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The Canadian Engineer

WEEKLY

ESTABLISHED 1893

VOL. 17. TORONTO, CANADA, JULY 16th, 1909. No. 3

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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Present Terms of Subscription, payable in advance:

Canada and Great Britain:		United States and other Countries:	
One Year - -	$2.00	One Year - -	$2.50
Six Months - -	1.25	Six Months - -	1.50
Three Months -	0.75	Three Months -	1.00

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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.

PRINTED AT THE OFFICE OF THE MONETARY TIMES PRINTING CO., LIMITED, TORONTO, CANADA.

TORONTO, CANADA, JULY 16, 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.

MUNICIPAL OWNERSHIP.

Canada is just now on the crest of a wave of public and municipal ownership. The National Transcontinental Railway, the Ontario Hydro-Electric power line, and the hundred and one municipal lighting and street railway lines all indicate the general interest in this method of control, and go to strengthen the belief that municipal ownership is here to stay.

Municipal ownership has many advantages, but it has one or two great disadvantages, and perhaps the greatest is the number of indifferent employees such a system keeps on the pay-roll. The method of promotion, system of payment and control make men time-servers, and do not encourage that resourcefulness nor interest which one meets with among the employees of private corporations. The older a municipal-operated plant becomes the more inefficient workers you will find on the pay-roll. The ratepayer is in many instances finding municipal-controlled enterprises a distinct disadvantage.

Not only is this becoming true because of the inefficient employees on the pay-roll, but also because of the system of bookkeeping employed.

The board or committee having charge of such undertakings are up for election annually. Among the electorate are a large number of their own employees, and frequently their vote is organized and directed with a view of electing a friend of the employer instead of the community.

Then, again, alderman or councillor must keep the tax rate down, and many items that should be charged to current account are placed in capital account, and the general tax pays many bills that should be charged to special accounts.

Our present system of municipal bookkeeping and municipal management is not the best friend of municipal ownership.

PROFESSIONAL ADVERTISING.

In Great Britain the etiquette of the engineering profession and the regulations of some engineering societies are opposed to engineers advertising by inserting cards in technical or class papers.

This may be a very proper stand to take, but we venture the opinion that it will not be long before British engineers follow the business methods of the professional man in other countries. The British engineer, instead of using the professional card in the technical press or daily paper, keeps himself before the public and the profession by their published expert reports, addresses and papers before societies and institutes, and even by having their social and domestic affairs reported in the social columns.

To these leaders cold-blooded advertising would bring little return—therefore they make it non-professional.

To the younger man, advertising by the line or inch would bring returns. It would place him on a more equal footing with the older practitioner. As it is now, in the Old Land, he must wait for some lucky moment when he is called as a witness in some large law suit or arbitration, or, as a junior, becomes associated, on a report, with a senior in the profession.

Restricted business-like advertising would be more profitable, honest and professionable than the present method of devising means and expedients to avoid the unwritten law in this matter.

PIG-IRON BY MEANS OF ELECTRICITY.

Some recent experiments at the Domnarfvet Iron Works, Sweden, are of considerable interest in that they show the practicability of smelting iron by the aid of electric current.

The electric current, three-phase alternating was conducted to the furnace through electrodes of carbon, passing to the cylinder-shaped part of the furnace through the arch, which is cooled by means of water. The pressure during the experiments has been about 40 volts, with about 8,000 to 9,500 amperes, and the load 480 to 500 kilowatts. In order to protect the arch of the furnace against the high temperatures, furnace gas, which was obtained from the upper part of the furnace, was brought down under the arch through three openings by which a cooling effect was obtained.

The furnace was started and worked in the same way as an ordinary blast furnace. The charge used at present was of a weight of about two cwts. of ore from the Grangesberg iron mines (containing about 60 per cent. of iron), seven pounds of slaked lime, and 40 pounds of coke. According to an estimate made, this was equal to a consumption of five cwts. 3 quarters of coke per ton of pig-iron. The coke which was utilized contains 81 per cent. of carbon, 7 per cent. of water, and 11 per cent. of ash.

In a previous case an experiment was made with a charge, containing two cwts. of ore, 39 pounds of coke, and four pounds of lime, which was equal to about five cwts. two quarters of coke per ton of pig-iron.

In the products obtained, in some cases, the percentage of carbon was as low as that of steel. This was not the rule, however.

In these experiments the carbon content averaged about 1.80 per cent. The content of silicon varies from 0.2 to 0.07 per cent. The content of sulphur in grey pig-iron has been reduced to 0.005 per cent, while the content of sulphur in the coke used was about 0.5 per cent.

The quantity of electric power used is one of the most important matters in the question. No definite results have been secured, but the average of the more favorable runs has been something above two tons per electric horse-power year. With larger furnaces they expect to be able to secure three tons per electric horse-power year.

EDITORIAL NOTES.

The prosperity and happiness of our country depends upon the quality of scientific technical training of those who guide our industries and control our trade.

* * * *

In the fiscal year ending March 31st, 1909, there was a decrease of $330,555 in amount of iron and steel bounties paid. The statement in detail is as follows:—

	1907-8.	1908-9.
Pig iron	$ 863,816	$693,423
Steel	1,092,200	838,100
Wire rods	347,134	333,090

In 1908-9 the production of pig-iron amounted to 609,431 tons, a decrease of 74,348 tons. The steel output was 570,588 tons, a decrease of 91,351 tons. In the manufacture of pig iron there was used during the fiscal year 1909 a total of 179,735 tons of Canadian ore, a decrease as compared wtih the previous year of 53,778 tons, and of foreign ore 1,037,585, a decrease of 131,221 tons.

From the United States Department of Agriculture and Forestry it is learned that the production of wooden poles for the use of telegraph, railway and telephone poles was less in 1908 than in 1907 in the proportion of 3,249,000 to 3,283,000. But there was a decline in cost of 26 per cent., namely, from $8,081,000, or $2.46 per pole, in 1907, to $5,928,000, or $1.82 per pole, in 1908. The decline in general business is given as the cause of the decline. Sixty-eight per cent. of the poles used are of cedar and 16 per cent. chestnut, the other woods used for the purpose being oak, pine, cypress, juniper and tamarack. The decline in purchases arose from the smaller wants of electric railway and power companies, for telegraph and telephone companies increased their purchases.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

The Twentieth Annual Convention of the Canadian Association of Stationary Engineers will be held this year in London, Ont., July 27th to 30th.

Programme.

First Day—

10.30 a.m. Opening address of welcome by Mayor Stevely.

2.co p.m. Session.

3.30 p.m. Excursion to Springbank. Launches provided for delegates by the Canadian Fairbanks Company. The remainder of the afternoon and evening the delegates will be entertained at Springbank by the Exhibitors' Association.

Second Day—

9.co a.m. Session.

12.00 a.m. An hour among the exhibits.

1.oc p.m. Delegates and resident engineers will be entertained at the London Hunt Kennels by E. Leonard & Sons. This will be followed by a trolley trip, from which the delegates will return to the hall for the evening session, which will adjourn for the Grand Banquet.

Third Day—

9.00 a.m. Regular session.

2.00 p.m. Installation of officers. Presentation of Past President's Jewel. Closing.

OBITUARY.

PROFESSOR SIMON NEWCOMB, the astronomer and mathematician, died at his home, Washington, D.C., July 12th, 1909, at the age of 74. Professor Newcomb was the oldest son of John Newcomb, of Wallace, Nova Scotia. He was educated by his father and taught school in Nova Scotia, and also in the United States, after his removal there in 1853. While in Maryland he became acquainted with Joseph Henry and Julius E. Halgard, who, recognizing his aptitude for mathematics, secured his appointment in 1857 as computor on the Nautical Almanac, then published in Cambridge, Mass. On graduating from the Lawrence Scientific School, in 1858, he continued there for three years as a graduate student. He was appointed professor of mathematics in the United States navy in 1861, being assigned to duty in the United States Naval Observatory, Washington. While there he negotiated the contract for the 26-inch equatorial telescope authorized by Congress, supervised its construction, and planned the tower and dome in which it is mounted. In 1871 he was appointed secretary of the Commission that was created by Congress for the purpose of observing the transit of Venus, December 9th, 1874. He was elected to the American National Academy of Science in 1869, and since 1883 had been vice-president of this organization. In 1876 he was elected president of the American Association for the Advancement of Science, and he delivered his retiring address at the St. Louis meeting, 1878. He had also held the presidency of the American Society for Psychical Research.

STEAM TURBINES, FROM THE USERS' POINT OF VIEW.*

By Alfred S. Blackman, Borough Electrical Engineer and Manager, Sunderland.

There is such an abundance of literature on the subject of the steam turbine giving descriptions of types and systems, that only a passing reference will be made to this point. Briefly, the present situation of the steam turbine industry is a battle for supremacy between the Impulse and Reaction types, and while the partisans of each type claim all sorts of wonderful advantages which the other does not possess, yet the following statements are put forward as representing the point of view of a user who has studied the problem from all sides. (1) All turbines must fulfil a certain law of combination of blade speed and a number of running rows. (2) Steam expanding between boiler pressure and condenser must generate a certain velocity, and this velocity must be imparted to the revolving mass in small increments as in the Parsons machine, entailing many rows of blades, or in larger increments, as in the Zoelly of Curtis machines, or in one increment as in the Laval. (3) The fewer the rows of running blades the higher must be the speed at which the blades run, and consequently the higher the speed of the steam impinging on the blades. (4) The Impulse type turbine runs at a much higher speed at blading than the Reaction type, and necessitates particular attention being given to the design of the wheels and blades, owing to the greater stresses that prevail. (5) The Impulse type turbine lends itself to a more mechanical-looking construction than the Reaction type. (6) The Reaction type, as illustrated by the best Parsons type, is more economical than the Impulse type. (7) For speeds of 3,000 revolutions per minute and below 1,000 kw. the Impulse type is better than the Reaction. (8) For speeds of 1,500 revolutions per minute and up to 3,000 kw. the Reaction type has, up to the present, proved most satisfactory. (9) For speeds of 1,000 and 750 revolutions per minute, and up to the largest sizes likely to be used, there is absolutely no evidence that the Impulse type can compete in reliability or economy with the Parsons type.

In making the above statements regarding reliability and economy, isolated cases have not been considered, only an opinion expressed on a general survey; and a very important point which must be considered, both for and against the two types, is that the Reaction type has been longest in the field, the uses to which it has been put are of wider application, and the horse-power in use must very greatly exceed that of the Impulse type; whether the Impulse type will come through the many vicissitudes that are supposed to beset all turbines is a matter which has yet to be proved.

A review of the progress of the last two years, the writer thinks, shows that while trouble with the Reaction type has shown a marked diminution—due to the defects of the earlier designs having had time to come to light, thus showing the necessity of more mechanical construction, and notably of stiffer shafts—the Impulse type has not made the headway many people looked for, and may still be said to have its infantile complaints ahead.

Turbine Outputs and Speeds.

Too little attention is given nowadays to selecting an efficient combination of power and speed, although the latter is such an important point from every point of view. Take two instances:—(1) 750 kw. on 50 cycle; (2) 1,500 kw. on 40 cycle. In case 1 the periodicity being 50, only two speeds can be considered, viz.; 3,000 revolutions per minute with a two-pole machine, or 1,500 revolutions per minute with a four-pole machine. Many engineers have selected the slower speed in putting down their installations, but there is no arguments in reason which can be given against the higher speed of 3,000 revolutions per minute, as the high-speed set will be (1) more economical by about 10 per cent.; (2) take up less floor space; (3) be about 15 per cent. cheaper in first cost.

The same remarks apply to case 2, where of the two speeds of 2,400 revolutions per minute and 1,200 revolutions per minute, it is an uncommercial proceeding to put in the slow-speed set. A very good rule to follow, and one which should be insisted on is:—Choose the size of your unit to suit the highest speed that the periodicity will allow, and here the assistance to be obtained from external fan cooling of the generator should not be overlooked, because the higher the speed at which the set is run, the greater the benefits which will be obtained from a turbine installation.

At Sunderland we have a 1,500-revolutions per minute, Willans-Dick-Kerr combination installed to carry a load of 2,000 kw. continuously, and 2,500 kw. for two hours, and the economies effected by this plant, have been most pronounced, as is very practically exemplified by the fact that with the present normal works day load, amounting to about 2,300 kw. on the turbine, two boilers will easily steam the turbine, but upon changing over to three modern high-speed reciprocating engines, of about 700 kw. capacity each, it is impossible to hold the steam without substantial assistance from a third boiler, and we always hold additional boilers banked against the contingency of a failure of the turbine plant.

For direct-current turbo sets, the merits of the tandem machine must not be lost sight of. For a given size of unit the advantages accruing from tandem machines are many. For instance: (1) by putting in tandem generators, the speed of the set can be increased by about 75 per cent. with all the attendant advantages, as already pointed out. (2) The electrical portion being divided into two, there is only 50 per cent of the machine out of commission should troubles of any sort arise.

Turbines v. Reciprocating Engines.

It is often a subject of some concern to an engineer to decide at what size of unit it becomes advisable to adopt turbines in preference to reciprocating engines; a general statement which has been made very frequently is that above 750 kw. as a unit use turbines, below 750 kw. use engines. It is, however, impossible to draw any definite line of demarcation, as so much depends upon the available conditions and the requirements. For instance, the temperature and quantity of circulating water affects the situation very seriously, and must be taken into consideration as regards both capital and running costs, before any decision can be arrived at. Every case calls for a detailed investigation, which it will repay to make thoroughly. There is, however, not the slightest doubt that with the higher speeds at which it is now possible to run turbo-generators, the proposition of turbines versus engines, will soon disappear, and it will be a case of turbines only; in fact, it is even now difficult to prove a case for the reciprocating engine under any ordinary conditions.

The Brush Company, who have made a specialty of small turbo-generator sets, give the following typical figures for a 300 kw. plant:—

Steam consumption in lbs. of steam per kw.-hour with steam at 160 lbs. per square inch:—

	Dry steam.	With 100 degrees superheat.
Reciprocating engine, 26-in. vacuum..	24	29½
Turbines, 28-in. vacuum	22	19¾

The capital cost of the two plants complete with condensers is practically the same.

Granting that capital and steam costs are equal upon so small a unit, and taking into consideration the undeniable advantages the turbine has in cost of oil and general upkeep, it does indeed appear that the reciprocating plant has only a small field left, except upon sites where the facilities for obtaining cooling water are exceptionally bad.

The selection of conditions for turbine installation can be summed up in few words:—

*Paper read before the Incorporated Municipal Electrical Association.

(1) 150 lbs. per square inch steam pressure.	Because at pressures above 150 lbs. per square inch the volume becomes small and leakage percentages are increased, with only a small gain in B.T.U.'s available.
(2) 150 degrees superheat.	Because there is no appreciable gain in plant over all economy above 150 degrees superheat.
(3) Highest possible speed	Already commented on.
(4) Best vacuum possible.	Because it is the strongest feature in turbine working, and it will pay to maintain as high a vacuum as possible.

Condensing Equipment and Vacuum.

The condensing plant is the most important detail of the plant, and yet how often is it neglected, or, one should say, not paid sufficient attention to. A vacuum should be selected with an equivalent temperature about 25 degrees above the available temperature of circulating water, and this gives a commercially obtainable and maintainable vacuum. Having once obtained this, see that it is always maintained. If a vacuum of 28½-in. can be obtained, never let it drop to 27½-in., which it will easily do with a little inattention and neglect of glands, joints, sluice, and automatic valves, etc. An inch down in vacuum will mean a 5 per cent. rise in the coal bill. Work this out in expenditure per annum and it will draw its own moral. The writer has found a vacuum recorder kept under lock and key worth considerably more than its weight in gold. The writer is of opinion that the field for improvement in condensing plant is even greater than in turbines.

As regards types of condensing plant in use, this again depends on circumstances. There are three main types:—(1) Surface; (2) low-level jet; (3) barometric.

(1) Surface can be sub-divided as follows:—(a) Ordinary, viz., generally consisting of surface condenser, air pump, and circulating pump. (b) Parson's Augmenter Surface, which is as in (a) with the addition of a steam jet and auxiliary condenser, which allows smaller cooling surface, and less circulating water to be employed. Further, the hot-well temperature is higher than with (a). This is, in the writer's opinion, undoubtedly the best form of surface condensing plant. (c) Counter-current, an arrangement of (a) with compartment drainage. From the point of general works economy, as a rule, the capital cost of surface condensing plant will be rather higher than either jet or barometric condensers.

(2) Jet condensers are made in many highly successful ways, and require, if anything, rather more power than surface plants. Upon account of air entrained with the circulating water, very complete air-extracting apparatus is necessary.

(3) Barometric condensers are a very satisfactory form of plant, provided every precaution is taken to prevent air leakage, and ample passage way given to steam and water. The power taken for pumping is, however, slightly in excess of other types of condensing plant, but from the writer's experience it makes a very satisfactory installation. A great point is the uniformity of the vacuum which can be maintained owing to the absence of cooling surfaces which become dirty and therefore inefficient. In some cases no air pump is installed, but where a high vacuum is essential a really powerful dry air pump is necessary. It is probable that this type of condensing plant has been kept back owing to the fact that when used with reciprocating engines the presence of oil in the exhaust steam put difficulties in the way of using the hot-well water for boiler-feed purposes. With turbines this difficulty has, of course, disappeared, and it is possible that barometric condensing plants will be more heard of in future; they are certainly more easy to maintain at their best than surface condensers.

Reliability of Turbines as Prime Movers.

Sunderland experience has shown the Willans-Parsons turbine to be absolutely trustworthy. For over 16 months the bulk of the work has been done by the 2,000-kw. turbine plant of this make, running at 1,500 revolutions per minute, and during the year ending March 31st last, the total units generated in the works were 9,207,227, of which no less than 8,009,000, or 87 per cent. of the whole output, were generated by the one turbine plant.

This turbine has with very few exceptions, been put on load every Sunday at noon, and has run through without any stop until the following Sunday, at about 1 a.m. During the night the load drops, as a rule, to about 400 kw., and the day peaks have been about 2,300 kw.; when this has been exceeded, one or more 700-kw. reciprocating sets have been paralleled. Throughout the day the work has consisted of about three-quarters shipyard and one-quarter tramway load, and it is of a very fluctuating character.

During the whole of this time any sudden mishap to the turbine would have shut the whole system down, because in no case has there been sufficient plant in parallel with the turbine to take the load up temporarily, but in no instance has there been a hitch in any way attributable to the turbine; it runs through week after week with an entire absence of incident. It will be realized that these are severe and exacting conditions, and such dependence upon a single unit calls for the utmost reliability, and after fairly lengthy experience of both high-speed piston valve and slow-speed Corliss valve reciprocating engines, the writer trusts the turbine with equal confidence to either of these alternatives.

Maintenance of Turbine Plant.

The writer is of the opinion that maintenance costs on steam turbine plant (consisting of turbine, alternator and condensing plant) complete, should not exceed, say, $500 per annum per 10,000,000 units generated, and if careful record were taken in some of the larger turbine works, and fair maintenance debits were allocated against units generated, it would be found in many cases less than this amount. As a matter of fact, the maintenance of the Sunderland 2,000-kw. plant for the year ending March 31st last, including opening the turbine twice to measure clearances, came to less than $175, and while it is true that the set was under the contractor's maintenance, a detailed and careful check was taken of all that was done to the plant, including the renewal of exciter brushes, etc., and the figure given is a liberal allowance of what it would cost the Corporation to do the same work, although the contractors will have expended more than this, by reason of men's travelling expenses and out-money.

Exhaust Steam Turbines.

The advantages of the application of the exhaust-steam turbine do not appear to be fully appreciated, even at the present time. As compared with a high-pressure turbine, an exhaust steam set requires about double the steam, and the gain due to high vacua is more than twice as great. The machine can be of robust construction owing to there being no necessity for fine clearances, and, moreover, the temperature distortions are small. The Impulse type can be of very simple construction for exhaust steam working, but does not, upon the other hand, lend itself so well to economical working as the Reaction type, as it works with higher steam velocities, and if the steam is wet, as is usual, the friction losses due to this cause are high.

Many present-day condensing engine plants, with a good supply of cold water for circulating, could be increased in output by 25 per cent. without any appreciable extra expense, save the capital cost of the exhaust turbine installation; it is, however, the exception to find such plants in electricity works, but their installation seems such an absolutely sound scheme that it is a wonder the development has not been more rapid.

Economies to be Obtained from Turbines.

Sunderland experience shows the cost of working with turbine plant to be much lower than with reciprocating engines. The writer has already dealt with maintenance costs, and as regards steam consumption, it has been argued against the steam turbine that it does not maintain its economy, but

the following experience of the writer's shows that good results can be maintained after the hardest work.

The 2,000-kw. Willans-Parsons set installed at Hylton Road was tested on setting to work, and again on the expiration of one year and two months' work, during which time the plant ran over 9,000 hours, and generated over 9,000,000 units. The steam consumption on a 27½-in. vacuum was 17.07 lbs. of steam per unit on one test, and 17.1 lbs. of steam per unit on the other.

As regards oil, which was logged separately from the other plant, the total cost for the year ending March last was for the turbine, $67, and for the turbine auxiliaries, $92, a total of $159, equivalent to 0.000953 of a penny per unit generated. It would be difficult to claim such a record of maintained economy for any prime mover other than the steam turbine.

CONCRETE BRIDGE SPECIFICATIONS.*

By T. H. Macdonald, Iowa Highway Commission.

