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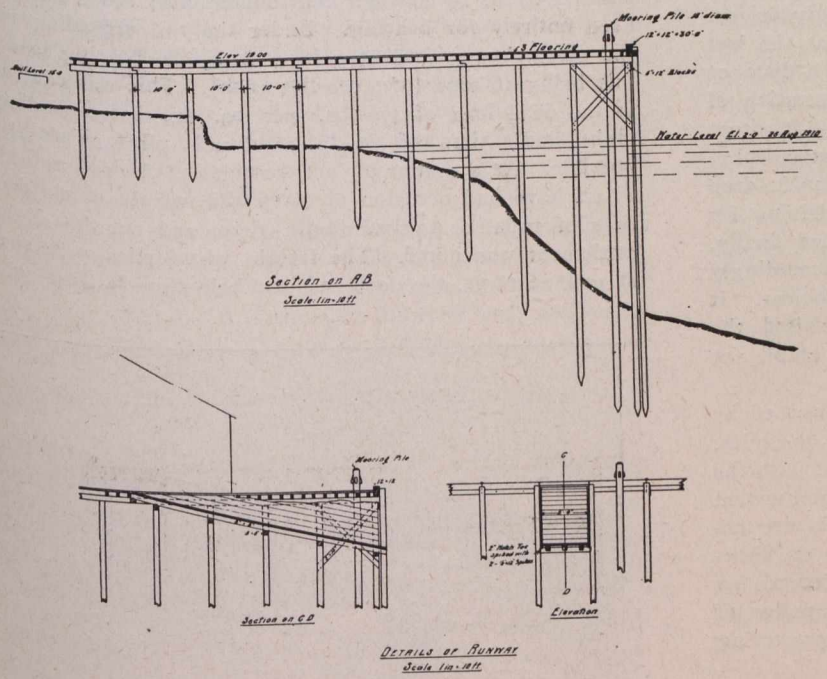
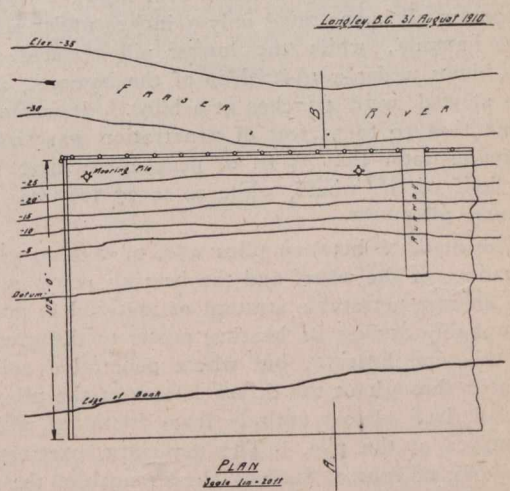
CANADIAN NORTHERN PACIFIC RAILWAY COMPANY'S WHARF AT PORT MANN, B.C.

BY W. G. SWAN, C.E.

The Fraser River is by far the greatest highway for fresh water shipping in British Columbia. It is navigable at low water for a distance of 60 miles from its mouth, while at high water it is navigable as far up as the town of Yale, more than 100 miles from the mouth. The river is tidal for 55 miles, at which point very slight rapids, known as the Sumas Riffle, overcome the effect of the tide. The current flows at the rate of seven miles per hour through the Riffle. The average rate of flow on the lower 50 miles of the river is about three miles per hour during the greater part of the year, and five miles per hour during the freshet time of June and July.



CANADIAN NORTHERN PACIFIC RLY.
Drawing of Wharf
AT PORT MANN. B.C.



The finest agricultural land of British Columbia is, undoubtedly, to be found in the Lower Fraser Valley. The low lying portions, subject to flood at high water, are gradually being reclaimed by the construction of privately owned and government dykes. The corrosion of the bank is, however, the greatest difficulty to be overcome in preserving this splendid soil. Hundreds of acres are washed away annually, and the writer knows of one farm which has, during the past ten years, lost forty acres of first-class farm land. It would require, at the lowest estimate, $40,000,000 to adequately protect the banks of the Lower Fraser Valley, and to properly confine the river to its present channel.

