decidedly worse case can be made out against the use of steam. In the case where numerous machines are distributed over considerable areas, where the machines are all of them operated intermittently and with constantly varying loads, it is obviously impossible to make tests of power consumption for record or comparison. It is possible, however, to come to some agreement as to probable performance. A hoisting engine may be assumed to be as good an example as any of the machines to be driven. It will probably be fair to assume that the hoisting engine driven by air and working under fair ordinary conditions will, when actually working, realize 25 per cent. of the power consumed in compressing the air. That is, if a horse-power at the compressor costs 4 pounds of coal per horse-power hour, the coal cost at the hoisting engine will be 16 pounds per horse-power hour. One important thing in connection with each employment of compressed air is that it costs practically nothing except for the work actually done by it, and only while the work is being done. There are no heat losses and the losses by leakage, which we speak of later, are practically negligible. To cover all imaginable losses, however, we may concede an additional 5 per cent. thus allowing the net horse-power realized in work actually done by the compressed air machine to be only 20 per cent. of the initial horse-power at the steam driven compressor, and making the coal cost per horse-power hour, therefore, five times as great as at the compressor, or 20 pounds per horse-power hour.

As a matter of record it is quite possible to operate central compressor plants, with compound steam cylinders and condensers, and with boilers and boiler accessories designed and operated for economy, with less than three pounds of coal per horse-power hour. Then five times this, as above, would be only 15 pounds as the coal cost at the air driven machine.

When water can be utilized as the source of power, with or without the employment of electricity for transmission, the cost which then takes the place of the coal cost must be usually much less, or the water-power would not be employed, and this means that the cost which takes the place of the coal cost at the air driven machine is also less than it would be if steam was employed to drive the compressor, or it would be less than the equivalent of 15 pounds of coal per horse-power hour.

It is concededly impossible to generate steam at a central station and to transmit it by piping to the several machines to be operated, as we do transmit the air, on account of the constant heat radiation of the line and the consequent losses of condensation, besides the trouble caused by expansion and contraction of piping, water hammer, etc., the necessity of providing arrangements for trapping or disposing of the water of condensation, and, in spite of all precautions, the frequent stoppage for repairs entailed. Each steam operated machine, therefore, must have its own boiler and all appurtenances, its own supply of fuel and water. Such isolated and intermittently operated machines, taking the day through, cost in coal actually consumed at least 30 pounds, and often much more, per horse-power hour of work actually done, or about twice as much as the coal cost of the air operated machine.

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compressed air were more or less of a temporary or experimental character and many things were permitted which long discredited compressed air practice. There is no excuse for this to-day.

The steam engine element of the steam driven compressor is in no essential different from the stationary steam engine, and it has the advantage of a practically constant load per stroke, so that the relative and actual sizes and capacities of cylinders may be selected with close adaptation to the work to be done. The details which secure accuracy of working are sufficiently familiar.

High pressure steam, with or without the refinement of super-heating, compound cylinders and condenser, are the essentials, not all of which can be always insisted on; then the compression of the air should be two-stage with efficient intercooling and aftercooling.

With respectable compressors secured and installed, the valves and connections and piping should correspond. There is no excuse for leakage and there should be no opportunity to talk about it. Steam has the advantage that it can tell of its leaks and insist upon their avoidance, so when first-class steam piping is required it can be laid and connected so that there can be given an almost positive guarantee that there shall be no leak when the steam is turned on, and if a leak is revealed it is more or less a reproach to the workman or the supervising engineer.

If piping can be laid perfectly tight for steam, it can be laid as tight and reliable for air, for what will suffice for the one will be quite as satisfactory for the other. In fact, as the air pipes are not heated and cooled and expanded and contracted as steam pipes are, it is easier to make them tight and to keep them so, and this is practically demonstrated and enforced by the excellent piping throughout the installations at Crescent and at Vischer's Ferry, where those in charge assured the writer that the leakage losses were inappreciable. Where rock drills are driven by air with hose connections, some leakage may occur, but even here it is almost entirely preventable. There is a certain quarry of large extent in Ohio which is operated entirely by compressed air from a central plant and which is so perfectly piped and so carefully looked after, that when the compressors are stopped, the pressure is maintained in the pipes all night.

To an engineer familiar with the running of hoisting engines and the usual types of machines employed for outdoor service and driven by steam from the boiler to which it is tied, the use of air for the same purpose comes as a pleasant experience. The instant readiness of the air and the lively movement of the machine at once is so different and such a relief from the sluggish action of the steam. There is no waiting for the cylinders to heat up and no watching of pet-cocks to save the cylinders. The hand or the bare arm can come in contact with any part without fear of burning.

This is the universal experience in the use of compressed air for power. There is, however, one familiar accompaniment of inconvenience—the accumulation of moisture in the air pipes and the choking and freezing up of the exhaust pipes in consequence. This is, of course, an objectionable feature and at first it might be urged as even without remedy but later practice has minimized, if not abolished, this troubl.e.

There is no way of securing dry, free air to begin with. All air contains a considerable percentage of moisture, so that after the air is compressed into much smaller volume it is then saturated, and more than saturated, with moisture, so that water begins to be dropped in the pipes as it flows along and ultimately may make trouble in the drill or engine where the air is used. The simple remedy is to allow the air to deposit its moisture and then draw the water off, before it comes to the machine.

When the air is at its highest pressure and its lowest temperature, its saturation point, or its capacity for carrying moisture, we might say, as a part of itself, is at the lowest, and then, if it has the opportunity, it will give up so much of the moisture that what remains will not be heard of. It is almost the universal custom, when a compressor is installed, to place an air receiver close to it, and all the air compressed first passes through this receiver. The receiver is provided with a drain cock and the engineer is instructed to occasionally open this and draw off the water. But really very little water is ever found here. Some oil and dirt, originally inpalpable dust in the air, will accumulate, and this it is proper to get rid of, but the air has not got ready to release and deposit the moisture, because as it passes through this receiver, it is still hot with the heat of compression. When the air passes through pipes of sufficient length to thoroughly cool it, if there is then provided another receiver or other opportunity for depositing the moisture, with means for drawing it off, always remembering that water runs down hill, then the air will be sufficiently dried for use without annoyance.

Outside the compressor house at Crescent there is a large horizontal receiver with valves and piping for distributing the air in the different directions required. Here, as usual, there is a drain cock, but little or no water can be drawn from it. One air line from this compressor runs more than a quarter of a mile to two three-drum hoisting engines used for loading crushed stone upon boats in the Erie Canal. It happens that it is sometimes desired to run these hoists when the compressor is not in operation, and so a steam boiler has been placed in position with all the necessary connections. When the air is in use this boiler becomes an air receiver, the air passing into it and then through the connecting pipes to the hoists, the same pipes and valves being used for either the air or the steam. As the air comes to this boiler, or receiver, cooled by its journey through the pipes, it is here in position to deposit its moisture, and here the water is found, and the hoisting engines are then run without trouble.

The better way, after all, is to drain the air as completely as possible immediately after the compression. A fine example of advanced modern practice is offered in the compressed air plants for the Rondout siphon of the Catskill water-supply for New York city. Here there is an immense job of shaft-sinking and tunneling, the compressors to be used being 10 Ingersoll-Rand Imperial Type X Corliss, compound condensing steam, and two-stage air, the air pressure being maintained at 110 pounds. There are here, as usual, air receivers near the compressors, one large receiver for each pair of compressors, but directly connecting with each receiver is a large intercooler, through which the air must pass and be cooled to normal temperature before entering the receiver. This provides the conditions of highest pressure and lowest temperature for the air, so that it cannot fail here to drop superfluous water, which, therefore, can cause no further trouble when the air is finally used.

TOLL OF THE RAILWAYS.

Accidents in August.

Thirty-two persons were killed and fifteen were injured by the steam railways of Canada during August. On the electric roads 27 were injured and three killed. Many of the accidents, due to trespassing, are avoidable. Most of the fatalities were due to carelessness and neglect. It is an unenviable record. But, when compared with July, the figures for August are more desirable, and it is obvious that more care is being exercised by those connected with the operation of trains. Exclusive of trespassers and persons crossing the tracks at grade, only ten people were killed during the month. Which proves conclusively that the majority of the accidents are preventable.

Statistics issued by the Board of Trade show that not a single passenger in the United Kingdom lost his life in a train wreck during the year 1908, though many persons were killed by railway trains in various other ways, such as crossing the tracks, trespassing. This is a notable record. It has been made possible by the fact that the roadbeds are maintained in the highest condition of excellence, that all

the important railroads are double-tracked and that the tracks are kept comparatively free from trespassers. There is also the important fact that human life is not held so cheaply in the Old Country as it is in the United States, and, we regret to add, in Canada.

The totals for July and August compare as follows:

	Passengers.		Employees.		Others.		Totals.	
1909	Killed	Injured	K.	I.	K.	I.	K.	I.
July	3	12	26	12	22	7	51	31
August	4	5	6	8	22	2	32	15
Decrease		7	20	4	0	5	19	16

Here is the record of the electric railways:

	Killed.	Injured.
Run Over	2	2
Falling Off	1	6
Struck by car	—	6
Derailment	—	12
Collision with fire engine	—	1
Total	3	27

A gratifying decrease in the number of employees killed during August is worthy of note. But there is still room for improvement.

Character of Accident.	Passengers.		Employees.		Others.		Total.	
	Killed	Injured	K.	I.	K.	I.	K.	I.
Derailment	..	..	1	..	..	..	1	..
Head on Collision ...	1	3	1	1	..	..	2	4
While Shunting	..	..	1	3	..	..	1	3
Highway Crossing ..	..	..	..	..	8	1	8	1
Fell off Freight Cars.	..	..	..	1	..	..	..	1
Trespassing	..	..	..	..	14	1	14	1
Pitch in with hand car	..	..	1	..	..	..	1	..
Adjusting Couplings.	..	..	1	2	..	..	1	2
Passengers falling off	2	..	..	..	..	..	2	..
Working on track ...	..	..	1	..	..	..	1	..
Attempt to board moving train	1	1	..	..	..	..	1	1
Falling off hand car.	..	..	..	1	..	..	..	1
Unclassified	..	1	..	..	..	..	..	1

Railway wrecks are expensive. They invariably result in serious damage to the rolling stock or the track, not to mention loss of life and terrible injury. A Great Northern locomotive which plunged through a burning bridge on June 19, and dropped forty feet into the Fraser River, near New Westminster, resulting in the loss of two lives, was recovered on the 23rd August. Repairs which are necessary will cost thousands of dollars. This is only one instance of costly mishaps which might be avoided if more caution were used.

Some notes regarding wrecks in which much damage was done to rolling stock and other railway property follow:

Near New Glasgow, N. S., an I.C.R. freight train was ditched, causing much damage to rolling stock, and considerable delay.

Near Sunnyside, Toronto, three coal cars were derailed and many ties torn up, resulting in six hours delay to the C.P.R. Coldwater express.

A C.N.R. freight was ditched at Matawawan, near Port Arthur, blocking the road for many hours.

At the Caledon Horse Shoe Curve, a C.P.R. passenger train left the rails, causing some hours' delay.

West of Ingolf, Ont., a C.P.R. work-train of 8 cars was derailed, damaging the track and blocking the line for 8 hours.

Four hours delay and considerable damage to the track and rolling stock was the result of a break in the axle of a G.T.R. tender near Waubaushene.

A G.T.R. passenger train ran into an open switch near West Toronto. The engine and several cars were derailed.

A broken axle caused the derailment of a car on a C.P.R. passenger train. The track was slightly damaged and the train delayed six hours.

The C. P. R. Atlantic express was ditched at Woman River, causing serious damage to rolling stock and 5 hours' delay.

Near Young's Cove, N.B., a freight train of the N.B. Coal and Railway Co., was derailed, resulting in several hours delay.

LONDON PUMPING PLANT.

Messrs. Vandeleur and Nichols of Toronto have been awarded the contract for the supply and installation of the complete apparatus required for the new London, Ontario, Domestic Pumping Service. It will be remembered that a short while ago the Honorable Adam Beck, on behalf of the citizens of London investigated the conditions affecting their water supply and came to the conclusion that there was room for improvement. The rate payers approved of Mr. Beck's suggestions and empowered him to complete such arrangements as he had deemed advisable. In consequence, Mr. Beck secured control of a considerable quantity of land on which he has sunk the shafts for fifteen artesian wells. The water from these wells is to be lifted by means of compressed air. It will flow by gravitation into a central located reservoir and from there it will be drawn by powerful triplex plunger pumps. There are some unique features about the installation which will bear nothing. The total capacity of the plant is stated on the air compressor side to be of 1500 cubic feet per minute, and on the pump side, of four and one half million gallons per day. There are three air compressor units and three pump units. Two of each of these machines are to be motor driven, the power being obtained from the Hydro-Electric power distribution system, the third unit being operated by a gas engine. The air compressor units comprise Reavell's single stage, quadruplex, water jacketed compressors, directly connected by flange coupling to a slow speed alternating current, 3 phase, 25 cycle motor of 82 B.H.P. capacity. In the gas engine driven air compressor unit the two machines are united by a disc coupling, the gas engine in this case being of 90 B.H.P. The reason the gas-engine-driven units are installed, having one half capacity of both motor driven sets, is that occasion might arise whereby the electric supply would be interrupted, and it is as an insurance against a prolonged shut-down that such a provision has been made. The two motor driven pumps are gear connected, the gear in each case being enclosed in an oil bath. This is to reduce the noise. The gears are composed of the new unica product, which is nothing more than compressed cotton. The motors in this case are of 120 B.H.P. capacity and will operate at 720 r.p.m. The gas engine driven pump consists of the pump and a 150 B.H.P. gas engine. This is a direct drive, flexible coupling uniting the two. This pump is so arranged that the gas engine can readily be thrown out of commission and a motor at the other end of the pump shaft quickly connected through gearing and clutch and three pumps operated together, thereby increasing the pressure in the mains in the event of conflagration. The pumps and gas engines are manufactured by Messrs. T. H. & J. Daniels of Stroud, Glos., and the pumps are fitted with the famous 'Guttermuth' valves which permit of operation at a comparatively high speed, namely, 170 r.p.m. The compressors also operate at a comparatively high speed, namely, 235 r.p.m. Special arrangements have been made to make the plant as automatic as possible and it is anticipated that for its size this pumping station will require less atendance than any other similar plant. Notwithstanding the fact that the capacity of these units is large, the space they will occupy is only 26′ x 80′ which includes provision for office and wash rooms, etc. Mr. H. J. Glaubitz, C.E., is consulting engineer for this scheme.

The question of forestry laws in Sydney, N.S.W., is shortly to be taken up by the Hon. C. G. Wade, K.C., prime minister, Provision will be made for classification of the timber lands of the state, for the dedicating of areas as permanent forests, for afforestation, and generally for regulating the timber trade in such a way as to safeguard the public interest and preserve the rights of those engaged in the industry. The lumber wealth of New South Wales is almost incalculable, and hardwood and cedar trees abound.

RAILWAY EARNINGS AND STOCK QUOTATIONS

NAME OF COMPANY	Mileage Operated	Capital in Thousands	Par Value	EARNINGS Week of Aug. 31		STOCK QUOTATIONS TORONTO				MONTREAL			
				1909	1908	Price Aug. 27 '08	Price Aug 20 '09	Price Aug. 27 '09	Sales Week End'd Aug27	Price Aug 27 '08	Price Aug. 20 '09	Price Aug. 27 '09	Sales Week End'd Aug27
Canadian Pacific Railway	8,920.6	$150,000	$100	$2,384.000	2,008.000	177	.....	184¼	350	176¾ 176½	.....	186 185	930
Canadian Northern Railway	2,986.9	.....	.....	253.600	242,900	.....	.....	.....	.....	.....	.....	.....	.....
*Grand Trunk Railway	3,536	226,000	100	1,321.529	1.112.000	.....	.... *1st. pref. 107½, 3rd pref. 68⅞, ordinary 24¾						.....
T. & N. O.	334	(Gov. Road)	.....	52,342	25,844	.....	.....	.....	.....	.....	.....	.....	.....
Montreal Street Railway	138.3	18,000	100	80,013	71,335	.....	.....	.....	.....	180 178½	.....	213 212½	30
Toronto Street Railway	114	8,000	100	77,434	68,556	.....	.....	124⅜ 123	88	105½ 105	.....	124⅜ 124	229
Winnipeg Electric	70	6,000	100	.....	.....	167 165½	.....	190 187	2	.....	.....	 186	.....

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

RAILWAY EARNINGS FOR AUGUST.

Substantial increases in the earnings of the Canadian railways continue. The accompanying table, which gives the figures relating to the month of August, together with statistics from January 1st to August 31st, compared with the records for 1908, is probably one of the best indications of Canada's march of progress.

C.P.R. gross earnings in August broke all previous records for that month. The earnings were $7,152,000, as compared with $6,254,000 for the same month last year, an increase of $898,000. The gross for the month also showed a considerable increase over the figures for 1907, when the takings of the road for the month reached a record of $6,900,000, showing an increase for the present month of $252,000 over the best previous August in the company's history.

For the last week of August the earnings of the road were very near to making a record, being exceeded only by two or three similar periods in the history of the C.P.R. For the "week" of ten days, ending August 31, the gross earnings of the system were $2,384,000, as against $2,008,000 last year, and $2,243,000 in 1907, showing a handsome increase over both.

With remarkably few exceptions the returns for August this year show good increases over those for July, as will be observed from the following table:

	Aug. 1909	July 1909	Increase or Decrease
C. P. R.	$7,152,000	$7,004,000	+ $148,000
C. N. R.	807,100	843,500	— 36,400
G. T. R.	3,789,948	3,491,184	+ 298,764
T. & N. O.	147,983	136,627	11,356
Montreal Street	312,678	300,968	+ 11,710
Toronto Street	300,887	292,589	+ 8,298
London Street	21,806	23,692	— 1,886

The August 1909 earnings of the large steam roads have only been exceeded during one or two of the big October week's in previous years, when the East and West traffic was at its height. The past few weeks show returns which beat all records in this country for the carrying of passengers, and this is what is causing the remarkably high earnings. While freight traffic is also good, it is not approaching the figures which will be reached later on, when the Western wheat starts moving heavily, with its resultant westbound traffic. But the passenger traffic at the present time has reached its zenith.

Company	Month of Aug. 1909	Month of Aug. 1908	Increase	Jan. 1 to Aug. 31, 1909	Jan. 1 to Aug. 31, 1908	Increase
Canadian Pacific Railway	$7,152,000	$6,234,000	$918,000	$49,124,860	$42,464,000	$6,660,860
Grand Trunk Railway	3,789,948	3,573,244	216,704	25,521,076	24,628,954	892,122
Canadian Northern Railway	807,100	747,400	59,700	5,694,460	5,188,400	506,060
T. & N. O.	147,983	80,440	67,543	929,639	516,282	413,357
Montreal Street	312,678	286,715	25,963	2,334,438	2,204,336	130,102
Toronto Street	300,887	276,132	24,755	2,349,955	2,167,179	182,776
London Street	21,806	25,228	*3,422	154,464	151,788	2,676

* Decrease

RAILROAD EARNINGS.