It is clearly an impossibility to present anything approaching a complete set of specifications in a paper that would not be tiresome to the auditors and unfair to the other numbers on the programme. I shall, therefore, attempt to touch only a few of what we consider the more important considerations, general and specific, relating to concrete and its use in bridge construction.

The first requirement of any set of specifications should be its ability to defend itself in any court of law, if permissible to express it in this way. That is, a specification should first of all be legal, which would mean the entire absence of catch phrases or the uncommon use of words or phrases that could be construed to the disadvantage of either party. Technical terms and phrases must, of course, constitute a large part of the text, and yet it is possible so to construct them that if read before a jury of twelve men, the meaning and general fairness of the various clauses would be apparent if the finer technical distinctions were not.

This may be well illustrated by the attitude taken by a capable engineer who uses a certain method for determining earth work. This method is not as accurate as some others but he justifies its use because it is easily demonstrated to and understood by a jury as ordinarily made up. It is questionable how long any specification will stand before a jury if the actual facts do not substantiate it.

A second important requirement is the practicability of the methods outlined. It is undoubtedly poor practice to write exceedingly stiff specifications if there is no intention of carrying them out practically as written. There probably never has been a piece of work where little adjustments did not have to be made from time to time as the work progressed, but this does not necessarily mean that the specifications were not practical. And there are also clauses which are included only to be used in the event of certain contingencies. For instance, we specify that no concrete shall be dropped more than three feet while being placed in the forms, but this specification is not strictly enforced unless concrete is being placed in thin sections or in water.

Specifications should also be definite to enable the contractor to know just as nearly as possible the grade of material he will be expected to furnish and the amount of work he will have to do, together with as much other accurate information of this character as possible. For instance, we try to specify the exact elevation to which the contractor will be required to carry his foundations at the price bid, and allow an extra for concrete placed below this elevation.

For large bridges, standard specifications will not prove applicable without the addition of many specific clauses but for smaller structures, particularly for concrete slab culverts, general specifications can be used that prove fairly satisfactory for covering the work of a township or a country. A table has been prepared and is included herewith which shows the thickness, the amount of reinforcing in square inches per foot of width, the stress in the concrete and in the steel for culvert slabs from two to twenty feet clear span. The loading used is the dead load which includes the weight of the concrete and the earth fill plus a concentrated live load of twelve-ton traction engine mounted on axles, eleven-foot centres, the rear axle carrying a weight of eight tons.

The classes of concrete to be used in these structures are as follows:—

For the tops: Class A concrete.

For the side and wing walls: Class B concrete.

For the foundations and footings: Either Class B or class C concrete.

The following is our standard specification for classes of concrete:—

Classes of Concrete:—The concrete shall be designated by classes which shall be proportioned as follows:—

Class A. concrete:—1 part cement, 2 parts sand, 4 parts broken stone or screened pebbles passing 2-inch ring.

Class B. concrete:—1 part cement, 2½ parts sand, 5 parts broken stone or screened pebbles passing 2½-inch ring.

Class C. concrete:—1 part cement, 3 parts sand, 6 parts broken stone or screened pebbles passing 2½-inch ring.

Sand Content:—Unscreened gravel may be used for classes B. and C. concrete, subject to frequent tests by the engineer to determine the sand and pebble content, and in no case shall the sand be greater than the class requirements or less than is necessary to fill the voids in the pebbles.

Class B. mortar:—1 part cement, 2½ parts sand passing ¼-inch mesh.

The approximate quantities for a cubic yard of concrete of the above proportions are as follows:—

Kind.	Cement. Barrels.	Sand. Cu. Yd.	Screened Pebbles, Broken Stone. Cu. Yd.
Class A.	1.57	0.44	0.88
Class B.	1.25	0.46	0.92
Class C.	1.10	0.47	0.94

Note:—"It shall be permissible for the inspector to slightly vary the above proportions of sand and aggregate for the different classes to secure a denser concrete with the materials used."

It will be noticed that we do not adhere strictly to the exact amount of aggregates in the various classes where the materials can be used to produce a smoother concrete by slightly adjusting the amounts as given. The class C concrete is the weakest that we use and at the present price of cement we believe it is false economy to use a leaner mixture, except in very heavy construction, and even then we prefer a fairly rich concrete with one man rubble stone imbedded in this concrete. The division line between sand and gravel is placed at about a No. 8 screen. The advisability of following the specification in regard to determining the sand and pebble content is well illustrated by the following table, which reports the results of tests made on sample sent in from various counties:—

Gravel.	No.	Pebbles per cent.	Sand per cent.
Greene Co.	1	80.8	19.2
Greene Co.	2	46.3	53.7
Greene Co.	3	34.3	65.7
Greene Co.	4	43.0	57.0
Greene Co.	5	57.1	42.9
Carroll Co.	1	33.8	66.2
Story Co.	1	58.7	41.3
Story Co.	2	47.3	52.7
Story Co.	3	42.4	57.6
Emmet Co.	1	65.2	34.8
Emmet Co.	2	30.4	69.6
Emmet Co.	3	51.7	48.3

*Read before the Iowa Cement Users' Association.

REINFORCED CONCRETE SLABS.

Live Load—One 12-Ton Engine.

Clear span.	Effective span.	D	1 Ft. Fill. M	1 Ft. Fill. C	S	D	2 Ft. Fill. M	2 Ft. Fill. C	S	D	3 Ft. Fill. M	3 Ft. Fill. C	S	D	4 Ft. Fill. M	4 Ft. Fill. C	S	D	5 Ft. Fill. M	5 Ft. Fill. C	S	D	6 Ft. Fill. M	6 Ft. Fill. C	S	D	7 Ft. Fill. M	7 Ft. Fill. C	S	D	8 Ft. Fill. M	8 Ft. Fill. C	S
2 Feet	2 ft. 6 in.	6	1387	530	0.30	6	1405	560	0.32	6	1293	494	0.28	6	1085	413	0.24	6	1022	390	0.22	6	1027	392	0.22	6	1035	390	0.22	6	1068	407	0.23
3 "	3 " 6 "	7	2038	497	0.35	7	2192	530	0.38	7	1865	453	0.32	7	1746	424	0.30	7	1728	420	0.30	7	1755	425	0.30	7	1819	442	0.31	7	1899	461	0.33
4 "	4 " 6 "	8	2757	467	0.40	8	3010	509	0.43	8	2650	448	0.38	8	2550	432	0.38	8	2580	437	0.38	8	2671	452	0.38	8	2808	474	0.40	8	2968	503	0.43
5 "	5 " 6 "	9	3903	485	0.48	9	4355	542	0.54	9	4035	501	0.50	9	4020	500	0.50	9	4170	519	0.51	9	4405	548	0.54	9	4705	585	0.58	10	5083	485	0.55
6 "	6 " 6 "	9	4730	589	0.58	10	5490	523	0.59	10	5150	490	0.55	10	5220	498	0.56	10	5480	522	0.59	10	5840	557	0.63	10	6277	598	0.68	11	6818	513	0.65
7 "	7 " 6 "	10	5800	552	0.62	11	6700	504	0.64	11	6410	482	0.62	11	6585	496	0.63	11	6985	526	0.67	11	7500	564	0.72	12	8190	499	0.71	12	8830	538	0.70
8 "	8 " 6 "	11	7430	559	0.71	12	8710	531	0.75	12	8535	520	0.74	12	8930	545	0.77	12	9585	584	0.82	13	10510	530	0.82	13	10480	530	0.82	13	11320	572	0.89
9 "	9 " 6 "	12	8700	531	0.75	13	10260	517	0.80	13	10300	520	0.81	13	10750	543	0.84	13	11600	585	0.91	14	12800	541	0.92	14	13925	589	1.00	15	15215	550	1.01
10 "	10 " 6 "	13	10100	510	0.79	13	11760	593	0.92	14	12040	510	0.87	14	12805	542	0.92	14	13870	586	0.99	15	15300	552	1.01	16	16900	527	1.04	16	18320	570	1.12
11 "	11 " 6 "	13	11350	573	0.89	14	13560	574	0.97	14	13800	583	0.99	15	13010	542	0.99	15	10340	590	1.08	16	18100	563	1.11	17	19970	540	1.14	17	21975	595	1.26
12 "	12 " 6 "	14	13020	550	0.93	15	15570	563	1.03	15	16010	578	1.06	16	17550	546	1.08	16	19130	595	1.17	17	21200	573	1.21	18	23445	559	1.26	19	25075	543	1.30
13 "	13 " 6 "	14	14800	535	0.98	16	17750	552	1.09	16	18425	573	1.13	17	20240	548	1.16	17	22110	597	1.27	18	24600	586	1.32	19	26950	569	1.36	20	29830	561	1.42
14 "	14 " 6 "	15	16370	591	1.08	17	20120	544	1.15	17	21040	570	1.21	18	23180	552	1.24	19	25750	544	1.30	19	28200	597	1.43	20	31190	588	1.49	21	34280	579	1.55
15 "	15 " 6 "	16	18450	574	1.13	18	22700	541	1.22	18	23850	568	1.28	19	26360	557	1.33	20	29380	553	1.40	21	32600	550	1.47	21	35620	599	1.61	22	39140	598	1.68
16 "	16 " 6 "	17	20700	560	1.19	18	25050	597	1.35	19	26960	570	1.36	20	29900	562	1.43	21	33320	562	1.51	22	37000	564	1.59	23	40840	566	1.67	24	44890	567	1.75
17 "	17 " 6 "	18	23150	551	1.24	19	27950	591	1.41	20	30230	569	1.44	21	33680	568	1.52	22	37560	572	1.61	23	41700	576	1.70	24	46020	580	1.80	25	50440	582	1.88
18 "	18 " 6 "	18	25180	599	1.35	20	31150	586	1.49	21	33780	570	1.53	22	37020	574	1.61	23	41990	581	1.72	24	46000	587	1.82	25	51490	595	1.92	26	56500	597	2.02
19 "	19 " 6 "	19	27950	591	1.41	21	34550	583	1.56	22	37650	574	1.61	23	42060	581	1.72	24	46920	592	1.83	26	52700	557	1.89	27	58060	567	1.99	28	63050	575	2.09
20 "	20 " 6 "	20	30950	583	1.48	22	38150	581	1.64	23	41710	577	1.71	24	46640	589	1.82	26	52760	558	1.89	27	58500	571	2.01	28	64440	582	2.12	29	70510	590	2.24

D—Depth of beam in inches. M—Max. Mom. in ft. lbs. C—Compressive stress in concrete in lbs. per sq. in. S—Area of steel in sq. in. per ft. of width.

A variation in the compressive strength of these samples mixed in a proportion one part cement to six of the sample is illustrated by the seven and twenty-eight day tests given:—

Compressive Strength of Gravel Concrete.

Gravel.	No.	7 Days, lbs. sq. in.	28 Days, lbs. sq. in.
Greene Co.	1	625	1,030
Greene Co.	2	774	1,490
Greene Co.	3	636	1,170
Greene Co.	4	475	865
Greene Co.	5	557	1,195
Carroll Co.	1	504	1,137
Story Co.	1	720	1,485
Story Co.	2	735	1,370
Story Co.	3	531	1,275
Emmet Co.	1	940	1,950
Emmett Co.	2	389	744
Emmett Co.	3	465	873
Average		612.6	1,215.3

The specification for classes of concrete is referred to in the following paragraph:—

"Measuring and Proportioning:—The proportions of the different classes of concrete shall be carefully maintained by some method of measuring satisfactory to the engineer, the cement being measured as packed by the manufacturers and the aggregate loose. The use of bottomless boxes and square wheelbarrows of uniform size, designed for this purpose, will be accepted as satisfactory methods."

Without going into this subject too much in detail, it is perhaps worth while to include the following specification for the reinforcing steel:—

"Reinforcing Steel:—Except as otherwise specifically stated herein, all reinforcing steel used shall be of such a section as to provide a mechanical bond at frequent intervals and to insure a thorough contact between the steel and concrete. Net sections, sizes and distribution and bonding shall be exactly as shown on the drawings. The transverse bars shall consist of one-half inch round rods placed in pairs as shown on the drawings, and connected by a lattice bar of the required length, punched with five-eighths inch holes, and placed at intervals of three feet. The lattice bars shall be held rigidly to position by blocking to the forms and wiring to the bars it crosses. Medium steel, having an elastic limit not less than 32,000 pounds per square inch shall be used, and shall withstand cold bending equal to twice the diameter of the test piece without fracture. Only steel free from rust, dirt and grease shall be used, and some means shall be provided for cleaning the surface of the steel before placing."

PATENTS.

The following is a list of Canadian patents recently obtained through the agency of Messrs. Ridout & Maybee, 103 Bay Street, Toronto, from whom further particulars may be obtained:—

Antoine H. Imbert, electric rotary furnace; Lyman Melvin Jones, combined side delivery rake and hay tedder; Lyman Melvin Jones and R. H. Verity, lifting device for mower cutter bars; John Taylor and E. W. Buckley, mechanical weft feeling mechanism for looms; John Taylor and E. W. Buckley, mechanical weft feeling mechanism for looms (No. 2); John Taylor and E. W. Buckley, mechanical warp stop motion for looms; Wm. Henderson, stoves; Thomas L. Mullally, portable sectional coverings; Milton E. Shantz, Grate Bars; J. C. Wagg, stone gathering machine; Ernest W. Lee, baker's peel.

FIREPROOF CONSTRUCTION IN REINFORCED CONCRETE.

There appears to be a general lack of knowledge of the recent rapid development of the important features which enter into fireproof construction whereby its cost has been materially reduced. It now costs only about 10 per cent. more to build a structure in which the fire hazard is practically negligible than one of the slow-burning type. Although the cost of thoroughly fireproof construction as provided by reinforced concrete is naturally somewhat greater than that of ordinary construction, its durability and its exemption from fire risk greatly reduce the net annual charges.

The advantages of reinforced concrete as a fireproof material are well set forth in a paper recently presented before the National Fire Protection Association by Mr. Leonard C. Wason, president of the Aberthaw Construction Co., of Boston, from which we quote in part:—

"Numerous fire tests have been made to determine both the resistance of concrete to actual test, and also the depth to which the reinforcement must be embedded to prevent its being damaged. The maximum depth of pitting observed by the writer in actual fire tests where a temperature of 1,700 degrees F. or more has been maintained for a period of five hours has been in either walls or ceilings, one inch to one and one-half inches. Also, by the examination of actual conflagrations, such as that at Baltimore and elsewhere, it has been apparent that the pre-arranged fire tests are more severe in the results shown by the structure than actual conflagrations. Therefore, if we can protect the materials against damage in a pre-arranged test, they will stand any actual service. The concensus of opinion of engineers is that there should be at least one inch of concrete between the nearest point of a bar to the ceiling in panels, at least two inches below the steel in beams and girders, and also two inches of concrete outside the vertical bars in columns. In designing columns it is common to figure only that area of column inside the vertical bars when hooped as carrying the load, or, if hoops are omitted and but light reinforcement is used to prevent bending stresses, to add an extra inch beyond that needed to carry the load all around the outside, which might be burned away without endangering the load-carrying capacity of the balance of the column within. If this is burned off it can be plastered back, giving the column the same fire-resisting qualities as before.

"The other types of fireproof construction which are coming into competition with reinforced concrete are structural steel encased in concrete, and this, when thoroughly encased from a fireproof standpoint, is similar to an all-concrete building. Structural steel frame encased in terra cotta, and to a small extent plaster of paris and brick have been used in fireproofing steel, but not to a sufficient extent to be worthy of much comment. Thoroughly well-laid brick work is a good protection to columns, but when cast as arches between beams it leaves the bottom flange exposed, which is a serious defect. Actual conflagrations have conclusively shown that terra cotta is not so perfect a fire protection as concrete. This is largely, in the writer's opinion, due to the fact that its coefficient of expansion is high, so that it expands to such an extent that when confined between the beams it is crushed, the lower member falling, and thus weakening the floor. It is also more susceptible to a combination of fire and water, being to some extent brittle, and cracking when a cold stream strikes a hot surface.

"Before concrete will disintegrate when exposed to fire the large amount of moisture chemically combined in the setting of the cement being 20 to 25 per cent. of its weight, has to be driven off by heat, and then the vapor thus driven off has to be evaporated from the pores of the concrete before it becomes sufficiently hot to crumble. The slowness of evaporating this vapor is probably the cause of concrete resisting extremely high temperatures for the brief period of a few hours, while a much lower temperature, if long continued, would ultimately disintegrate it. Cement will resist 500 degrees F. for an indefinite period, while a continuous temperature of over 700 degrees F. is disastrous. The cement coating of the stones of the concrete will resist the attack of fire so long that it is of less consequence whether the stone can be damaged by the fire or not. Thus, pure limestone is a most excellent aggregate, and will not decompose until after the cement has, and after the cement has gone it it immaterial what aggregate is used, as the work has then failed anyway.

"Regarding the cost of this type of construction as compared with others, the large use has proved conclusively that it will compete, because the item of cost is considered paramount in ninety-nine out of every hundred structures. For large buildings the structural frame is almost always cheaper than the steel. Thin curtain walls cannot be built as cheaply on account of form work, which is constant for a thin wall as well as for a thick one, but if the wall must be sixteen inches or omre in thickness concrete is cheaper than brick."

THE TRUE VALUE OF CONSERVATIVE REINFORCED CONCRETE CONSTRUCTION.

M. C. Tuttle.*

The advisability, if not the necessity, of allowing a sufficiently large factor of safety in the design of reinforced concrete buildings to provide against serious injury from the action of fire, should be emphasized. In considering the value of concrete as a fireproof building material, it is well to remember what are its constituent parts. Well made stone concrete consists of crushed stone or gravel, sand, and Portland cement, in such proportion that each particle of sand is coated with cement, and that each piece of stone is covered with mortar. In the best concrete the stones are graded, and when the whole is mixed and tamped the result is a compact mass with mortar between. Fire has a varying effect on different kinds of stone, but when this stone is covered with mortar as in well made concrete its destructive effect is decidedly less.

A block of concrete subjected to a severe heat for a short time would crumble somewhat, and upon cooling would show considerable strength. If heated red hot a similar block would become soft and probably be broken by a severe blow. The stones on the outside may have disintegrated, but those on the inside would be found intact and covered with mortar.

Experience has shown that the action of fire on reinforced concrete is of a similar nature. The concrete on the under side of reinforced concrete floors may crumble to a more or less extent, and if there is not enough to spare the steel will be overheated and serious injury done. In the case of columns surface disintegration may so decrease their bearing area that collapse of both columns and floors is a possibility. Of such buildings, where the factor of "fire safety" is small or non-existent, the most that can be said, is, that they are non-combustible.

Hence in a conservative design ample concrete should be specified to protect the steel and the concrete immediately about the steel. In event of a fire the damaged concrete surface may then be inexpensively repaired with plaster, and the floors and columns still retain their figured strength. Under similar circumstances, the repairs on a light structure would be found very expensive, while the cost of removal of the whole building would be so great that owners and designers would not care to consider it.

It is obvious, then, that it is decided economy in the end to employ honest, capable designers and contractors, and to pay a fair price for the work done. In no other way can satisfactory results be obtained.

*Of the Aberthaw Construction Company, Boston, Mass.

PANAMA CANAL EXPENDITURES.

The classified expenditure on the Panama Canal up to May 1st, 1909, is as follows:—

Civil administration	$ 2,806,491
Sanitation	8,468,515
Construction and engineering	45,195,326
Municipal improvements	6,428,439
Plant account	38,759,489
Total	$101,658,260

This is actual construction expenditures and does not include the price paid for the French franchise or to Columbia—$50,000,000 in all.

PERSONAL.

MR. FRANK BARBER, County Engineer for York, and for a number of years chief assistant engineer to Mr. J. McDougall, late County Engineer of York, and Mr. C. R. Young, B.A.Sc., Lecturer in Applied Mechanics of Toronto University, and for three years connected with the structural departments of the Dominion Bridge Company, and Canada Foundry have entered into partnership as consulting and designing engineers on steel and concrete bridges and general engineering. Their offices will be 57 Adelaide Street East, Toronto, Ont.

MR. CHAS. F. BOEHLER, B.S.A., a graduate of Cornell University, has been given charge of the Landscape Department of Stone and Wellington, nurserymen, Toronto, Ont.

RAILWAY EARNINGS AND STOCK QUOTATIONS

NAME OF COMPANY	Mileage Operated	Capital in Thousands	Par Value	EARNINGS Week of July 7		STOCK QUOTATIONS TORONTO				MONTREAL			
				1909	1908	Price July 9 '08	Price July 1 '09	Price July 8 '09	Sales Week End'd July 8	Price July 9 '08	Price July 1 '09	Price July 8 '09	Sales Week End'd July 8
Canadian Pacific Railway	8,920.6	$150,000	$100	1,611,000	1,399,000	162	183 –	183	20	163	162½	182½ 182	183⅝ 182¾	1078
Canadian Northern Railway	2,986.9			179,200	152,300									
*Grand Trunk Railway	3,536	226,000	100	768,409	728,831		*1st. pref. 105½, 3rd pref. 56½, ordinary 23¾							
T. & N. O.	334	(Gov. Road)		29,072	16,337									
Montreal Street Railway	138.3	18,000	100	75,474	70,389					172¾	172¼	218½ 218	218 217	200
Toronto Street Railway	114	8,000	100	74,711	68,488		123¾	124½	41	99	98½	124 123⅝	124 123⅝	665
Winnipeg Electric	70	6,000	100			156½	187½ 186	186 185¾	35	156			185¾	40

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

JUNE RAILROAD EARNINGS.