Situated 20 miles from the mouth of the river is the townsite of Port Mann, the future industrial terminus of the Canadian Northern Railway on the Pacific Coast. Seven hundred and fifty acres, or about a third part of the townsite, have already been cleared. The accompanying photograph will give some idea of the natural features of the townsite. The location has been pronounced by prominent landscape artists and engineers to be an ideal one, as it undoubtedly is. Running back from the river, it is level for about half a mile, then there is a fairly abrupt rise of about seventy-five feet, beyond which a uniform slope of two or three feet per hundred is maintained clear to the boundary of the townsite. The area is broken only by three small streams.

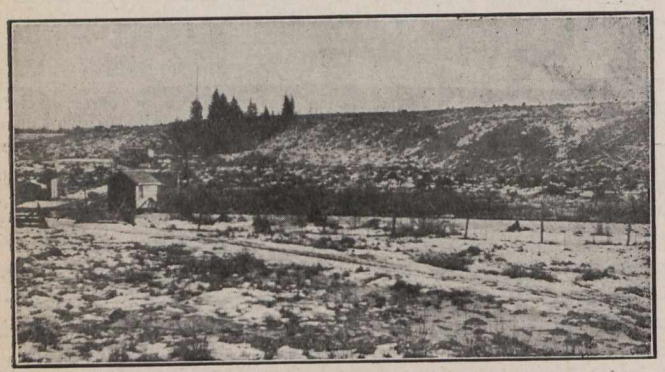
Situated on the waterfront, slightly east of the central portion of the townsite, lie the Port Mann yards, where several miles of track have already been laid. Port Mann wharf stands on the Fraser River opposite the middle point of the yards. The object of this article is a description of Port Mann wharf.

The pardon of the reader is requested for so lengthy an introduction, but in view of the comparatively recent development of British Columbia, it has seemed to the writer that this geographical description might not be amiss.

Before locating Port Mann wharf, two and a half miles of water frontage were carefully sounded, lines of sounding being extended from the shore at short intervals, for 150 ft. into the river. The location selected gives the best water

availab e, for although a depth of 30 ft. of water was obtained 100 ft. from shore for practically the whole two and a half miles of water frontage, 45 ft. is found 100 ft. out from the shore for the entire length of the wharf, and for severol hundred feet farther west. The accompanying cross section of the wharf gives an accurate idea of the river bed at the point in question.

The sounding rods were then used to determine the nature of the foundation for piling. It was with great difficulty that the rods were put down, and with still greater difficulty that they were withdrawn. The soil is a river silt for a depth of at least thirty feet. This silt is a very



View of Port Mann Townsite, Looking South.—Taken from the Wharf.

fine sand, sticky like quicksand, when wet, but much firmer. Before making out a bill of piling, it was thought advisable to drive test piles. Two test piles were accordingly driven. The first was given a 25-ft. penetration, going at the last blow under a six-foot drop of a 4,300-lb. hammer, a distance of 15 inches. The second pile was given a penetration of 35 ft., going at the last blow 6 inches under a 10-ft. drop. Both piles were allowed to stand over night. Next morning the shorter pile penetrated only 3 inches under a 10-ft. drop of the hammer, while the longer pile resisted driving for seven blows under a 10-ft. drop of the hammer, and finally, being started, went 4 inches at a blow. It was accordingly decided that 30 to 35 feet of penetration was sufficient. It was found later that 35 ft. of penetration best suited the inner half of the wharf, while 20 to 25 feet was ample for the outer piles.

The distance between piles was, of course, governed by the loading of the wharf and the bearing power of the piles. When an impenetratable stratum of material is met with the pile probably derives its bearing power to the greater extent from this end bearing, but where penetrable soils are encountered throughout the driven length of the pile, the bearing is derived almost entirely from frictional resistance on the surface of the pile. The maximum bearing power of any pile is, of course, fixed by the strength of the projecting portion of the pile as a column.