All railroads reporting weekly have now reported for the three weeks of August, and the total gross earnings are $21,541,714, an increase of 10.8 per cent. over last year, and a loss of only 2.6 per cent. as compared with a like period in 1907. Large gains continue to be reported over last year and several roads show increases as compared with the very active year 1907. In the following table is given earnings of United States roads reporting for the three weeks of August and same roads for a like period in July and June:

	Gross Earnings 1909	Gain	Per Cent.
August—three weeks	$21,541,714	$2,101,115	10.8
July—three weeks	19,909,497	979,028	5.2
June—three weeks	19,875,232	1,749,658	9.7

A number of United States roads have now reported for July, and total gross earnings are $98,311,912, an increase of 10.6 per cent. over last year and a loss of 7.0 as compared with July 1907. Good gains are reported by all classes of roads, which are very heavy on the Eastern Trunk lines. Pacific systems and other Eastern roads. The Granger roads also report a large gain over last year, and a gain of nearly 6 per cent. over July 1907. The statement is printed below:—

July	Gross Earnings 1909	Gain	Per Cent.
Trunk Eastern	$19,866,634	$ 2,762,467	16.8
Trunk Western	8,146,393	520,398	6.9
Coal	3,092,399	174,928	6.0
Other Eastern	3,383,503	346,291	11.4
Central Western	6,254,183	284,985	4.8
Granger	14,151,534	1,681,956	13.5
Southern	15,905,767	878,028	5.8
South-Western	22,366,524	2,046,206	10.1
Pacific	5,144,975	694,482	15.6
United States Roads	$98,311,912	$ 9,389,662	10.6
Canadian	7,004,000	808,000	13.1
Mexican	4,442,621	209,588	5.1
Total	$109,738,533	$10,407,250	10.5

Dun's Review.

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

WATER SUPPLY AND PURIFICATION.*

By T. Aird Murray, C.E., of Toronto.**

The general question of water supply is an extremely wide one. The question of purification is no less wide. It would be impossible for me to do justice to the subject within the limits of a single paper. If I attempted to deal with the various headings into which the subject may be divided, such as Available Rainfall and other sources of supply, (such as direct collection of rainfall, springs, wells, streams, rivers, lakes, and storage reservoirs, and the different values to be attached to shallow wells as against deep wells, the various methods of water purification by means of chemical re-agents, slow or rapid sand filtration, sterilization, etc.), I feel sure that such a dessertation would only weary you, and my observations would be so incomplete that no definite data could be conveyed.

I have, therefore, as it were, mentally reviewed the whole subject with a view to selecting one or two particular phases of the problem of water supply which I consider are more particularly of practical value as effecting general economy and efficiency. The subjects which I have selected are:—"Tuberculation and growths in water mains, their prevention and removal," and "Purification of Water by Mechanical Filtration." Even to treat these two subjects conclusively would present a gigantic task; no one expects, however, that more than the salient features can be touched upon in a short paper.

Tuberculation and Growths.

These may be divided as follows:—(a) Rust, tuberculation, rust nodules. (b) Incrustation due to alkalinity. (c) Biological formations due to organisms. (d) Sedimentary deposits. All of the above either separately or together frequently occur in water mains. They are the cause (apart from extended distribution) of the gradual diminution pressure so common in our water systems. They are the further cause of the gradual and sometimes enormous increase in power required to maintain necessary pressures.

Mr. Desmond Fitzgeralds' (Transactions of the A.S. C.E. Vol. 15, p. 337, 1886), states:—"Great attention is paid by hydraulic engineers to the designing of dams, aqueducts, reservoirs, etc., structures connected with the source of water supply; but the question may well be asked:—Is proper attention paid to the pipe or distribution system? Experiments and formulae we certainly have of the flow of water through pipes, but the writer is inclined to believe, as the result of observations, that when the water has once been turned into a pipe system, little more attention is paid to the condition of the pipes. Sometimes, it is true, small pipes fill up entirely, and then specimens are exhibited showing the growth of tuberculation. Again the water becomes bad in one street whilst it is good in the adjoining neighborhood, and the result is attributed to some mysterious agency. It is believed by the writer that one of the great steps in advance that will be made in years to come in the designing of pipe systems will be the introduction of facilities for cleaning out the pipes at stated intervals of time. This will be found necessary, not so much for restoring the normal capacity of the pipes as for maintaining the purity of the water." The above statement was true twenty years ago when it was made, it is equally true to-day. Numbers of water systems can be pointed to, where the water as delivered at the tap is more impure than the water at the source, and where it becomes year by year more difficult and expensive to maintain satisfactory pressure owing to the reduction of the diameter of t' e pipes.

Although much attention has been given to the subject of growths in water mains and their removal in Great Britain, comparatively little has been given in this continent. Where attention has been given, however, the results have provided the utmost satisfaction, both from an economical and efficiency point of view. Electric engineers are careful to provide inspection boxes on their transmission lines, and even sewers are provided with manholes which allow of inspection; but as a rule no means are provided for the general inspection of the condition of water mains, or facilities provided for cleaning out even the dirt which will accumulate apart from the removal of rust and other growths.

Before going into the question of the removal of tuberculation and growths it may be well to shortly review what knowledge we have of these incrustations.

Tuberculation is the term applied to rust or oxide of iron which forms on water mains, principally in such mains where pipes have not been originally properly protected with some coating mixture. Small pipes may become completely choked with rust. With large pipes, however, there appears to be a limit to the thickness of rust, an inch and a half of incrustation provides a protection to the body of metal forming the pipe. Rust incrustation in pipes, commences as a rule as small specks, appearing at points where the protective coating leaves the pipes exposed. The specks grow rapidly in the form of nodules like limpets, gradually covering the whole internal surface and eating under the protective coating which they scale off and destroy. These limpet-shaped cones, or rust tubercles, as they are called, are generally hard on the surface and soft inside, and are easily removed by scraping. The rust is the result of a combination of the iron and the air which is always present in water; it occurs equally with filtered or unfiltered waters, and grows at greater rapidity with soft waters than with hard. In fact under certain hard waters rust tuberculation is practically unknown, even with uncoated pipes. The tendency to rust growth with soft water is due not to the degree of softness or hardness, but due to the fact that most soft waters are of surface origin and contain vegetable acids, such as carbonic acid due to organic fermentation. One thing is certain, and that is that no tuberculation will occur where the internal lining of the pipes is properly protected. Rust tuberculation means the gradual diminution of the pipe thickness, and consequent weakening.

There are, however, other incrustations which are not dependent upon the amount of protection to the pipe surface, such may be due to alkalinity. Hard water is caused principally by the presence of salts of magnesium and calcium. The carbonates and bicarbonates of these salts producing temporary hardness. Permanent hardness on the other hand is produced by the sulphates, chlorides and nitrites of these salts. In the case of the salts producing permanent hardness, we have the incrustations found in boilers due to evaporation of the water leaving the salts behind, these do not affect the distributing mains. In the case of the salts

*Paper read before the Convention of the Municipalities of the Province of Saskatchewan at Regina, September.

**Consulting Sanitary Engineer to the Saskatchewan Government.

producing temporary hardness, however, we find that the carbonates are soluble in the presence of carbonic acid, and form incrustations of crystallized scale of calcium carbonate. This scale is found in large quantities in some places, depending upon the quantity of bicarbonate of lime and carbonic acid in the water. The usual method of removing temporary hardness is to add milk of lime according to "Clarke's" process for softening water.

Biological formations due to organisms are frequently found as growths in water mains and concrete or brick conduits, they exist as "Sponge," "Pipe moss," "Ferruginous slime," etc. These as well as curtailing the diameter of the pipes and reducing pressure, are the cause of unpalatable conditions, and even of foul odors from the water. The most serious of these growths is that known as "ferruginous slime," which is the product of certain iron organisms known as the "Grenthrix" group. The deposit is generally black, or red, or of a dirty yellow, or brown color; and flocculent masses may often be seen floating, which have become disengaged from the pipes. The writer has seen this deposit lining a water main to over an inch in thickness. The iron which is contained in the slime is not due to the pipes, but is entirely due to iron in the water, and has nothing to do with the question of rust formation; as it may form in brick or concrete conduits, as stated above. It just as readily forms in coated pipes as uncoated, and it is for this reason that many do not consider it necessary to use coated pipes, confusing this organic iron growth with rust. The writer has had occasion to make several observations and experiments in connection with this particular growth, and concludes that it is due to a combination of iron in solution and organic impurities in the water. The growth is more common in connection with ground waters, and in his continent has made itself evident at Jamestown, N.Y., Brookl'n, Waltertown, and other places in Massachusetts. It is also very common in the surface waters of English towns, especially in the waters from the Penine Range of hills. I regret that I have not yet had an opportunity of studying the waters of this province, in order to make a systematic examination as to their relation to the particular growths with which I am dealing. This, however, is something for the future, and I have no doubt, that many of you are practically acquainted with many of the growths noted.

Sponge or Spongidae is the chief cause of many waters becoming foul in autumn time. It dies during the autumn, and in the process of decay imparts an unpalatable taste and odor to the water. It is really a fresh water sponge. They are usually found on the tops and sides of pipes. They only occur in connection with surface waters, more especially in the case of lake water.

Pipe moss forms an extremely common growth in water mains, and may take the form of matting covering large areas to considerable thickness. It is very permanent and is not usually found floating, as may be the case with the iron slime and sponge. It has all the appearance of moss and may take the form of branching filaments.

Sedimentary deposits are too well known, and require little explanation. Such are common when the water is obtained from rivers or turbid sources. Mud, sand and clay are their chief constituents.

The above incrustations may be again summarized along with remedies required for their prevention or removal.

Rust tuberculation or rust nodules.	Well coated pipes	Scraping the mains.
Incrustation due to alklinity.	Treatment with milk of lime. (Clarke's process).	Scraping the mains.
Biological growths.	Filtration.	Scraping the mains.
Sedimentary deposits.	Sedimentation in basins with or without coagulants.	Flushing and scraping the mains.

Now, even after taking all the preventive measures necessary with many waters, it will be found that mains will still have a tendency towards incrustation. The question, therefore, arises as to whether money would be well spent in the first instance in providing sufficient means of control over a water system to allow any length of main to be readily cleaned out at any time. The usual method of providing control is by means of hatch boxes placed at intervals on the lengths of mains; these allow of an opening to the main being made without cutting into it and breaking into the roadway. Scraping machines, of which there are many in the market, are simply cutting tools which are forced through the pipes by the pressure of the water, and have the effect of increasing the pipe diameter to the original bore. The following list shows the percentage of pressures gained at various places in England immediately after scraping the mains.

	%	Main.
Owestry	54	6"
Lancaster	56	8"
Bradford	55	18"
Whitelawn	28	12"
Waterford	40	13"
Cuper Fife	52	7"
Merthyr Tydfil	30	14"
" "	82	12"
Omagh	300	6"
Lanark	34	7"
Bridge of Allen	35	6"
Thurso	7	6"
Cowdenheath	23	6"
Burntisland	43	8"
Torquay	28	10"
Aberdeen	107	4"

At Halifax, N. S., Canada, the effect of removing incrustation was most marked. The mains there are scraped out yearly. The first operation occurring in 1880 brought about 34.2 lbs. sq. in., pressure at 25 hydrants at which the nozzles previously showed no signs of water. In 1881 the same hydrants showed 43.5 lbs., sq. in., and in 1882 52.4 lbs. sq. in. The engineer reported that the mains were all heavily tuberculated in some instances the incrustation being 1-½ in. thick. Similar experience was gained at St. Johns, at Boston Mass. Scraping the pipes just more than doubled the supply of water. It is quite practical to remove the whole of rust or other growths from mains without injuring the original coating of the pipes.

Mr. N. S. Hill before the American Water Works Association has recently given some interesting figures upon the cost of scraping water mains. He takes for example a 6-in. main to cost $1.00 per foot, and to require replacing with another main of the same size in 20 years, owing to the increased consumption and the effects of tubercular deposits. Assuming money to be worth 4 per cent. per annum, then the cost of a new main at $1.00 per foot, 20 years hence, would be equivalent to 46 cents at the present time. Assuming that by proper inspection and cleaning the construction of the additional main could be delayed 10 years, the cost of a new main 30 years hence would be equivalent to 30 cents at the present time, viz: 46-30 = 16c. per foot would thus be saved, which at 4 per cent. equals 64 cents per foot per year, add to this the saving in interest on $1.00 per foot for 10 years = 4 cents per foot per annum and we have (6.4 x 20 or 12.8) + (4 x 10 or 40) = 52.8 cents per ft. of 6 in. main as the amount, we should be justified in spending in maintenance during 30 years, in addition to present cost in repairs, which we assume to be the same, and which averages about 17 cents per foot per year for all sizes of mains. In other words we would be justified in spending just 10 times as much for maintenance as we do at present even if all the pipes were only 6 inches. If the periods are reduced to 10 and 20 years respectively, which is more probable with heavy incrustations, then the justifiable expenditure for maintenance would be 48.4 cents per foot for 20 years, and 2.42 cents per foot per annum, which would be sufficient to clean the mains every five years.

A great deal more could be said on this subject from the economic point of view in connection with pumping and forcing water through incrusted mains. Atlantic City suffered for many years as a result of tubercular growths in the water mains. As a result of cleaning out the mains the pumping efficiency was increased as follows: Before cleaning, the 18,000,000 gallon pump, which delivers the water into the reservoir was put under a pressure of 110 pounds, and made 11 revolutions per minute, delivering 11,888,000 gallons. After cleaning under the same pressure it made 16-½ revolutions per minute, delivering 17,820,000 gallons, showing an increase in delivering capacity of 5,400,000 gallons in 24 hours, or 45.4 per cent. This enabled the department to fill the reservoir, and saved a contemplated expense of laying an additional main 30 in. (18,000 feet) at that time. Also, the amount saved in fuel required before and after the pipes were cleaned worked out at about 36 per cent.

Now supposing that a municipality contemplated putting down a water system with ample provision for control by means of hatch boxes, so that the system might be examined and scraped at any time without disturbing roads or cutting into the mains. What would be the cost? It is estimated for a population of 50,000 with 92 miles of main averaging 12 inches in diameter, the cost of distribution system amounting to $1.80 per foot of main, consumption at 60 gallons per head per day, that the cost for an ample supply of batch boxes would add 15 cents per foot of main, or 8.3 per cent. increase to distribution system. If the supply be one of pumping, the increase on the total cost of plant amounts to about 4.7 per cent.

Experts on this question, and in fact all who have had experience in this matter, are agreed that the actual cost incurred by the installation of hatch boxes, intelligently spaced out, is more than balanced by the benefits obtained.

I have also promised to make a few remarks on the question of mechanical filtration as applied to water supplies.

There is a rapidly growing opinion that all surface collected waters, especially those drawn from rivers, should undergo some purification process before being delivered for consumption; apart from the direct discharge of sewage into water courses there are many other sources of contamination. We have seen that many of the biological growths occurring in water mains are directly due to organic impurities in surface water. The removal of these impurities ensures longer life to the mains, more constant pressures, and a water free from mal-odours, bad tastes, and less contained nutriment on which pathogenic bacteria can be maintained.

Water purification may be effected by (a) filtration (b) direct sterilisation.

Filtration may be divided into two processes. 1st, slow sand filtration, and 2nd, rapid mechanical filtration.

Slow sand filtration necessitates large areas of filter beds, and very fine grained sand is used. The purifying powers of these filters is primarily due to the formation of a sediment blanket on the surface of the filter. At first very little bacterial purification results, but as the sediment scum forms, the percentage removal increases up to very high rate efficiencies, gradually as the scum or blanket thickens, the rate of filtration is lowered until it is necessary to remove the scum by scraping, until the scum blanket forms the water passing through the filter is passed to waste. The filter beds are naturally about 1 acre in area, the rate of filtration being about 2,000,000 gallons per acre per day. This system has been adopted largely in Europe in connection with river waters. Its introduction has invariably been followed by a marked reduction in the typhoid fever rate. Several cities in the American States have also adopted the system. Toronto in Canada is at present putting down a large plant to treat 30,000,000 gallons per day. The system as compared with others is very expensive both in first charges and in maintenance, and it is doubtful whether it would be possible to work it under the severe frost conditions of this province.

Mechanical or rapid filtration occupies much smaller areas. The sand used is coarser than in the case of slow sand filtration. The rate of filtration is about 120,000,000 gallons per acre per day, or 60 times the rate of slow sand filtration. With municipal plants, the size of a single filter is equal to about a hundreth part of an acre. Very high purification efficiencies are obtained by this method. Efficiency depends not so much upon the filter, however, as upon the use of a coagulant and general attention and care to proper working. At Harrisburg, Pa., the average bacterial removal for the year 1908 was 99.62 per cent. Similiar high efficiencies are obtained elsewhere. The filter is constructed more with a view to obtaining an efficient sand washing apparatus, while purification is obtained by the proper use of a coagulant, combined of course with the filter action.

This system is peculiarly adapted for our Province, as the whole plant can be housed in a small building and thereby worked independently of severe frost. Its power of removing turbidity is very great, and we are all well aware how turbid our rivers are in the early months of the year. I saw this for myself last July in visiting Saskatoon and Prince Albert, where although small sedimentation basins were provided the finer particles of the suspended matter remained in the water.

With reference to the use of a coagulant, I will quote from a report of the "Joint Special Committee to examine and report relative to the pollution of water supply, and the best method of filtration." City Document No. 15 of the City of Providence, R.I., as follows:—

"If the diameter of matter floating about in water is much less than that of the interstices between the grains of sand composing the filter-bed, such matter, except as much as is caught upon the sharp edges of the quartz, will go right through the filter with the water.

"Now, if a substance could be introduced, drop by drop, into the water before it comes to the filter-bed, which would have the effect of curdling the matter together, so that every one hundred or so of the smaller particles were made to join together and become one large particle, much as vapour or steam is condensed into drops, it would follow that they would be caught and held from going through the filter. This is accomplished by adding dissolved sulphate of alumina (Alum) to the water as it flows to the filter.

"The amount required is from almost none at all to about three-quarters of a grain, according to the state of the water, say, an average of from one-quarter to one-half gain per gallon in the ordinary condition of the Pawtucket River water.

"The action is the same as when coffee is cleared by means of the white of egg. No white of the egg goes to the drinker of the coffee—it is all drained out with the grounds; and, as no alum goes to the drinker of the water, it unites with the impurities in the water an setles in feathery flakes of insoluble hydrate on the top of the filter, and is washed out with its accumulation of impurities when the filter is cleaned.

"The analysis of the purified water shows no trace of the alumina used, while the analysis of the wash water shows that the alumina is all washed out with other impurities. This feathery bed of precipitate flakes produced by the alum forms a filtering material of insoluble mineral matter which is well nigh perfect in its character. Bacteria are like the very fine particles of clay of some water, so small as to pass the sand or quartz, but they are caught by the feathery precipitate of alumina hydrate, much as the bacteria contained in the air are prevented from entering a vial closed with sterilized cotton."

The above is an exact description of the use of a coagulant, and its importance in the use of a filter will be at once appreciated, when it is explained, that, one drop of alum in solution to one hundred thousand drops of water (about one-sixteenth of a grain to the gallon) is sufficient to render an average turbid water bright.

At Harrisburg we have the operating expenses for the year 1908, which are worth quoting, in view of the fact, that,

I give the results of the plant as a typical example of efficiency. The water commissioners of Harrisburg treat 3,358,029,150 gallons per annum, of which 3,271,732,550 were delivered to the pumps, and 86,246,600 gallons, or 2.6 per cent. of the whole was used in washing.

The annual cost for 1908 was as follows:

Coagulant	$ 5,919.27
Coal	2,043.92
Oil and waste	297.39
Supplies	837.95
Repairs	639.89
Laboratory	1,395.76
Labor	8,209.33
	$19,343.00

The above amounts to a charge of $5.91 per million gallons. Coagulant cost per million gallons $1.81, coal 62 cents, repairs 20 cents, laboratory, 42 cents, and labor $2.51.

This cost per million gallons at Harrisburg of $5.91 is a fair estimate of profitable cost when nothing is neglected to obtain efficiency. In certain cases the cost may be under this amount, in others over.

Now the assertion may be made, "But, this method of mechanical filtration is not a perfect one." Efficiencies are given of something over 99 per cent; but, what about the remaining bacteria which may be dangerous to health, and the percentage number of which remaining must depend upon the original number to start with? To this assertion, only one answer can be given. Science has not yet discovered any method which can guarantee absolute perfection in purification of water methods.