Company.	Month of June, '09.	Month of June, '08.	Increase.	Jan. 1 to June 30, '09.	Jan. 1 to June 30, '08.	Increase.
C. P. R.	$6,354,000	$5,458,000	$896,000	$34,968,860	$30,034,000	$4,934,860
C. N. R.	805,000	682,400	122,600	4,043,800	3,712,500	331,300
G. T. R.	3,506,056	3,422,858	83,198	18,239,944	17,735,596	504,348
T. & N. O.	114,194	68,116	46,078	645,029	358,294	286,735
Montreal Street	319,446	299,737	19,709	1,720,792	1,630,747	90,045
Toronto Street	308,335	281,912	26,423	1,756,479	1,624,560	131,919
London Street	20,936	20,233	703	108,965	105,098	3,867

TORONTO RAILWAY COMPANY.

The earnings of the Toronto Railway Company for last week were greater by $1,755 than those of the Montreal Street Railway. This is the first time this has occurred.

QUEBEC STREET RAILWAY.

The Montreal directors of the Quebec Street, Light and Power Company recently returned from an official inspection of that system.

Mr. J. N. Greenshields, K.C., a director of the company, in discussing the matter, said that he was convinced from what he saw that the Quebec Street Railway will prove to be a little later on one of the most profitable traction corporations in the country.

"We inspected the city lines and offices, and we went over the line to Ste. Anne de Beaupre. Of course, nothing definite has been decided as yet, but I may say that the whole system will be greatly improved, such as new extensions, double tracks, larger cars, and faster time, and also by arranging for less change of cars from lower to upper town. A trip to the exhibition grounds was made across the St. Charles River. We found this line in fair condition, but by building a new bridge across the river the cars will be enabled to serve a larger area, and thereby afford access to a new section of the district which is rapidly filling up with the working classes. An inspection was also made of the St. Foy and St. Louis lines. The idea, I should think, would be to run a loop line out by St. Foy and back by St. Louis. It is also intended to double the elevator capacity at Montmorency Falls to the Kent House as the increase of traffic demands it."

LEVEL CROSSINGS.

The Canadian Railway Commission has directed all railway companies to furnish by September 1st a return showing all crossings at which accidents have occurred since January 1st, 1900. In the case of every crossing where more than one has occurred there must be statements of the protection existing. The statement, which is to be full and explicit, must be certified to by a responsible officer of the company.

The receipts and expenses of the Cape Breton Electric Co. (including its share in the Sydney and Glace Bay Railway Co.) for the first four months of 1909 as compared with 1908, are as follows:—

	1909.	1908.
Receipts.		
January	$18,331 76	$20,864 68
February	15,891 54	18,024 43
March	16,462 33	17,432 06
April	16,511 14	18,073 65
Expenses.		
January	$12,090 87	$12,692 73
February	11,559 27	11,827 44
March	11,142 49	11,433 07
April	11,208 85	10,790 17

Toronto Railway net May earnings increased $30,784, and five months' net increased $131,315.

For six months the Montreal Street Railway shows gross earnings of $1,823,421 against $1,734,069 for the same period last year.

THE

Sanitary Review

SEWERAGE, SEWAGE DISPOSAL, WATER SUPPLY AND WATER PURIFICATION

THE ONTARIO GOVERNMENT vs. THE CAMERON SEPTIC TANK PATENTS.

When a deputation from a number of Ontario municipalities waited upon the Premier of Ontario asking his assistance in the septic tank difficulty they found an interested and sympathetic listener.

Since then it has been announced that the Government will secure expert advice on the question of alleged infringement of patents.

No matter what this report may say, it is safe to predict that the report will not end the matter. The question will yet be fought out in the Canadian courts. It will be well that the matter receive early attention, for many municipalities are interested and several schemes are being delayed by the uncertainty.

PROFITABLE SEWAGE DISPOSAL.

W. A. Mackinnon.*

The meetings of the seventh International Congress of Applied Chemistry recently held in South Kensington have been full of interest, but perhaps no subject with which they have dealt concerns the general public more closely than sewage disposal. A paper read before the Hygienic Section describes a system which unites the elimination of undesirable products from sewage intended for use as fertilizer, with the utilization of these very products for the purpose of making commercial profit.

Ordinary Method of Sewage Disposal.

At present the contents of sewers are in some towns discharged into large tanks where solids are settled out forming a "sludge" containing about 90 per cent. of water. This is filtered, reducing it to a cake which contains only about 50 per cent. of water, which is usually dumped on land specially secured for the purpose. As the writer of the paper points out, however, a city of 100,000 will produce something like 30 tons of sludge per diem; the cost both for land and cartage becomes tremendous, and the land used for dumping is unfitted for building purposes.

Sewage as Manure.

When the sludge is used as manure it necessarily creates a nuisance to the neighborhood, in the course of decomposition; to this objection is added another, namely, that while the chemical composition of the sludge would indicate considerable fertilizer value, this is greatly diminished, and in some cases quite extinguished by the presence of large quantities of fatty matter, grease and soap. These come chiefly from domestic sources, the washing of dinner dishes providing much grease, while practically all the soap used in the country (the estimate for England is 4,000,000 tons annually) ultimately finds its way into the sewers.

Acids the Source of Profit.

It is from the recovery of the valuable fatty acids contained in the soap that the process now recommended derives a large part of its revenue, the remainder coming from the residue of the sludge cake, the fertilizing value of which can now be realized, while the resulting manure is also sterilized and odorless, so that it can be stored or used without creating any nuisance. It takes the form of a dry powder, fine as flour, containing nitrogen equal to 8 per cent. of sulphate of ammonia, and other chemicals, together with about 40 per cent. of partly decomposed organic matter.

Description of the Process.

The system is as follows:—The sludge cake having been dried by heat is mixed with a little acid and passed through a specially designed retort in which it is subjected to a current of superheated steam, which carries away with it the fatty acids to be condensed in a water-cooled tower. The fat can be easily and cheaply purified, yielding a grease rich in steria acid—a valuable commercial chemical. The average profit for a city of 100,000 is estimated at, roughly, $12,500.

*Trade Commissioner for Canada at Birmingham, in his report to Ottawa.

THE PURIFICATION OF WATER BY OZONE.

M. L. Borne,—Société des Ingenieurs Civils de France.

The problem of pure water supply has been solved at Chartres, France, a city of about 23,000 inhabitants, by the addition to the existing works of apparatus for treatment of the water by ozone. The waters of the River Eure, from which the supply for Chartres is drawn, contain numerous bacteria, many of them of a pathogenic character. These are entirely removed by the ozone treatment. The apparatus installed, which has a capacity of about 6,000 cubic metres (1,600,000 gallons) per day, represents an outlay of only $70,000. The low first cost of this plant and its complete success are evidence of the economy and efficiency of the process. We take a few details of the practice at Chartres from a recent paper by M. L. Borne, read before the Société des Ingenieurs Civils de France.

Power is supplied by two 40 horse-power steam engines, one of which is held in reserve. Each engine drives an alternator. The water is raised to the filter plant by means of a centrifugal pump. The apparatus for the production of the ozone is wholly enclosed in glass. It consists of two hollow metallic electrodes, separated by glass and cooled by jets of water, which receive the current, at 500 periods and 15,000 volts, from the generator. The ozone is produced by the sparkling between the electrodes. Cooled and dried air is supplied to the case containing the ozone apparatus by means of a fan. The ozonated air is led to a Gay-Lussac tower which receives at the top the water to be sterilized. The tower has two compartments, each 1½ by 7 meters, filled with crushed flint to a depth of 4½ metres.

The sterilization of 1 cubic metre, (265 gallons) of water requires 370 litres of air containing 5/6 milligram of ozone per litre. A little more than 2 grams of ozone are required, therefore, for each cubic metre of Eure water treated. The amount of ozone required varies, of course, with the amount of organic matter in the water. That of the Chartres supply contains about 3 milligrams of organic matter per litre.

The clarifying plant comprises ten sand filtres, 6 by 7 metres, with a sand bed 1 metre thick supported on iron grills which allow the escape of the water and facilitate mechanical cleaning of the filtres. The capacity of these filters is about 15 to 20 cubic metres per square metre of filter surface per day. Before reaching the sand filters, the water passes

through biological filters filled with coke, two of which precede each sand filter and are operated alternately. In them the water is subjected to an oxidizing action, and about 80 per cent. of the bacteria are removed.

The filter plant with piping and appliances for cleaning cost 90,000 france and the building containing the filtres, 60,000 francs. The first cost was therefore 25 francs per cubic metre of water treated per day. The ozone installation cost 110,000 francs, inclusive of the sterilizing tower. Adding to these amounts the cost of the land, the electric plant and the piping connecting the two plants, the total cost of the water treatment works was 350,000 francs for a capacity of 6,000 cubic metres per day, a first cost of 58 francs per cubic metre. Excluding the cost of the land this is reduced to 50 francs per cubic metre.

Purification plants embodying in their design all modern improvements are higher in first cost than those of the old types, but the cost of ozone treatment increases only very slightly the unit cost of operation. Allowing 5% interest on capital and a plant life of forty years, the purification of water containing not more than 1 milligram of organic matter per litre varies between 0.025 and 0.013 francs per cubic metre when ozone sterilization is used, according to whether clarification of the water is necessary. The cost of filtration without sterilization varies between 0.010 and 0.015 francs per cubic metre.

MODERN ASPECTS OF SEWAGE DISPOSAL AND SEWERAGE PROBLEMS.*

T. Aird Murray.†

Sewage and water purification have, during the last 50 years, passed through an evolutionary period. These two subjects are closely related. Sewage contamination to a large extent provides the most objectionable impurities usually found in water. There are certain diseases which are recognized as capable of being water borne; such as typhoid, dysentery, cholera, etc. On the other hand, there may be impurities connected with water which are organic, and may have nothing to do with sewage contamination. Two distinct public duties are now being recognized in order to guard health from the evils of impure water; one, prevention in the first instance, or the guarding of water supply sources from pollution; and the other is taking proper measures to remove and counteract any pollution either organic or inorganic in the water before serving it out to the public.

The problem of prevention comprises the subject of efficient sewage disposal. Wherever one or more persons locate, sewage is a necessary product. When people live in communities and are served by a common water supply conveyed by pipes, the product "sewage" is about equal to the amount of water supply. A water supply is the cleansing medium of a town; it is used not only for dietetic purposes, but also to scour and wash away human waste or dirt. It is not sufficient that water be supplied by pipes and led to taps, it must, in the converted form of sewage, be further taken care of and led away as quickly and cleanly as possible, and either disposed of where it may be harmless or be rendered harmless before being disposed of. Domestic sewage, as well as containing effete poisonous organic matters, is charged with innumerable microscopic organisms to the number of from 30 to 40 million per thimbleful or cubic centimeter. Many of these organisms are known to be harmful, and are the effective carriers of the infection of disease.

There is a constant fight between the human body and disease; victory to the host means the passing off of disease. In zymotic cases, disease is passed off in the form of media which is infectious. The free and constant use of water is the chief means of carrying away the infectious media. We must take precaution that the media is not transmitted to others by the water or brought back into contact with ourselves.

We rely upon the water which drops as rain for our water supply. The water may be used direct as surface water from rivers or creeks, or brought back from the earth into which it has percolated by dug wells or by natural springs. The water may be mixed with water which has already been in human use. Unless the well or spring is sufficiently isolated from human contact, or unless the river or creek flows from an uninhabited area, such a mixture is generally inevitable.

It is generally recognized that water is sent by Providence as a necessity to the welfare of mankind. It is now generally being recognized that it is a crime on the part of mankind to unnecessarily pollute this God-sent water. If it is necessary for a community to use this water, and it is so necessary, then it is the duty of the community to return the water which it has borrowed, as pure as it is possible to reasonably make it, so that others may also have the privilege of the right of using that water without fear of evil from it.

Hence, the question of sewage disposal. It has already been said that the principals and application of methods of sewage disposal have undergone a period of evolution. The subject has received a great amount of attention both in Europe and in the United States. It is now receiving attention in Canada. Canada has not too early opened its eyes to the fact that it cannot neglect this subject. Canada in one respect is in a fortunate position, inasmuch as it can profit by the experience of other countries and the great amount of experimental and research work done.

Last year there was published to the world the results of nine years' experiments and collection of valuable evidence in the shape of the 5th Report of the Royal Commission on Sewage Disposal (Great Britain). Immediately after the report came the results of about nine years' experiments by one of the greatest authorities on the subject, Professor Dunbar, of the Hamburg Institute of Hygiene. The conclusions and results of these two authorities practically coincide, and it is not difficult for the sanitary engineer trained to deal with this subject, to crystalize the whole matter, and provide water to any degree of efficiency required to suit the local conditions under particular consideration.

Many old pre-conceived theories with reference to sewage disposal have received their death blow. Chief among these is the well-known and well-advertised septic tank.

At one time, advocates of the septic tank held that it solved the sludge question, inasmuch as all the organic solids were digested by putrefaction. The Royal Commission by extensive experiments at the parent septic tank installation at Exeter, have shown that not more than 25 per cent. of the sludge is thus got rid of, while other authorities put the putrefaction elimination as low as 6 per cent.

It was also held that zymotic germs were killed by septic action. Nothing of the kind happens. The effluent from a septic tank is bacteriologically as impure as the sewage entering it. It was further held that the putrefactive process which breaks up the organic carbons, prepared the sewage so that it was more easily oxidized by land or other filter processes. Nothing of the kind. Dunbar has clearly shown that you can successfully treat three times as much fresh settled sewage, as you can septic liquor on the same area of filter bed.

But there still remain some who maintain the total digestion theory, because, after the sludge attains a certain height in the tank, it may stop at that height. The reason for this cessation of accumulation has been thoroughly demonstrated. If the sludge is allowed to remain, it becomes broken up into finer particles, when it attains a certain height, it is stirred up by the inflowing sewage and mixes with the liquid, and an amount of solids in fine particles equal to the amount of solids of solids entering the tanks passes off at the outlet. Hence, there is no further accumulation of sludge in the tanks. After three months' working the increase of solids passing out of a septic tank is 50 per cent.; at six months

*Read before the Saskatchewan Medical Association at Saskatoon, July 7th, 1909.

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about 70 per cent. The result is, that, if such tanks are used as preliminary settling tanks for the removal of solids to prevent filters or land from choking, they are attended with failure as compared with the ordinary sedimentation tanks in which septic action is not allowed to prevail.

The above does not mean that septic tanks stand absolutely condemned. There are occasions in which it is both expedient and profitable to use the septic tank, such as for instance, where no purification is looked for and where only the grosser and unsightly solids are required to be removed and no further purification by filtration is necessary. In such cases the benefit by any sludge digestion and saving in maintenance by neglect of sludge removal may be taken advantage of.

Let it be understood, however, that a septic tank or any number of septic tanks do in no way chemically change the sewage and render it harmless. It is not a means of purification, but only a means of partial retention of the objectionable solids, a small per centage of which will disappear by the ordinary process of putrefaction if left undisturbed.

The organic constituents of sewage are changed into their now putrescible inorganic forms by a process of nitrification, by which organic nitrogen is oxidized to nitrates and nitrites. This is the natural process which takes place in soils, by which organic effete matter is rendered into forms suitable for the rebuilding of plant life.

The process of nitrification is connected with the presence of oxygen and micro-organisms and may take place either in ordinary soil or in specially designed biological filter beds.

By allowing sewage to run over land of an open and friable nature, the sewage gradually percolates into the land, the organic matter is absorbed by the soil in the upper layers and is then gradually oxidized or nitrified. Where an equilibrium can be maintained between the amount of organic matter retained and the active power of the nitrifying organisms, the purifying efficiency of soil is perpetual. We have an example of this perpetual action in soil where the autumn decay of vegetable growth is re-absorbed year after year to provide food for future growth.

The organic matter in sewage, however, forms a very small proportion as compared with the volume of water, hence the great difficulty of maintaining land, dosed continually with sewage, in a condition in which nitrification can be efficiently effected. The large volume of water renders nitrification slow and ineffective, hence equilibrium is not maintained. The organic matter obtains the mastery, the land chokes and becomes what is called sewage sick.

Various methods have been tried to ease the land of part of the burden of sewage purification. The solids have been strained from the sewage or precipitated both by the use of chemicals or otherwise, but still it has been found, unless under exceptional conditions of sand land, land has failed to deal with the large amount of liquid forming the chief component of sewage.

"Broad Irrigation" and "Intermittent Filtration" are the two recognized methods of land treatment.

Broad irrigation simply means using the sewage for irrigation purposes on crop lands and distributing it by means of ridges and furrows. Intermittent filtration means the employment of land devoted solely to sewage disposal apart from any crop consideration, the land being divided into lots, which alternately receive a dose of sewage, thus giving time for the liquid to pass out of the soil pores, the admission of oxygen, higher nitrification, and a possible maintenance of equilibrium as between retention and oxidation.

Dr. Hodgets, assisted by Dr. Amyot, of the Ontario Provincial Board of Health, was instrumental, after many careful experiments with the sewage of Berlin (Ont.), in introducing land intermittent filtration for that city. The sewage is screened and the solids partly settled out by simple precipitation, the liquid sewage being taken care of by a large tract of ideal sand land divided into lots. The effluent sewage continues to show a high degree of purity during both summer and winter, and the oxidation equilibrium is so far maintained.

When land is resorted to as the purification media, the system of intermittent filtration provides the greatest measure of success. The continued success depends, however, entirely on the suitability of the land. It is seldom possible to obtain suitable land just in the locality required; hence, the system has been tried on land of a clayey character, and in all such cases the system has had to be abandoned.

The unsuitability of land led sanitarians to experiment with, and to adopt in practice, chemical treatment methods. Almost all the chemicals which can possibly act as re-agents on the organic compounds of sewage, have been tried. None have been really successful. Chemical sewage purification is a thing of the past, althought there are occasions in which the use of a coagulant may be useful in settling out solids which otherwise are difficult to precipitate, such as in the case of brewery wastes, etc. Such, however, only occupy a position in preliminary treatment and not in the final treatment of purification.

All the labor and thought which has been expended on land treatment has not been wasted. The Lawrence (Mass.) experiments were commenced in order to determine the best character and amount of land suitable for sewage disposal. It was early demonstrated that the purification process of sewage was not the simple result of filtering or straining the sewage by passing it through soil pores. Simple gravel, the size of peas or walnuts, was found to be more effective than ordinary soil, when worked under certain conditions. Sewage purification was found to depend not only on the mechanical action of retention, but on an action of deorganization depending on the presence of oxygen accompanied by micro-organisms, which in the presence of oxygen have the power of splitting up complex organic compounds into their more elementary inorganic forms. Hence the biological system of sewage purification. This system makes sewage purification independent of the character of the land; all that is required is a solid base on which to build simple structures, ideal homes built for the propagation and maintenance of the nitrifying and other organisms, homes or filter beds, if you like to so call them, in which under proper conditions and management the equilibrium between retention, absorption, and oxidation can be successfully maintained.

Biological sewage disposal does not mean revolution, but devolution. It is not the utilization of any new invented process. It is the perfected utilization of nature's own process, the process by which all effete organic matter has been reduced on the cycle of birth and death since the commencement of this planet as an organic constitution.

Any degree of purification required can be obtained. It is, however, a question of reasonable purification and of cost. The system is capable of measurement in length, breadth, and depth. Given an analysis and estimated amount of sewage, a plant can be built accordingly. These nitrifying homes will act in any climate, provided they are guarded from zero chills. The area occupied is small, they are easily and cheaply protected.

The success of the system depends upon the following essential features: (a) Preliminary treatment for removal of as much of the solids from the sewage as possible. This is best done by simple sedimentation tanks of a capacity from 12 to 24 hours daily flow. In such tanks the velocity flow is reduced to such an extent that from 60 to 70 per cent. of the solids precipitate by gravity, while the matters of a specific gravity less than water float to the surface. Scum boards are fixed at the inlets and outlets to keep back the floating matter from the outlet. The solids should be removed once every two months at least, either by gravity when there is sufficient fall, or by means of a hand chain pump. The solids are allowed to flow in to dug out, well drained drying beds, shallow in depth to allow of evaporation, and the sludge can be dug into land when sufficiently dry.

(b) Secondary treatment of passing the sewage through filtering media about walnut size. The depth of the media

should not be less than 3 feet, and it is unnecessary to have it more than 8 feet. Within these limits success does not so much depend upon the depth of the media, as upon the cubic quantity of filtering material bearing a certain relation to the amount of sewage to be treated. With ordinary domestic sewage there should not be less than one cubic yard of filtering media to each 150 gallons of dry weather flow of sewage to be treated. Success depends further upon even distribution of the sewage over the whole surface of the filter. There are various appliances for this purpose. The best up to date is the revolving sprinkler worked automatically by the sewage In cold climates, owing to frost this apparatus must be cut off in winter and alternative distribution provided by means of weeping pipes fixed 6 inches below the filter surface. The sewage must be fed intermittently over the surface by means of an automatic dosing tank at a rate of not more than two gallons per each square yard of filter surface, so as to allow of each dose to draw air with it and guard against any hydrostatic head forming in the filter, causing undue hurry in percolation or flushing by means of which the nitrifying organisms may be removed from the filter.

Such a biological system will so chemically change any ordinary sewage that it is no longer sewage. The effluent will be non-putrescible, incapable of further fermentation or producing any nuisance.