To determine the bearing power of piles from calculation the Engineering News formula is the most simple and quite as reliable as any.

$$P = \frac{2\,w\,h}{d - 1}$$

where P is the safe bearing load in tons
W is the weight of the hammer in tons.
h is the fall of the hammer in feet, last blow.
and d is the penetration in inches, last blow.

Another simple formula is given by Saunders.

$$P = \frac{w\,h}{8\,d}$$

the notation being the same as above with the exception that "d" is the penetration in feet. Both are empirical formulae, and must, of course, be used with judgment. I consider that either of these formulae is very reliable and convenient. The following is a comparison of values given for "P" for the same pile.

W = 1.5 tons.
h = 10 ft.
d = 2½ inches = 0.21 ft.

Engineering News formula—

$$P = \frac{2 \times 1.5 \times 10}{2.5 - 1} = \frac{2 \times 1.5 \times 10}{3.5} = 8.6 \text{ tons.}$$

Saunders' formula—

$$P = \frac{1.5 \times 10}{8 \times .21} = \frac{1.5 \times 10}{1.68} = 8.9 \text{ tons.}$$

This is, indeed, a very good comparison, having less than 4 per cent. variation.

Before giving the details of construction of Port Mann wharf, it may be well to note the dimensions, which are as follows: Floor length, 1,000 ft.; floor width, 102 ft. The floor of the wharf is 16 ft. above mean water level of the Fraser River at this point. A bill of material covering all the materials of construction is given at the close of this article. The east 500-ft. section is known as the rail unloading wharf, and the west 500-ft. section as the freight wharf, over which it is proposed to construct freight sheds 76 ft. by 490 ft.

Let us now look at the details of construction of the wharf. First, to consider the foundations; cedar piles were used entirely for bearing. Under the rail unloading wharf the piles were spaced at 9 ft. centres, the bearing load per pile being 16 tons (of 2,000 lbs. each). This was equivalent to the dead load of 400 lbs. per sq. ft., corresponding to eight single tiers of 80 lb. steel rails piled as closely as possible. As a matter of fact, portions of the rail unloading wharf have had occasion to carry the weight of six double tiers of rails, or twelve single tiers, and not the slightest settlement was noted. The freight wharf piles were spaced at 10 ft. centres, the designed load being 300 lbs. per sq. ft.,

Rear View of Port Mann Wharf and Yards Under Construction.

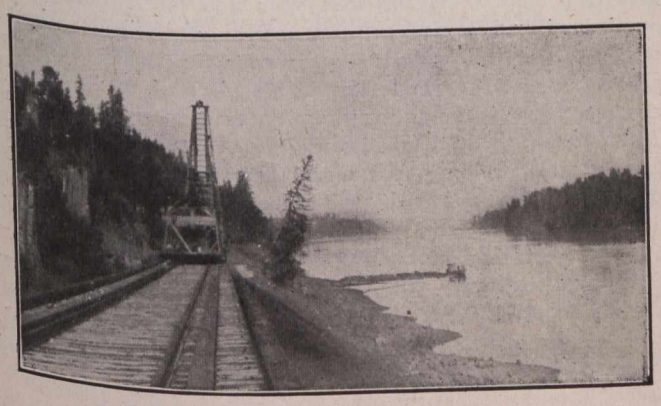
which gave a total bearing of approximately 15 tons per pile. In every case where the driven piles were allowed to stand over night, and the hammer put on the next morning, they resisted driving entirely for several blows, so that a bearing load of 15 or 20 tons per pile gave an entirely ample factor of safety. The piles used were a splendid quality of cedar, such as are only to be found in British Columbia, being straight, sound and maintaining well their size. The longest of these was 90 feet. Springing piles at the face and end

of the wharf were of fir, as were also protection clusters driven at the wharf ends and the mooring piles, since, in a matter of cross bending fir has nearly three times the strength of cedar.