The fact that one hundred per cent. efficiencies have not yet been obtained in practice by any method of purification of water by filtration, has led to many experiments being made in sterilisation. It is admitted that any system of straining or filtering, even if added by the formation of a scum blanket, as in slow sand filtration, or by the addition of a coagulant, as in the case of mechanical filtration, will still allow some bacteria to pass which may or may not be injurious to the human system. It is natural, therefore, that the question has been asked. Is it possible to destroy all the bacteria in the water, by adding something to the water which will destroy the bacteria without injuring the water as far as its drinking properties are concerned? Experiments have been carried out for many years of applying different chemical forms of chlorine, both electrically and directly obtained, to water; as well as attempting to impregnate water by intensified forms of oxygen such as ozone, with the idea of disinfecting the water and rendering inert all properties of micro-organic character. While laboratory experiments have shown, that, it is possible to sterilise a water, absolute sterilisation has never been reached in practice. In dealing with large quantities of water, the difficulty has never been overcome, of reaching every particle of the water with the disinfectant. Further, in the case of water containing matters in suspension, it has been found impossible, in practice, to penetrate these matters so as to obtain absolute disinfection.

Disinfection or sterilization may be feasible as an adjunct or accessory to filtration; but as a method of purifying water, by itself, it is absolutely useless. For instance, if we could obtain a water entirely free from all suspended matter, and containing only organic matter in solution along with the presence of bacteria, then sterilisation might be effective. But no such water is ever placed before us to deal with, unless it has been first treated by efficient filtration. We, therefore, find that in all cases of so called sterilisation processes, filtration of the water is insisted upon as a primary necessity. We have a case illustrative of this point in Canada at the present time at Lindsay, Ontario. At Lindsay, there has been recently installed an ozone sterilising plant. The water is first treated by filtration, and then charged with the ozone gas. The filtration is only of a rough and ready character as it is expected that the ozone will do the real work. According to a recent analysis of the treated water, however, we find that the filters remove 67 per cent. of the bacteria, and that the ozone only removes a further 57 per cent of the bacteria from this partially clarified water. The total percentage removal of bacteria from the original water by the combined processes being only 87 per cent, or 8 per cent. below the standard required for mechanical filters.

In the above case, if filtration had been of an efficient character to remove the whole of, or practically the whole of, the suspended matter, the result might have been satisfactory, too much was asked of ozone, and two little of filtration.

The fact of the matter is, that up to the present, no data exist which will allow of a pronouncement in favor of sterilisation as opposed to filtration. On the other hand, sterilisation may be a useful and efficient addition to filtration in certain cases, where the original organic impurities are so high as to leave an undrinkable water with a bacterial removal of even over 99 per cent.

It must be remembered, that, one of the chief reasons for filtering water will always be the removal of sediment which causes turbidity and choking mains. All the methods of sterilisation, yet put forth, do not affect turbidity or matter in suspension, unless, aided by filtration. It must be filtration first, and the best that can be done by filtration; then if necessary, when all is filtered out that it is possible to filter, sterilisation may follow as a method of dealing with matter in solution or so minute that any filter cannot take cognisance of it.

THE FLOW OF WATER IN PIPES, CULVERTS AND CHANNELS.*

Being a Comparison of Different Formulæ in Common Use, and a Record of Some Recent Tests.

By Ernest H. Essex, A.M.I.C.E. (Graduate), Deputy Surveyor, Leyton.

Every municipal engineer is called upon more or less frequently during his professional career to make calculations for the discharge of sewers or water mains; the issue at stake is often of considerable importance, especially when the question of pumping arises, and it is, therefore, the more surprising to find such a difference of opinion existing as to the best formula to be used in the calculations. Not a little of this is due to experts and experimentalists endeavoring to supply a comprehensive formula which shall at one and the same time apply to such extreme cases as, say, a small channel formed with smooth-planed boards on the one hand, and the River Mississippi on the other; whereas the municipal engineer's requirements will probably be well covered by particulars as to pipes and culverts ranging up to 9 feet diameter. The author will endeavor to show that old original formula of Chezy* *—i.e., $V = C\sqrt{rs}$ is to this day the most **practical** formula to use. and it may not be out of place here to quote the following extract from a recent leader in one of our professional papers: "Formulæ are never essential, but often convenient. We would even go further and say that the misuse or abuse of formulæ is responsible more than anything else for unintel-

* Paper read before the Institute of County and Municipal Engineers, England.

**Throughout these notes all letters will have the following meaning:—

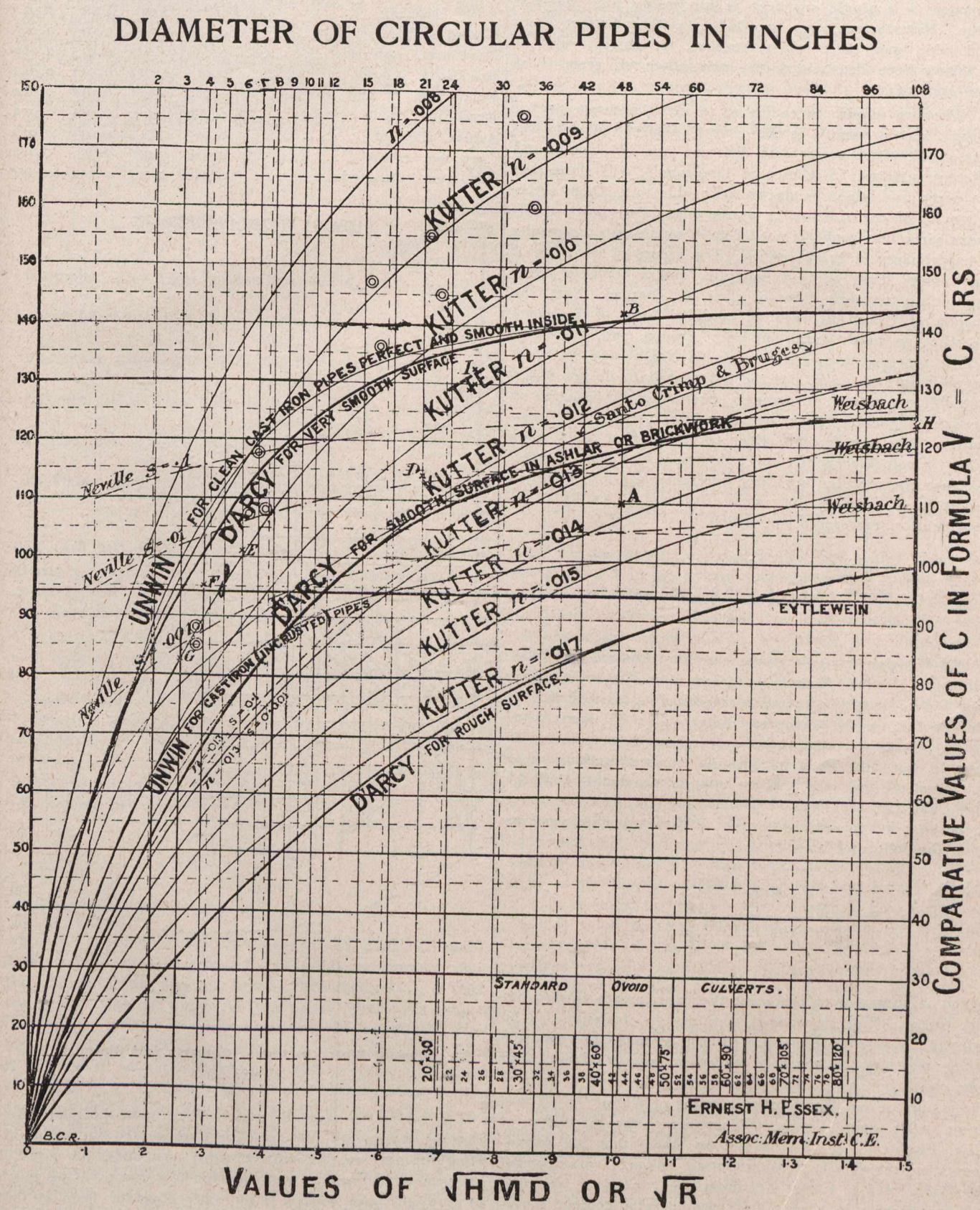
V = velocity in feet per second.
r = hydraulic mean depth in feet.
s = sine of slope.
n = coefficient of friction.
e = coefficient of entrance to pipe.

ligent engineering and bad text-books. The blind use of formulæ is to be deprecated; it is a reliance upon authority (often unknown), not on personal knowledge. When we believe a thing because somebody else has said it, we don't really know it, we only know that we think he thinks he knows it; this is wholly destructive of the scientific habit of mind, and is a growing evil in popular science. We do not mean that no one should use a formula without verifying it, but he ought to know whether it is absolute or empirical, and, if the latter, within what limits it is trustworthy, and on what experimental evidence it rests." Some engineers are quite satisfied to pin their faith to the Chezy formula, using Eytlewein's value of 94 for the empirical constant C or Beardmore's adaptation of the formula, $V = 55\sqrt{r} \times 2f$, while others are content to use the tables in Molesworth's Pocket-book based on Neville's formula, $V = 140\sqrt{rs} - 11^3\sqrt{rs}$. Some are still in love with Weisbach's formula:—

$$V = \sqrt{\frac{2gH}{1+e+\left(n\times\frac{L}{4r}\right)}}, \quad H = \left\{1 + e + \left(n \times \frac{L}{4r}\right)\right\}\frac{V_2}{2g},$$

$$n = 0{\cdot}01439 + \frac{0{\cdot}016921}{\sqrt{V}}, \text{ and } L = \text{length of pipe in feet}$$

probably because it looks somewhat imposing in print; but it would puzzle them to find much difference between the results obtained by this formula and that of Neville. In 1878



Flow of Water in Pipes, Culverts and Channels.

(Plate I.)

this formula appealed so strongly to the eminent sanitary engineer, Mr. Baldwin Latham, that he was persuaded to publish in the second edition of his book "Sanitary Engineering" a revised set of tables based upon the following modification of it:—

$$V = \frac{64.4}{1.505 + \frac{nV}{4\sqrt{rs}}}$$

These tables have been, and the author is afraid still are, very largely relied upon by municipal engineers; it is, therefore, the more surprising to note that the formula might quite as well have been written $V = 100\sqrt{rs}$, and that had it been so written at that time it could never have appealed to a single engineer as possessing any practical value. Nevertheless, this knowledge confers distinct practical value upon these tables, because, the correct value of C having been determined, the percentage of error is at once apparent.

What we require to enable us to make accurate use of Chezy's simple formula is the correct value of the empirical constant C, which varies with different sizes of channel and different surfaces. A glance at Diagram I. will show that one curve line might be drawn applicable to a whole series of results of experiments in glazed pipes, but quite a different curve line would be needed to coincide with the results of experiments in brick sewers. The record of each set of experiments must be kept separate, and a separate curve line set up for each different class of channel. Now, the formula of Eytlewein and the modified form of Weisbach are what we might term one-line formulæ, and, therefore, of little practical use. The formulæ of Neville and Weisbach are multi-line formulæ, but the different lines do not represent different classes of channels, only different velocities in the same channel; they are, therefore, useless and misleading. The next formula given to us was that based upon D'Arcy's valuable experiments; this may be called a three-line formula, representing three different classes of channel, and it is of considerable merit. Its worst feature is its mathematical representation, which is—

$$V = \frac{1}{\sqrt{A\left(1 + \frac{B}{r}\right)}}\sqrt{rs}$$

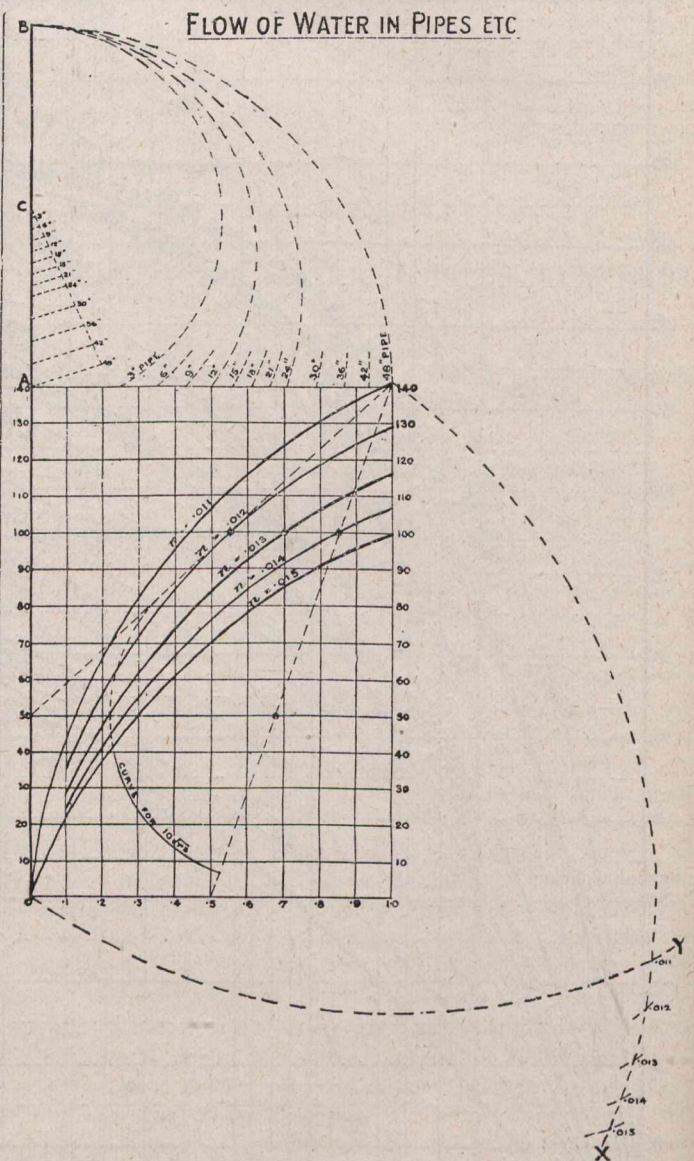
A and B being variable coefficients for different surfaces. Professor Unwin's formula is based upon D'Arcy's, being modified to suit the extensive experiments carried out by Dr. Riedler on the compressed-air mains of Paris. For water, steam, and compressed- air mains it is undoubtedly reliable, but, like D'Arcy's formula, it is something of a mathematical nuisance. There can be no doubt that the mathematician considers the municipal engineer fair game to be shot at, for on the top of all these abominations we have the following atrocity:—

$$V = \left\{\frac{\frac{1{\cdot}811}{n} + 41{\cdot}6 + \frac{0\ 00281}{s}}{\left(1 + 4{\cdot}16 + \frac{0{\cdot}00281}{s}\right)\frac{n}{\sqrt{r}}}\right\}\sqrt{rs}$$

which is supposed to represent the experiments carried out by Kutter. This is, indeed, a multi-line formula, for by adopting different values of n it can be made to cover the whole diagram. It must be called an active formula, but who can call it a practical one, unless it be used to express the results of our experiments in terms of Kutter? This was done by Mr. Santo Crimp in his paper to the Institution of Civil Engineers in 1895, where he stated that his experiments on the North London outfall culverts corresponded to a value of n in Kutter's formula equal to 0.0122, and that his experiments in a new brick semicircular channel corresponded to a value of n = 0.095. In these statements, however, Mr. Santo Crimp was not quite correct, for a glance at the diagram will show that the first case, point H, corresponds to n = 0.014, while the latter, point I, corresponds to n = 0.0109. The fact that so eminent an engineer could make an error of 15 to 20 per cent. in his estimation of the value of n in connection with his own experiments seems to point to the formula being a dangerous one to play with; but, being the latest mathematical toy, it is to be presumed that many engineers will continue to use it, and the most to be hoped for is that an occasional reference to the diagram will enable them to keep somewhere within the bounds of probability in making choice of the value of n to adopt, and the following table may, perhaps, prove useful also:—

Table No. 1.—Average Values of n (Kutter).

Material.	Condition of Surface. Perfect.	Good.	Fair.	Bad.
Glazed stoneware pipe.....	0.010	0.011	0.013	0.015
Brickwork, ordinary	0.011	0.013	0.015	0.017
Brickwork, glazed	0.010	0.012	0.013	0.015
Rendering, cement mortar.....	0.010	0.011	0.012	0.014
Rendering, neat cement.....	0.009	0.010	0.011	0.014
Ashlar, dressed	0.013	0.014	0.015	0.017
Cast-iron, coated	0.009	0.010	0.011	0.014
Cast-iron, uncoated	0.010	0.011	0.012	0.014



Flow of Water in Pipes, Culverts and Channels.
(Plate 2.)

It is wise to pause here and reflect upon the many misleading statements that have been presented to the municipal engineer on this subject in the past under the cloak of mathematical formulæ, and consider how unconvincing much of it would have looked if put into diagram form at that time. We must not, however, be too ready to imagine that the increased use of diagrams can insure against the pro-

duction of further misleading mathematical formulæ of an empirical nature.

In 1895 Mr. Santo Crimp published another new formula, namely:—

$$V = 124^3 \sqrt{r^2} \times \sqrt{s},$$

and later still, Messrs. Saph and Schoder presented us with $V = 174\ r.^{67}\ s.^{54}$ as the one infallible formula for water mains. It is a source of wonder and great surprise that engineers can be found willing to countenance or adopt such proposals as these. What can a formula like Mr. Santo Crimp's possibly have to recommend it? A glance at the diagram shows it to be one of those practically worthless formulæ we have just now designated one-line formulæ; hence it is not surprising to find that it does not in any way coincide with his own experiments as indicated at points H and I. Mr. Lloyd-Davies, in an article to the Institution of Civil Engineers, in 1906, states that "Mr. Santo Crimp's formula has been demonstrated by experiments in Birmingham to be very accurate for sewers that have been in use for some time," and so spreads abroad a certain amount of credit for this impossible formula. The only experiment he quotes is that of a 4-ft. 6-in. sewer with about 1 ft. depth of flow, giving a result of C = 92 for a value of $\sqrt{r} = 0.418$, which is marked on the diagram with a **X**. Scaling, however, from the diagram accompanying the paper, we get a result of C = 87 for a value of $\sqrt{r} = 0.437$, marked on the diagram with a **O**. It is, to say the least, misleading to argue from this one experiment that Mr. Santo Crimp's formula is correct; we might just as well argue that the experiment proves Eytlewein's formula to be correct, which we know to be impossible; or we may argue that it proves D'Arcy's formula for brick culverts to be correct, which is more than probable. Again, as recently as 1907, Mr. A. W. Brightmore proposed yet another new formula for iron pipes, namely:—

$$V = \frac{112}{1 + \frac{3{\cdot}6}{d^2}} \sqrt{rs}$$

which he based upon the three experiments shown at points E, F, and G on the diagram. It is needless to comment upon the merits of this formula beyond remarking that it illustrates the extent to which the profession may suffer, unless it decidedly refuses to countenance any further matematical formulæ of an empirical nature. What the author does hope is that every municipal engineer reading this paper will determine to set up in his office a chart for different sewers, and mark thereon the value of C in Chezy's formula as found by him from any experiments he may make from time to time. Points marked on such a diagram present a number of distinctly interesting facts in a very concise manner; thus points A and B represent the value of the coefficient found by Desmond Fitzgerald in two 1,800-ft. lengths of 48-in. cast-iron water main, A showing the result after sixteen years, when the pipes were badly tubercled, and B the improved result after the pipes had been scraped and cleaned, very closely approximating to the value found for the same pipes when new. Point D represents the value of C found by Mr. C. A. Friend for the discharge from five miles of 21-in. cast-iron water main after ten years' use. Points E, F, and G are the average of a number of tests carried out by Mr. A. W. Brightmore at the Royal Indian Engineering College on 3-in., 4-in., and 6-in. cast-iron pipes, clean but uncoated. Point H shows the value of C found by Mr. Santo Crimp from the discharge of the three 9-ft. brick culverts of the North London outfall after twenty-eight years' service, and point I the value found by him for the discharge in a 300-ft. length of new 3-ft. semi-circular channel constructed with hard bricks in cement finished to a perfectly smoth surface, with an inclination of 1 in 1,200, and flowing at a depth of about one foot.