But what about the removal of intestinal bacteria and pathogenic germs? Is it pretended that this simple process of sedimentation and passing sewage through matured material of walnut size, and subjecting it to nitrification, is capable of retaining or exterminating the micro-organism of disease? Any man who makes this claim for either the above process or for any of the other known ordinary processes of sewage disposal, stands condemned as ignorant of the results of modern sanitary research work.

The biological method, or the land intermittent filtration process, will greatly reduce the number of B. Coli, and other bacteria, but will not efficiently reduce their number to bring the effluent anywhere near the bacterial standard required for drinking water. Fortunately the greater number of bacteria are not isolated as individuals, but are either in colonies held together by gelatinous matter, or are wrapt up and held by suspended solids. The result is that the retention of the solids in the settling tanks will retain from 60 to 70 per cent. of the bacteria entering with the sewage. A further reduction is effected by the retention of organic solids in suspension and organic solids in solution absorbed in the filter to the amount of about 85 per cent. of the number entering the filter. So large, however, is the original bacterial count, that the resultant percentage is still in a proportion to render the non-putrescible effluent unsafe for dietetic purposes, unless mixed with a large volume of pure water. The life of the resultant bacteria in an effluent practically free from organic matter and thoroughly oxidized, is very short.

It, therefore, cannot be denied that although it is absurd to speak of nitrified sewage as potable water, a great and beneficial work is accomplished.

This nitrified and non-putrescible sewage effluent can be rendered practically sterile if required. The process, however, is in most cases unnecessary. Slow sand filtration as applied to drinking water, is effective to the extent of about a 95 per cent. further bacterial removal. Sterilization can be effected by chlorine processes at a cost of from 80 cents to one dollar per 1,000,000 gallons of sewage treated. The question in all such cases to be considered is the character of the stream into which the effluent enters and mixes. In many cases it will be found that the stream or river receiving the sewage effluent, is organically more impure than the purified sewage, or in other cases, that the volume of the stream or river is so great in proportion to the sewage effluent that an analysis of a sample taken one hundred yards below the effluent will compare equally with one taken above the effluent.

In the case of rivers or streams passing through settled areas, pollution does not depend solely upon the sewage of combined communities. There are a hundred and one other causes which may constitute polluting sources. In the case of a community drawing water from any such source, it would appear, apart from the question of whether sewage is treated or not, that a duty still remains to provide that such water is rendered beyond suspicion. In Europe, in Great Britain, and in the United States this question of the relative responsibility as between the degree of purification required for sewage effluents on the one hand, and the obtaining of a pure water supply on the other, has received a great amount of attention. The concensus of opinion is that the responsibility must be divided. It is considered unreasonable to ask a community to discharge a sterilized sewage effluent, on the other hand, it is considered reasonable that those responsible for the supply of water should take all necessary measures to deliver that water in a pure condition. Sewage purification to the extent of producing a non-putrescible effluent, goes a long way towards making the work of supplying a pure water an easy one. In fact, if measures to this extent are not adopted, the supply of a pure water becomes almost a practical impossibility.

The production of a non-putrescible sewage effluent means, an effluent which will not change the visible character of a stream, it will not affect fish life, and when 1,000 times diluted, may be safely used for watering cattle one hundred yards below the effluent outlet; and when 10,000 times diluted with equally pure water, may be used for dietetic purposes half a mile below the effluent outlet with comparatively no risk.

The main point, however, as far as drinking water is concerned is this, that whenever water is drawn from any suspicious sources, such as surface water from settled areas, such water should be treated by either mechanical or slow sand filtration, or rendered sterile by any of the well-known methods of ozone or hypochlorite.

The foregoing general description of a biological plant applies more particularly to what is termed the percolating filter process as distinct from the "contact bed system." This paper would be incomplete without a reference to the "contact" system.

The percolating system is the most modern development of biological treatment; the "contact bed" was the earlier method of application. With the former the sewage is allowed to percolate continuously through the filtering material from the surface to the base—with the latter the shell holding the filtering media is made water-tight so that the filter remains full of sewage for a period of time. The rule generally in vogue is, say an hour to fill with sewage, an hour for the tank to remain full of sewage, and an hour for the tank to remain empty for a period of rest or recuperation.

The principal of the contact bed has no scientific basis; it is purely empirical. It was a question of how best to bring the sewage into contact with every particle of filtering material so that the nitrifying organisms might have full scope for their energies. The obvious solution was, fill the tank to the point of saturation and give every organism an equal chance. In order to give these organisms a good and a long chance, a period of contact was assumed as necessary. After what was supposed to be a sufficient period of contact, the outlet valve from the bed was opened, the treated sewage drawn off, analyzed and disclosed an abundant presence of nitrates and nitrites, proving that the desired chemical change had occurred. It was at once assumed almost without debate, that the nitrifying organisms fed, as it were, upon the organic matter in the sewage and rested their jaded appetites during the period when the bed remained empty. Dibden, and others in England preached this from the very house tops, and contact beds were scattered over the land, as the end-all and final conclusion of the sewage problem. The humor of the whole farce lay, however, in attaching to these contact beds preliminary treatment in the form of septic tank action. It was claimed that the septic half of this treatment represented anaerobic fermentation, fermentation apart from light and air. It was further claimed that the second half the contact bed treatment represented aerobic fermentation, or fermentation in the presence of free oxygen.

Doubters, however, appeared on the scene—the scientist and the bacteriologist were not satisfied. Professor Dunbar of Hamburg made a visit to England, saw, examined and spoke. He said, but both your tanks are anaerobic, your contact beds stand full of sewage, oxygen is excluded during the very period when you claim nitrification, which depends on oxgyen, takes place. There is something wrong. Dibden and others would not argue, they pointed to Sutton in Surrey, and other plants and simply said, look at the results; there is an argument you can't get over. Dunbar went back to Hamburg and started experiments on an extensive scale in his own slow methodical German manner. The result of those experiments is the most valuable ever produced in connection with sewage disposal. Nearly all that was mystery is made clear. Nitrification does take place in the contact bed, but not during the period of contact. During this thought to be valuable period, practically nothing happens; the bacteria, as it were, waited in patience, waited till the liquid sewage was withdrawn and the entrance of oxygen and their feeding time commenced on the organic compounds left clinging to the filtering media from the departed liquid. The nitrates and nitrites were the result not of the last sewage dose, but of previous doses. Dunbar showed that better results could be obtained by a three-minute period of contact and a three hours rest. In fact, that the period of contact was humbug, without a single scientific point in its favor. Hence, the percolating or continuous filter and the period of contact abolished and remaining of historical interest only.

The difficulty of equal distribution has, as above explained, been overcome, the result is, no time is wasted, nitrification continuously goes on, free oxygen is ever present, and the equilibrium between retention and oxidation maintained granted that the proportions between the sewage treated and area of filter bed is correct.

The whole process of the decomposition of sewage cannot yet be said to be cleared up. Sufficient, however, has been demonstrated to prove that it is not merely the simple bacterial action as at first understood. The attacking and digesting of organic compounds by ravenous bacteria was a simple and easy explanation appealing to anyone who had ever seen the wild animals fed in a menagerie. It takes a certain length of time before a biological filter arrives at maturity; it was thought at one time that this maturity depended upon the necessary supply of nitrifying organisms being developed. Nothing of the kind! Maturity depends upon the ability of the filter to extract, absorb, and retain the organic matter both in suspension and in solution from the sewage. The power of absorption and retention depends not on the presence of micro-organisms, but on the gradual formation of a gelatinous film of a spongy character which covers the superficies of the filtering material. The film under the microscope presents a coral like appearance and has an immense power of suction and absorption. An inch in area presents about one million square inches of suction surface. The organic compounds in the sewage are absorbed by this sponge film, which is charged with micro-organisms. The presence of oxygen is necessary for its growth. In this sponge film the organic compounds are broken up and oxidized, but how much of this action is due to the mere chemical action of oxidation, and how much is due to the influence of the bacteria directly, is as yet unknown. Probably a combination of both chemical and biological action is necessary, as the sterilization of a filter by a strong antisceptic causes nitrification to cease for a time.

An interesting and practical feature in connection with contact versus percolating beds is that three times the amount of sewage can be even more efficiently treated on a given area of filtering media by the adoption of the percolating system in preference to the contact. The British Royal Commission make this point clear.

Before closing this paper it will be well to say a few words on the question of main sewerage. On the system of sewerage adopted, to a large extent depends the success of any system of sewage disposal. The main sewerage should wherever possible be on the "separate" system; that is, it is advisable that only domestic sewage, together with roof water and cellar drainage, be collected for treatment. Storm water from the surface of streets and roads must be separately dealt with, and may be allowed to discharge direct into the river or stream, as at such times the streams or rivers will be in flood and can easily take care of this large volume of only slightly polluted water. The separate system is necessary to successful sewage treatment, as it allows of a fairly exact estimate being made of the amount of sewage requiring treatment. If surface water be admitted into the sewage sewers, it means either works built to an extent enormously greater than is ordinarily required, or else with works suitable for the sewage only; it means a hopeless mess and complete unsetting of the biological system in times of heavy rainfall.

From a hygienic point of view the combined system of sewerage presents grave objections. In order to take the large volume of surface water during heavy rain storms and prevent backing and flooding of cellars, large diameter sewers must be built. The velocity of flow necessary for the removal of solids are only maintained in such sewers when running half-full or over; consequently, in dry weather, when only domestic sewage is flowing, the velocities are reduced to such an extent that they form simply long lengths of cesspools in which the solids are retained in hot, dry weather, giving off the noxious smells so common at the manholes on such systems.

The separate systems call for only small diameter pipes in which high velocities are maintained, which ensure constant, complete removal of solids, and consequently little or no sewer gases.

The cost of the separate system is generally considered against its adoption; it appears so much more simple and economical to make the one line of pipes serve all purposes. This saving is more apparent than real. In dealing with surface water it is not necessary to run sewers up all short lengths of streets. If the roadway is properly graded and there is a fall to either end, the road channel may be allowed for the drainage. When, however, it is a question of sewage disposal, any saving in cost in adopting the combined in preference to the separate system in the first instance, immediately vanishes, and if it is a case of pumping the sewage at the disposal work, then the saving in the case of the separate system at once makes itself evident.

Some are content, however, to provide what are called storm overflows, so that in time of heavy rain, when the river is in flood, the excess volume of water may be allowed to proceed direct into the stream without treatment. These storm overflows would be all right as such if they discharged only storm or surface water; but the opposite is the case. With the combined system, especially with flat or almost level grades, the large sewers, as we have seen, become stored with putrefying filth; practically, in dry weather, only the liquid dribbles through and finds its way to the treatment plant. As dry weather continues, this storage of filth goes on increasing until the long-looked-for storm comes along, fills the sewers, the storm overflows come into action, and the whole of the collected putrefying mass of filth which the works were built to purify is swept clean into the stream by way of these so-called storm overflows. Sewerage systems constructed on the above lines are the cause of the common saying: "We never had smells or illness until we had drains."

In order to show how compact the biological system of sewage disposal is and how little area it takes up, the following figures are given, comparing the amount of land necessary for various populations, capable of treating three times the dry weather flow, for broad irrigation, intermittent land filtration, and biological treatment on the percolating continuous system:—

Broad irrigation requires about one acre per 1,000 gallons of sewage per day.

Intermittent land filtration requires about one acre per 5,000 to 20,000 gallons of sewage per day, depending on the porosity of the land.

Biological treatment requires one acre per 1,452,000 gallons of sewage per day at the rate of 150 gallons per cubic yard of filtering material at six feet deep, independent of the porosity or character of the land on which the filters are constructed.

Comparing the above, and assuming each 1,000 gallons of sewage as a unit:—

Broad irrigation—One acre will treat one unit.

Intermittent land filtration—One acre will treat twenty units

Biological treatment—One acre will treat 1,452 units.

Assuming a water supply of 60 gallons per head per day, towns of the following populations would require the following areas of land in the cases of broad irrigation and land intermittent filtration and the following areas of filtering material requiring protection from severe frost in winter in the case of biological treatment. To the figures in each case, from one to three acres of land would be required for settlement tanks, sludge removal, and general elbow room. Dry weather flows are given, but the areas are capable of treating three times this quantity.

Pop.	Gals. of sewage per day.	Broad irrigation. Acres.	Intermittent filtration. Acres.	Biological, 3 feet deep. Acres.	Filtration, 6 feet deep. Acres.
1,000	60,000	60	12 to 3	.08	.04
3,000	180,000	180	36 to 9	.24	.12
6,000	360,000	360	72 to 18	.48	.24
9,000	540,000	540	108 to 27	.72	.36
12,000	720,000	720	144 to 36	.88	.44
13,000	780,000	780	156 to 39	1.04	.52
24,000	1,440,000	1,440	288 to 76	1.76	.88

From the above it will be seen that the total area requiring protection from severe frost for a population of 24,000 people is just under one acre. Why, they listen to the chronic pessimists, who say sewage purification is impossible in Saskatchewan because of the severity of the winter! Only a short time ago there were many to be found who said it was impossible to produce wheat in this Province. Many who held such opinions are still among the living. Let them gaze from their feet to the horizon and conclude that this Province has no room for the pessimist.

In conclusion, Dr Seymour has asked me to say a few words as to my prospective duties in connection with the post of engineering adviser to the Government of Saskatchewan on health questions. I may state that I am against adopting any universal standard of degree of purity required with reference to sewage effluents. Every problem must be considered in the light of local conditions. What may be necessary in one locality may not be necessary in another. The quality of a sewage effluent depends upon the character and volume of the stream into which it enters. I do not wish by my advice to the Government to harass unnecessarily any community, or create hardships for the sake of carrying out something which may be good in principal, but may have no particular practical application to the case in point.

My endeavor will be, along with Dr. Seymour's co-operation, and, I trust, with the co-operation of all the medical men in the Province, to guide the new and youthful communities in these matters with a view to the future, so that any work done may not be wasted and errors committed which may in the future be regretted. The principle of my action will be based on the belief that this Province of Saskatchewan is in the near future to become largely inhabited, and that villages are evolving every day, villages will become towns, towns will become cities. Let us, then, make the right start to the very best of our knowledge in matters appertaining to the general health.

The progress, morality and happiness of a community depends upon its measure of health. Health is a jewel beyond price. I shall make errors; "It is human to err." Kindly point out, frankly and immediately, such errors. It may be unfortunate to err. It is a thousand times more unfortunate to do so and not know of the error. By mistakes in life we discover the fittest. Errors are the educational force in the whole process of evolution.

ORDER OF THE RAILWAY COMMISSIONERS OF CANADA.

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

7392—June 29—Granting leave to the North American Telephone Co. to erect, place, and maintain its wires across the track of the Brockville and Westport Railway at Soperton, Ont.

7393—June 21—Dismissing application of the Red Mountain Railway Co. for amendment to Order No. 2115 (making applicable the general interswitching Order), prescribing the rates to be charged for interswitching between the tracks of the Red Mountain Railway and those of the Columbia Western Railway at Rossland, B.C., amending previous Order of the Board dated February 14th, 1906.

7394—June 28—Ordering and directing that the G.T.R take and expropriate certain lands additional to those they now occupy lying between Wyndham Street on the west, Market Street on the north, and the right-of-way of the G.T.R.

7395—July 2—Authorizing the Hamilton, Grimsby & Beamsville Electric Railway Company to construct, maintain, and operate spur through the lands owned by Algernon McKay, of the Township of Saltfleet, County of Wentworth, Ont., connecting the H. G. & B. Electric Railway with those of the G.T.R.

7396—July 3—Granting leave to the M.C.R.R. to construct an interchange track with the track of the G.T.R. on Bathurst Street, London, Ont.

7397—July 3—Granting leave to the G.T.P. Railway to construct its railway across three highways at grade between Sections 22 and 27, Township 51, R. 20, West 4th Mer., between 27 and 28, and between Sections 32, Township 51, R. 20, and Section 5, Township 52, R. 20, west 4th Mer., Alberta.

7398—July 3—Granting leave to the C.P.R. to construct a new crossing over the tracks of the main line of its railway in the town of Coleridge, Alta.

7399—July 5—Authorizing the C.P.R. to reconstruct bridge No. 105.6 over the Victoria Road, Pembroke, Ont.

7400 to 7411, inclusive—June 30—Granting leave to the Government of the Province of Alberta, to erect, place, and maintain its wires across the track of the C.N.R. at eleven different points, and over the C.P.R. at one point in the Province of Alberta.

7412 to 7423, inclusive—July 2—Granting leave to the B.T. Company to erect, place, and maintain its wires across the track of the C.P.R. at five points in Ontario, and one in Quebec; across the G.T.R. and five points in Ontario; and across the Pere Marquette R.R. at one point in Ontario.

7424—June 30—Granting leave to the Government of the Province of Alberta to erect, place, and maintain its wires across the track of the C.N.R. about one mile west of Mundare, Alta.

7425—July 5—Granting leave to the Caradoc & Ekfrid Telephone Company to cross with its wires the track of the G.T.R. on the town line between Caradoc & Ekfrid Townships, Ont.

7426—July 5—Granting leave to the Perth & Christies Lake Telephone Association to cross with its wires the track of the C.P.R. at the Third Line of Bathurst, County of Lanark.

7427 and 7428—July 5—Granting leave to the rural municipality of Miniota, Man., to erect, place, and maintain its wires across the track of the G.T.P. Railway at P.C. 3½ miles east of Quadra, Man., and at P.C. two miles northwest of Quadra, Man.

7429—June 30—Granting leave to J. P. Ernst, of New Hamburg, Ont., to erect, place, and maintain wires across

the track of the G.T.R. at side road between Lots 12 and 13, Township of Willmot, Ont., about 1 mile east of Baden station.

7430 and 7431—July 5—Granting leave to the Government of the Province of Alberta to erect, place, and maintain its wires across the track of the C.P.R. at ¾ of a mile west of railway company's station at Taber, Alta., and at Deveber Avenue, Taber, Alta.

7432—July 5—Granting leave to Morris & Kemp to erect, place, and maintain telephone wires across the track of the C.P.R. at P. Rd. 1.8 miles north of Chaudiere Junction, Township of Gloucester, Ont.

7433—July 3—Authorizing Paul Sylvester, of St. Cuthbert, P.Q., to lay water main under the track of the C.P.R. one mile east of station.

7434—July 5—Granting leave to the Canadian Pacific Railway to construct its railway across highway, at mileage 13.52, Township of Glenelg, County of Grey, Ont.

7435—July 5—Approving and sanctioning proposed deviation of the Manitoulin and North Shore Railway, between stations 739 and 1140, portion of its railway between Sudbury and Little Current.

7436—July 5—Approving location and detail plans of the Central Ontario Railway Company's proposed new station and freight shed at Bloomfield, Ont.

7437—July 6—Granting leave to the Government of the Province of Alberta, to erect, place, and maintain its wires across the track of the C.P.R. about 2½ miles west of Rosenroll, Alta.

7438—July 6—Authorizing the T. H. & B. Railway to reconstruct, or alter railway bridge known as 45.83 over which it crosses a side road or highway leading to the Ancaster & Copetown Road, Township Ancaster, County Wentworth, Ontario.

7439—July 6—Authorizing the corporation of the city of Quebec, to lay and thereafter maintain water and drainage pipes under the track of the C.P.R. in St. Malo Ward, St. Valier, P.Q.

7440—July 6—Granting leave to the G.T.R. and C.P.R. to appeal from the Order of the Board, dated the 9th of June, 1909, to the Supreme Court of Canada, upon all questions of law involved, in re application of the city of Toronto, Ont., for Order directing G.T.R. and C.P.R. to carry York Street and certain other streets under the tracks of the said companies.

7441—June 30—Reporting to the Governor-in-Council for sanction by-law of the V.V. & E. Railway and Navigation Company re spitting in cars and on premises.

7442—July 7—Granting leave to the B.T. Company to cross the tracks of the G.T.R. with its wires at Duke and Durham Streets, Lindsay, Ont.

7443—July 6—Granting leave to the British Columbia Telephone Company to cross the tracks of the E. & N. Railway at east end of Railway Bridge, at Victoria, B.C.

7444—July 7—Granting leave to John M. Bergstrom, of Wauchope, Sask., to cross the track of the C.P.R. with telephones wires at Wauchope, Sask.

7445 to 7454, inclusive—July 7—Granting leave to the Government of the Province of Alberta, to cross with its telephone wires the track of the C.P.R. at certain points in the said province.

7455 to 7458, inclusive—July 7—Authorizing the corporation of the city of Saskatoon, Sask., to lay water and drain pipes under the track of the C.N.R. and C.P.R. (C.N.R. 3) (C.P.R. 1) at four points in the said city.

7459—July 7—Authorizing the corporation of the town of Chesley, Ont., to lay water main under the G.T.R. at four streets in the said town.

7460—July 8—Approving by-law of the Atlantic and Lake Superior Railway authorizing Chas. R. Scoles, general manager, to prepare and issue tariffs of tolls to be charged for all traffic carried.

7461—July 8—Granting permission to the Hull Electric Railway Company to operate its cars over the tracks of the C.P.R. in the city of Hull, P.Q.

7462—July 7—Authorizing the C.P.R. to construct bridge No. 15.83 over the Bremner River, on the Schreiber Section, Lake Superior division of its line.

7463—July 6—Approving plans of G.T.R. new combination passenger and freight station at South Indian, Ontario.