Next, let us consider the timber in the wharf. Douglas fir was used entirely, being the cheapest, and also the best, timber in British Columbia. This timber retails at from $13 to $15 per M., according to the sizes. It was supplied by the Canadian Western Lumber Co., whose immense mills on the north bank of the Fraser River, almost directly opposite Port Mann, are probably the largest in the world. The caps are 14-in. by 14-in. timber, a section of which, although not the most economical for the given loading, was considered best, as it gave added stiffness to the bents and provided a better joint. The caps were run at right angles to the face of the wharf. The splice indicated on the accompanying elevation was a 12-in. step joint, which, with the head of the pile having a minimum diameter of 18 in., provided for at least a 3-in. bearing of the cap outside the splice. To obtain this 3-in. bearing, however, occasioned some difficulty with the contractor, so that a butt joint was substituted, the ends of the caps being fastened down with a 24-in. drift bolt, driven 4½ inches from the end of the cap. The position of the shorter cap, as shown on the elevation, was varied, so that the break in the cap joints of alternate bents did not fall opposite to one another.

The joists were of dimensions 4 in. by 10 in., being staggered and overlapping one foot. They were toe-spiked to the cap with 6 in. wire spikes. The flooring was 3 in. in thickness. It should have been specified as dressed to 3 in. thickness, but this was not done, and in consequence the first portion of the floor laid was somewhat rough. The wharf floor was faced with two pieces of 12 in. by 12 in. waling drift bolted to one another, as shown in the elevation, and drifted in turn to the caps. This waling was perfectly lined, and has given the face of the wharf a very finished appearance, and has also done good service in operating the wharf to date.

Outside of each of the outer bearing piles were driven springing piles of fir. These springing piles were driven rather farther from the bearing piles than is shown on the plan, being distant 3 ft. centres at the river bed, and butted against the 14-in. by 14-in. cap with twelve inches clear between the piles at the top. Their object is, of course, to take the shock of a vessel coming to her mooring alongside the wharf. These springing piles were cut off on a bevel, being flush with the upper 12-in. by 12-in. wale on the inside, and sloping outward at an inclination of 30 to the horizontal. This uniformity of slope of these outer piles considerably enhances the appearance of the wharf. An 8-in. by 12-in. spacing wale was made fast along the entire face of the wharf, between these springing piles.



Fraser River, from C.N.P. Railway Track.

Mooring piles were driven as shown on the plan. They were braced to the four nearest bearing piles by means of 8-in. by 8-in. struts.

On the freight wharf two runways were constructed according to the details shown on the plan. Sliding stringers support the removal planks of the flooring over the runway, so that when not in use the runways may be covered in. These sliding stringers operate on rollers suspended from the joists of the adjoining portion of the wharf. They may be handled by one man quite readily.

Three four-pile clusters were driven at each end of the wharf, the first at the outside corners as a protection to that portion of the structure, and the two inner clusters in a line,

Port Mann Wharf, from the River.

making an angle of 45 with the face of the wharf. These clusters support glance booms, which were placed at the wharf ends to fend off ice in winter, and floating trees, &c., at freshet time. Owing to the tide causing a change in the direction of the current during the winter season, the placing of a glance boom at the west end of the wharf was also necessitated. The cluster piles were bound together near the top with ¾-inch steel cable.

Below is given the bill of material for the entire wharf.

CANADIAN NORTHERN PACIFIC RAILWAY.
Bill of Material, Port Mann Wharf.
Piling.

Bearing Piles 12 in. up—					
226	piles,	45 ft.	long	10170	lin. ft.
484	"	55 "		26620	" "
122	"	60 "		7320	" "
77	"	65 "		5005	" "
90	"	70 "		6300	" "
60	"	75 "		4500	" "
102	"	80 "		8160	" "
59	"	85 "		5015	" "
17	"	90 "		1530	" "
1237				74620	lin. ft.
Springing Piles 12 in. up—					
8	piles,	35 ft.	long	280	lin. ft.
1	"	45 "		45	" "
1	"	55 "		55	" "
10	"	60 "		600	" "
79	"	65 "		5135	" "
26	"	70 "		1820	" "
125				7935	lin. ft.
				82555	lin. ft.
Mooring Piles 18 in.—					
4	piles,	60 ft.	long	240	lin. ft.
2	"	75 "		150	" "
5	"	85 "		425	" "
11				815	lin. ft.
				83370	lin. ft.