The points indicated by the double circles represent the extreme values of the coefficient found by the author from a series of experiments carried out in a 250-ft. length of effluent channel at the Leyton sewage disposal works after the channel had been in use for five years. It was laid to a fall of 1 in 2,775, and constructed with a flat concrete invert, 6 ft. wide, rendered with cement mortar, and having red brick in cement side walls built to a batter of 1 in 2; the discharge was by floating arms from precipitation tanks of about 280,000 gallons capacity each, carefully measured to obtain the correct rate of flow, and took place through submerged pipes at right angles to the channel, the length of channel selected for the experiment being 350 ft. from the nearest tank outlet in order to modify as far as possible any effect from the initial velocity of discharge. The value of the coefficient compared with Kutter's formula will be seen to lie between n = 0.009 and n = 0.010. The mean velocity was tested with both limewater and permanganate of potash, and the value 0.83 of the observed central surface velocity was found to be consistently accurate. A short summary of the figures obtained is given in the following table. It may be noted that the observed depths of flow vary somewhat considerably from the calculated depths, and this indicates one of the greatest difficulties in conducting such experiments, and emphasizes the advantage of being able to measure the rate of discharge. It is also important to note that some proportion of the readings indicated a fall of ½-in. in the water level in the length of channel tested, which in the case of this very flat channel has the effect of altering the hydraulic gradient to 1 in 2,000, and would reduce the value of C to between n = 0.010 and n = 0.011.

The author made himself a slide rule based on Chezy's formula, with an additional scale for correcting the value of C, which was found to be most convenient. Having obtained the value of $\sqrt{r}$ for each test, the slide was moved until this value came opposite the gradient figure 2,775, and the correct value of C read off on the scale opposite the observed velocity.

Table No. 2.

Channel 6 ft. wide. Fall 1 in 2,775.	Observed. Measured rate of discharge. Cubic feet per second.	Observed. Depth of flow. Inches.	Observed. Velocity of flow. Feet per second.	Calculated. Area of flow Feet	Calculated. Depth of flow. Inches.	Calculated. $\sqrt{r}$	Value of C.
November 4th—Eight tests—Highest	0.2123	0.9	0.454	0.4676	0.929	0.275	87
Lowest	0.2123	0.95	0.443	0.4792	0.9521	0.2785	85
November 6th—Eight tests—Highest	0.8	1.7	0.82	0.9756	1.932	0.394	108
Lowest	0.8	1.7	0.77	1.04	2.06	0.407	98
November 3rd—Eight tests—Highest	0.783	1.7	0.863	0.907	1.79	0.381	118
Lowest	0.625	1.45	0.740	0.8446	1.667	0.3676	107
October 31st — Four tests — Highest	3.54	3.85	1.6	2.2125	4.31	0.570	147
Lowest	3.54	3.9	1.5	2.36	4.597	0.589	135
October 31st — Four tests — Highest	6.25	4.7	2.0	3.125	6.048	0.673	155
Lowest	6.25	5.3	1.9	3.289	6.367	0.690	145
November 7th—Seven tests—Highest	15.125	9.75	2.777	5.445	10.178	0.825	176
Lowest	15.125	10.0	2.594	5.831	10.899	0.8537	158

Just one word for the benefit of the many students connected with the association. Whenever presented with an intricate mathematical formula try to plot it in a line diagram, and it will be surprising how familiar the formula becomes. Consider the case of Kutter's formula. From the table on page 4 it will be seen that all ordinary cases are covered by values of n = 0.011 to n = 0.015, and it is not difficult to remember that in the case of a 4-ft. culvert where $\sqrt{r} = 1$, the value of C in Chezy's formula varies from 100 for n = 0.015 to 141 for n = 0.011. Take a sheet of squared paper (see Diagram II.), number the vertical lines 0 — 140, to represent values of the coefficient C in Chezy's formula, and the horizontal lines 0 — 1 to represent values of $\sqrt{r}$. From centre 0, with radius 0 — 141, describe the arc 141 — x, and from centre 141 with same radius describe the arc 0 — Y; from the point of intersection, still using the same radius, describe the curve 0 — 141, which represents the values of C for n = 0.011. From point 100, with same radius, intersect the arc 0 — x as shown, and from this point as centre describe the n = 0.015 curve. From the three points shown on the 100 line (the positions of which once studied can never be forgotten), intersect the arc 0 — x as before, and still with the same radius describe the other three curves, and the diagram is complete for the five curves. After constructing such a diagram twice or three times, any student could set it up in five minutes in the examination-room. Note also the easy method of finding graphically the values of $\sqrt{r}$ for circular pipes at the top of the diagram. AB is a line, one unit in length, at right angles to the 140 line, upon which we desire to set out our values of $\sqrt{\frac{r}{2}}$. CA, therefore, equals 0.5, which is the value of $\frac{r}{2}$ for a 48-in. pipe; divide CA into forty-eight parts, and it represents the value of $\frac{r}{2}$ for any other diameter in inches, measuring from C. With centre at A and radius AB we obtain the value of $\sqrt{r}$ for a 48 in. pipe; with centre 24 and radius 24 — B, we obtain the value of $\sqrt{r}$ for a 24-in. pipe, and so for all sizes.

Join diagonals 141 — 50 and 141 — 0.5 as shown, and from the point of intersection of line 50 with diagonal 141 — 0.5 as centre, and with radius touching diagonal 141— 50, describe the curve shown. Within the limits of line 40 and diagonal 141 — 0.5 this curve will give very accurate readings of $10\sqrt{rs}$ on the horizontal line, for all values of $\frac{L}{d}$ read on the vertical line; L being the length of sewer required for a fall of 1 ft., and d the diameter of the pipe in inches. Thus, in the case of a 12-in. pipe with a fall of 1 in 300, $\frac{L}{d} = 25$; we find from the diagram that $\sqrt{rs} = 0.0295$, and if the value of n is taken at 0.013, C = 85; therefore, V = 85 × 0.0295 = 2.5 ft. per second, which is certainly preferable to attempting to work the mathematical formula presented to us.

In conclusion, the author desires to express the hope that this paper may be found to comprise a fairly complete and reliable summary of the best available information hitherto published with reference to the subject under consideration, and enable the busy engineer to readily acquire a wider grasp and comprehension of the relative value and importance to be attached to the various arguments upon the question which may be laid before him. The present incomplete record of the results of reliable experiments is a certain guarantee that fresh argument will still be forthcoming, but if this paper may in any way assist to minimize the undue importance given to arguments only slightly affecting the question, the consideration of which but tends to the confusion of that clear issue which should be the sole desire of everyone, the author will feel amply compensated for any trouble he has taken. It is quite certain that the simplification of the problem rests in the hands of the Association, so many of whose members have charge of sewers and culverts delivering into or out of storage and disposal tanks where the rate of discharge can be accurately measured, and water mains where the hydraulic pressures during discharge can be readily obtained. Particulars of reliable tests, if forwarded to the secretary, could be readily examined and plotted on a chart, which should ultimately prove of inestimable value.

It has been the author's endeavor throughout to emphasize most strongly his view that in all cases of empirical formulæ it is the experiments upon which such formulæ are based which are likely to prove of real value, while the formula itself may eventually prove, owing to its necessary limitations, to be inaccurate and misleading. In attempting this he trusts he will have given offence to none, but that many engineers will be found of the same opinion, and many others converted to it.

NATIONAL TRANSCONTINENTAL RAILWAY.*

Duncan MacPherson, M. Inst. C. E.

An act respecting the construction of a National Trans-Continental Railway was assented to by the Dominion Parliament on October 24, 1903, which provided for the construction of a line to be operated as a common railway highway across the Dominion of Canada from ocean to ocean, and wholly within Canadian territory.

This line was, by the Act, divided into two distinct parts—the Eastern Division, from Moncton to Winnipeg, to be constructed under a Government Commission; and the Western Division, to be constructed by the Grand Trunk Pacific Railway Company, extending from Winnipeg to the Pacific Ocean.

The Act provides that the Eastern Division shall be built from the eastern terminus at Moncton through the central parts of the Province of New Brunswick and through the Province of Quebec, by the shortest available line, to the city of Quebec; then westerly through the northern part of the Provinces of Quebec and Ontario, and through the Province of Manitoba to the city of Winnipeg; according to such plans and specifications as may be determined, having due regard to directness, easy gradients, and favorable curves.

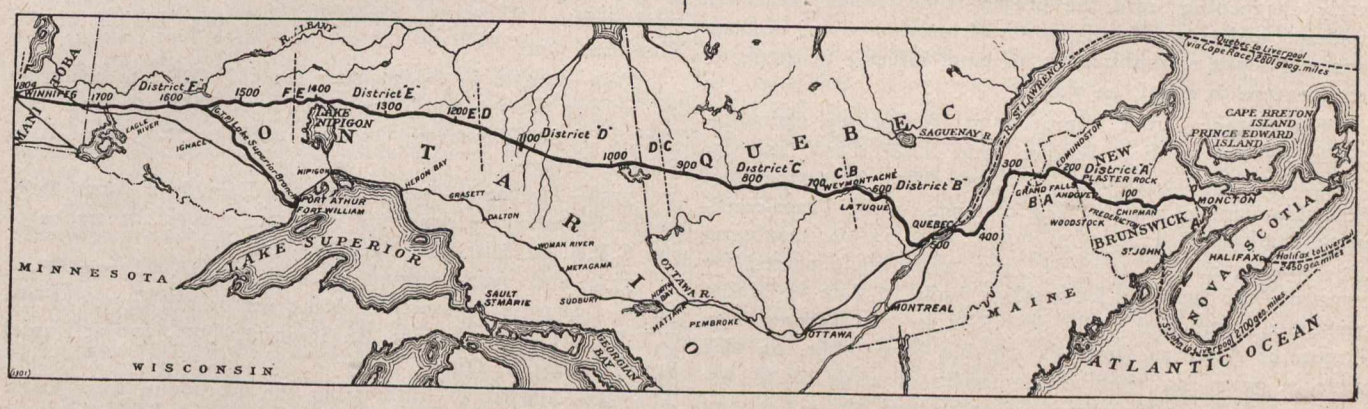
The Commissioners and Chief Engineer were appointed by Order-in-Council, August 20, 1904, and met within a few days for organization. One of the first questions to determine was in regard to the survey work to be undertaken, during the autumn and winter, on that portion of territory not covered by the Grand Trunk Pacific Railway parties who were out east of Winnipeg, in the direction of and nearly up to Lake Abitibi. It was decided to form the territory between Moncton and near longitude 84 degrees into four districts—"A," "B," "C," "D"—"A" from Moncton to the boundary between the Provinces of New Brunswick and Quebec, supposed to be about 290 miles; "B" from the boundary to Clear Lake, about 420 miles; "C" to the provincial boundary between Quebec and Ontario, about 300 miles; "D" to near longitude 84 degrees, about 240 miles.

Soon after these four districts had been formed the Commissioners arranged to take over from the Grand Trunk Pacific the survey parties east of Winnipeg, with their supplies, plans, profiles, etc., and organized two more districts "E" and "F," thus covering the whole distance between Moncton and Winnipeg. District "E" extends about 265 miles westerly from west boundary of "D" to a point about 30 miles west of Lake Nepigon. District "F" extends from this point to Winnipeg, about 385 miles. The

*Read before the British Association for the Advancement of Science, Winnipeg, 1909.

total distance from Moncton to Winnipeg was estimated to be about 1,900 miles, on what was assumed to be the most direct feasible route. The problem to be solved of definitely locating this most direct and feasible route was not an easy one, when it is remembered that for more than half the distance the line of general directness ran through an unsurveyed, unsettled, and practically unknown region, cut up in all directions with a network of lakes and rivers, many of them not shown on any existing maps, and, when so indicated, often found to be entirely misplaced. Our engineers had, therefore, in many cases to make their own maps as the surveys proceeded, and in all cases to correct and complete existing maps.

During the autumn of 1904 and the following spring some thirty-four survey parties were equipped and sent out, and before the end of 1905 there were forty-five parties in the field, consisting of about eighteen men each, not counting a large number of men engaged in transporting supplies by canoe and packing in summer, and by dog train in winter. Each survey party had an engineer-in-charge, transitman, leveller, topographer, draughtsman, rodman, picketman, and two chainmen, cook and eight or nine axemen and packers. Each party was given certain governing points to connect, and instructed to thoroughly exhaust the possibilities for the most favorable and reasonably direct line between these points. Barometric explorations and compass lines were followed by preliminary lines run with transit, and plans were plotted with 10-ft. contours on a scale of 400 ft. per inch.



With these plans and profiles on the same scale, projected locations were made on the most favorable lines, and afterwards actually run on the ground, and called a "first location." These plans and profiles were plotted in the field, and tracings, with reports, sent to headquarters monthly. These reports were carefully gone over by the chief and assistant chief engineer, necessary changes suggested, and instructions issued accordingly. Whenever the head of a party completed what he considered the best possible first location, the engineer-in-charge was changed, and another man given a chance to improve the line by making his best attempt at a revised location. The original head of the party, or a third man, was given a chance to still further revise for a further location. In this way it was found that a healthy rivalry was established, and good results obtained. Revision of location is, however, never considered as finished until construction work is well under way, as it is often found, after the line is cleared, that slight changes will effect a very considerable saving. An equation table giving definite values for savings in distance, curvature, rise and fall etc., was furnished all parties in the field, so that, having the estimated cost of construction of any two or more lines, the better one to adopt from all points of view could be at once determined. Copy of equation table annexed.

Maximum Curves.—The maximum curve used is 6 deg. (radius, 955 ft.), and is only used sparingly where the topographical conditions prohibit an easier radius with reasonable cost. All curves of 1 deg. (radius, 5,730 ft.) and sharper are connected to their tangents with easy spirals.

The maximum grades decided upon are, so far as the writer is aware, the easiest on any transcontinental line in America, being on tangents 0.4 per cent. =21.1 ft. per mile adverse to the major or east-bound traffic, and 0.6 per cent. = 31.68 per mile against the comparatively minor west-bound traffic. These maximum grades are used sparingly, and only for the purpose of avoiding heavy work. On curves the grades are reduced 0.04 ft. per degree in the index of the curve, so that on the maximum curve of 6 deg. the maximum east-bound grade would be 0.4 minimum 6 × 04 = 0.16 per cent., or 8.44 ft. per mile.

The whole line between Moncton and Winnipeg, with the slight exception of short approaches to the Quebec Bridge on 1 per cent. grades, was definitely located with the above-mentioned very easy maximum grades; but at one point in New Brunswick, at mileage 146 from Moncton, it was found that, by the insertion of about 12½ miles of 1.1 per cent. grade adverse to east-bound traffic a saving could be made of 17.2 miles in distance, nearly $2,000,000 in construction, $1,250,000 in capitalised operating value.

At another point in Quebec, near mileage 286 from Moncton, a similar grade, about 10 miles long, adverse to west-bound traffic, was found to effect a saving of 18.8 miles in distance, about half a million in construction, and over three-quarters of a million dollars in capitalised operating value. These possibly temporary grades were adopted with the corresponding saving in distance and cost. If the future traffic of the road justifies the expense, these two short links of standard grade can be built at any time.

The proviso for directness of alignment proved a very wise precaution, as, in the province of New Brunswick es pecially, the people inhabiting the fertile, well-settled, St. John River Valley, very naturally desired to secure the advantages which would accrue to their beautiful section of country by the construction of a trans-continental railway. the fact that this would unnecessarily lengthen the line by 29 miles—a most important factor on a through route—did not appeal to them as strongly as to the inhabitants of the more western provinces, anxious to secure the best possible outlet for the rapidly increasing volume of freight from the greatest potential wheat-fields of the world. Fortunately, our engineers were able to prove that the direct line would not only be much shorter, and effect a great saving in operation, but also that the total cost of construction would be very considerably less. An additional factor in favor of the direct line was the openng up new territory not hitherto enjoying railway facilities, whereas the St. John Valley is already served by the Canadian Pacific, and, to some extent by the Intercolonial Railway.

The surveys being well advanced for some distance east of Winnipeg and west of Quebec, tenders were called for, closing on March 12, 1906, for 150 miles of line from the north side of the St. Lawrence, at Cap Rouge westward, and for a steel viaduct 3,000 ft. long, 150 ft. high, across the Cap Rouge Valley; also for 245 miles from near Winnipeg to Peninsula Crossing, near the proposed junction with the Fort William branch of the Grand Trunk Pacific Railway. This branch line had been under construction for some time, and the intention was that, as soon as it and the portion of the main line between the junction and Winnipeg was completed, to start operating between Fort William, Winnipeg and west, thus giving another outlet to the Great Lakes from the western wheat-fields.

The summer of 1906 was a busy one in railroad construction all over the continent of North America, the result being that wages rose to the abnormal rate of $2.50 per day for unskilled labor, and even then good men were almost impossible to obtain, so that progress was not as fast as was anticipated on the first two main contracts let. The financial depression of 1907 proved, in some ways, a blessing in disguise to railway contractors; as only roads which were strong financially were able to do any new construction, men were more plentiful and at reduced wages. From time to time, as the final location was completed on different sections, new contracts were let until, on October 29, 1908 the last contracts were let on districts "D" and "E" In the summer of 1908, an army of 21,000 men were working on the various contracts between Moncton and Winnipeg. The originally estimated distance of 1,900 miles between these points had been reduced gradually by repeated revisions of location at various points to a distance of 1804.8 miles. This distance is 261 miles less than the shortest distance over any other combined railways between Moncton and Winnipeg. The distance between Winnipeg and Quebec City, over the Trans-continental Railway, will be 1,351 miles, which is 223 miles shorter than the Canadian Pacific Railway, and the grades are so much more favorable that engines of equal capacity should haul nearly twice the load on the former line that they could on the latter.

Transportation of grain by water has always been much cheaper than by rail, but the latter has been slowly and surely cheapening until the present time, when the easy gradients and tremendously powerful locomotives of modern lines will make a combination on land, difficult to excel, or peradventure to equal, on water.

The distance from Winnipeg to Quebec via Canadian Pacific Railway to Fort William and Lake Canal and St. Lawrence River to Quebec is 1,771 miles, involving five trans-shipments of wheat. The distance on the Trans-continental Railway will be 1,351 miles, and, as the maximum east-bound grade is 21.12 ft. per mile, compensated for curvature, the heaviest locomotives built to date—a Mallet articulated compound, fully described in the Railway Age Gazette of April 30, 1909—is capable of hauling, on this grade, a gross load behind the tender of 4,290 tons, Assuming the tare 33⅓ per cent. of gross load, the net paying load would be 2,860 tons, equal to 95,333 bushels of wheat, in one train. If we assume the earnings of such trains to be $4.40 per train mile, or exactly double the earnings of the Canadian Pacific Railway freight train-miles for 1908, we find the cost per bushel over the 1,351 miles between Winnipeg and Quebec to be 4.25 cents. The lowest rate that the writer is aware of having been in force from Fort William to Montreal, via the Lake Canal and St. Lawrence River, a distance of 1,216 miles, was 4 cents per bushel in 1908. This 4 cents per bushel for 1,216 miles would be equivalent to 4.44 cents for 1,351 miles, so that at $4.40 per train-mile the engines above referred to could haul grain on the Trans-continental Railway, east-bound from Winnipeg to Quebec, for 0.19 cent per bushel cheaper than the cheapest existing water route could haul it the same distance, and 10.86 cents per bushel cheaper than the present combined rail and water rates betwwen the two points in question. In brief, at about one-quarter the present rail and water rate.

It would appear that the days of the absolute supremacy of water transportation were in danger of at least a partial eclipse. Owing to the comparative inaccessibility of parts of the line, about 300 miles of it are yet actively under construction, though roads are being made and supplies put in, so that by the end of the year the whole line, not already finished, will be covered with workmen, rock-drills, steam-shovels, and all the necessaries of modern railway construction. In order to keep check on the rate of progress of the work the writer introduced on this line percentage forms of reports, being notifications and extensions of similar forms in use on the Canadian Pacific Railway. Form 127, sample annexed, is returned to the writer monthly by the division engineers through the district engineers, and it is then graphically plotted on the diagram, sample annexed, which shows at a glance not only the percentage done during the month on grading, ballasting, and all the other items of construction, but also shows the percentage done to date under each of these headings, and the percentage done of the whole work in each main contract. This form of report has been found invaluable as an aid in answering requests for information from the House of Commons when in session, and for compiling our annual reports.