7464—July 6—Approving detail plans of the G.T.R. new combination passenger and freight station at Corinth, Ont.

7465—July 8—Granting leave to the municipal corporation of the city of Lachine, P.Q., to cross, by means of a subway, for pedestrians only, the tracks and lands of the G.T.R. between 15th and 16th Streets, city of Lachine, P.Q.

7466—July 8—Granting leave to J. P. Coutlee, engineer-in-charge of the Georgian Bay Ship Canal, to construct a highway crossing over the track of the C.P.R. at Temiskaming Villiage, County of Pontiac, P.Q.

7467—July 6—Authorizing the municipal corporation of the Township of Sandwich East, to construct a suitable public crossing across the tracks of the P.M.R.R. at Edna Street in the said township.

7468—July 8—Authorizing the C.P.R. to construct, maintain, and operate spur to and into the premises of the Waterloo Manufacturing Company, Portage la Prairie, Manitoba.

7469—July 6—Granting leave to the Malahide & Bayham Telephone Company to cross with its wires the track of the M.C.R.R. at public road about one mile east of station, in the town of Tillsonburg, Ont.

SUBSTITUTION OF CONCRETE FOR BRICK WORK IN BOSTON SEWERAGE WORKS.

In view of the fact that the laying of brick costs the city of Boston about four times as much as it should, and that the total cost of brick masonry is over twice as high as the cost of concrete, the consulting engineers, Messrs. Metcalf & Eddy, of Boston, recommend that concrete be substituted for brick work wherever possible without detriment to the sewerage works. They point out in a recent report that there are two questions affecting this particular branch of the work:—

First, is the selection of brick as a building material in all cases justified?

Second, is the brick masonry, where adopted, economically built?

With regard to the first question, there may in some cases be a reasonable difference of opinion, as there are a number of arguments in favor of the use of brick instead of concrete, the only other material available for the larger sewers. One of these arguments is that it is practicable to make brick work more nearly water-tight than concrete. This argument, of course, loses its force to a large extent when the construction is in a locality which is not materially subject to the influence of ground water, and also when applied to surface water drains. Moreover, concrete as a building material is used in a great many structures which should be as nearly water-tight as possible, and has given satisfactory results in cases of very many sewers.

An argument which has been advanced in favor of brick linings for inverts is that the brick are said to withstand the erosive action of the flow of sewage or surface water better than concrete does. Under certain conditions where velocities of flow are very high, there is no doubt that this argument has considerable force. It does not, however, justify the use of brick in the arch, and sewers laid with concrete inverts are very common. Under some circumstances, possibly brickwork may be constructed as cheaply as concrete, but in general it will cost from 33⅓ per cent. to 100 per cent. more. The engineers, therefore, believe that on the whole there is no justifiable reason for using brick work to the extent that it is now used by the Sewer Division of the City of Boston. They consider it possible to thus make a saving of about 50 per cent. on the entire cost of masonry wherever concrete can be substituted.

A PAGE OF COSTS

ACTUAL, ESTIMATED and CONTRACTED

AMOUNT OF COAL CONSUMED IN PUMPING, GALLONS OF WATER PUMPED, AVERAGE HEIGHT PUMPED, COST PER MILLION GALLONS, IN ERIE, PA.*

Year.	Tons coal consumed	Cost coal from Jan. 1, to Dec. 31.	Grades of bituminous coal.	Gallons of water pumped.	Increase or decrease.	Number of places supplied.	No. of fire hydrants.	Average height of water in Reservoir above surface of Bay.	Cost coal per million gals. pumped.	Gallons pumped per pound of coal.
1880	3,076.1	6,978.41	Lump,	775,805,250	31,995,150 d	3,568	126	232.0	8.99	126.0
1890	2,583.6	3,052.89	Slack,	1,659,625,551	184,267,331 i	7,728	372	236.9	1.81	322.4
1900	5,285.9	7,754.34	Slack,	3,124,440,644	402,118,040 i	12,451	595	235.46	2.482	295.57
1907	5,664.12	9,928.88	Nut & Slack	4,326,096,848	204,806,994 i	16,520	820	236.08	2.295	381.85
1908	6,382.3	10,609.88	Nut & Slack	4,483,392,032	157,295,184 i	16.761	840	235.78	2.366	351.24

High service system installed in 1899, comprises all the territory south of Nineteenth Street. In this district the average lift in feet for 1908 was 298.05. See Pumping Statistics. Steam is also used for auxiliary purposes, such as steam siphons, elevating coal, running machine shop, heating buildings, stand pipe, etc.

*From the forty-second annual report of the Commissioners' of Waterworks.

COST OF CLEANING LAND.*

Frequently it is found necessary to clear land not only of the standing timber, but of logs and stumps as well. Town sites, reservoir sites, the location of dams and roadways have often to be cleared up.

Hand Method of Clearing Logged-off Land.

Until recent years clearing was almost wholly done by what is now known as the "by-hand" method, where the laborer, equipped with peavey, mattock, shovel, and ax, undertook to clear up. By this method the standing trees and brush were slashed; a fire was started and allowed to burn over the entire slashing, when most of the brush and small logs were burned completely. The remaining logs were sawed into convenient lengths, piled, and burned. The smaller stumps and roots were grubbed and pulled out. Often a stump puller of the capstan type was used in pulling the smaller stumps after they had been loosened by digging around them.

This type of stump puller is often used in clearing small tracts after the stumps have been broken into several pieces and loosened by the use of stumping powder, without which no clearing is undertaken in the present day. The stump puller should be of simple construction, strongly built. It generally consists of a drum, a wire cable, and a sweep to which a team is hitched. Powder has been used in all clearing operations for several years, and all methods, except that of burning the stumps, are dependent upon it to loosen the stumps so that they may be taken out.

Donkey-Engine Method of Clearing Logged-off Land.

Some six or seven years ago when logs were drawn in the market, and many logging outfits were idle, an enterprising logger took a contract for pulling the stumps from a meadow. He conceived the idea of using his donkey engine with its outfit of blocks and cables to pull and pile the stumps for burning. The usual method is to slash and burn over the tract to be cleared, in order to burn all the underbrush and as many small logs as possible.

*Adapted from circular No. 25, United States Department of Agriculture.

Then all the stumps more than 1 foot in diameter are split and loosened by a charge of stumping powder of from five to twenty sticks, according to size. A charge of twenty 1½-inch by 8-inch sticks will generally split a 5-foot stump into five pieces and loosen it so that an engine can pull the pieces from the ground.

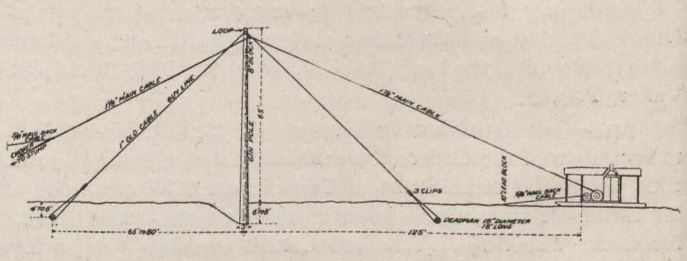


Fig. 1.—Elevation showing method of setting donkey engine and gin pole in clearing land.

A gin pole is now set in the centre of a tract of 8 or 10 acres and held in place by four guy lines from the top. (See Fig. 1.) This pole should be 60 feet or more above the ground.. A block is fixed securely near the top of the gin pole, through which is passed the main cable from the engine. This cable has the usual hook, ring, and swivels at the end, and is usually 1 inch or 1⅛ inches in diameter.

The haul-back cable, which is usually ⅝-inch in diameter, is now taken to a lead block and passed around three sides of one-fourth of the tract to be cleared at this setting of the gin pole, (see Fig. 2), and the end hooked into the ring of the main cable, thus forming an endless cable with the engine—one that will run in either direction to or from the gin pole.

In some cases, where the engine is built with the haul-back cable drum above the main-cable drum, it is better to fasten the block for the main cable about 5 feet from the top of the pole and run the haul-back cable through a block on top of the pole. The haul-back drum is usually geared to run much faster than the main-cable drum.

Each outfit should have on hand at least four chokers and a supply of lead lines and extra blocks. A choker is a section of cable from 20 to 30 feet in length, with a loop in one end and a choker hook on the other.

The choker is passed around the stump and hooked upon itself. The loop is then caught in the hook of the main cable, and the load is ready to go to the pile.

While this load is going to the pile another is made ready, so that there is no time lost. When the cable returns with the empty choker it is loosened and another hooked into its place. As the loads come to the gin pole they are piled around it as closely as possible (Fig. 3) by a man on the pile.

This method, while an economic success in the hands of a few, has proved a costly method of clearing as handled by many others. If everything is handled to advantage by capable, experienced men this method has many points to its credit over any other method of clearing now in use, the greatest of which is the saving of time. It is also cheaper than the "by-hand" methods on large tracts of heavy clearing.

The question of using a large or small donkey engine has been discussed, but those who have been most successful in clearing are generally in favor of an engine with sufficient power to take all roots out with a straight pull, avoiding the

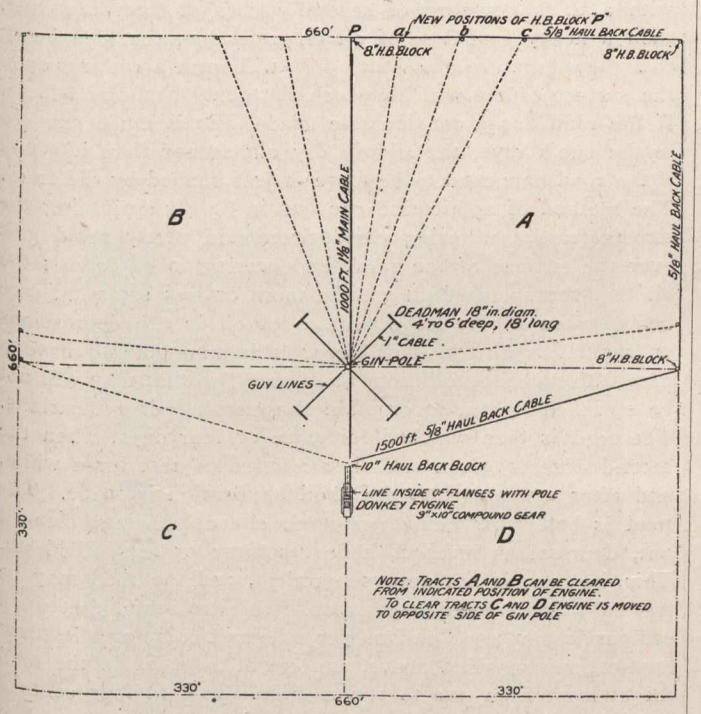


Fig. 2.—Diagram showing position of donkey engine and rigging for clearing a 10-acre tract.

use of blocks. A 9 by 10 inch compound gear, or 10 by 12 inch single gear, is said to be the best size for this work.

Use of Powder in Clearing Logged-off Land.

At the present time few undertake to clear even a small tract of land without the use of powder, and in the hands of an experienced man powder can be made to do a large amount of work at comparatively small expense.

The powder in general use at the present time is known as stumping powder, and is put up in sticks of 1½ by 8 inches, about 65 of which come in a box of 50 pounds. This powder costs at the present retail price $6.25 a box; in ton lots, $5.25 a box.

The charge of powder is placed as nearly as possible beneath the centre of the stump. The powder should be placed on the hardpan if the soil is not too deep; otherwise it is placed from 2 to 3 feet below the surface.

To get the best results the sticks are removed from the paper wrappers and packed closely together in the hole beneath the stump. This can not be done in wet places. The powder works best when the temperature is about 70 degrees F.

This powder has more effect when the soil is saturated with water. The wrappers are allowed to remain upon the sticks in wet places.

The following charges will be found effective under average ground conditions and where using stump pullers or blocks and teams:—

Diameter of stumps in inches	18	24	30	36	48	60	72
Sticks of powder	5	7	10	20	35	50	65

Where the soil is sandy and loose it will require one-half more powder for the same size stump.

As this powder does not work well at a temperature below 70 degrees F., it is necessary when using it in cold weather to keep it warm by some method. Some powder men bury the boxes in a manure pile; others lay it upon a perforated rack over boiling water. As in either of these methods the powder becomes more or less damp from the vapor it is thought that when dry heat is applied better results are obtained.

The following statement of stumping done by the Narrows Land Company, of Tacoma, Wash., for six months in 1907 will give an idea of the cost of the different items of material used and the labor in blasting stumps.

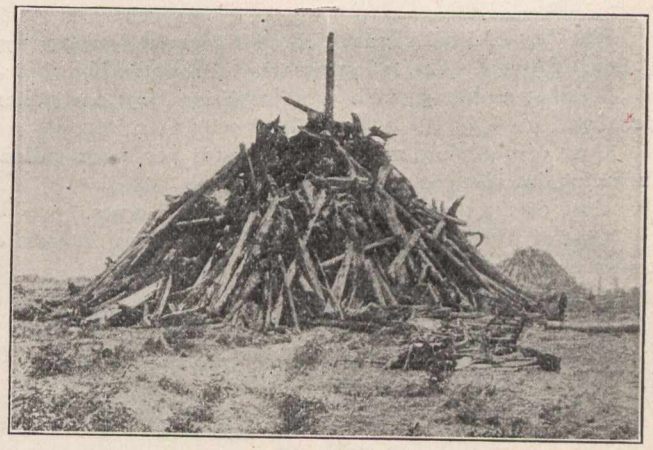


Fig. 3.—Stumps piled around gin pole in clearing with donkey engine.

Table I.—Cost of removing stumps from 1 foot to 4 feet in diameter from 120 acres of land in 1907.

Month.	Powder. Lbs.	Fuse. Ft.	Caps. No.	Stumps. No.	Labor. Hours.	Labor. $
June	13,700	10,100	2,400	2,135	2,380	650.00
July	1,750	2,050	400	239	260	87.00
August	2,750	2,700	700	445	324	114.90
September	1,950	2,150	500	383	324	126.37
October	1,250	1,000	300	238	198	77.53
November	2,350	3,100	800	378	283	114.97
Total	23,750	21,100	5,100	3,818	3,769	1,170.77
Average per stump	6.22	5.52	1.33	.....	0.987	0.3066
Average cost in cts.	19.76	2.37	.87	.....	.....	.....

The average cost of the removal of each stump is shown below:—

Powder. Cents.	Fuse. Cents.	Caps. Cents.	Labor. Cents.	Total. Cents.
49.76	2.37	0.87	30.66	83.66

The average cost of the materials used was as follows:—Powder, per pound, 8 cents; fuse, 100 feet, 43 cents; caps, per 100, 65 cents.

Cost of Various Methods of Clearing Land.

It has been a difficult matter to get definite figures on the cost of clearing land by the different methods in use, chiefly because those who have cleared land have not kept detailed records. Often the cost can not be determined because included with other work.

TABLE II.

Kind of land.	Method.	No. of acres.	Pounds. of powder.	Cost of labor	Cost per acre.	Remarks.
High Land	Donkey engine	40	7,500	.....	$218.00	Grubbing included.
" "	" "	100	1,200	$ 479.32	116.60	48 stumps per acre.
" "	" "	5	1,000	.....	90.00	Stumps only.
Valley land	" "	20	4,550	1,600.00	105.00	
Bench land	" "	10	900	1,010.30	123.00	Heavy clearing.
" "	Powder and grubbing	1	400	80.00	138.00	Large fir stumps.
" "	Powder & stump puller	6	900	205.00	50.00	Cedar and fir stumps.
" "	Donyey engine	1	300	60.00	100.00	Spruce stumps only.
" "	Powder and team	17	4,000		105.00	18-in. below surface.

COST OF FILTERING WATER.*

The city of Fredericton, N.B., filter annually 200,775,770 gallons of water. The following was the cost during 1908:—

Number units, 3, with total capacity 1,251,000 gallons per day.

Cost of pumping and filtering water per 1,000 gallons, including interest, 10.1 cents.

Cost of filtering, including interest, 2.6 cents.

Cost of filtering 1,000 gallons, not including interest on capital account, 0.98 cents.

Amount coal used 1908 908.5 long tons.

Amount coal used per day, 5,555 pounds.

Including 500 pounds for electric light, 200 pounds for heating, 50 pounds for washing filters.

Making total for pumping day of 4,805 pounds.

COST OF LAYING DUST WITH OIL.

Some Experiments on Toronto Streets.

Charles Sheard, M.D., Medical Health Officer, Toronto.

We have been conducting experiments with crude oil on our city streets for about one month, and on the whole the experiments have proven satisfactory. We have employed two varieties of this residue, and, so far, that obtained from the British American Oil Company, I think, is the preferable oil. I may say in this connection that varying localities will have different opportunities for securing an oil more or less free from smell. Thus, for instance, if Texas crude be employed, it has many advantages which the simple petroleum residue has not. It is comparatively odorless, and is to some extent misceable to water. This, however, we could not use here because of our difficulty in securing a plentiful supply, and also on the ground of expense. In Pennsylvania they have some varieties of petroleum residue which are practically odorless; that, I believe, produced from the neighborhood of Oleon is of this character. Nevertheless, the oil we are using has little to complain about regarding the odor, which soon dies away after its application. Generally, after five or six hours the odor is entirely gone. The method of application is to apply the oil in several relays, with a few days between. The number of applications required will vary somewhat according to the road to be treated. If the road is a reasonably good one, free from ruts and not subject to very heavy traffic, three applications of oil should last three months. If, however, the road is a bad one, full of ruts, and subject to being traversed by heavy drays and waggons, it will probably not last longer than one month. The better the roadbed, the lighter the dose required. If it be simply a sandy, mud road, with a thick covering of several inches of flour-like dust, then a heavy first dose of oil is preferable, the idea being that the admixture of oil and dust will form a coating upon the surface of the road to which the dusty particles adhere. If the road has a considerable grade, and is much exposed to the sun's rays, the oil will dry out sooner than it would if the road happened to be more or less shaded by the trees. The method of application consists in lightly sprinkling the streets from a watering cart driven at a pretty rapid gait over the surface of the road, endeavoring to so deposit the oil that the spots of oil will be more or less separate, care being taken not to leave puddles of oil in the depressions or channels. Should such occur it is advisable to have a man with a broom to broom these away, so that they will not be splashed by traffic or stain the clothing of pedestrians. The road is then watched for three or four days, when the second dose is given and then allowed to rest for a while, and after a week or so the third application is made. The road is better for being prepared, channels being cleaned out, depressions levelled, and ruts more or less filled up. This, howver, is not always practical, and the road may be treated without such preparation. We have found that upon ordinary roads 1,500 gallons per mile will complete the three applications specified above, and ought to maintain the road for at least from one to two months. This at four cents a gallon would be $60, and the cost of application from $10 to $15. This is probably less than the cost of sprinkling. A mile of road sprinkled twice a day would cost for labor alone $1 a day at least, which would leave the road more or less muddy. It would not be dustless for more than a couple of hours, and in some cases, if very dusty and sandy, a mile of road, or little more, would require the constant attention of a man and horse and watering-cart. Should the road be in good condition and in close proximity to other roads, the man would probably do a mile of road in an hour, and $1 a day would provide for two sprinklings per day.

Whn the cost of a large area of macadam road is considered, I think the oil would not be more expensive than the cost of sprinkling. On roads that are not much frequented by heavy traffic I consider the oil application would be exceedingly serviceable and comparatively inexpensive as a dust reducer. In setting forth the above facts as I have formed them in connection with work in the city of Toronto, I am free to admit that there is yet considerable investigation required as to the cheapest and best application to be employed. Preparations of tar have been used in the city of Boston, a mixture of oil, soap and tar in some places, and in other localities various oleaginous residues capable of a more or less admixture with water. However, they are, I think, apt to dry out more rapidly than the pure oil.

* From information supplied by A. K. Grimmer, B.A.I., City Engineer, Fredericton, N.B.

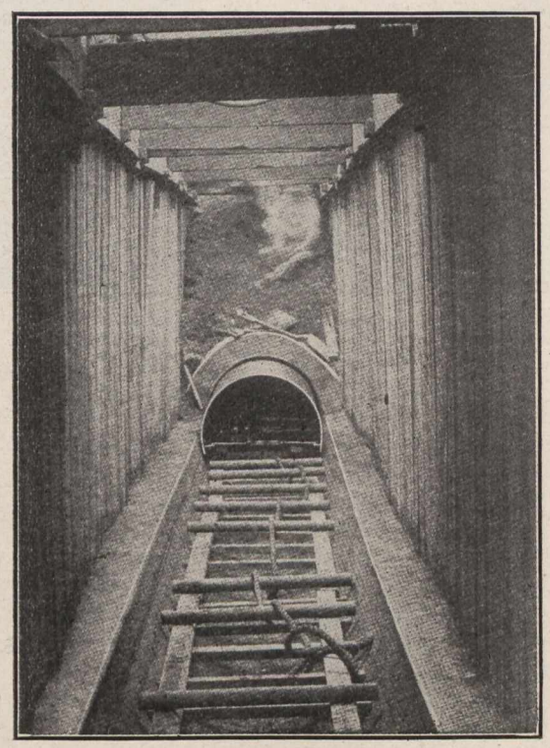
The Dominion Coal Company's output for the first six months of the year is 1,618,470 tons, against 1,922,236 tons last year, and 1,736,951 tons the year previous.

METHODS OF SEWER CONSTRUCTION IN CLINTON, IOWA.*

By Charles P. Chase, City Engineer.