Deck and Flooring.

Caps 14 in. by 14 in.—
153 pieces, 32 ft. long.....79968 F.B.M.
168 " 28 " .....76830 "
56 " 22 " .....20123 "
51 " 12 " ..... 9996 "
186917 F.B.M.

Stringers 4 in. by 10 in.—
816 pieces, 32 ft. long.....87040 F.B.M.
918 " 28 " 85680
51 " 26 " 4420
51 " 12 " 2040
179180 F.B.M.

Flooring 3 in..... 302000 F.B.M.

Wales—Upper and lower—
74 pieces, 12" x 12" x 30' 0" 26640 F.B.M.

Bracing 3 in. x 10 in. x 16 ft. 0 in.—
214 pieces ..... 8560 F.B.M.

Struts (Between Springing Piles) 8 in. by 12 in.—
48 pieces, 9 ft. long..... 3456 F.B.M.
56 " 8 " ..... 3584 "
7040 F.B.M.

Blocks (Between Springing and First Row Piles—
107 pieces, 6 in. x 12 in..... 642 F.B.M.

Cleats for Mooring Piles—
50 ft. 3 in x 5 in..... 62 F.B.M.

Iron.

107 machine bolts ¾" x 45", threaded 3" (Wrought iron)
208 machine bolts, ¾" x 27", threaded 3" (Wrought iron)
428 machine bolts, ¾" x 24", threaded 3" (Wrought iron)
337 machine bolts, ¾" x 17½" (Wrought iron)
1367 drift bolts, ¾" x 24" (Wrought iron)
2200 O. G. washers, ¾" x 3½" (Cast iron.)
120 kegs (100 lbs. each) 6" wire spikes.

RUNWAYS (TWO).

12 Cross pieces, 8" x 8" x 9' 4"..... 600 F.B.M.
6 Stringers, 8" x 8" x 26' 0"..... 832 F.B.M.
6 Stringers, 8" x 8" x 24' 0"..... 768 F.B.M.
Flooring, 3" .....2448 F.B.M.
Side sheathing, 3" x 12" x 418' 0" (x 2).....2520 F.B.M.
30 Sliding stringers, 5" x 10" x 12' 0".....1500 F.B.M.
2 Guards, 3" x 10" x 10' 0"..... 60 F.B.M.

Iron.

120 W. I. Spikes, ½" x 12".
1 Keg (100 lbs. to keg) 6" wire spikes.

In closing it will be of interest to note the cost of this work. The piling was paid for under two headings, "Piles driven in the finished work" and "Pile cut-offs," the price for the latter being the cost of the pile delivered on the work. Summing the daily records of time and material, the approximate cost of the various portions of the wharf was as follows:—

Piles driven in finished work	$ 0.18 per lin. ft.
Pile cut-off	0.10 per lin. ft.
Timber	17.50 per M.
Iron (wrought and cast)	0.0475 per lb.

Considering the high price paid for labor covering this work, the cost is very reasonable indeed, as wages for labor generally in British Columbia are 40 per cent. higher than those paid in Ontario at the present time; and it might be well to add, so is the cost of living. Why? Because we have in this province, generally speaking, the laziest farmer in Canada, living on the unearned increment. But that is another story.

Some minor changes were necessitated from time to time in the bill of material, but as the final estimate varied less than 2 per cent from the foregoing bill of material, these changes are not worth recording.