Our engineering organization consists of a chief engineer and assistant chief engineer, bridge engineer, district engineers, each in charge of a district from 250 to 400 miles long; division engineers, in charge of from 40 to 50 miles; resident engineers, in charge of 10 to 15 miles.

The annexed map, together with the foregoing general description, will, it is hoped, give a fair idea of the methods pursued in locating and constructing a great transcontinental line through a partial wilderness.

ORDER OF THE RAILWAY COMMISSIONERS OF CANADA.

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

7735—August 6—Recommending to Government-in-Council for approving by-law of C.N.R., with respect to spitting and smoking in railway cars and premises.

7736—August 6—Authorizing the Canadian Northern Quebec Railway to construct its railway across the public road between lot 624 and lots 622 and 623 Parish of St. Timothee, Que.

7737—August 6—Authorizing the C.N.Q.R., to construct its railway across public road between lots 162 and 159, Parish of St. Timothee, Que., at mileage 76.15 west from Quebec Bridge.

7738—August 6—Authorizing the Hazeldean Rural Telephone Company to construct its wires across the tracks of the C.P.R. at Stittsville Station, Ont.

7739 and 7740—August 5—Authorizing the Bell Telephone Company to erect its wires across the tracks of the G.T.R. at Ouimet Avenue, St. Laurent, Que., and at Daniel Street, Arnprior, Ont.

7741—August 5—Authorizing the Moosomin East Rural Telephone Company to erect its wires across the tracks of the C.P.R. between Section 27 and 34, Township 13, R. 31, W. 2 M., Saskatchewan.

7742—August 5—Authorizing the Leeds and Grenville Telephone Company, Ltd., to erect its wires across the tracks of the C.P.R. at Spencerville crossing on the Prescott and Ottawa branch.

7743 and 7744—August 5—Authorizing E. Blanchard, M.D., of Cannington, Ont., to erect telephone wires across the tracks of the G.T.R. at 11th Concession, Township of Brock, and at the side line south of Laidlaw Street, Cannington, Ont.

7745—August 20—Authorizing the C.P.R. to construct its railway across the road allowance known as the Banff Trail near Anthracite, Alta.

7746—August 5—Approving of location of the C.N.R. from Sec. Tp. 15, R. 17, W. of the 6th M., to Section 11, Township 14, R. 17, W. of the 6th M., mileage 0. to 5, B.C.

7747—July 23—Amending order No. 6538, dated March 18th, 1907, with respect to steel rolled tires on locomotive wheels.

7748—August 3—Authorizing the Bell Telephone Company to erect wires across the tracks of the C.P.R. at public highway crossing at about 600 feet west of mileage 49 (west of Webbwood, Ont.).

7749—August 7—Staying proceedings under Order 7394, dated June 28th, 1909, with respect to the G.T.R. station at Guelph, Ont., until question of subway at Neeve Street is disposed of.

7750—August 10—Authorizing the Thedford, Arkona and East Lambton Telephone Company, Ltd., to erect its wires across the tracks of the G.T.R. at Thedford, Ont.

7751 to 7753—**August 10—Authorizing** the Bell Telephone Company to erect its wires across the tracks of the C.P.R. and G.T.R. at three different points.

7754 to 7756—**August 10—Authorizing** the British Columbia Telephone Company to erect its wires across the tracks of the Esquimalt & Nanaimo Railway at 41 mile post near Duncans, B.C.; at the Quamichum Lumber Compnay's Saw Mills, near Duncans, B.C.; and at Evan's private crossing, near Duncans, B.C.

7757 to 7759—August 6—Authorizing the Hazeldean Rural Telephone Company to erect its wires across the tracks of the C.P.R. at a point three miles east of Stittsville Station, main line, at a point six miles east of Stittsville Station, and at a point five miles east of Stittsville Station, Ont.

7760—August 10—Authorizing the Claremont and Ashburn Telephone Company to erect its wires across the tracks of the G.T.R. at Mill Street, Brooklin, Ont.

7761—August 10—Authorizing the C.P.R. to construct a highway bridge carrying First Street, Brandon, Man., over Assiniboine River and C.P.R. yard at that point.

7762—August 10—Authorizing the Grand Trunk Pacific to construct its railway across highway between Sections 10 and 11, Tp. 36, R. 15, W. 3rd M., district of West Saskatchewan.

7763—August 6—Authorizing the C.N.Q.R. to construct its railway across public road between lots 624 and lot 27-12. Parish St. Timothee, Que., at mileage 77.11, west from Quebec bridge.

7764—August 10—Authorizing the Grand Trunk Railway to construct a branch line to the Blaugas Co., of Canada, in Parish of Montreal, lots 3409 and 3410.

7765—August 10—**Granting leave to the** Hamilton Cataract Power, Light & Traction Company, to erect, place, and maintain, its electric light wires across the track of the G.T.R., north of Desjardins Canal, Hamilton, Ont.

7766—August 10—Granting leave to the Saskatchewan Government to erect its wires across the track of the C.N.R. between Sections 24 and 25, Tp. 25, Range 29, West 2nd Meridian, Sask.

7767—August 7th—Ordering that the legal switching rate chargeable upon the cars switched by the M.C.R.R. for the Canada Iron Corp., Ltd., of St. Thomas, Ont., from the G.T.R. tracks to their works, between the dates July 19th. 1907, and June 4th, 1908, inclusive, was $3 a car, and the difference between this rate and $6 per car between the dates in question be refunded by the railway company.

7768—August 7—Dismissing complaint of C. W. Stewart. of St. John, N.B., complaining that he is unable to market cornmeal in consequence of an alleged discrimination by the C.P.R. in favor of his competitors and to his disadvantage.

7769—August 12—Granting leave to the Government of the Province of Alberta to place its wires across the track of the Alberta Railway and Irrigation Company at a point between Sections 6 and 9, Tp. 4, Range 24, West 4th Mer.

7770 to 7775—August 12—Granting leave to the Government of the Province of Alberta to place its wires across the track of the Alberta Railway and Irrigation Company at one point, and across the C.P.R. at five points in the Province of Alberta.

7776—August 12—Granting leave to the Bell Telephone Company to place its wires across the C.P.R., 1½ miles east of Durham Station, Ont.

7777 to 7779—August 12—Granting leave to the Bell Telephone Company to place its wires across the C.P.R. at two points and the G.T.R. at one point in Ontario and Quebec.

7780 and 7781—August 12—Granting leave to the Ingersoll Telephone Company to place its wires across the track of the C.P.R. on the First Con. road between Lots 1 and 2, Tp. of West Zorra, County of Oxford, Ont., and between 3rd and 4th Con. between Lots 1 and 2, Tp. of West Zorra, County Oxford, Ont.

7782 and 7783—August 10—Granting leave to the Government of the Province of Saskatchewan to place its wires across the C.N.R. between Sections 22 and 27, and 17 and 18, Tps. 24 and 25, Range 28, West 2nd Mer., Prov. of Sask.

7784—August 10—Authorizing the C.P.R. to construct, maintain and operate branch line to and into the premises of J. D. Clark & Company, Winnipeg, Man.

7785—August 12—Granting leave to the Rural Municipality of Pipestone to place its wires across the track of the C.P.R. at P.C., 3½ miles N.W. of Reston, Man.

7786—August 7—Granting leave to the G.T.R. to appeal to the Supreme Court of Canada from Order of the Board. No. 7613, dated 22nd July, 1909, directing that they provide station accommodation at or near the point where the G.T.R. Company's lines from the City of Hamilton to Niagara Falls. cross the town line between the Tps. of Climton and Louth, County of Lincoln, Ont.

7797—August 7—Directing the Red Mountain Railway to provide and construct a suitable highway crossing over its track at a point a little south of Patterson's Station, B.C.

7788—August 7—Granting leave to the Municipal Corp. of the village of Glencoe, Ont., to place its electric light wires across the track of the G.T.R. in the said village.

7789—July 26—Authorizing the C.N.Q.R. to construct. maintain and operate spur to and into the premises of Warden, King & Sons, Ltd., at Maisonneuve, P.Q.

7790—August 16—Amending Order of the Board, No. 6535, dated March 18th, 1909, by inserting the words "or steel-rolled" after the words "steel tire," in the fifth line of the operative part of said Order.

7791—August 10—Authorizing the Corporation of the City of Vernon, B.C., to lay and thereafter maintain sewer pipes under the track of the Shuswap & Okanagan branch of the C.P.R., where the same crosses South Vernon, Schubert and Seventh Streets, Vernon, B.C.

7792—August 17—Authorizing the G.T.R. to construct. maintain and operate branch line to and into the premises of the Gull Lumber Company on Lot 16, Tp. of Bexley, Ont.

7793—August 17—Authorizing the C.P.R. to construct. maintain and operate industrial spur into the warehouse of the Farmers' Grain & Supply Company at Wauchope, Sask.

7794—August 16—Authorizing the C.P.R. to construct, maintain and operate two branch lines of railway in the Tp. of St. Boniface, Man.

7795—August 17—Granting leave to the C.P.R. to construct a second line of its railway between Bolton & Bolton Junction in the Tp. of Albion, Ont.

7796—August 17—Authorizing the C.P.R. to construct. maintain and operate spur to and into the premises of J. Eveleigh & Company, Montreal. P.Q.

7797—August 17—Authorizing the C.P.R. to construct bridges at mileages 110.3 and 110.6, on the London section of its line.

7798—August 12—Granting leave to the Manitoba Government Telephone to maintain its wires across the track of the C.P.R. at P.C. ¼ mile west of Findlay, Man.

7799—August 13—Granting leave to the Thamesville Telephone Company to erect, place and maintain its wires across the track of the C.P.R. (Ontario & Quebec Railway Company) at North Thamesville, Ont.

7800 to 7802—August 13—Granting leave to the Government of the Province of Alberta to cross with its wires the track of the C.P.R. between Sections 2 and 3, Tp. 25, R. 1. West of the 5th Mer., Alberta, and at Section 3, Tp. 7, R. 20. West of the 4th Mer., Alberta; also at a point 4½ miles east of Camrose, Alberta.

7803 and 7804—August 13—Authorizing the Government of the Province of Alberta to erect its wires across the tracks of the C.P.R. at Osler Street, Carstairs, Alta., and at Hillcrest Station, Alta.

7805—August 13—Authorizing the Government of the Province of Alberta to erect wires across the tracks of the C.P.R. at two miles west of McLeod, Alta.

7806 and 7807—August 13—Authorizing the Bell Telephone Company to erect its wires across the tracks of the London & Port Stanley Railway Company at public crossing

at White Station, Ont., and across the G.T.R. tracks at public crossing at Preston Street, Ottawa, Ont.

7808—August 13—Authorizing the Golden Flat Rural Telephone Company, Ltd., to erect its wires across the tracks of the C.P.R. between Sections 13 and 14, Tp. 15, Range 23. West of 2nd Mer., Saskatchewan.

7809 to 7812—August 13—Authorizing the Volcanic Oil and Gas Company to lay and maintain pipe line to convey natural gas under the tracks of the Michigan Central and Pere Marquette at four different points.

7813—August 13—Authorizing the City of Toronto to construct bridge to carry the highway and tracks of the Toronto Street Railway Company over the tracks of the C.P.R. G.T.R. and C.N.O.R., where such tracks cross Queen Street East, in the City of Toronto, apportioning the costs maintained. Detail plans of bridge and approaches to be submitted to the Board's engineer by the 15th of September. 1909; bridge to be constructed, ready for traffic by July 1st, 1910.

7814—August 16—Authorizing the G.T.R. to construct a branch line extending from a point on its line of railway between Orillia and Midland at or near Tiffin, and running in a southerly direction through the townships of Tiny and Tay to the road allowance between Lots Nos. 91 and 92, in the 2nd Concession of the Township of Tiny, County of Simcoe, Ont.

7815—August 16—Authorizing the G.T.R. to construct branch line extending from a point on its line of railway, near the corner of Victoria Street and Fourth Street, in the town of Midland, Ont., and running in a westerly direction partly through the town of Midland, the townships of Tay and Tiny, and the town of Penetanguishene, to a junction with the Penetang branch of G.T.R. at or near Queen Street in the town of Penetanguishene, Ont.

7816—August 16—Authorizing the G.T.R. to construct branch extending from a point on its line of railway between Colwell and Penetanguishene, near Wyevale, township of Tiny, and running in a northerly direction to the road allowance between Lots Nos. 91 and 92, 2nd Concession, township of Tiny, Ont.

7817—August 20—Extending until the 1st day of November, 1909, the time in which the branch line authorized by Order No. 6365, dated January 27th, 1909, was to be constructed by the C.P.R. and C.N.O.R. in the town of Parry Sound, Ont.

7818—August 16—Approving Local Standard Passenger Tariff C.R.C. No. 7, of the Alberta Railway & Irrigation Company, superseding C.R.C No. 5, providing for a rate of three cents per mile.

7819—August 18—Approving revised location of the C.P.R. Crows Nest branch between Pincher and Coleman, from a point in Section 12, Tp. 7, Range 1, west of the 5th Mer., to a point in Section 3, Tp. 8, Range 4, west of the 5th Mer., Alberta, being from mileage 31.60 to mileage 37.56, and from mileage 53.42 to mileage 56.92.

7820—August 17—Authorizing the Council of the township of Humberstone, Ont., to lay a culvert under the tracks of the G.T.R. on Lot 25, Concession 3, Tp. of Humberstone, Ont.

7821—August 17—Authorizing the Bee Line Rural Telephone Company, Ltd., to erect its wires across the tracks of the C.P.R. between Sections 25 and 26, Tp. 20, Range 11. West of 2nd Mer., Province of Saskatchewan.

7822—August 17—Authorizing the C.P.R. to construct spur to premises of J. Y. Griffin & Company, Ltd., Winnipeg, Man.

7823—August 17—Authorizing the C.P.R. to construct spur to Tudhope, Anderson & Company, Ltd., Winnipeg, Man.

7824—August 17—Authorizing the C.P.R. to construct spur to the Alpha Company, Ltd., St. Phillippe Ward, Three Rivers, Que.

7825—August 17—Authorizing the C.P.R. to close the temporary crossing at Third Avenue and that portion of First Avenue crossing the right of way of C.P.R., and to rearrange its general yard at Moose Jaw, Sask. Also to open up a temporary crossing at Fourth Avenue.

7826—August 20—Authorizing the C.P.R. to construct spur into the premises of the Imperial Oil Company, Ltd., at Wetaskiwin, Alberta.

7827—August 20—Authorizing the C.P.R. to construct bridge over Dufferin and Lisgar streets, at Chapleau, Ont.

7828—August 16—Amending order No. 7639, dated July 27th, 1909, by striking out the words " Toronto Section," in Item 5 of the operative part of the Order, and substituting therefor the words "St. Maurice Valley Branch."

7829—August 18—Amending Order No. 6084, dated January 14th, 1909, by not requiring train No. 68, of the C.P.R., to stop at the crossing of the Canadian Northern Quebec Railway at St. Jerome, on Mondays.

7830—August 20—Authorizing the town of Listowel, Ont., to lay and maintain watermain under the tracks of the G.T.R., on Mill Street.

7831—August 20—Authorizing the Robitaille-Eureka Distillery, Ltd., to lay a one-inch water pipe across the tracks of the Quebec Railway, Light and Power Company, at Beauport, near Quebec.

7832—August 20—Authorizing the G.T.R. to reconstruct bridge No. 50, at mileage 136.94, over Holland Avenue, 1.16 miles west of Chaudiere Junction, Ont.

7833—August 19—Approving location of the Canadian Northern Railway, Greenway Branch extension, Adelpha to Wassena, through Township 2, Ranges 19-21 West Principal Meredian, mileage 52.11 to 64.77.

7834 and 7835—August 20—Authorizing the City of Revelstoke, B.C., to lay box drain under track of the smelter and old wharf siding of C.P.R. on Second Street and Campbell Aevnue, Revelstoke; and one on Pearson and Wynn streets.

7836—August 20—Authorizing the City of Revelstoke. B.C., to lay trunk sewer pipe across right of way of C.P.R., at Revelstoke.

7837 and 7838—August 20—Authorizing the City of Brantford to lay storm sewer under track of G.T.R., on Gray street, on Chatham street.

7839—August 20—Apthorizing the City of Brantford to lay sewer under track of the Toronto, Hamilton and Buffalo Railway Co., at Oxford street.

7840—August 17—Authorizing the Woodstock Water and Light System to erect its light and power wires across the track of the G.T.R. at Butler street, Woodstock, Ont.

7841—August 20—Authorizing the City of Toronto to construct and maintain steel drain pipe, fifteen inches in diameter, on the girders of the bridge carrying the rails of the G.T.R. at Lansdowne Avenue.

7842—August 19—Directing the C.P.R. to permit the Municipality of the Township of Laird, District of Algoma, to install a telephone instrument in the station at the Village of Echo Bay.

7843—August 17—Authorizing the C.P.R. to construct its railway across nine highways in the Province of Saskatchewan.

7844—August 18—Authorizing the Canadian Northern Railway to cross the lines and tracks of the Wolseley-Reston Branch of the C.P.R., in the northeast quarter or Section 18. Township 10, Range 13, West Principal Meridian, Sask.

7845—August 19—Authorizing the C.P.R. to construct branch line or spur to the premises of D. Maxwell & Sons. St. Mary's, Ont.

7846 and 7847—August 19—Authorizing the Manitoba Government Telephones to erect wires across tracks of Canadian Northern Railway, at public crossing three-quarters of a mile north of Rounthwaite, Man.; and at public crossing at Elphinstone, Man.

7848—August 19—Authorizing the Allan Rural Telephone Company, Ltd., to erect its wires across ths track of the G.T.R., between sections 2 and 3, in Township 34, Range 1, West Third Meridian, Province of Saskatchewan.

7849—August 17—Authorizing the Woodstock Water and Light System to erect its wires across the tracks of G.T.R.. at Burtch street, Woodstock, Ont.

ENGINEER'S LIBRARY

A MONTHLY INDEX.

Commencing with this issue we are opening a new department in this section of our paper— a Monthly Index.

This month the index is very incomplete—but from month to month it will grow. We do not purpose indexing articles that appear in our own journal, but purpose giving a list of the more important articles appearing in the leading technical publications of Canada and the United States. This section will be of interest from month to month, and will be of great value to those engineers who find it necessary on short notice to gather literature on particular subjects.

For the present we will confine our list of subjects to a few of the more important ones, increasing the size of the index as the section becomes more popular.

THE CANADIAN ENGINEER'S MONTHLY INDEX OF CIVIL ENGINEERING LITERATURE.

The purpose of this monthly index is: To inform engineers and contractors of the literature published on those subjects in which they are especially interested, the character of the article and the journal in which it appeared. **We do not index in this section articles that appear in The Canadian Engineer.**

Periodicals containing articles indexed, should be ordered direct from the publishers.

LIST OF PERIODICALS INDEXED.

Canadian Society of Civil Engineers Proceedings.—(Can. Soc. C. E. Proc.), Montreal, Can., m., 4 x 7 in., 50 cents.

Canadian Cement and Concrete Review.—(Can. Cem. and Con. Rev.), Toronto, Ont., m., 9 x 14, 15 cents.

Contractor.—(Contr.), Chicago, Ill., bi.-w.; 7 x 10 in., 20 cents.

Engineering—Contracting.—(Eng.-Cont.) Chicago, Ill., w.; 9 x 12 in., 10 cents.

Engineering News.—(Eng. News), New York, N.Y., w.; 10 x 14 in., 15 cents.

Engineering Magazine.—(Eng. Mag.), New York, N.Y., 7 x 10 in., 25 cents.