The largest piece of construction according to the sewer plans for Clinton, Iowa, described in previous articles, has been in District No. 4.

A contract was let in the fall of 1905 for about four miles of the mains in this district along the lines of the old water courses. Actual work began in December, 1905, and continued to April, 1908, when the last pipe was laid. The contractors carried on the work, winter and summer, rain or shine, night and day, for 801 days out of 820, never closing down the work but one day, which was in respect to a deceased relative. But it was a job where you could not stop. Water, mud, quicksand and rock was the programme. The Mississippi River came up the second month and had to be kept out for over a year, a bulkhead being constructed and the water pumped over with a centrifugal pump. In addition to this there were innumerable springs and several miles of house sewers emptying into the old drain that had to be taken care of. Nearly all the work was sheeted, and out of 23,000 feet there was but 1,000 feet of dry work, and that on smaller side lines. At one time two centrifugal pumps, three steam siphons, four diaphragm pumps and numerous



College Avenue Sewer, Indianapolis, Ind.
I. Completed Invert and Completed Arch, with Centre Ready to Move.

buckets were at work in a 400-foot length of trench for a month before it was drained. The average depth of trench was twelve feet, and water was generally found at two feet. Most of the water came through gravel or the seams in the rock, and was shut off by draining the gravel below grade or in the rock at times by actually caulking with cement sacks. Small amounts were shut off with dry concrete, or the various other devices known to the trade.

Steel Forms.—The first block of ten-foot sections was put in with wooden forms. After this steel forms were used with much better results. These steel forms are a great advance for good construction, and, the writer holds, are as much ahead of wood as the modern breech-loading gun is ahead of the muzzle-loader of our fathers. The steel form is quickly placed, can be taken down in a few minutes, leaves smooth, hard, glossy work, and is the only form for cold weather, as it radiates heat applied and keeps the concrete warm. Forms were greased every time they were used. After this experience I do not want any other forms for either brick or concrete. In the large sections, particularly the arch shapes, the concrete sewers were a great success, and I believe were better adapted to the adverse conditions than any form we could have used, especially in the winter work. But in the small work I would advise vitrified brick for the invert; in fact, use a vitrified brick for inverts in all small work (below four feet) where there are water or existing sewers to contend with. As to concrete in general, the writer never discovered any gray hairs before this work, but there were plenty when the job was finished.

Concreting in freezing weather was carried on without difficulty and successfully. Many methods were tried to heat the gravel used as an aggregate, and finally the method of a steam jet was found best, the steam pipe being thrust into the pile. This wet heat gave excellent results. The water was warm, and salt was used when the temperature was below ten degrees above zero. As soon as the concrete was in place it was covered with manure or canvas, sometimes both, and coke heaters kept going all the time inside. I made up a set of instructions, which were issued to my assistants and inspectors and the contractor's foreman for work in freezing weather, which I give herewith with the hope that it may be of benefit.

Sewer Construction in Freezing Weather.

Use warm water and heated sand or gravel.

Use one pail salt to each barrel of water in all mortar on pipe and brick sewers.

Use less water than ordinarily, and mix all mortars as dry as can be efficiently used.

Only plaster in middle of the day, and see that frost is out of brick, and if not, take it out with water or steam jet, otherwise plaster will not stick.

Cover all joints in pipe work or masonry as fast as laid with dry earth or other material to protect from frost.

On concrete sewer, for the bottoms use salt in water, heated gravel and but small amount of water on cold days and tamp in place, and finish with top coat. Put such work in between hours of 10 to 12 a.m. if possible.

As soon as laid protect from weather by covering with manure or straw and placing canvas or tarpaulin over this; or when steam can be used excellent results can be obtained by covering with tarpaulin laid about 18 inches above the work and turning in small amount of steam. Do not turn on steam too strong, but just enough to keep warm. Empty bags over straw are also a help if tarpaulin is not handy.

Be sure all ice and dirt are removed before placing side walls on bottom or arch on walls, otherwise there will be no bond.

Keep stoves or salamanders going on inside of all concrete sewers.

Cold makes cement set slow, and freezing and thawing of water in concrete before final set will ruin it.

Excavation.

It is much cheaper to thaw out ground with fire or steam than to pick frost.

Watch frozen banks for caving when frost goes out. It will drop all at once.

In back filling frozen ground allow 20 per cent. more shrinkage than when dry. (This does not apply to rock.)

Cover all work as fast as laid with unfrozen earth, if possible.

Back fill and clean up as close to work as possible before excavating materials freeze.

Chas. P. Chase,
Engineer in Charge.

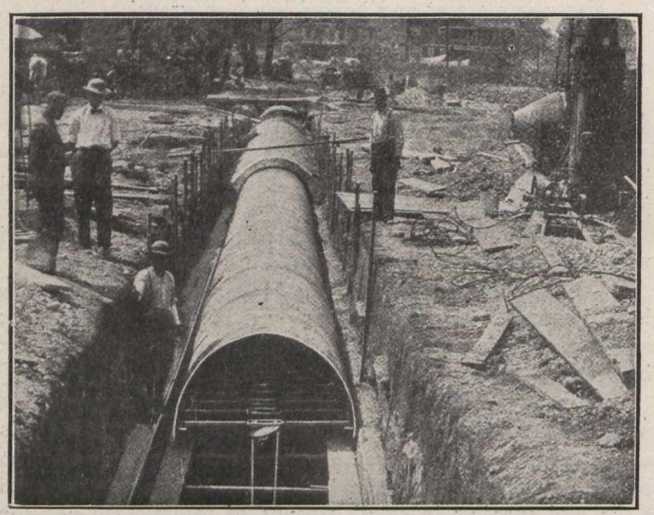
(Please add what your experience suggests or what may arise from time to time.)

The issuing of these instructions seemed to awaken more interest in the work and cause the men to discuss the matter and think about it, with the result that several valuable suggestions were made and changes followed accordingly. I believe I am justified in saying that if any of you

* From a paper before the Iowa Society of Engineers.

will follow these instructions you need not fear work in cold weather. In two winters we lost no work on account of freezing, and only had two bottoms of twelve feet each that needed touching up. The steam jet was especially useful.

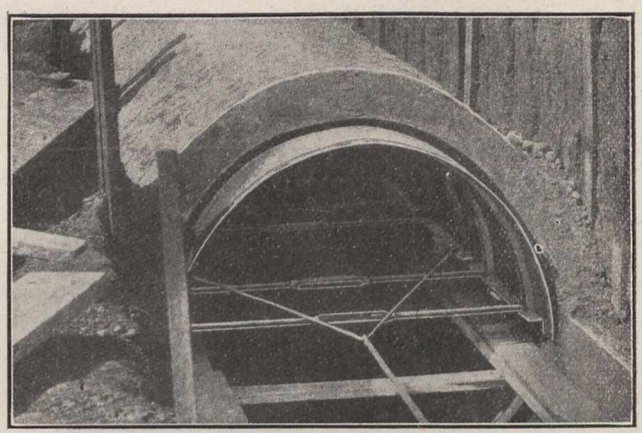
The materials used for concrete were clean-washed river gravel, containing in its natural state just about the right amount of gritty sand and Portland cement. Every car of cement was tested for tensile strength, pat test, boiling test, and action in water and on the work. During the work three cars of cement, about 600 barrels, were rejected. In two of these the cement hardened slowly and required a large amount of water and watching to keep it from slacking and going to pieces; the third car fell down all around. A record was made of the tests, of which there were over a thousand, but such tests are now so common I will not reproduce them here, but simply mention it to show the value of testing. The amount of water was watched and varied according to the practical demand of the actual conditions, varying from "no water concrete" to "slop." When using reinforcement we found it almost impossible to use a tamped "dry mixture," so called, as the spring of the metal dislodged the concrete. The best results were obtained by using the mixture as wet and soft as it would stand, pounding down with shovels and smoothing off. Inside, the steel forms gave a finish like glass. The bottom was kept well ahead of the top, so it was usually hard when the arch forms were moved. Mixing was done with Foote continuous automatic mixers,



College Avenue Sewer, Indianapolis, Ind.
II. Shallow Trench, Showing Stages of Work.

and we experienced no trouble in keeping proportions if the machine was kept clean. In fact, I liked their work better than the batch mixer on the job. Only one arch fell during construction, and this was when a "wise" foreman dumped several tons of mud from six buckets about twenty-five feet drop on a green arch. It not only wrecked the arch, but the steel form under it. No need to say it did not happen again. On brick and pipe sewers as well as the concrete we endeavored to mix practical "horse sense" and reason with our instructions, according to conditions and what our experience had taught would give best results. In an injunction law suit that developed (and failed) during construction, an engineer for the "kickers" testified that we were not measuring the ingredients (it was an automatic self-proportioning machine), and that on the brick work they were not wetting invert brick (in water and quicksand) where we had to build wooden cradles to start. I mentioned this brick testimony to the Italian bricklayer. He said: "Wetta hell; before I lay two brick they are so wetta they slida on my foots." Crude, but a world of truth; with no diploma, but perhaps nearly all of us in our blind younger days in commendable enthusiasm to follow the exact, hair-splitting terms of the modern specifications have "strained at a gnat" and frequently "swallowed the camel."

Owing to the extreme scarcity of labor much machinery was used on the contract. In fact, it was a "machine job." Excavation was done with steam shovels, Carson bucket machines, Parsons excavators, by teams, and by hand. The steam shovels were not a howling success in excavating, owing to the narrow ditches and not being able to blast heavily on city streets, but (take note) as the excavation was nearly half rock, in back filling the steam shovels did excellent work, which would have been impossible by team, and bankruptcy by hand. In the rock where the walls had to be close trimmed, the bucket machines made the best time, as they obtained a much cleaner ditch, completed as they went along. Both steam and air drills were used, steam being the most satisfactory, but the air drills were handy in trimming up. But for the heavy work they were not in it. However, the air was utilized (take note) in blowing out the holes, freeing them from all dirt and water and in cleaning of concrete, cleaning rock, etc. The Parsons machine unfortunately got on the job in the winter with two feet of frosty macadam on the street where it was tried, which stuck it, and its next job was too soft and sticky, but when they struck the only dry earth on the job, it went along like an automobile.



College Avenue Sewer, Indianapolis, Ind.
III. Detail of Shallow Trench Work

The main items of contractors' plant consisted of the following:—

Two steam shovels.
Two Carson bucket machines.
One Parsons excavator.
One air compressor plant with air drills.
Two steam drill plants, ten drills.
Four concrete mixers.
Four extra steam boilers on trucks for warming materials and thawing ground, etc.
Two centrifugal pumps.
Four steam siphons.
One duplex pump, one pulsometer.
Four hand pumps.
Ten to twenty teams with dump wagons.
Hand tools, shovels, picks, etc.
Complete blacksmith and repair shop.
Cement warehouse.
Estimated value, $30,000.

The contractors were the Peoples Construction Company, of Davenport, Iowa, and they were always fair and quick to execute any proper orders, and carried out the letter and spirit of the contract to the best of their ability with but little friction and much to the satisfaction of the engineer.

This constitutes about four miles of work at a total cost of $180,000, exclusive of plant, general costs and interest, legal expenses and damages amounting to $10,000. Cost of engineering was about $5,000. These costs are according to "force accounts." The contractor lost heavily owing to the excessive rains, high water in the river, high wages and scarcity of labor, and also that the old drains were so obstructed that the soil was saturated to the limit. The bid of the contractor was $165,500.

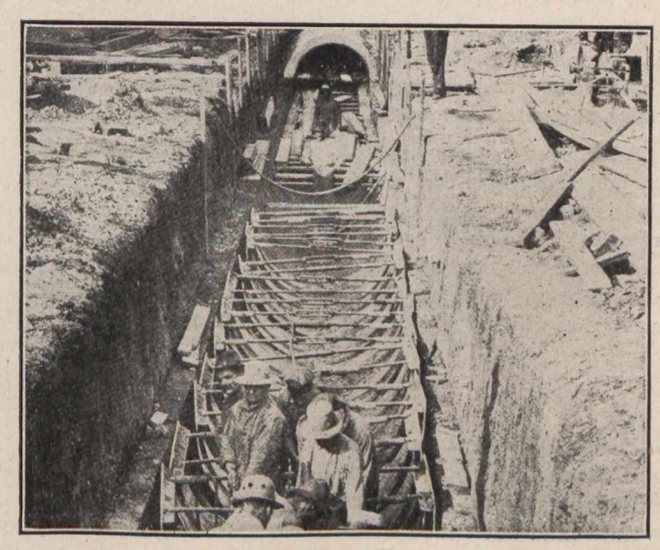
Cost of the Work.—Complete cost data were kept of the of inspectors, who kept force account on specially prepared work in sections from start to finish. All work was in charge blanks in book form. I give below the approximate costs:—

Description.	Length, feet.	Size, Feet and inches.	Cost, per foot.
Steel and concrete, earth section	1,700	6 ft. 3 in. x 10 ft.	$20 00
Steel and concrete, rock section	380	6 ft. 3 in. x 10 ft.	15 00
Steel and concrete, rock section	1,360	6 ft. 3 in. x 9 ft.	10 00
Steel and concrete, rock section	372	5 ft. 9 in. x 8 ft.	10 00
Steel and concrete, earth section	500	5 ft. 9 in. x 8 ft.	11 00
Steel and concrete, circular	1,040	66 in.	6 00
Plain concrete, rock section	400	5 ft. 3 in. x 7 ft.	6 50
Plain concrete, earth section	400	5 ft. 3 in. x 7 ft.	7 00
Plain concrete, earth section	600	5 ft. 3 in. x 6 ft.	7 00
Plain concrete, rock section	200		6 00
Plain concrete, earth section	300	4 ft. 6 in. x 5 ft. 6 in.	5 90
Plain concrete, rock section	510		5 50
Plain concrete, earth section	810	4 ft. 3 in. x 5 ft.	5 00
Plain concrete, circular	376	60 in.	5 00
Plain concrete, circular	376	57 in.	4 70
Plain concrete, circular	376	51 in.	4 30
Plain concrete, circular	786	42 in.	4 00
Plain concrete, rock section	1,050	40 in.	4 50
Plain concrete, rock section	340	40 in.	4 60
Two-ring brick, circular	800	48 in.	6 00
Two-ring brick, circular	480	40 in.	5 25
One-ring brick, circular	400	42 in.	4 00
One-ring brick	1,200	30 in. x 45 in.	4 50
One-ring brick	800	26 in. x 39 in.	4 00
One-ring brick	400	28 in. x 42 in.	4 20
One-ring brick	410	22 in. x 33 in.	4 00
Vitrified pipe, kiln run	1,417	36 in.	4 21
Vitrified pipe	2,077	30 in.	3 53
Vitrified pipe	1,321	24 in.	2 20
Vitrified pipe	820	22 in.	2 10
Vitrified pipe	1,871	18 in.	1 40
Vitrified pipe	200	12 in.	80
Catch basins, complete	....	153 ....each	25 00
Catch basins, connecting pipe	3,973	10 in.	45
Manholes, complete	....	....each	30 00
Protection bulkhead, complete	....		300 00
Rip-rap, per sq. yd.	....	2,500 yds.	1 00
Extra concrete, under railways, per cu. yd.	....		8 00
Rock excavation, per cu. yd.	....	18,600 yds.	2 00
Rock disposal	....		50
Vitrified drain tile	....	23,872 ft. 8 in.	25
Timber left in trench by order of engineer, per M ft.	....		30 00

Extra Work.—When the work was commenced it was freely predicted by enemies of the project that there would be an enormous bill of extra work, but the conditions had been so carefully examined and provided for in the plans that there was practically no extra work, the final estimate being a few dollars less than the original bid.

The work was paid for by bonds of $140,000 voted under the laws for changing water courses, and an abutting property tax of the balance according to benefits. The whole construction was carried on under the writer's direct supervision, and I personally endeavored to go "over the line" once each day to watch progress (and there was plenty to see). An instrument party attended to the lines and grades and an inspector was in charge of each point of construction. The project as above contracted for was first started by the writer nineteen years ago, and it took eighteen years to see it finished, but it is done, and the haunts of the duck and mosquito are destroyed, the domestic relations of the muskrats are disrupted and broken, the turtle's trail is obliterated and he wets his back in new pools, cellars are dry, sidewalks no longer serve as ferries, and, as one old fellow told me: "You've nearly dried me well; it is twelve feet to water and it used to be two, and I want damages." Let us hope that the malaria and typhoid have sunk with the water.

In the fall of 1907 and early winter of 1908 the detail plans for the balance of District 4 were ordered and completed, calling for about 12 miles of brick, brick and concrete, and pipe sewers. Bids were received in March, 1908, the low bid being $179,800, but owing to a political fluke part of the work was cut out. The conditions found in this second contract are worthy of note as showing the benefit



College Avenue Sewer, Indianapolis, Ind.

IV. Showing Assembling of Centres for Extension of Invert.

of the first work. Where last year it required centrifugal pumps and constant exertion and watchfulness to keep the water down enough to work, the ground is now thoroughly drained and dry to a depth of nine feet, and this has been the case over several miles of ditches.

THE FORCING OF FIRE TUBE BOILERS.

In a recent paper F. W. Dean, mill engineer and architect Boston, Mass., undertakes to show that the prevailing opinion upon the relative forcing capabilities of the fire and water tube boiler is incorrect, and in support of this claim gives particulars of several boiler tests. Mr. Dean begins his discussion with the statement that there is a widespread impression among many persons interested in boilers that the fire-tube type of boiler has less capacity to be worked above its rated power than boilers of the water-tube type, and that it is necessary to provide such boilers with more heating surface per horse-power than water-tube boilers require. It is pointed out that for many years it has been customary to base the horse-power of horizontal return tubular boilers upon 15 square feet of heating surface per horse-power, although at present some makers of this boiler venture to place it upon 12 square feet.

It is important to remember that the rating of 15 square feet was in use long before the A.S.M.E. established the meaning and measure of a boiler horse-power, and by persons who probably knew very little about boiler performance and the capacity of heating surface to absorb heat. It probably had been found at some time, that, with the prevailing type of engine in use it was always safe to provide boiler power upon this basis. It had not been customary to make boiler tests at that time as frequently as now, and no exact knowledge of boiler performance existed, or, if it did, it was confined to comparatively few persons.

The introduction of water tube boilers had caused more intelligent study of boiler phenomena, and there are now associated with the builders of this type of boiler many of the brightest men and most energetic salesmen.

Mr. Dean continues, "Before proceeding with the details, however, I will briefly mention the reasons given for the alleged superiority of the water-tube boiler in the respect under consideration. It may also be well to state what is meant by ability to stand forcing. In a general way this ability is the capacity to evaporate much more water than the rated power of the boiler would require. This amount is often 20, 50, or even 100 per cent. in excess of the rated requirements, and depends upon the amount of fuel consumed in a unit of time. This in turn depends chiefly upon the draft in the fire-box and the freedom with which air can pass through the gate or stoker and through the fuel itself.

An alleged reason for the superiority is that the water-tube boiler contains less water than the fire-tube boiler, by which is meant, I suppose, that it contains less water in proportion to the heating surface. I have been able to ascertain the amount of water contained by a few water-tube boilers, and have computed that contained by several fire-tube boilers, drawings of which I have. The results are as follows:—

	Lb. per sq. ft. of heating surface.
Horizontal water tube boiler A	7.66
Horizontal water tube boiler B	8.34
Horizontal water tube boiler C	8.62
Horizontal water tube boiler D	8.37
Vertical water tube boiler	10.30
Semi-vertical water tube boiler	11.42
90-in. horizontal water tube boiler	7.74
84-in. horizontal water tube boiler	7.24
78-in. horizontal water tube boiler	7.00
72-in. horizontal water tube boiler	6.73

	Lb. per sq. ft. of total surface.
Manning vertical tube boiler	7.14
Corliss vertical tube boiler	11.00

Some vertical boilers of my own design contain more water than the Corliss.

An inspection of this table as far as it goes shows that water-tube boilers generally contain more water than horizontal fire-tube boilers. It appears from this that whatever advantage accrues from small water contents lies with the horizontal return tubular boiler. The vertical water-tube boiler, as well as some designs of fire-tube boilers, contains more water than horizontal boilers.

The comparison of horizontal boilers reveals conditions that should not be surprising, for water-tube boilers are made up of drums, headers and tubes, all of which contain considerable water, while the horizontal return tubular boiler has most of its water space filled with tubes, especially when there is no manhole in the front head below the tubes.

A little consideration will show, however, that the quantity of water contained by a boiler has no effect upon forcing capacity after steam is once up to the working pressure. The reason for this is that heat added cannot raise the temperatity of steam formed and increase the quantity and temperature of the escaping gases. It, therefore, appears that both types of boiler have equal merits in this respect.

Another claim is that as the flame enters among the tubes of water-tube boilers the evaporation is forced more than if it did not reach them. As flame is combustion in process, and is likely to be prematurely terminated by contact with the relatively cold surfaces of the tubes, it is apparent that it is disadvantageous to have the flame pass among the tubes.

Another claim is that the hot gases impinge against water-tubes, and, therefore, give up more heat than they would if they passed parallel to them. The fallacy of this argument is apparent when it is remembered that gases give up heat because their temperature is higher than that of the heat receiving medium, and not because they are thrown against this medium. Moreover, some kinds of water-tube boilers compel the gases to move parallel to the tubes, and this feature is held to be highly advantageous by interested persons. Incidentally it will be found disadvantageous to project boiler gases against the outside of tubes, for examination shows that it causes wedge-shaped accumulations of soot at the very part of the tubes where the greatest reception of heat was expected, thus rendering this part the least effective of any.