Machinery.—(Mach.), New York, N.Y., m., 7 x 11 in., 20 cents.

Municipal Journal and Engineer.—(Mun. Jl. and Eng.), w., New York, N.Y., 9 x 12, 10 cents.

Municipal Engineering Magazine.—(Mun. Eng. Mag.), Indianapolis, Ill., m., 7 x 10 in., 25 cents.

Power and Engineer.—(Pow. and Eng.), New York, N.Y., w.; 9 x 12 in., 5 cents.

Railway Age Gazette.—(R. R. Age Gaz.), New York, w.; 8 x 11 in., 15 cents.

Surveyor, The.—(Sur.), London, Eng., w.; 6 x 11, 10 cents.

BRIDGES, CULVERTS AND FOUNDATIONS.

Cost of Several Culverts in Missouri.—Con. Sept. 1st, 1909, pp. 1.

This article gives the cost per cubic yard for material, labor, etc.

Monroe St. Bridge, Spokane.—Eng. News. Sept. 2nd, 1909, pp. 2.

Description of a concrete bridge with a 281-ft. arch. Dimentioned illustrations.

Bridges of New York City.—Eng. Mag., Sept., 1909, pp. 16.

An illustrated article by T. Kennard Thomson, Consulting Engineer of New York.

MISCELLANEOUS.

Calculation of Pillar Cranes.—Mac., Sept., 1909, pp. 3.

An article by Charles A. Schranz, in which he deals with the stresses in the boom, tie-bars, tie-rods and on the foundation.

Design of Members Subjected to Combined Stresses.—Eng. News. Sept. 2, 1909, pp. 2.

Article by E. L. Hancock, Assistant Professor of Applied Mechanics, Purdue University.

SEWERS, SEWAGE AND WATERWORKS.

Water Purification Plant of Toledo.—Mun. Jl. and Eng., Sept. 1st, 1909, pp. 8.

A description of a filtration method. Sanitary significance of bacteria in the air of drains and sewers.—Eng. News, Sept. 2nd, 1909, pp. 3.

The New Pittsburg Filters.—Mun. Eng. Mag., Sept., 1909, pp. 6.

A description of the largest individual sand filtration plant in the United States.

RAILWAYS.

Train Resistance.—R. R. Age Gaz., Sept. 3, 1909, pp. 2.

The second division of a series by F. J. Cole, Consulting Engineer for the American Locomotive Works. Illustrated.

Uniform Cassification.—R. R. Age Gaz., Sept. 3, 1909, pp. 2.

The first of a series by Samuel O. Dunn.

Electric Power or Steam Railways.—Eng. Mag., Sept., 1909, pp. 13.

CONCRETE AND REINFORCED CONCRETE.

Placing Concrete on Unusual Bridge Structures.—Con. Sept. 1st, 1909, pp. 2.

Reinforced-Concrete Dome at Los Angeles, Cal.—Eng. News, Sept. 2, 1909, pp. 2. Illustrated.

Sidewalk and Curb Design and Construction.—Mun. Eng. Mag., Sept., 1909, pp. 8.

Illustrated with dimentioned drawings.

BOOK REVIEWS.

Books reviewed in these columns may be secured from the Book Department, Canadian Engineer, 62 Church Street, Toronto.

Azimuth, by George L. Hosmer; published by John Wiley & Sons, New York. Size, 4½ × 7; 73 pages; bound in pocket-book form. Price, $1.

The author of this little work is George L. Hosmer, Assistant Professor of Civil Engineering, Massachusetts Institute of Technology. The object of the work, as stated in the preface, is to serve as a handbook for practical use in the field, rather than as a text-book for instruction in theory; so that the book contains very little theory and no derivations of formulae, while explicit directions are given for taking observations with the engineer's transit, together with forms of record and illustrative examples.

The methods treated are the following:

By altitudes of the sun.

By observations of Polaris, using altitudes of other circumpolar stars to determine its hour angle.

By observations of Polaris and other stars on the same vertical circle.

The more accurate method by observing Polaris at any hour angle.

By Polaris at elongation.

By equal altitudes of a star or the sun. Some of the simpler methods of determining latitude and time are also introduced incidentally.

The application of the second method above indicated is facilitated by the use of extension tables which are appended; and in addition to these are given several other tables required in the reduction of the observations; such as tables of refraction; logarithms of numbers; logarithmetic sins and versed sins; a table giving the value of the sun's declination from 1909-1912 inclusive, etc. Tables are also given for reducing stadia measurements.

The problem of determining azimuth is the most important one in Practical Astronomy from the standpoint of the engineers, who may be called upon at any time to determine the direction of the meridian; and Professor Hosmer's little book may be heartily recommended to those who have not the time to master the theory of the subject as laid down in our standard text-books, but who wish to have at hand the practice set forth in a concise form.

L. B. S.

Engineering Wonders of the World, Part 5.—C.P.R. Number, edited by Archibald Williams; published by Thomas Nelson & Sons, London, England, and New York, U.S.A., with map and twenty-eight illustrations. Price, 15 cents. Specially written by J. M. Gibbon and Stephen Pardoe, of the Canadian Pacific Railway Company.

Popular in style, but interesting alike, to the engineer and the general reader, is the story of the Canadian Pacific Railway—one of the engineering wonders of the world. If the selling price of the publication were increased fourfold, it would still merit the same demand. From a cursory glance at the article, some idea of its scope and value may be formed. An elaborate specimen of color printing is offered by the frontispiece which depicts, in vivid tints, a snow shed typical of those built over the tracks as they wend their way across the steep slopes of the Rockies, while the article itself is replete with scenes and views profusely illustrating some of the more interesting incidents and landmarks connected with the history of the road.

At the head of the article, which is cleverly written by men on the inside—one of them actually helping to lay the track—appears a drawing of the new viaduct at Lethbridge, the largest structure of its kind in the world.

In 1871, British Columbia entered the federation of the provinces of Canada—on conditions, one being that a railway should be built across the continent to give her more direct access to Eastern Canada and the Atlantic. It is largely to this agreement that the Canadian Pacific owes its origin.

Following the introduction, the authors briefly outline some of the difficulties, including political differences, which had to be faced.

Some information is then given regarding the financing of the project, and the men at the helm. This is immediately followed by an account of Sir Sanford Fleming's exploratory expedition across the prairies and the Rockies, from Nepigon to Victoria, via Fort Garry, (now Winnipeg), Fort Edmonton, the Yellowhead Pass, and the Fraser River, a trip that now occupies three days taking him and his party as many months. Interesting reference, in which Sir Sanford Fleming's observations apropos at the opening of the Lake Superior section of the line are quoted at some length, constitutes another portion of the story. This includes notes worthy of study upon the obstacles that had to be overcome and the engineering feats which the men in charge of the construction work accomplished.

Figures relative to the time and cost of construction, paragraphs telling in detail how the prairie section was built, a page describing camp life, a survey story, some amusing anecdotes well told, and numerous illustrations of a high order form what is probably the most attractive part of the volume. And yet, thrilling from start to finish is that portion which is devoted to a description of the line from the "Great Divide," at the summit of Kicking Horse Pass, to Vancouver, now one of the first five cities on the route by which travels the trade of the world—"the keystone of the world's commercial arch."

To read of the mountain section of the road is the next best thing to seeing it. The story recalls fairy tales of flying trips in a magic carpet and is extremely suggestive of aerial navigation dreams and travels by the latest mode, whose joys are fondly anticipated by all. Every incident of importance, from the location of the line to the driving of the last spike, at Craigellachie, by Lord Strathcona, is chronicled in a style which is pleasing. Events of national importance are referred to.

The C.P.R. has done much for Canada. The C.P.R. has made the West. It has made a nation. And thus, as the authors remind us, it has forged one of the strongest links in the chain which now binds together a mighty Empire.

Wm. M.

Northland Exploration.—There has just been issued from the Railway Lands Branch of the Department of the Interior, by order of the Hon. Frank Oliver, Minister, a report on Northland Exploration under his Department during the season of 1908, covering that portion of Saskatchewan north of Prince Albert as far as the Churchill River, extending from Montreal Lake and Lac la Ronge, on the east, to Green Lake, and connecting waters as far north as Portage la Loche on the west. The report was prepared by Frank J. P. Crean, C.E., and copies can be obtained free on application to the Superintendent, Railway Lands Branch, Department of the Interior, Ottawa.

Tables of the Properties of Steam, and other vapours and Temperature-Entropy Tables, by Cecil H. Peabody. Published by John Wiley & Sons, New York, 133 pages. Price, $1 net.

This is the eighth edition of the author's well-known Steam Tables, published in 1888, and was thoroughly revised in 1907, introducing information from the important experimental investigations by Callendar, Barnes, Knoblanch, Thomas and others, and adding a Temperature Entropy Table. The properties of saturated and superheated steam have recently been determined by methods susceptible of certainty and precision, so that computations based upon them show satisfactory concordance. This information has been used and the tables entirely recomputed The introduction contains original experimental data and the derivation of formulae used in computing tables. The Temperature-Entropy Tables are constructed for both saturated and superheated steam, and facilitate the solution of adiabatic problems which are given prominence by the development of the steam turbine.

A Brief Course in Elementary Dynamics for Students of Engineering.—By Erwin S. Ferry. Published by MacMillan Company, New York, pages 182, illustrations and diagrams, 121. Price, $1.25 net.

A text book for students, presenting a clear and consistent development of the laws of dynamics, discussing statics or the laws of equilibrium, friction between solids, kinetics, or the laws of connecting force and motion, statics of fluids, motion of bodies under variable forces, etc., with numerous problems collected by the author over a number of years, which are made more practical than usual. The book is well written and will prove of value to the engineering student. The principles and fundamental laws are thoroughly taken up without discussing a vast range of different phenomena, and the illustrations are chosen from familiar subjects.—F. A. G.

The Economy Factor in Steam Power Plants.—By Geo. W. Hawkens, published by Hill Publishing Company, 505 Pearl Street, New York; pp. 133, with 50 diagrams. Price, $3 net.

The material embodied in this book covers a most valuable lot of data and diagrams bearing on the efficiency of apparatus and economy of steam power plants. It is divided into four parts:—Part I. treating of the individual pieces of apparatus forming a steam power plant; discussing briefly their economy and the conditions which tend to vary it. A number of valuable curves on boiler and engine economy are given.

Part II. deals with the factors of evaporation discussing feed water temperatures, and the comparative efficiencies of auxiliary apparatus.

In Part III., under complete plant economy the authors discuss three types of plants, viz.; (1) non-condensing, (2) surface condensing, (3) jet condensing, developing formulae in each case for obtaining the economy of the plant, with tables and graphic representation of these formulae. Examples of their use are appended.

Part IV. contains a discussion of the economy of a plant working under variable load, with numerous load curves and diagrams, illustrating deduced formulae by examples.

The book forms a most valuable treatise on plant economy, illustrating the importance of the fuel economy factor in the design of the power-station. It will prove a most useful book to the designing engineer and the student, containing specific information which cannot be obtained in such complete form elsewhere.

Electric Smelting of Iron Ores.—As a sequence to the reports on Electric Smelting of Iron Ores, published in 1904, 1906, and 1907, the Mines Branch of the Department of Mines of Canada has just issued the results of "An Investigation of an Electric Shaft Furnace" in operation at Domnarfvet, Sweden. The investigation was made by Dr. Eugene Haanel, in December, 1908, on the invitation of the inventors, and the results given represent the latest developments of the electric smelting of iron ores.

The report contains 38 pages and is divided into four parts.—Part 1 deals with the Domnarfvet furnace, the trial runs witnessed by the writer of the report and the comparative costs of production of pig-iron by the furnace. The other three parts which are more of the nature of appendices, describe:—(1) A new electric furnace for the manufacture of steel, (2) the manufacture of electrodes, (3) methods of manufacturing wood-charcoal, this material being used to supply the carbon which enters into the composition of pig-iron manufactured by electric smelting.

Three full page plates, from photographs, and numerous drawings, illustrate clearly the descriptive matter of the book, which, taken in conjunction with the reports previously published by the Mines Branch on the subject of electric smelting, brings up to date the literature on the electro-metallurgy of iron.

The "Report on the Investigation of an Electric Shaft Furnace" at Domnarfvet, Sweden, may be obtained on application to Dr. Eugene Haanel, Director of Mines, Department of Mines of Canada, Ottawa.

PUBLICATIONS RECEIVED.

Hydroelectric Developments and Engineering.—By Frank Koester. Assoc. Mem. Am. Inst. E.E., 454 pp., 500 illustrations, price, $5. D. Van Nostrand Company, publishers, 23 Murray, and 27 Warren Streets, New York, U.S.A.

Electric Railway Power Stations.—By Calvin F. Twingle, M.E., 720 pp., 6 x 9, cloth, $2. Frederick J. Drake & Company, publishers, Chicago, Ill.

The Fire-Resistive Properties of Various Building Materials.—By Richard L. Humphrey, 100 pp., 6 x 9. Bulletin 370, Dept. of the Interior, N.S., Geological Survey, Technologic Branch, Washington, D.C.

Simplified Methods of Calculating Reinforced Concrete Beams. — By W. Noble Twelvetrees, M.I. Mech. E. A.M.I.E.E., M.R.S.I., 25 pp., pocket size; 15 cents. Whittaker & Company, publishers, 2 White Hart St., Paternoster Square, London, E.C., and 64-66 Fifth Avenue, New York, U.S.A.

Canadian Annual Review of Public Affairs, 1908.—By J. Castell Hopkins, 669 pp., 6 x 9, cloth, $5. (?)—Annual Review Publishing Company, 2 College Street, Toronto.

Railroad Promotion and Capitalization in the United States.—By Frederick A. Cleveland, Ph.D., and Fred. Wilbur Powell, A.M., 365 pages, 6 x 9, cloth. Longmans, Green & Company, 91 and 93 Fifth Avenue, New York, and London, England.

Practical Armature and Magnet Winding.—By Horstmann and Tousley, 250 pages, pocket size. Morocco leather binding, price, $1.50. Frederick J. Drake & Company, publishers, Chicago, Ill.

Wrought-Iron Cement-Lined Water Pipe.—By Leonard Metcalf, civil engineer, Boston, Mass., 90 pp., 6 x 9.

Waterproofing.—By Myron H. Lewis, C.E., 260 pp., 6 x 9, reprinted from paper read before the municipal engineers of the city of New York. Engineering News, Book Department, 220 Broadway, New York City.

Tungsten Ores of Canada: A Report by T. L. Walker, M.A., PhD.., containing 60 pages, 6 x 9; Pub. Doc., Mines Branch, Ottawa. Hon. W. Templeman, Minister.

Journal of the American Society of Engineering-Contractors:—June 1, 1909, Vol. 1, containing constitution and list of members:—Daniel J. Haner, Secretary, Consulting Engineer, Park Row Building, New York City.

CATALOGUES.

Pumps:—A complete power driven outfit for use of contractors, builders, railroads, or on public works, where it is necessary to raise large quantities of water, or to handle water containing mud, sand, grit, gravel, coal, grain or chips, sewage, or any liquid that will flow, is described in Bulletin No. 500, which the Fuller and Johnson Manufacturing Company, of Madison, Wis., are just distributing. A price list is included.

Blueprints:—Several kinds of blueprint paper and a price list are dealt with by the Keuffel & Esser Company, Hoboken, N.J., in a pamphlet which has just been prepared for them. The directions given for obtaining the best results will undoubtedly be appreciated by men who have to do with blueprints and blueprinting.

Heating and Ventilating:—The best obtainable illustrations and descriptions of the Buffalo Fan System of heating, ventilating, humidifying and drying are given in catalogue 197, just published by The Canadian Buffalo Forge Company, of Montreal, Canada. Heating and ventilating buildings of all kinds is dealt with at some length in the first two sections. Part III. contains interesting matter regarding the apparatus itself, while Part IV. gives reliable data, with tables, on heating and ventilating, which has never before appeared in print. The volume, comprising 144 pages, is replete with valuable information.

Concrete Blocks:—A booklet issued by the Dominion Concrete Company, Limited, Kemptville, Ont., contains several illustrations which demonstrate the adaptability of concrete blocks for various kind of buildings. Builders will be interested in the publication, and the publishers will be pleased to send it to those interested, on application.

Supplies:—The Brydges Engineering & Supply Company, of Winnipeg, have issued a very handy catalogue cover, by which separate sheets of any line desired can be sent out to those desiring same. The device saves the expense of supplying anyone with the large amount of material in the ordinary catalogue, the majority of which they are not interested in.

Riveting Machines for structural, bridge and railroad work, boiler, tank and stack construction, which are manufactured by John F. Allen, 370-372 Gerrard Avenue, New York City, are dealt with in an interesting fashion by this old-established manufacturer. Copies of this pamphlet will be cheerfully sent upon application.

Valves:—Canada's highest grade valve, the "Standard Crown," is illustrated and described by the Standard Engineering Company, of Toronto, in a handy booklet, which also contains a price list that is useful for reference purposes.

ENGINEERING SOCIETIES.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—413 Dorchester Street West, Montreal. President, Geo. A. Mountain; Secretary, Prof. C. H. McLeod.

QUEBEC BRANCH—
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, J. G. G. Kerry; Secretary, E. A. James, 62 Church Street, Toronto.

MANITOBA BRANCH—
Chairman, H. N. Ruttan; 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 College.

OTTAWA BRANCH—
Chairman, C. R. Coutlee, Box 560, Ottawa; S. J. Chapleau, Box 203.

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

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

AMERICAN MINING CONGRESS.—President, J. H. Richards; Secretary, James F. Callbreath, Jr., Denver, Colorado.

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

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE OF WAY ASSOCIATION.—President, Wm. McNab, Principal Assistant Engineer, G.T.R., Montreal, Que.; 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, Geo. W. Jackson, contractor, Chicago; Secretary, Daniel J. Haner, Park Row Building, New York.

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

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.—President, E. Grandbois, 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, Alfred E. Uren, 62 Church Street, Toronto.

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

CANADIAN FORESTRY ASSOCIATION. — President, Thomas Southworth; Secretary-Treasurer, King Radiator Co., Toronto; Secretary, James Lawler, 11 Queen's Park, Toronto.

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

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

CANADIAN RAILWAY CLUB.—President, 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, C. A. Jeffers, Secretary, C. L. Worth, 409 Union Station. Meets third Tuesday each month except June, July, August.

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

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

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

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

INTERNAL COMBUSTION ENGINEERS' ASSOCIATION.—Homer R. Linn, President; Walter A. Sittig, Secretary, 61 Ward Street, Chicago, Ill.

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

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

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

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, Louis Bolton; Secretary, Killaly Gamble, 703 Temple Building, Toronto.

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

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.

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

COMING MEETINGS.

Nova Scotia Society of Engineers: September 9 and 10. Third annual meeting at New Glasgow, N.S. S. Fenn, Halifax, N.S., secretary.

American Railway Bridge and Building Association.—October 19-21. Nineteenth annual convention at Jacksonville, Florida. Secretary, S. F. Patterson, Boston & Maine Railway, Concord, N.H.

American Society of Municipal Improvements.—November 9-11. Annual convention at Little Rock, Ark., U.S.A. A. Prescott Folwell, Secretary, 241 W. 39th St., New York City.

Royal Architectural Institute of Canada.—October 5-7, at Toronto, general annual assembly. Secretary, Alcide Chaussé R.S.A.; P.O. Box 259, Montreal, Que.

National Gas and Gasoline Engine Trades Association. Harry T. Wilson, treasurer, Middleton, Ohio; Albert Stritmatter, Cincinnati, Ohio. Next meeting November 30, December 1, 2, 1909, at Chicago, Ill.

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.

Nova Scotia.

HALIFAX.—Tenders will be received up to Wednesday, September 15th, for electric fittings for the Technical College. Herbert E. Gates, architect; Christopher P. Chisholm, Com. Public Works and Mines.

Quebec.

ST. JOHNS—Tenders for Customs fittings, St. Johns, P.Q., will be received until Wednesday, September 15. Plans to be seen on application to Mr. Leon Forant, caretaker, Public Building, St. John, P.Q., and at the Department of Public Works, Ottawa. Napoleonn Tessier, secretary, Ottawa.

MONTREAL.—Tenders for laying concrete at the La Fontaine Park Pond will be received until September 13, by L. O. David, city clerk.

QUEBEC.—Tenders will be received by Rene P. Lemay, architect, 21 d'Aiguillon Street, up to September 20th, for the construction of the Quebec Technical School. Antonin Galipeault, secretary-treasurer.

ST JOHNS.—Tenders for Customs fittings will be received until Wednesday, September 15. Napoleon Tessier, secretary, Department of Public Works, Ottawa.

THREE RIVERS.—Tenders will be received until Thursday, Sept. 16th, for supplying and installing pressure filters with a capacity of two million gallons per 24 hours. L. T. Desaulniers, Secretary-treasurer.

THREE RIVERS.—Tenders will be received up to the 16th Sept., for the construction of a reinforced concrete or iron bridge, of 16 feet wide, on Ste. Marguerite Road, to be finished before the 16th Nov. Each tenderer must furnish his plans and specifications. L. T. Desaulniers, secretary-treasurer. City Hall, Three Rivers, 28th Aug., 1909.

Ontario.

BARRIE.—Tenders will be received until September 13 for material for sewers. C. H. & P. H. Mitchell, Toronto, engineers; E. Donnell, clerk. (Advertised in the Canadian Engineer.)

BARRIE.—Tenders will be received until September 13 for outfall works in connection with sewage disposal. C. H. & P. H. Mitchell, Toronto, engineers; E. Donnell, clerk. (Advertised in the Canadian Engineer.)

LEAMINGTON.—Tenders for electric wiring and fittings for the Public Building, will be received until Thursday, September 16. G. Roach, Clerk of Works, Leamington; T. A. Hastings, Clerk of Works, Customs House, Toronto. Napoleon Tessier, Secretary, Department of Public Works, Ottawa.

OTTAWA.—Tenders will be received until 28th September, 1909, for the construction of steel superstructures and floor systems for bridges at the points named below:

District "A."

Mile	Bridge	Date of Completion
82.0	Cains River	December 1, 1909
124.5	South-West Maramichi, N.B.	March 15, 1910
133.0	South-West Maramichi, N.B.	March 15, 1910
134.07	Juniper Brook	April 1, 1910
1.42.0	Odell Brook	April 1, 1910

District "D."

62.25	Circle River	July 1, 1910
62.5	Low Brush River	June 1, 1910
99.0	Brule Creek	April 1, 1910
109.29	Frederichouse River	April 1, 1910
113.48	Buskegow River	April 15, 1910
123.5	Driftwood River	May 1, 1910
135.0	Mattagama River	June 1, 1910

Plans and profiles may be seen at the office of the Chief Engineer at Ottawa. P. E. Ryan, secretary.

TORONTO.—Tenders will be received until Thursday, October 28, for turbine pumps. Further particulars may be had from the city engineer. (Advertised in the Canadian Engineer.)

TORONTO.—Tenders will be received until Thursday, October 28, for electric motors. Further particulars may be had from the city engineer. (Advertised in the Canadian Engineer.)

TORONTO.—Tenders will be received up till Sept. 14th, for all the various trades required in the erection and completion of an 8-storey fireproof building on the south-east corner of King and Jordan Streets, Toronto, for the Standard Bank. Darling & Pearson, 2 Leader Lane, Toronto, architects.

TORONTO.—Tenders will be received up to noon on Tuesday, September 21, for an underground public lavatory, proposed to be constructed on Broadview Avenue, near Queen Street. Joseph **Oliver (Mayor), Chairman** of Board of Control.

WALLACETOWN.—Tenders will be received up till Monday, September 13, for the erection of two schoolhouses in S.S. No. 14, Dunwich. Basements and walls to be of concrete. D. B. McPherson, secretary.

Manitoba.

WINNIPEG.—Tenders will be received up to September 14, 1909, for the excavation and back filling of a pipe line from the Red River to the locomotive shops, etc., east of St. Boniface, Man., on the line of the Transcontinental Railway, to be completed by December 31, 1909. Full information with respect to the work may be obtained at the office of the Chief Engineer at Ottawa, Ont., and the office of the District Engineer at St. Boniface, Man. P. E. Ryan, secretary, Commissioners of the Transcontinental Railway, Ottawa.

WINNIPEG.—Tenders will be received up to Friday, 3rd September, for 2,700 lineal feet wire fencing for Brookside Cemetery, and 820 lineal feet iron fencing for William Whyte Park. J. H. Blackwood, secretary, Public Parks Board Office.

WINNIPEG.—Tenders for the following supplies for the fire department will be received up to Tuesday, September 14th, 2,000 feet of 2½ inch cotton rubber lined fire hose. complete with couplings. 15 fire alarm boxes, non-interfering and weight movement type, and complete with key box on door, piping, rain cap, keys, etc. 127 pairs felt-lined rubber boots. 274 pairs woolen mitts. M. Peterson, secretary, Board of Control.

Saskatchewan.

ESTEVAN.—Tenders for electric wiring and fittings will be received until Tuesday, September 21. Mr. G. T. Falkner, Clerk of Works, Estevan; Napoleon Tessier, secretary, Department of Public Works, Ottawa.

CONTRACTS AWARDED.

Quebec.

QUEBEC.—Mr. Ign. Bilodeau, who secured the contract for laying water mains at 67 cents a foot, recently asked for $1.10 on the ground that he was losing money. The contract has been cancelled, and the city will do the work by day labor.

Ontario.

LONDON.—E. Leonard & Sons of this city have been awarded contracts amounting to about $2,500 for twelve oil tanks for the six transformer stations of the Hydro-Electric

line at London, St. Thomas, St. Mary's, Stratford, Woodstock and Paris.

ST. THOMAS.—A contract for the construction of a concrete culvert over Mill Creek on the L. & P.S. Gravel road was awarded to Scoyne & Ramey, of Talbotville, for $810. The other tenders were G. A. Ponsford, $899; H. F. Woodry, $1,185, and Powell & Gunning, $1,184.

WATERLOO.—The following tenders were received for sewer construction:

	G. Moogk per foot	P. Bergman per foot
Foundry Street	$1.05	$1.20
Park Avenue	1.05	1.20
Victoria Street	1.05	1.25

The lowest were accepted

Manitoba.

WINNIPEG.—Messrs. E. R. Watts & Son have just supplied one of their 8-foot telescopes to the Astronomical Department of the University of Manitoba. E. R. Watts & Son, Winnipeg branch report that they have had a splendid season, especially in their smaller makes of instrument, which they state they have not been able to get out fast enough.

WINNIPEG.—The City of Winnipeg have awarded the contracts for electrical apparatus in connection with the power plant at Point du Bois, which shows a saving to the city of approximately $157,000 lower than the best tenders recommended in October 1907. The total of the figures of contracts awarded is approximately $425,000, and the successful tenderers are as follows:—Turbines: Jens, Orten Boving & Company, London, Eng., $97.150; includes $11,000 for erection. Generators and Exciters: Vickers, Sons & Maxim, Ltd., Sheffield, Eng., $93,080; this price includes erection. Transformers, Switching and Protective Apparatus: Canadian Westinghouse Company, Ltd., Hamilton, Ont., $150,800; including spare parts. Light, Heat & Power System, Generating Station: Canadian General Electric Company, Toronto, Ont., $11,600. Travelling Cranes: Canadian Fairbanks Company, Ltd., Winnipeg, Man. (Niles-Bement-Pond Company), $14,900; including estimated cost of erection. Auxiliary Apparatus—Canadian Apparatus: Canada Foundry Company, Ltd., Toronto, $27,520; Canadian Fairbanks Company, Ltd., Winnipeg, Man., $6,901; allowance for contingencies and spare parts, say $23,049.

British Columbia.

NAKUSP.—A logging contract of considerable importance to the town has been entered into between Lindsley Bros. Company, of Spokane, and A. Criel & Hartling, of Nakusp, whereby the latter will take off all the timber on 1,200 acres of land on the lake shore south of the town.

NEW WESTMINSTER.—The City Council have accepted a tender of $218,527 for the steel pipe needed between Coquitlam Lake and Queen Park Reservoir, 74,600 feet of riveted pipe for the new 24-inch main, letting the contract to the lowest tenderer, J. C. McDonald, of Grand Forks. There was a lengthy discussion as to whether the tender for the whole work, 12 and 24-inch pipe, should not have been let to one contractor, but ultimately the Council decided to offer the Robertson Godson Company of Vancouver, who had tendered lowest, for the 12-inch pipe. This is the section from Queen's Park to the city boundary on Lulu Island. Their figure was $21,242.

VANCOUVER.—The contract for material for a 11,000-ton floating pontoon dry-dock, which is to be built on Burrard Inlet, has been awarded to Swan & Hunter, Wallsend-on-Tyne, England.

VICTORIA.—The City of Victoria recently purchased from the Waterous Engine Works Company, of Brantford, a $5,000 fire engine, which is proving entirely satisfactory.

SEWERAGE AND WATERWORKS.

Quebec.

LORETTE.—The installation of waterworks here has been decided on by a number of residents, who have formed a company. Mr. Louis Narcisse Leclerc a physican, is one of the provisional directors.

MONTREAL.—Messrs. Ouimet and Lesage will shortly proceed to construct a part of the sewerage systems for the towns of Berthier and Lachute.

MONTREAL.—The town of Limilou has instructed Messrs. Ouimet and Lesage to proceed to construct their new concrete reservoir and to carry out certain improvements to their aqueduct.

Ontario.

PERTH.—The City Council are constructing a sewer from the House of Industry across the Matheson farm to connect with the sewerage system of the town. The town is to have the privilege at any time of connecting with the portion necessary for the county to construct. This is the method necessary to solve the question of the pollution of the town's water supply, which was taken from a point in too close proximity to the place where the House of Industry sewage formerly entered the river.

TORONTO.—A system of drainage for the district between Sunnyside avenue and High Park, has been recommended by City Engineer Rust, at an estimated cost of $62,000. It will be necessary to have a pumping plant to lift the sewage up into the King street sewer.

British Columbia.

VICTORIA.—A special meeting was held recently to deal with the question of additional water supply, in view of the recent defeat of the by-law introduced for the expropriation of the Esquimalt Waterworks Company. Expert advice will be secured regarding Sooke Lake.

RAILWAYS—STEAM AND ELECTRIC.

Quebec.

MONTREAL.—The Angus shops of the C.P.R. have just turned out the last of thirteen 95-ton freight engines for the Western lines. Eight locomotives were built at these shops during August.

MONTREAL.—That telephones for train despatching will soon be general all over the C.P.R. system was the announcement made recently by Mr. James Kent, the manager of telegraphs, Canadian Pacific Railway, on his return from his annual tour of inspection of the company's telegraph system in Western Canada. As is known, the telephone has been in use for train despatching on the C.P.R. between Montreal and Newport for over a year, and while in the West Mr. Kent superintended the opening of three new telephone divisions, namely, between Swift Current and Medicine Hat, a hundred and thirty miles; between Winnipeg and Brandon, about the same distance, and between White River and Fort William.

Ontario.

BERLIN.—The G.T.R. will erect a steel bridge here.

LONDON.—On October 20th next, at 12.30, at the offices of the London & Western Trusts Company, 382 Richmond Street, there will be offered for sale the South-Western Traction Company—a railway about 28 miles in length, connecting London with Port Stanley and passing St. Thomas. Thomson, Tilley & Johnson, 59 Yonge Street, Toronto, solicitors.

PORT COBALT.—All grading has been done on the roadbed of the Nipissing Electric Railway, contracts have been let for the construction, and the rails will be on the ground by the first of next week. It is the intention to at once lay six miles of rails. This will be done by the first of November. The line will first be built from Cobalt right to Haileybury, and will run half way down to the lake at Port Cobalt along Lakeview Avenue.

TORONTO.—The repair shops of the C.N.R. will probably be located in the Don Valley, Toronto, when connections are made with the lines from the East and the West.

Manitoba.

WINNIPEG.—The C.P.R. will extend their line into the Peace River country, building north from Edmonton.

WINNIPEG.—Commencing this week the tri-weekly passenger trains over the Grand Trunk Pacific Railway west. which have hitherto run only to Scott, Sask., will go through to Wainwright, Alta., 100 miles farther west. The regular passenger service is now within 115 miles of Edmonton, and it is thought that through trains from Winnipeg to the Alberta capital will be in operation next month.

WINNIPEG.—There still remain forty miles of the N.T.R. upon which steel must be laid to link up this city with the head of the lakes over the new system, and the road will be enabled to take its share of the crop to the lakefront. This will take the contractors about five weeks to complete as they are handicapped by lack of sufficient labor. The new steel bridge over the Wabigoon, near Dryden, has been holding up work, but this is now completed and track-laying can proceed rapidly.

Alberta.

EDMONTON.—Wetaskiwin will shortly be connected to Winnipeg and the east by a short line on the C.P.R. All that remains to be done is the completion of 75 miles between Hardisty and Macklin. The grading is already completed and about two and a half miles of steel is being laid per day. This distance should be completed and trains runing over the line by the first of November. This is the first time in the history of C.P.R. building that 85-pound steel rails are being used. When the steel-laying on the C.P.R. is finished the service between this place and Calgary will be quicker by five hours.

British Columbia.

FERNIE.—The C.P.R. is enlarging its yards here.

NEW WESTMINSTER.—Work of constructing the first section of the new Chilliwack line of the British Columbia Electric Railway Company is progressing favorably. Large quantities of steel and track spikes are being taken out to the scene of operations each day from the stock of the British Columbia Electric Railway wharf in this city. One of the newly purchased locomotives with a string of flat cars, attends to this part of the work, the other being attached to the track laying machine, which is working satisfactorily. The rails are now strung for five miles from the Westminster Bridge or about half-way to Cloverdale, but the construction is considerably delayed by lack of men.

PRINCE RUPERT.—The extension of the city yards of the G.T.P. will be built immediately. The grading of two miles or so will be finished by spring. This track will be for the convenience of the Government wharf and the owners of the waterfront leases.

VANCOUVER. — Engineering parties representing the Canadian Northern and the Grand Trunk Pacific Railways are engaged in a neck-and-neck race to locate their respective routes in the vicinity of the summit between North Thompson River and the south fork of the Fraser River. Conditions for securing a minimum grade were found to be excellent. The elevation at the summit is only 2,886 feet. Canadian Northern officials report the advantage thus far with their parties.

VANCOUVER.—Mr. Collingwood Schreiber, consulting engineer of the Dominion Government and consulting engineer of the National Transcontinental Railway, was in Vancouver this week on his way north to Prince Rupert to meet there Mr. Charles M. Hays and Sir Charles Rivers Wilson and made an emphatic pronouncement in regard to the labor question. He was quite animated in stating that British Columbia not only wanted the G.T.P., but needed it badly, yet it imposed the condition that only white labor should be employed. Consequently, where 3,000 men are now employed, 10,000 could be given employment, and the construction is proceeding slowly. He suggested that some provision be made whereby anyone could be employed, and if foreigners were required that they come into the country only under agreement to get out again after they were not required by the railway contractors. Mr. B. B. Kelliher chief engineer of the G.T.P., accompanied Mr. Schreiber and added that every white man that could be got was put on the work, and if he supported Mr. Schreiber's suggestion it was not because he wanted foreigners in opposition to the white men. He told the Canadian Engineer that he preferred the white man every time because of his better work. and if any other color was employed lower wages would be given. It was simply because labor was needed to get the line ahead that they wanted any kind of men. As it was, it meant that the money in the completed line would be tied up, without any earning power, until the remainder of the line was completed.

England.

LONDON.—The British Columbia Electric Railway Company is issuing $2,500,000 new capital for the purpose of making extensive improvements and of building a new terminal in Vancouver.

Foreign.

PORT HURON, Mich.—The big addition to Block 1 shops of the G. T. R., which will comprise 10,000 feet of floor space, will be started in the near future. When the new addition to the shops is completed the force at the big institution will be increased 50 per cent.

LIGHT, HEAT, AND POWER.

Quebec.

FARNHAM.—The vote on the electric light by-law, providing for the borrowing of $21,000, announced for Monday, did not take place. Mr. Poulin, who owns the present plant, but who had asked $14,000 for his property, made a new proposal to sell for $8,500, and as a consequence the by-law was withdrawn and the purchase of the Poulin property at $8,500 sanctioned.

MONTREAL.—The Montreal Light, Heat & Power Company has sent to the city its street lighting account for July, amounting to $12,837, plus five per cent., and giving notice that action will be at once taken to recover this amount, together with that due to July 30, namely $82,256.

Ontario.

TORONTO.—Work has been commenced in connection with the establishment of the city's new electrical distribution plant for which Golden & Lansing, of Troy, N.J., secured the contract. The laying of conduits is to cost $65,800.

TORONTO.—Rapid progress is being made by the McGuigan Construction Co. with the work of erecting the steel towers for the transmission line between Glanford and Ancaster townships, where a line of steel towers five miles long greets the eye. So far eighty-five towers have been put in place and the work is proceeding at the rate of eight towers per day. The completed system will involve the longest transmission line in the world. With branches it will be 297 miles in length, and will carry a current of 110,000 volts.

Manitoba.

BRANDON.—The Maple Leaf Flour Mills are undergoing extensive alterations. A producer gas engine of 375 horse-power is being installed to supply power for the large mill. This large gas engine, which is horizontal, is 33 feet in length, weighs 95,000 pounds, will cost $20,000 to install, and when completed will revolutionize cheap power in Brandon.

FINANCING PUBLIC WORKS.

Nova Scotia.

YARMOUTH.—The town council is considering by-laws to borrow $6,000 to build an engine house and not more than $80,000 for waterworks improvements. Mr. Hiram Gondey is town clerk.

Quebec.

FARNHAM.—The vote on electric light by-law which was to raise $21,000, did not take place. An agreement has been made with the owner of the present plant.

MONTREAL.—The municipality of Point Claire, near Montreal, is borrowing $75,000 to enable their engineers, Messrs. Ouimet and Lesage, to carry out the sewerage and aqueduct system devised for the village.

Ontario.

WESTON.—By a vote of 149 to 87, a majority of 62, Weston ratepayers on Saturday voted to expend $57,000 on a waterworks system, the source of the supply being the Humber River. Mr. Willis Chipman, of Toronto is the engineer.

Manitoba.

WINNIPEG.—A $600,000 by-law to cover the cost of building three new schools has been passed by the Winnipeg city council. .....

British Columbia.

NANAIMO.—A by-law to raise $60,000 for sewage disposal works has passed its first and second reading here.

NEW WESTMINSTER.—By-laws for street improvements, water-works extensions, etc., amounting to $398,000 were passed by the ratepayers.

VICTORIA.—Mayor Hall has intimated, since the defeat of the Esquimalt Waterworks by-law, that he intends introducing a by-law to raise money to bring water from Sooke Lake.

CEMENT—CONCRETE.

Quebec.

MONTREAL.—A new concrete reservoir will shortly be built for the town of Limilou by Messrs. Ouimet and Lesage, engineers, Montreal.

MONTREAL.—Some concrete work is to be done in connection with the La Fontaine Park pond, and Mr. L. O. David, city clerk, will receive tenders until September 13th.

MONTREAL.—The official announcement was made on Monday that the final negotiations and legal details of the new big cement merger, to be known as the Canada Cement Company, had been closed, and the underwriters within a day or two will be in a position to announce the terms of the public offering of the securities of the company. A leading official of the new company stated it would start out with an annual output of 4,500,000 barrels, or an average of 15,000 barrels a day for every working day in the year.