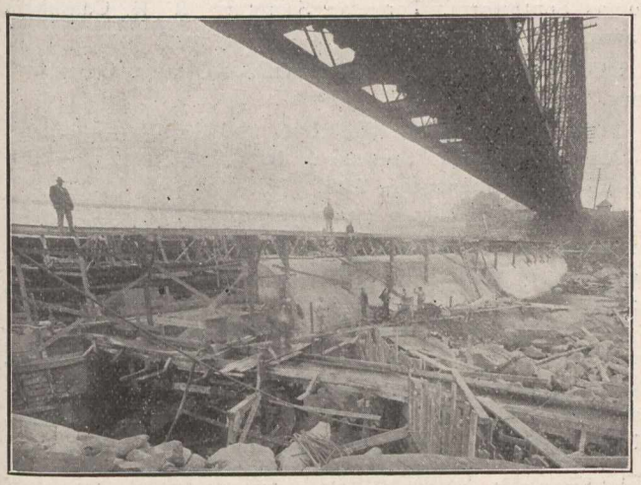
I believe it is also claimed that there is less reduction of draft between the smoke flue and the fire box in water-tube than in fire-tube boilers on account of larger spaces between the tubes of the former than through the tubes of the latter. Whether this is true or not I cannot say in general, but in cases where I have determined it the results are inconsistent and contradictory. I have found, however, that the vertical fire-tube boiler requires the least draft for burning coal at a given rate. This, I think, is due to the path of the air being at right angles to the fuel and, therefore, shorter and less impeded by the fuel than with horizontal boilers, in which the path of the air is diagonally through the fire."

METHOD OF CONSTRUCTION OF THE NEW DAM AT BELLOWS FALLS, VERMONT.

The old wooden crib dam across the Connecticut River at Bellows Falls has recently been replaced by one of concrete, in the construction of which unusual efficiency was secured through the use of special equipment and methods. This dam, which was designed by Charles T. Main, of Boston, Mass., who acted as consulting engineer, joins the Vermont and New Hampshire Shores. In the effort to economize material and utilize outcropping ledges for footings the dam was made to follow a somewhat zigzag course, its total length being about 600 feet.

The contract was let to the Aberthaw Construction Company, Boston, Mass., who began work in July, 1908, and was completed in about four months.

The dam is of very irregular cross section, the crest, of course, remaining the same throughout its entire length, but the base varying with the depth of the river bed. At the maximum it is 38 feet deep. It changes direction five times.



Down Stream Side of Bellows Falls Dam.

The down-stream face of the old crib dam served to some extent in place of forms in placing the concrete. Elsewhere matched spruce was used. The concrete was mixed in the proportion of 1:3:5. Almost 80 per cent. of the crushed stone was brought down to a size that would pass through a 2-inch screen. Rubble stones were at least one cubic foot in volume.

In the construction of the mixing plant which was designed by the contractors a platform was provided for receiving the wagon loads of sand and stone, and connecting therewith were a cement runway, chutes for sand, gravel and stone. Power was furnished by a 35 horse-power motor. A centrifugal pump supplied water for washing, and a 21 cubic foot Smith mixer delivered concrete by gravity into Koppell dumping cars. These cars run from one end of the dam to the other on a 24-inch track, supported on a timber trestle about 4 feet above the crest. Beneath the upper platform pockets were provided for gravel and stone which was received through chutes. Through the medium of these pockets, which were built in the correct ratio of volume, the proper mixture was insured, the bags of cement being emptied into the mixer from a special platform.

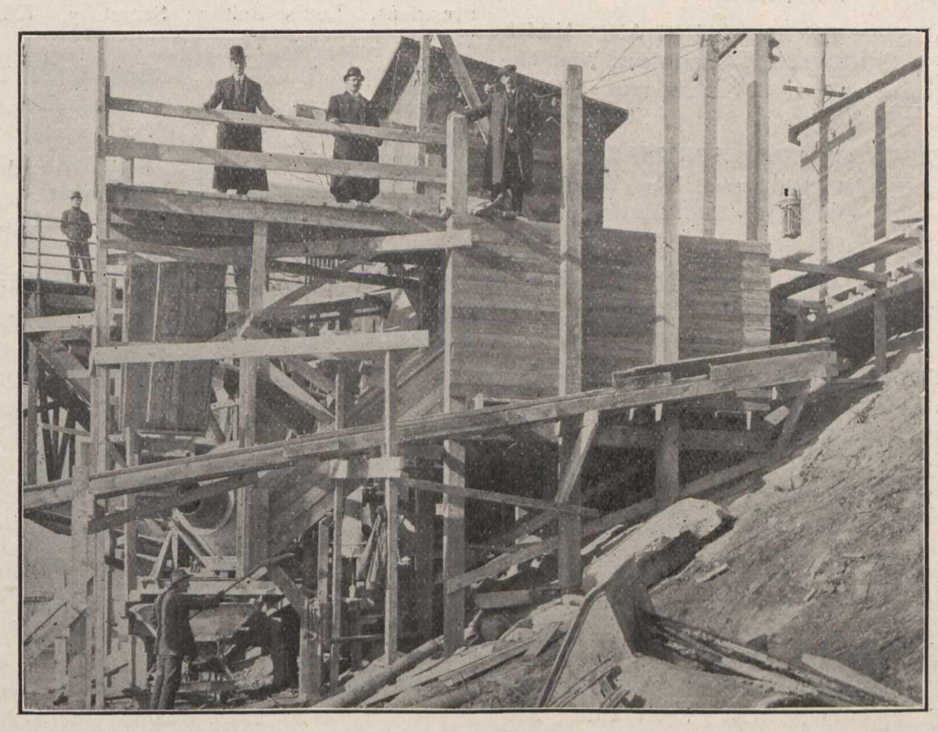
Gravel and sand were taken from a pit about one-eighth of a mile away, and stone from a quarry at a distance of three-quarters of a mile. Gravel was handled at the pit by a ½ cubic yard orange peel bucket in connection with a derrick having a 70 foot boom and 40 foot mast. The contractors maintained a screening plant at the gravel pit. All sand and stone were carted to the mixing plant.

The working gang averaged about 125 men. The cost of labor per cubic yard averaged about 12 cents at the mixer. A total of about 15 cents per cubic yard was chargeable to the original cost of the mixer plant and the electrical operation of the mixer, and about 30 cents per cubic yard to transportation, dumping and placing. The form work cost approximately 9 cents per square foot of surface contact.

The concrete was deposited along the top of the dam by means of the cars which were propelled by hand. It was dumped into chutes leading to the base of the dam and there spread by laborers.

Coffer dams were required throughout most of the work, particularly on the Vermont side where the greatest trouble with water was experienced. These were generally built of 12 inch logs, bolted together with cross logs 10 ft. on centres. These coffer dams, which were constructed as rafts, were towed out into the stream and there sunk to the level of the dam foundation. Four-inch spliced and grooved sheeting was driven to a firm foundation by a maul. It was then withdrawn and trimmed if necessary for the final driving to bed rock.

The work was done in sections with bulk heads installed at right angles to the general direction of the coffer dam work, parallel to the face of the dam. After the completion of the concrete work dynamite was employed to blow up the crib work. A derrick was first employed to remove the stones which were previously used to sink the crib. The total amount blasted out of the river bed in the preparation of the dam footings was about 300 cubic yards; the total amount of concrete was about 5,250 cubic yards. The aggregate cost of the work, including forms, coffer dams, pumping and incidental charges, was approximately $43,500.



Mixing Plant.

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.

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

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

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

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

CANADIAN RAILWAY CLUB.—President, 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 FORESTRY ASSOCIATION.—President, Thomas Southworth, Toronto; Secretary, R. H. Campbell, Ottawa.

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. Prtsident, 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.

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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.

National Irrigation Congress.—Seventeenth meeting, August 9-14, at Spokane, Washington; Arthur Hooker, Secretary, Board of Control, Spokane, Wash.

League of American Municipalities.—August 25-27. Thirteenth annual convention at Montreal, Que. John MacVicar, Secretary, Des Moines, Iowa.

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.

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.

Quebec.

ST. LOUIS.—Tenders for street paving in asphalt and paving blocks will be received until the 20th inst. J. Emile Vanier, Town Engineer, 5 Beaver Hall Square, Montreal.

Ontario.

COCHRANE.—Tenders will be received until July 21st for the construction of a union station. A. J. McGee, secretary-treasurer, Temiskaming and Northern Ontario Railway Commission, 25 Toronto Street, Toronto. (Advertised in The Canadian Engineer.)

LONDON.—Tenders will be received up to Saturday, July 24th, for construction of the Scanlon drain, London East. F. W. Farncomb, Township Engineer.

MIDLAND.—Tenders will be received up to Monday, the 26th July, for the construction of approximately 20,000 lineal feet of concrete walks. Thos. I. Trueman, Town Clerk.

NORTH BAY.—Tenders for the erection of a court house at Kenora and an addition to the court house at North Bay, heating, plumbing, and for lighting electric fixtures for the Normal School, North Bay, will be received until Friday, the 23rd July. H. F. McNaughten, Secretary, Department of Public Works, Toronto.

OTTAWA.—Tenders will be received up to August 15 for the furnishing of iron posts for use on the survey of Dominion lands. P. G. Keyes, secretary, Department of the Interior.

OTTAWA.—Tenders will be received until Friday, July 23, for the construction of a building for refinery, Royal Mint. Napoleon Tessier, secretary, Department of Public Works.

PETERBOROUGH.—Tenders will be received up to Saturday, the 17th July, for the construction of abutments for the steel bridge over the Indian River. Plans and specification may be seen at the office of the County Engineer, J. E. Belcher. Ed. M. Elliott, County Clerk, Peterborough.

PETERBOROUGH.—Tenders will be received up to the 17th July for the steel work of a bridge over the Indian River, 75 feet span from abutments' faces at water level. County Engineer, J. E. Belcher. Ed. M. Elliott, county clerk.

PETERBOROUGH.—Tenders for the erection of Knox Church will be received up to Monday, July 19th. Secretary Building Committee, 283 Park Street.

PETERBORO'.—Tenders for grading, sodding, drives, concrete and stone work, drill hall, will be received until Wednesday, July 21st. Napoleon Tessier, Secretary, Department of Public Works, Ottawa.

RAINY RIVER.—Tenders will be received until July 28th for pipelaying, pumping machinery and other waterworks equipment. Jas. A. Bell, Consulting Engineer, St. Thomas, Ont. J. H. Wilson, Town Clerk. (Advertised in The Canadian Engineer.)

TORONTO.—Tenders will be received up to Tuesday, August 3rd, for the construction of reinforced concrete arch of 35-foot span, having a 42-foot roadway, and two 6-foot sidewalks, containing about 1,500 cubic yards of concrete. Joseph Oliver (Mayor), Chairman Board of Control.

TORONTO.—Tenders will be received until July 28th for the construction of transformer and interswitching stations at Toronto and other points in Ontario. Hydro-Electric Power Commission, Continental Life Building.

Manitoba.

BIRTLE.—Tenders will be received until July 23rd for the construction of a bridge five miles south-west of Birtle. Tenders may be for cement piers and superstructure, separate or combined. Plans and specifications may be seen at the Department of Public Works, Winnipeg. T. W. Thompson, Secretary-treasurer Birtle Municipality.

BRANDON.—Tenders will be received up to July 17th for a supply of creosote wood paving blocks for bridge paving. Price to be per yard f.o.b. Brandon, duty paid. Harry Brown, city clerk.

KILLARNEY.—Tenders will be received until Saturday, July 17th, for the erection of a municipal hall building. Plans and specifications will be on file at the Builders' Exchange, Winnipeg. George G. Teeter, Architect, 604 Builders' Exchange, Winnipeg.

PIPESTONE.—Tenders for the construction of two steel bridges with concrete abutments will be received up to the 17th July. Plans and specifications can be seen at the offices of the Chief Engineer, Public Works Department, Winnipeg. A. P. Power, Secretary-treasurer, Virden P.O.

WINNIPEG.—Tenders will be received up to Monday, July 26th, for the supply of 1,000,000 feet of B.M. lumber. M. Peterson, Secretary, Board of Control.

WINNIPEG.—Tenders for supply of twenty-two 8-inch and ten 5-inch valves for waterworks system will be received up to July 21st. M. Peterson, Secretary, Board of Control office.

WINNIPEG.—Tenders will be received until August 2nd and August 16th for hydraulic, electric, and auxiliary equipment for the generating station at Point du Bois. For plans, etc., apply Smith, Kerry & Chace, engineers, Winnipeg; William Kennedy, jr., Y. M. C. A. Building, Montreal, and M. Peterson, secretary, Board of Control, Winnipeg.

Saskatchewan.

FRANCIS.—Tenders will be received until Monday, July 26th for: (a) Furnishing material and constructing a concrete collecting basin, 25 ft. x 25 ft. x 18 ft. (b) Furnishing 9,750 feet 6-inch wooden pipe. (c) Furnishing 4,630 feet 6-inch cast-iron pipe, with necessary special castings. (d) Gate valves, valve boxes and soft lead. (e) Labor laying wooden and iron pipe. C. R. Gough, Secretary-treasurer.

MOOSE JAW.—Tenders will be received up to Monday, 18th July:—1-50 light, constant current transformer or regulator, with 35 arc lamps and suitable switchboard, with necessary instruments for controlling same; one year's supply of Watt meters; one' year's supply of transformers. John D. Simpson, City Clerk.

REGINA.—Tenders will be received up to Monday, July 19th, 1909, for the construction of reinforced concrete bridge abutments for several highway traffic bridges. F. J. Robinson, Deputy Commissioner, Department of Public Works.

REGINA.—Tenders will be received until July 19th, for a supply of sewer pipe. Angus Smith, City Engineer. (Advertized in the Canadian Engineer.)

REGINA.—Tenders will be received until July 19th, for concrete pavements, curbs, and sidewalks. Angus Smith, City Engineer. (Advertized in the Canadian Engineer.)

REGINA.—Tenders will be received until July 19th, for a supply of pipes and valves for waterworks system. Angus Smith, City Engineer. (Advertized in the Canadian Engineer.)

SASKATOON.—Tenders are wanted for the construction of a subway under the C.N.R. tracks. Geo. T. Clark, City Engineer.

Alberta.

EDMONTON.—Tenders will be received until Friday, July 30th, for the construction of post-office, customs and inland revenue fittings. R. T. Manson, Clerk of Works, Edmonton. Napoleon Tessier, Secretary, Department of Public Works, Ottawa.

British Columbia.

VANCOUVER.—Tenders for post-office fittings will be received until Wednesday, July 21st. Napoleon Tessier, Secretary, Department of Public Works, Ottawa.

VICTORIA.—Tenders will be received up to Monday, 16 August, for the supplying of cast iron water pipe, pig lead, gate valves, for waterworks. W. W. Northcott, Purchasing Agent.

CONTRACTS AWARDED.

Ontario.

ARNPRIOR.—Following is the list of tenderers for the bridge across the Madawaska River at Stewartville:—

Name.	Superstructure.	Substructure.
Hamilton Bridge Company	$4,200	.....
Jenks-Dresser Co., Sarnia	5,075	$7,000
Dickson Bros., Cambellford ..	4,925	5,072
J. R. McQuigge, Arnprior	4,975	4,995
George A. Begy, St. Catharines	.....	5,945
Western Bridge Co., Chatham..	3,250	6,750
Edward B. Merrill, Toronto ..	.....	5,270
McMannus & Co., Hamilton ..	5,930	6,250
Stratford Bridge Co., Stratford	5,469	.....

Contract for superstructure awarded to Hamilton Bridge Co.; contract for substructure awarded to Jenks-Dresser Co., Sarnia. Mr. A. L. McAllister, B.A.Sc., of Toronto, was the consulting engineer.

BLENHEIM.—R. Leitch, of Blenheim, has received the contract for the concrete sidewalks to be laid by the town at 10¼ cents a square foot.

SMYTHE.—Mr. A. L. McLennan, of Toronto, has received a contract for the construction of a waggon road from Smythe to Gow Ganda. The length of the road is about 27 miles and the contract includes chopping, clearing, stumping and grubbing.

TORONTO.—The controllers recently awarded to the Canada Foundry Company the contract for supplying 12 and 15-inch penstocks for $29.84 and $35.02, and to the John Inglis Company the contract for the 18 and 24-inch penstocks at $43.75 and $57.65. The penstocks are for the high level interceptor sewer.

TORONTO.—The contract for the concrete foundation and piers of the new wing of the Parliament buildings has been awarded by the Provincial Public Works Department to A. Gardiner & Company, Toronto. The contract price is $16,000.

NIAGARA FALLS.—The following figures represent tenders submitted for the sewers on Main Street:—

	S. Critelli & Son.	P. Lorenzo.
Lump sum	$2,379 00	$2,560 00
Rock, per yard	3 50	3 50
Manholes	60 00	60 00
Catch basins	30 00	35 00

Manitoba.

WINNIPEG.—Mr. Moen, a Norwood contractor, will construct for the town of St. Boniface granolithic walks to cost $5,300.

Saskatchewan.

SASKATOON.—The tender of W. T. and J. Arrand for concrete sidewalks at 19¾ cents, 25 cents, 68 cents and 24¾ cents, was accepted.

PRINCE ALBERT.—Sewer and waterworks extension tenders were as follows:—

	Extensions.	Catch Basins.
Bolton & Company .....*	$9,500	$45.75 each
McVean & Craig	9,837	*42.70 each

*Accepted.

The figures for extension were $1,450 below the engineer's estimate.

British Columbia.

VANCOUVER.—Tenders for supplying the city with an automatic ambulance which will be operated directly under council control were as follows:—Frank Darling, for Wilson & Stockhall, Old Country apparatus, $5,200; W. E. Seagraves, Walkerville, Ont., $5,600; W. J. Massey Company, $4,400; Storey & Campbell, Studebaker machine, $4,992, for 30 horse-power, and $5,708 for 40 horse-power; White Company, of San Francisco, steam propelled machine, $6,500. The contract was not awarded.

VANCOUVER.—Subject to the approval of the ratepayers, a contract amounting to $105,250 has been given to the Hassam Paving Company of this city. It includes: Paving Columbia Street, $53,000; cement sidewalks, $31,500; sewer system, $20,750.

RAILWAYS—STEAM AND ELECTRIC.

Quebec.

NOMINING.—This extension of the C.P.R., which runs from Nomining to Rapid l'Original, a distance of nearly 36 miles, is rapidly nearing completion, the Toronto Construction Company, who are grading, hope to have the line taken off their hands this month, preparatory to commencing operations in New Brunswick. The station at mile 12 (near village of Chemin Govin), a handsome structure of No. 5 pattern is completed, as also the single and double section houses. The latter would be a credit to a city. Work is being rushed at the 40,000 gallon tank at mile 19, and the station at mile 26 (near village of Val Barrette). This is also a standard station of No. 4 design. The tank, two stall engine houses, coal platform and station at Rapid l'Original while not yet commenced will be shortly, and completed be-
contractor for this work.
fore the 30th August. C. E. Deakin, of Montreal, is the

SHERBROOKE.—From Sherbrooke to Quebec has been completed a survey of the Quebec Eastern Railway, which measures 117 miles.

New Brunswick.

ST. JOHN.—Eleven new tracks, having an average length of 1,200 feet, are being laid in the C.P.R. yards at this point.

Ontario.

CHATHAM.—A deputation of English capitalists visited Chatham last week, and in company with John Piggott and other directors is making an inspection of the Windsor, Essex and Lake Shore Railroad. If they can be induced to put up the capital they talk of doing the road will immediately be extended to Chatham, and later it is the intention to build it on to London.

COCHRANE.—A union station of red pressed brick, with stone trimmings will be erected here this fall for the use of the T. & N. O. and the N. T. Railways.

GUELPH.—The Dominion Railway Commission has issued an order compelling the Grand Trunk to erect a new passenger station in Guelph before September, 1910. The company is also compelled to put in a subway at Gordon Street and a foot subway at Huskisson Street. There will be a subway at Neeve Street, the cost of which may be borne by the city or the company, whichever can prove the right of first survey over the property.

OTTAWA.—The Railway Commission recently issued an order to all railway companies requiring them to fyle with the Board by September 1st a detailed statement as to all level crossings on their lines of railway where accidents have occurred since January 1st, 1900.

OTTAWA.—The G. T. R. intends commencing work on new freight sheds of brick, 340 feet in length by 60 in width.

ST. MARY'S.—An extension of the C.P.R. from Code's Junction to Ingersoll will be commenced shortly.

TORONTO.—The Ontario Railway Board has approved for subsidy purposes of 66.16 miles of the Lake Superior Branch of the G.T.P., 22 miles west of Fort William. The bonus is $2,000 and 3,375 acres per mile.

Manitoba.

WINNIPEG.—The telegraphone system, which the C.P.R. started installing on the Western lines last winter, has proved so successful between Fort William and Winnipeg, that the company has been continuing its installation with a view to equipping the entire line from coast to coast with the system. The system from Winnipeg to Brandon, and from Swift Current to Medicine Hat has been completed, and work will be continued on the other lines.

WINNIPEG.—The Pas Mission branch of the C.N.R., the first link in the road to Hudson's Bay, will be taken over by the operating department shortly. The final estimates on the construction will be ready to be turned over to the Government within the next couple of weeks, and will include figures for the cost of the work, quantities and grades of materials to be handled, together with maps and plans showing the final location and profiles of the two routes. At present there are two parties of engineers in the field. These parties recently made progress reports to headquarters, and it is expected that they will be ready to come out about the end of August.