MONTREAL.—Official announcement was made here on Tuesday of the total capitalization of the new Canadian cement merger and of the terms on which the public offering of the securities of the company will be made. The company will have $8,000,000 of 6 per cent. gold bonds, of which $5,000,000 will be issued at present of the capital stock of $30,000,000. It is intended to issue at present $10,000,000 of the total of $11,000,000 of preferred shares and $12,500,000 of the total of $19,000,000 of common shares, making the amount of both stocks to be issued at present $22,500,000. The Royal Securities Corporation, on behalf of the underwriters, will offer for subscription $5,000,000 of 7 per cent. cumulative preferred shares at $93 per share, the same to carry with them a bonus of one share of common stock for every four shares of preferred stock subscribed for. All applications are to be made through the Royal Trust Company.

Ontario.

WALLACETOWN.—Mr. D. D. McPherson, Sec. S. S. No. 14, Dunwich desires tenders for the erection of two concrete schoolhouses.

MISCELLANEOUS.

Quebec.

MONTREAL.—Engineers have been at work since Wednesday last on a survey for a new bridge between this city and St. Lambert. It is said the surveyors have been engaged by the Delaware & Hudson, the N.Y. Central and the Rutland Railways.

MONTREAL. — The Quebec Bridge Commission have decided to call for tenders for types of bridge, cantilever and suspension. The new bridge will be 150 feet above high tide for 600 feet in the centre of the river; it will also be 24 feet wider than the old bridge, which was only 61 feet wide. The centre span will be reduced from 1,800 feet to 1,715 by building a new pier 100 feet farther from the north shore than the present pier. On the south side the present pier will be widened and strengthened, so as to bear the greater weight. Nickel steel will be used in the eye bars and for compression members, and, in brief, the new structure will be made as safe and strong as human ingenuity and skill can make it. It is expected that a start will be made very shortly, as the meeting has removed many of the causes of delay.

Ontario.

TORONTO.—At a meeting on September 2nd in the offices of Fetherstonhaugh & Company, a society was formed for the advancement of the Science of Aeronautics. It will be called "The Aeronautic Society of Canada." Mr. F. B. Fetherstonhaugh was chairman and Mr. E. H. Guthrie, secretary.

Manitoba.

WINNIPEG.—The Manitoba Bridge & Iron Works have a large amount of work under contract, and there is yet no sign of any decrease in the amount of business for the remainder of the season. Some of the contracts and orders taken recently are:—Large steel smoke stack for the City of Saskatoon; bridge for the Canadian Northern Railway: structural steel and iron for Bank of British North America, Calgary; ornamental iron work for new court house, Brandon; structural steel and iron for new I.O.O.F. Building at Kenora; fire escapes for four new public schools, Winnipeg: structural steel and iron works for court house, Fernie, B.C.; public press building, Winnipeg; Canadian Bank of Commerce, Macleod; Trite-Wood Block, Fernie, B.C., and nine others. One hundred and twenty complete outfits for transmission equipment for grain elevators. The new structural shop built by this company is now completely equipped with modern machinery and appliances, and is in operation night and day.

PERSONAL.

MR. A. J. NIXON, formerly of the G.T.R., at London, Ont., has been appointed by the Dominion Railway Board head of the newly established department known as the Operating Branch.

PROFESSOR L. A. HERDT, of McGill University and Mr. W. A. Lambe, of the Canadian General Electric Company, of Peterborough, have been appointed by the Dominion Government to be a Board of Examiners to examine candidates for positions as Electrical Inspectors in the Inland Revenue Department.

MR. GILMORE BROWN, C.E., of St. John, has been appointed assistant chief engineer of the Department of Public Works. Mr. Brown's appointment will relieve the present chief engineer, Mr. Lafleur, of some of the constantly-increasing responsibilities and work connected with his office.

MR. B. J. HARPELL has opened an office at 24 Aikins Block, Winnipeg. He is sales agent for Brodesser Elevator Manufacturing Company; Ideal Motors and Generators: Buffalo Forge Fans, Pumps, etc. Mr. Harpell has also taken the Western agency of the Machan & Mayer Electrical Manufacturing Company of Philadelphia, who make a great many lines of electrical specialties.

MARKET CONDITIONS.

Toronto, September 9th, 1909.

Accounts from Ontario points indicate a moderate movement in the building trade. Hardware and metal dealers find business rather slow, but account for it by the absorption of farmers in harvest matters. In Toronto, neither retail nor wholesale trade is so active as might be supposed from the crowds of people in the streets these four days past. They are mostly Exhibition visitors, and benefit mainly certain classes of trade, and those not staple ones. Later on, an active fall trade may be expected, as the result of generally good crops.

A real revival of business has come in the United States. A good proof of it is the fact that 100,000 unused railway cars have gone into service

during August. The iron and steel trades have most felt this revival, which tends to stiffen prices of metals generally. The higher market in tin is likely to be continued. Consumption of copper is increasing, and now or later improved quotations may be expected. Of spelter, while the present tendency seems downward, it will hardly remain depressed. Trade in Britain and on the Continent is dull.

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

Antimony.—Demand inactive, market unchanged at $9 per 100 lbs.

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

Bar Iron.—$1.95 to $2, base, per 100 lbs., from stock to wholesale dealer. Market well supplied.

Boiler Plates.—¼-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate.

Boiler Tubes.—Orders continue active. Lap-welded, steel, 1¼-inch, 10c.; 1½-inch, 9c. per foot; 2-inch, $8.50; 2¼-inch, $10; 2½-inch, $10.60; 3-inch, $12.10; 3½-inch, $15; 4-inch, $18.50 to $19 per 100 feet.

Building Paper.—Plain, 30c. per roll; tarred, 40c. per roll. Demand increased within the last fortnight.

Bricks.—Business is very active, price at some yards $9 to $9.50, at others, $9.50 to $10, for common. Don Valley pressed brick move also freely. Red and buff pressed are worth $18 delivered and $17 at works per 1,000.

Broken Stone.—Lime stone, good hard, for roadways or concrete, f.o.b., Schaw station, C.P.R., 60c. per ton of 2,000 lbs., 1-inch, 2-inch, or larger, price all the same. The supply is excessive; hence the lowered price. Broken granite is selling at $3 per ton for good Oshawa.

Cement.—The price continues low, $1.55 per bbl. in car lots, including bags. Demand is slack in Ontario, but some fair lots have been sold for Manitoba and Alberta. Smaller dealers report a fair movement in small lots at $1.40 per barrel in load lots delivered in town, bags extra. In packages, $1.40 to $1.50, including paper bags.

Coal.—Retail price for Pennsylvania hard, $6.75 net, steady. This price applies to grate, egg, stove, and chestnut; only pea coal is cheaper, namely, $5.75. These are all cash, and the quantity purchased does not 60c.; No. 2 tarred, 62½c.; plain, 56c.

affect the price. Soft coal is in good supply, American brokers have been covering the ground very fully. 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, $3.70 to $3.80; mine run, $3.60 to $3.75; slack, $2.65 to $2.85; lump coal from other districts, $3.40 to $3.70; mine run 10c. less; slack, $2.50 to $2.70; cannel coal plentiful at $7.50 per ton; coke, Solvey foundry, which is largely used here, quotes at from $5.25 to $5.50; Reynoldsville, $4.50 to $4.75; Connellsville, 72-hour coke, $5.25 to $5.50.

Copper Ingot.—The market is very firm, but heavy stocks still act as a drag. We quote as before $13.85 to $14.05 in this market, with a fair movement.

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

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

Roofing Felt.—An improvement in demand of late, no change in price.

Fire Bricks.—English and Scotch, $30 to $35; American, $25 to $35 per 1,000. The demand is steady and stocks light.

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.

Galvanized Sheets.—Apollo Brand.—Sheets 6 or 8 feet long, 30 or 36 inches wide; 10-gauge, $2.90; 12-14 gauge, $3.00; 16, 18, 20, $3.10; 22-24, $3.25; 26, $3.40; 28, $3.85; 29, $4.15; 10¾, $4.50 per 100 lbs. Fleur de Lis—gauge, $4.50; 26-gauge, $4.25; per 10 lbs. This downward change is the result of dissolution of an agreement between British and U. S. makers. Impossible to say how long it will last.

Iron Chain.—¼-inch, $5.75; 5-16-inch, $5.15; ¾-inch, $4.15; 7-16-inch $3.95; ½-inch, $3.75; 9-16-inch. $3.70; ⅝-inch, $3.55; ¾-inch, $3.45; ⅞-inch $3.40; 1-inch, $3.40, per 100 lbs.

Iron Pipe.—Black, ¼-inch, $2.03; ⅜-inch, $2.26; ½-inch, $2.63; ¾-inch $3.16; 1-inch, $4.54; 1¼-inch, $6.19; 1½-inch, $7.43; 2-inch, $9.90; 2½-inch $15.81; 3-inch, $20.76; 3½-inch, $26.13; 4-inch, $29.70; 4½-inch, $38; 5-inch $43.50; 6-inch, $56. Galvanized, ¼-inch, $2.86; ⅜-inch, $3.08; ½-inch, $3.48 ¾-inch, $4.31; 1-inch, $6.19; 1¼-inch, $8.44; 1½-inch, $10.13; 2-inch, $13.50 per 100 feet. Talk is still heard of an advance, but nothing definite.

Lead.—Prices steady outside. This market is steadier, and demand rather better at $3.75 to $3.85 per 100 lbs.

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. Demand is good.

Lumber.—A fair demand is reported for city trade, not so much from the country. Southern pine is the main item here. Hemlock is steady but not active. Lath are held stiffly at quotations, and none too plentiful; many are being made up north to go to the States. The 32-inch lath, so long a feature of the market, are nearly all gone. We quote dressing pine, $32 to $35 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, $16.50 to $17 spruce flooring in car lots, $22; shingles, British Columbia, $3.20; lath, No 1, $4.25; No. 2, $3.75; for white pine, 48-inch; for 32-inch, $1.60, and very few to be had.

Nails.—Wire, $2.25 base; cut, $2.70; spikes, $3, per keg of 100 lbs.

Pitch and Tar.—Pitch, demand moderate, price so far unchanged at 70c. per 100 lbs. Coal tar fairly active at $3.50 per barrel.

Pig Iron.—There is fair activity and prices are maintained. Clarence quotes at $20.50 for No. 3; Cleveland, $20.50 to $21; in Canadian pig, Hamilton quotes $19.50 to $20 per ton.

Plaster of Paris.—Calcined, New Brunswick, hammer brand, car lots, $2; retail, $2.15 per barrel of 300 lbs.

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

Ready Roofing.—An improved request is noted lately, at catalogue prices before quoted.

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 Pennsylvania slate 10 x 16 may be quoted at $7.25 per square of 100 square feet, f.o.b., cars, Toronto; seconds, 50c. less. The demand continues active; competent roofers are scarce.

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

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	.....
... traps	2.00	3.50	7.50	....	15.00	.....
... H. traps	2.50	4.00	8.00	....	15.00	.....

...siness steady; price, 73 per cent. off list at factory for car-load ... per cent off list retail. Small lots subject to advance.

Steel Beams and Channels.—Quiet. We quote:—$2.50 to $2.75 per 100 lbs., according to size and quantity; if cut $2.75 to $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.

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

Sheet Steel.—Market steady, at the former prices; 10-gauge, $2.50; 12-gauge, $2.55; American Bessemer, 14-gauge, $2.35; 17, 18, and 20-gauge, $2.45; 22 and 24-gauge, $2.50; 26-gauge, $2.65; 28-gauge, $2.85. Quite a quantity of light sheets moving.

Tank Plate.—3-16-inch, $2.40 per 100 lbs.

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

Tin.—The feeling in tin is firm, and we quote an advance of ½c., say 31½c. to 32c.

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

Zinc Spelter.—A very active movement continues, and the market is firm at $5.50 to $5.75.

CAMP SUPPLIES.

Beans.—Hand Picked, $2.60 to $2.70; prime, $2.40 to $2.50; Rangoon, hand-picked. $1.90 to $2.

Cheese.—No old cheese on hand; new cheese, large, 12¾c.; twins, 13c.

Coffee.—Rio, green, 10 to 12½c.; Mocha, 21 to 23c.; Java, 20 to 31c.; Santos, 11 to 15c.

Dried Fruits.—Raisins, Valencia, 6 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, ¼c. lower than cleaned. California Dried Fruits,—Evaporated apricots, 12 to 15c. per lb.; prunes, 60s to 70s, 7 to 7½c.; 90s to 100s, 6½c.; evaporated apples, 8c.

Eggs.—New laid, 24 to 25c. per dozen, in case lots.

Lard.—Now quite scarce. Tierces, 14¼c.; tub, 14¾c.; pails, 15c. per lb.

Molasses.—Barbadoes, barrels, 37 to 45c.; Porto Rico, 45 to 60c.; New Orleans, 30 to 33c. for medium.

Pork.—Short cut, $26.50 to $27 per barrel; mess, $25.

Potatoes.—Ontario,.

Rice.—B grade, 3½c. per lb.; Patna, 5½ to 5¾c.; Japan, 5¼ to 6c.

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

Smoked and Dry Salt Meats.—Long clear bacon, 13¾c. to 14c.; firm, tons and cases; hams, large, 14 to 14½c.; small, 15½ to 16c.; rolls, 13¾ to 14c.; breakfast bacon, 17c.; backs (plain), 17½c. to 18c.; backs (peameal), 18c. to 18½c.; shoulder hams, 12c.; green meats out of pickle, 1c. less than smoked.

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.

Sugar.—Granulated, $4.75 per 100 lbs. in barrels; Acadia, $4.65; yellow, $4.35; bags, 5c. lower; bright coffee, $4.60; bags, 5c. less.

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

Teas.—Japans, 18 to 35c .per lb.; Young Hysons, 16 to 35c.; Ceylons, medium, 16 to 45c.

* * * *

Montreal, September 9th, 1909.

Advices from Cleveland, state that merchant producers of Lake Superior iron ore will advance their prices 50c. per ton, all round, for the season 1910, thereby restoring the 1907 level, which was the highest since 1900. Some think that the announcement will be made early, others thinking that it will be delayed till well on towards next year. The reduction in duty from 40c. to 15c. does not seem to be having the effect of putting prices down in Lake Superior districts, consequently. It is said that there are large importations of ore, in the east, from Spain and Sweden, and some Newfoundland ore, from the Wabana seams, is now being reported. It is thought that fully 1,000,000 tons of ore will be imported into the east next year. The eastern trade is now lost to the Lake Superior producers.

Pig-iron continues to show strength, and an advancing tendency is shown for early delivery. The market for next year is not advancing as rapidly, so that the two markets are approaching each other. A large sale has been made at $18 per ton, delivered, which is better than $15.50 at the furnaces. Foundry iron is very strong, at $15.75, Valley furnaces, for this year, or $16.25 to $16.50 for next year. Bessemer pig is 25c. higher, at $17 per ton, minimum.

In Glasgow, there has been a large turnover in Cleveland warrants. The tone was generally strong, although there was some fluctuating and profit taking. This referred to the week before last, the advices being by mail. Subsequently, cables were received stating that the market had advanced. The movement in hematite is more marked, warrants having risen considerably.

The local market is exceedingly strong, and demand is active. In fact, reports from some of the largest firms in the city are to the effect that last week's sales, for general distribution, formed a new high record, for any similar period, in their recollection. Consumers are now coming rapidly into the market with a view to covering for their fall and winter requirements. Prices on Canadian made metal are stiffening in sympathy with those of other countries, and supplies are limited to two or three furnaces, the others, belonging to the steel companies, consuming all

their own metal in steel making. Enquiry is apparently still keeping up, and it begins to look as though purchasers would have speedily to cover for their requirements in order to get the advantage of present prices. Should ore advance in the United States, it will not be long till pig iron advances also, the result of which advances will be immediately reflected on the English markets, and hence upon Canadian.

A few advances took place during the week in the prices of iron in this market. Other alterations will also be found in the following list, none of the changes being very startling, however:—

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

Bar Iron and Steel.—Prices are steady and trade is quiet. Bar iron, $1.85 per 100 pounds; best refined horseshoe, $2.10; forged iron, $2; mild steel, $1.85; sleigh shoe steel, $1.85 for 1 x ¾-base; tire steel, $1.90 for 1 x ¾-base; toe calk steel, $2.35; machine steel, iron finish, $1.90; imported, $2.20.

Boiler Tubes.—The market is steady, quotations being as follows:—1½ and 2-inch tubes, 8¼c.; 2½-inch, 10c.; 3-inch, 11¼c.; 3½-inch, 14 1-2c.; 4-inch, 18 1-2c.

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 fibre, 55c. per roll; dry fibre, 45c. (See Roofing; also Tar and Pitch).

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.

Chain.—Prices are as follows:—¾-inch, $5.10; 5-16-inch, $3.95, ⅜-inch, $3.55; 7-16-inch, $3.35; ½-inch, $3.20; 9-16-inch, $3.05; ⅝-inch, $2.95; ¾-inch, $2.90; ⅞-inch, $2.85; 1-inch, $2.85.

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 14½ to 14¾c.

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 strentgh, per 100 fuses:—4-ft. wires, $3; 6-ft. wires, $3.54; 8-ft. wires, $4.08; 10-ft. wires, $5. Double strength fuses, 4-ft., $3.75; 6-ft., $4.20; 8-ft., $4.83; 10-ft., $5.37. Fuses, time, double-tape, $6 per 1,000 feet; explohmeters, fuse and circuit, $7.50 each.

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

Galvanized Iron.—The market is steady. Prices, basis, 28-gauge, are:—Queen's Head, $4.40; Comet, $4.25; Gorbal's Best, $4.25; Apollo, 10¾ oz., $4.35. Add 25c. to above figures for less than case lots; 26-gauge is 10c. less than 28-gauge. American 28-gauge and English 26 are equivalents, as are American 10¾ oz., and English 28-gauge.

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

Iron.—The outlook is strong. The following prices are for carload quantities and over, free on dock, Montreal, prompt delivery: No. 1 Summerlee, $20 to $20.50; selected Summerlee, $19.50 to $20; soft Summerlee, $19 to $19.50; Clarence, $17.50 to $17.75; Midland or Hamilton pig is quoted at $20.50 to $21, Montreal. It is said Dominion and Scotia companies are not quoting prompt delivery. Carron special, $19.50 to $20; Carron, soft, $19.25.

Laths.—See Lumber, etc.

Lead.—Prices are about steady, at $3.50 to $3.60.

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

Lumber, Etc.—Prices on lumber are for car lots, to contractors, at mill points, carrying a freight rate of $1.50. 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 50c. rate to Montreal. Telegraph Poles: Seven-inch top, cedar poles, 25-ft. poles, $1.35 to $1.50 each; 30-ft., $1.75 to $2; 35-ft., $2.75 to $3.25 each, at manufacturers' points, with 5c. freight rate to Montreal. Laths: Quotations per 1,000 laths, at points carrying $1.50 freight rate to Montreal, $2 to $3. Shingles: Cedar shingles, same conditions as laths, X, $1.50; XX, $2.50; XXX, $3.

Nails.—Demand for nails is better, but prices are steady at $2.30 per keg for cut, and $2.25 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 is unsettled and uncertain, as dealers are compelled to meet competition from all sources. Prices are easy and approximately as follows:—$31 for 6 and 8-inch pipe and larger; $32 for 5-inch and 4-inch at the foundry. Pipe, specials, $3 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

Pipe.—Wrought and Galvanized.—Demand is much better 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 72½ per cent. off for black, and 62½ per cent. off for galvanized; ¾-inch, $11.50; 1-inch, $16.50; 1¼-inch, $22.50; 1½-nch, $27; 2-inch, $36; 2½-inch, $57.50; 3-inch, $75.50; 3½-inch, $95; 4-inch, $108.

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.

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.

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).

Rope.—Prices are steady, at 9c. per lb. for sisal, and 10½c. for Manila. Wire rope, crucible steel, six-strands, nineteen wires; ¾-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.

Spikes.—Railway spikes are steady at $2.35 per 100 pounds, base of 5/16 x 9-16. Ship spikes are steady at $2.85 per 100 pounds, base of ⅝ x 10-inch, and ⅝ x 12-inch.

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

Telegraph Poles.—See lumber, etc.