WINNIPEG.—G. T. P. steel was within eight miles of Edmonton on Tuesday, and the last spike will likely be driven in a day or two. This will give four lines between Winnipeg and the capital of Alberta.

Saskatchewan.

INDIAN HEAD.—A gang of men has commenced preliminary work in connection with the construction of the new C.P.R. depot at this point.

PRINCE ALBERT.—Surveys have started on a branch of the G.T.P. from Watrous to Prince Albert.

REGINA.—The Canadian Northern has decided to construct a new main line to Edmonton, using their Winnipeg-Brandon-Regina route as the first section. From Regina the Prince Albert branch will be utilized to a point near Craik; from there a new line will be built crossing the South Saskatchewan at the Elbow and running northwesterly to Edmonton, and on to the Pacific.

REGINA.—James J. Hill has men surveying the Crow's Nest coal field district, north from Flathead County, Montana, and on July 6th there was filed with the Secretary of State a resolution by the directors of the Great Northern, announcing that company's intention to build northward into Saskatchewan.

Alberta.

EDMONTON.—The G.T.P. track laying gang is working night and day 18 miles this side of Tofield. Steel reached Edmonton last week. The G.T.P. will use C.N.R. lines from the packing plant in the northern part of the city for a couple of weeks until the line is completed to the centre of the city. They are now removing buildings and ballasting the right of way in the city.

British Columbia.

VANCOUVER.—The B.C. Electric Railway Company will shortly extend its line to Huntingdon.

VANCOUVER.—Boyd & Craig, of this city, have secured the contract for grading the Howe Sound, Pemberton Valley & Northern Railway proposed line from the head of tidewater on Squamish to Chee Kee Creek, 7½ miles. The work is to be finished by December 15th, and the ballasting will be completed by the middle of January. Surveys for the line between Anderson Lake and Lillooet, a distance of 50 miles, are now being undertaken.

VICTORIA.—Dixon & Moore, who have done much construction work on the Alberni Extension of the E. & N. Railway, have just been given a contract for another seven miles.

United States.

CHICAGO, ILL.—Steel street cars, the first to be used on surface lines in any city in America, will be placed in service within a few days here, by the Chicago Railway Co.

CEMENT—CONCRETE.

Ontario.

BLENHEIM.—A contract for cement sidewalks has been given to P. Leitch of this town at 10¼ cents a square foot.

BRANTFORD.—A concrete culvert will shortly be built across Colborne Street by this city.

BROCKVILLE.—If the by-law passes, six concrete bridges, to cost (estimated) $15,715 will be built by this municipality. Mr. Frank Barber, York County Engineer, prepared the plans.

HAMILTON.—For the construction of cement sidewalks, debenture by-laws of Barton Township, amounting to $42,-261.44, have been validated by the Ontario Railway and Municipal Board.

LONDON.—The Bell Telephone Company will place its wires underground, and 360 barrels of cement will be required.

MIDLAND.—Twenty thousand lineal feet of concrete walks will shortly be constructed here. Thomas I. Trueman, the town clerk, now asks for tenders.

OMEMEE.—Lake Bros., of Lindsay, have been awarded a contract for the building of three thousand four hundred feet of granolithic walk here.

OTTAWA.—The International Portland Cement Co. has declared a half-yearly dividend of five per cent. Up to June 30th the shipments of the company show the substantial increase of 22,285 barrels over the corresponding period of last year.

PETERBOROUGH.—Concrete will be used here in the construction of a drill hall, for which the Department of Public Works invites tenders until July 21st.

ST. THOMAS.—Cement will be used in the construction of a new reservoir at the waterworks here. James A. Bell is City Engineer.

ST. CATHARINES.—By-laws for the construction of cement sidewalks have been passed by this municipality.

TORONTO.—A reinforced concrete arch, which will require about fifteen hundred cubic yards of cement is to be erected by the city of Toronto over Beatrice Street. Mayor Oliver invites tenders for the work.

Manitoba.

BIRTLE.—Tenders are invited for cement piers for a bridge until July 23rd by T. W. Thompson, secretary of this municipality.

BRANDON.—Granolithic walks to cost $3,000 will be constructed by this city.

VIRDEN.—Two bridges, with concrete abutments, will be erected by the municipality of Pipestone as soon as tenders have been awarded. A. P. Power is secretary of the municipality.

WINNIPEG.—Contractor Moen, of Norwood, has a contract amounting to $5,300 for the construction of granolithic walks for the town of St. Boniface.

Saskatchewan.

REGINA.—Several highway bridges will be erected by the Saskatchewan Department of Public Works. F. J. Robinson, the Deputy Commissioner, invites tenders for the abutments, which are to be of reinforced concrete.

SASKATOON.—This city has given to W. T. and J. Arrand a contract for concrete sidewalks.

SASKATOON.—The Saskatoon Concrete Company will commence this week on a contract for the construction of walks.

British Columbia.

VANCOUVER.—Notice is given of the city's intention to make local improvements at a cost of many thousand of

dollars. Concrete sidewalks are responsible for the largest items.

VANCOUVER.—The Hassam Paving Company, of Vancouver, has received a contract for concrete sidewalks which will cost $31,500.

VICTORIA.—A fireproof office building, in which will be beams of reinforced concrete, will be erected here by the Royal Bank as soon as the contract is let.

LIGHT, HEAT, AND POWER

Ontario.

NIAGARA FALLS.—Another rise of two cents per thousand feet in the price of gas was made by the Provincial Natural Gas Company, making the price 30 cents.

PETERBOROUGH.—The special committee appointed to negotiate with the Central Power Company with a view to acquiring Burleigh Falls power has decided that $50,000 is a fair sum, and that figure has been offered. The company asks $125,000.

WALKERVILLE.—One thousand steel towers for the transmission line of the Ontario Hydro-Electric Commission have been completed at the plant of the Canadian Bridge Company. Shipments have begun and will continue at the rate of 300 a month until the full order of 3,000 has been filled.

British Columbia.

VICTORIA.—In connection with the proposed arrangement between the city and the B. C. Electric Company, construction work will be commenced at Jordan River on a plant to develop 10,000 horse-power, at an estimated cost of $1,500,000.

FINANCING PUBLIC WORKS.

The municipalities mentioned below have sold debentures:—

Almonte, Ont,, $15,000 street improvements,
Brampton, Ont., $15,404 sidewalks and $50,488 sewers.
Prince Albert, Sask., $83,300.
Truro, N.S., $113,025 sewerage and waterworks system.

Quebec.

HULL.—The $112,000 which Hull wants for various civic improvements will be divided into five by-laws, including $52,000 for waterworks.

VERDUN.—The council are considering the advisability of securing a loan of $150,000; for electric light plant, $110,000; water mains, $10,000; bridges, $5,000.

Ontario.

AYLMER.—The by-law for the raising of $4,000 to build a bridge was carried.

COLLINGWOOD.—Debentures for sewers $57,694 and others, amounting to $14,300 are offered by this town. The clerk is J. H. Duncan.

HAMILTON.—The Ontario Railway and Municipal Board has validated a series of debenture by-laws of Barton township, totalling $42,261.44 for the construction of cement sidewalks.

HAWKESBURY.—D. Doyle, town clerk, invites tenders for sidewalk debentures amounting to $9,400.

LONDON.—The Township of Westminster has for sale debentures amounting to $5,000.

STRATFORD.—A by-law of $15,000 for an extension to the hospital carried.

VERDUN.—The proprietors of Verdun have offered no objection to the proposed loan of $150,000 for street and other improvements.

WINDSOR.—Tenders are invited by Stephen Lusted, clerk of this municipality, for $20,000 waterworks debentures and $19,000 school debentures, until the 21st July.

Manitoba.

DELORAINE.—Tenders are desired until August 1st by D. L. Livingstone, secretary-treasurer, for $5,500 local improvement debentures.

KILLARNEY.—This municipality has for sale $10,000 debentures, presumably to cover the cost of local improvements. Geo. B. Monteith is secretary-treasurer.

Saskatchewan.

WHITEWOOD.—Tenders will be received up to July 31st for $4,000 debentures for erecting a skating and curling rink.

Alberta.

RED DEER.—This municipality offers for sale $4,500 debentures. A. T. Stephenson, secretary-treasurer.

British Columbia.

KAMLOOPS.—On August 1st ratepayers here will vote on a by-law to raise $20,000 for waterworks extensions.

VANCOUVER.—The corporation of Burnaby offers for sale $150,000 road improvement debentures. C. T. Saunders, C.M.C., Drawer 10, New Westminster.

VICTORIA.—A by-law will shortly be submitted to the ratepayers of Victoria to provide $1,350,000 in connection with the city's offer to purchase the plant of the Esquimalt Waterworks Company.

TELEPHONY.

Ontario.

LONDON.—The Bell Telephone will place its wires in this city underground at an estimated cost of $50,000.

Saskatchewan.

REGINA.—Announcement is made in the Saskatchewan Gazette of the incorporation of the following telephone companies:—Fairview Rural Telephone Company, Regina; Central Rural Telephone Company, Regina; Ellisboro' Rural Telephone Company, Ellisboro'; Rose Plain Rural Telephone Company, Regina.

REGINA.—Tenders have just closed with G. P. Porter, Deputy Commissioner of Telephones, for the construction of a line between Saskatoon and Prince Albert.

SEWERAGE AND WATERWORKS.

Ontario.

GUELPH.—Last Saturday afternoon, for the first time, water from Arkell Springs, four miles distant, was used by the citizens of Guelph.

LONDON.—Until July 15th tenders were received for the construction of a number of sewers.

ST. THOMAS.—Dr. Amyot, of Toronto, Provincial bacteriologist, is investigating the waterworks system here. The growth of algae has blocked the filters and prevents proper filtration.

ST. THOMAS.—The Water Commissioners have decided to construct a new reservoir at the waterworks the same size as the present one. Plans will be prepared and the work begun as quickly as possible.

TORONTO.—Engineers will be appointed by the Ontario Government to look into the claims of the Cameron Septic Tank Company, of Chicago, relative to the infringement of their patent.

WELLAND.—The council have passed a by-law for the Myrtle Avenue sewer, which will require 350 feet of 15-inch pipe and 510 feet of 12-inch pipe, to be laid from 7 to 15 feet deep. Estimated cost, $1,420.

Saskatchewan.

FRANCIS.—This municipality desires tenders until July 26th for the construction of waterworks. C. P. Gough is secretary-treasurer.

Alberta.

RAYMOND.—The Town Council of Raymond will immediately engage an engineer to look after the installation of a waterworks system.

British Columbia.

FERNIE.—Broley & Martin have been given a contract by this city to lay a 12-inch pipe line from Farley Creek at a cost of $30,000.

NEW WESTMINSTER.—At a recent meeting of the council an important report on the proposed new intake for the city water supply from Lake Coquitlam was submitted by City Engineer Blackman and Consulting Engineers Hermon & Burwell, of Vancouver, which outlined a scheme for installing a substantial and permanent intake in the lake, the work to be carried out by the Vancouver Power Company, while that company is erecting the large new dam proposed at the outlet of the lake. The report of the engineers was adopted and the power company will be asked to furnish detailed drawings of the proposed intake, which will provide for a capacity of over 1,000 inches of water, while the city at the present time is using less than 100 inches. The plans also provide for an emergency intake which will be at a much lower level than the lake intake, so that in case of the water being particularly low in the lake on account of special reasons the second intake may be used.

VANCOUVER.—The council of South Vancouver are discussing the question of a new water by-law.

MISCELLANEOUS.

Ontario.

BROCKVILLE.—Mr. Frank Barber, consulting bridge engineer, of Toronto, recently prepared plans and specifications for the reconstruction of six bridges, whose estimated cost is $15,715. The material used in construction will be concrete. A by-law covering the work will shortly be voted on by the ratepayers.

GUELPH.—The Board of Works have decided to pave a number of streets. Westrumite, vitrified brick and asphalt will be used.

HASTINGS.—The first work on this section of the Trent Valley Canal has begun and the river front for some distance up will be completely changed by a concrete and steel pier.

TORONTO.—City Engineer Rust has recommended for construction pavements which will cost $141,855.

Manitoba.

BRANDON.—City Engineer Speakman recently submitted to the council an estimate of the cost of street improvements totalling $30,000.

WINNIPEG.—Notice has been given of the city's intention to make certain local improvements, including pavements, walks and sewers.

WINNIPEG.—Plans are in course of preparation for new superstructure for the Louise bridge and for the Main Street bridge. The estimated cost of an overhead bridge exceeds two hundred thousand.

WINNIPEG.—Two big contracts have been started by Haney, Quinlan and Robertson, contractors for the National Transcontinental Railway. Work on the fundations of the new Lombard Street bridge is under way and a gang of 125 men has started on the work of driving the thirty-five-foot steel concrete piles. Preparations are being made also for laying the foundations of the locomotive shops on the Transcontinental site at Springfield.

Saskatchewan.

REGINA.—The number of permits issued for building in Regina during June amount to 34, and are valued at $121,650. Total to date, 153 permits issued, value $362,645. Permits issued during June, 1908, 30; value, $75,310. Total to 30th June, 1908, 142 permits, value, $156,183.

British Columbia.

VANCOUVER.—The corporation of Oak Bay received tenders until July 15th for the construction of numerous sidewalks and sewers.

Foreign.

BOSTON, MASS.—The Aberthaw Construction Company report the completion of the eight-storey Baxter Building at Portland, Maine, and the Goodell-Pratt Company's foundry at Greenfield, Mass. Work is well under way on the reinforced concrete factory building for the Carter Ink Company, at East Cambridge, Mass. The Aberthaw Company are also building some reinforced concrete floors for the Mittineague Paper Company, Mittineague, Mass.

CURRENT NEWS.

New Brunswick.

ST. JOHN.—The transfer of the Rhodes, Curry business at Amherst is announced. The owners now are C. Meredith & Company, Limited, and the Royal Securities Corporation, Montreal, and J. M. Robinson & Sons, and W. B. Tennant of this city, and J. R. Douglas, of Amherst.

Ontario.

OTTAWA.—Work is progressing satisfactorily on the Trent Canal, which will be finished in about four years. Data and information are being collected with reference to the projected deepening of the Welland Canal or the construction of a new canal adjacent to it.

OTTAWA.—The Government is not expecting to receive much before September 1st, the report of the Quebec Bridge Commission and the outside engineers called in consultation with it. It is stated that building operations will not be begun before spring, though the contract will be let late this fall.

TORONTO.—It is reported that two of the contractors who tendered and were awarded contracts for the construction of portions of the waggon roadway from Elk Lake to Gow Ganda, have abandoned their contracts and will lose the checks deposited with the Government for the completion of their work. No official statement has yet been made concerning the matter, but it is believed that the chief difficulties were lack of transportation facilities and inability to secure and hold labor. The route is believed to be an exceptionally good one for the country, but the contractors, necessarily encountered many obstacles by reason of its primitive character. It is understood the Government will call for new tenders at once.

TORONTO.—Manager J. O. Orr, of the Canadian National Exhibition has received a letter from the chairman of the universities engineering trip from London, to the effect that the party will be in Toronto during the Exhibition. They will be entertained at the Fair. The civil engineers, ten in number, representing the English universities, will visit several large manufacturing establishments.

Saskatchewan.

SASKATOON.—Messrs. Brown & Vallance, of Montreal, have been asked to prepare plans for the University of Saskatchewan buildings, which will accommodate 5,000 students.

British Columbia.

VANCOUVER.—Preliminary plans for a high level bridge over False Creek at Cambie Street, estimated by Engineer J. L. Harrington to cost about $750,000, have been approved by the Bridge Committee of the City Council. A by-law will shortly be submitted to the ratepayers.

PERSONAL.

MR. LOUIS COSTE, of the Department of Public Works, visited St. John, N.B., recently for the purpose, it is understood, of furthering the scheme for a drydock.

JAMES SMEATON has been engaged as inspector of concrete work at the Point du Bois (Winnipeg) power plant, by Smith, Kerry & Chace, the engineers in charge.

MR. F. P. GLOVER, assistant manager of the B. C. Electric Railway, Mr. T. Blundell-Brown, a London director, and Mr. Mitchell-Innes, who is connected with the board of management, recently made a thorough inspection of the road.

MR. ALBERT H. E. WILKES, formerly assistant storage battery engineer with The Chloride Electrical Storage Co., Limited, of Manchester and London, England, has joined the staff of the Canadian General Electric Co., Limited, Toronto. He will take charge of their storage battery department.

MR. HARRY G. NICHOLLS, for many years assistant general manager of the Canadian General Electric Co., has

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MARKET CONDITIONS.

Toronto, July 15th, 1909.

Business in metals is quiet. There is no very disturbing news from abroad, and prices both there and here are steady. Hardware merchants are talking already about the mid-summer holiday dullness, which appears to have come prematurely on. We can hear of no alteration in prices. Hot weather goods and sporting goods are the only ones that can be said to be moving actively.

Bricks, lumber, lime, and other building materials are moving freely in Toronto, where the erection of dwellings goes on as if there were soon to be no old ones left tenanted. Cement is, however, an exception to the general activity, for there is but a limited movement and prices have reached a very low point.

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. The spring rush is over and business steady.

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., 70c. per ton of 2,000 lbs., 1-inch, 2-inch, or larger, price all the same. Broken granite is selling at $3 per ton for good Oshawa.

Cement.—Cement is being offered at the low price of $1.55 per barrel in car lots, including cotton bags, which is an indication of the state of the wholesale market, a price heretofore unheard of. The over-supply continues. Smaller dealers report a fair movement in small lots at $1.40 to $1.50 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, $6.50, steady. This price applies to grate, egg, stove, and chestnut; only pea coal is cheaper, namely, $5.50. These are all cash, and the quantity purchased does not 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.—Unchanged and quiet at $13.85 to $14.05 per 100 lbs. Demand abroad not commensurate with real values at present prices.

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

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

Roofing Felt.—Unseasonably quiet, price maintained at $1.80 per 100 lbs.

Fire Bricks.—English and Scotch, $30 to $35; American, $27.50 to $35 per 1,000. The demand 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, $3.05; 12-14-gauge, $3.15; 16, 18, 20, $3.35; 22-24, $3.50; 26, $3.75; 28, $4.20; 29, $4.50; 10¾, $4.50 per 100 lbs. Fleur de Lis—28-gauge, $4.30; 26-gauge, $4.05; 22-24-gauge, $3.50. Queen's Head—28-gauge, $4.50; 26-gauge, $4.25, per 100 lbs. Sheets continue in active request.

Iron Chain.—¼-inch, $5.75; 5-16-inch, $5.15; ⅜-inch, $4.15; 7-16-inch, $3.95; ½-inch, $3.75; 9-16-inch. $3.70; ⅝-inch, $3.55; ¾-inch, $3.45; ⅞-inch, $3.40; 1-inch, $3.40, 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. Some talk of an advance in price.

Lead.—Prices steady outside. This market is rather weaker, 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. In active demand.

Lumber.—Considerable demand for both Southern and Canadian dimension pine continues; hemlock dull. Prices are rather stiff all along the line. Dressing pine quotes $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 quotes $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, wholesale, $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.—In moderate request at prices per catalogue. It is impracticable to quote figures, so great is the variety of this kind of goods, but prices are steady.

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.

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

Not much moving; price, 73 per cent. off list at factory for car-load lots; 65 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.—Prices steady and demand good. The price continues at 31c. to 31½c.

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.

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Montreal, July 14th, 1909.

In certain sections of the United States, pig-iron has advanced slightly in price. A message from Chicago, dated Monday, announces that prices have been advanced 50c. per ton, putting northern grade on a basis of $17, and No. 2 foundry and southern at $12.50. Both from Chicago and other portions of the country come predictions of further advances in the near future. The most hopeful sign of the times is the increased demand from railways, for rails and cars and other supplies of like nature. This is bound to shortly be felt right along the line, and, if continued, as is at present the promise, there is every likelihood of something in the nature of a boom taking place in the iron industry. The recent troubles and uncertainty, as respects the iron and steel duties in the United States, will soon have passed away and the promise of a good crop and remunerative employment to the rolling stock will have a good effect upon the trade of the entire country.

In Great Britain, the sound of woe still arises, but there is evidence that the people, having glutted themselves with pessimism, will shortly turn to and get busy at their industrial pursuits, once more. Meantime, there is but little export demand for iron, and the home demand is not sufficient to cause the business to look prosperous.

Canada continues in good shape. The outlook for the fall trade is excellent. Practically all the reports from the wheat fields of the West are such as are welcomed and, although the crop has still a few critical stages to go through, every day improves the chances in its favor. A large crop will go a very considerable distance towards restoring trade in iron and steel. The strike is still on in Glace Bay, but there are evidences of growing strength on the part of the company. Prices in the following list are holding fairly steady:—

Antimony.—The market is steady at 8¾ to 9c.

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 ⅜-base; tire steel, $1.90 for 1 x ⅜-base; toe calk steel, $2.35; machine steel, iron finish, $1.90; smooth finish, $2.70; imported, $2.20.

Boiler Tubes.—The market is steady, quotations being as follows:—1¼ and 2-inch tubes, 8½c.; 2¼-inch, 10c.; 3-inch, 11½c.; 3 1-2-inch, 14¼c.; 4-inch, 19c.

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.,