PEEL COUNTY ROADS.*

C. R. Wheelock, County Engineer.

The system of roads assumed by the county of Peel, and approved by the Lieutenant Governor-in-Council, as provided by the Highway Improvement Act, is said to be one of the best laid out systems in the province. The county is an irregular shape, the townships adjoining the easterly and northerly boundaries being gores. It increases from a width of eight miles at the southerly boundary (the northerly shore of Lake Ontario) to a width of 19 miles at the north and the greatest length from south to north is 35 miles. The road system consists of one main north and south road, known as Hurontario Street, running through the county from Port Credit on the lake shore at the south to Orangeville at the extreme north, and the following main roads running east and west, all of which cross Hurontario Street; the Lake Shore Road, running along the lake shore through the county; Dundas Street from the Etobicoke River (the easterly boundary of the county) to Erindale; the Brampton Side Road, from the ninth line of Toronto Gore Township (near the easterly boundary of the county) to the westerly boundary of the county; the Bolton and Terra Cotta Road, from Bolton to the westerly boundary of the county. Besides the above main roads, there are a number of shorter pieces, all connected with the main roads except ten miles in the north part of the township of Albion, leading to the village of Palgrave. This makes a well connected system of roads leading to the markets of the county, and also forming connections with main roads in adjoining counties for through traffic.

The by-law designating a system of roads to be assumed by the county was passed by the council in 1906, and work was commenced on the roads in the following year. The principal work done the first year was the building of a number of bridges and culverts necessary to allow the heavy road-building machinery to pass over the roads, only one mile of road was completed. This piece of road was well constructed. In the first place, it was properly graded and drained and then metalled with crushed stone consolidated with a steam roller. Although there was considerable opposition from the people while the work was being done, after it was completed everyone seemed to be well satisfied, and the work on the county roads has gone on steadily since that time with very little opposition. At the end of last season 65 miles had been graded, metalled and completed, and besides about 10 miles were graded ready for metal. Permanent bridges and culverts, of cement concrete and steel, have been built where required on almost the whole system, leaving very few old ones to be replaced. We have built a total of 41 bridges of 10-feet span and over, and 58 reinforced concrete culverts up to 10-feet span, and besides have put in 357 concrete and steel pipe culverts. The total amount expended up to the 15th of November last and certified as coming under the provisions of the Highway Improvement Act is $240,618.77, and the total amount paid to the county by the government, as provided by the Act, is $81,995.94 (including the one-third due for last season's work).

* Paper read at Ontario Good Roads Association Convention, Feb. 27th, 1912.

The roads are graded from 22 ft. to 28 ft. wide and metalled from 8 feet to 15 feet wide. The depth of the metal consolidated is from 6 inches to 7 inches. The metal used was crushed stone, crushed and screened gravel and natural pit gravel. The most of the crushed stone used was brought in by rail, as local material was not available, and in such cases the freight rates increased the cost very materially. In some cases the freight on stone which cost 50 cents per ton f.o.b. at the quarries was $1.00 per ton. If this association would take this matter up and could succeed in having the freight rates on stone reduced, it would certainly help along the good work of road improvement in sections where local material cannot be procured.

The total cost per mile for the different classes of roads was as follows:—

Roads metalled with crushed stone, shipped in, from	$2,500 to	$4,000
Roads metalled with crushed stone, local, from	2,000 to	2,500
Roads metalled with gravel crushed and screened from	1,800 to	2,300
Roads metalled with screened gravel	1,500 to	1,700
Roads metalled with pit gravel, from	900 to	1,300

The road machinery owned by the county is as follows: 3 ten-ton steam rollers which cost $8,300; 3 road sprinklers, cost $734; 2 rock-crushing plants, consisting of a crusher, elevator, rotary screen and 20-ton mounted bins, cost $1,400 for each plant; 1 gravel-screening plant, consisting of a 4 horse-power gasoline engine, elevator, rotary screen and 12-ton mounted bins, cost $1,125; together with graders, wheel scrapers, drag scrapers, plows and tools; amounting in all for the entire plant to about $14,500.

The cost of operating a plant crushing stone amounted to $15 per day, including the amount paid per day for a 14 horse-power traction engine which supplied the power. The amount of stone crushed averaged about 40 cubic yards per day, making the cost of crushing about 37½ cents per cubic yard.

The crushing plants were also used in gravel pits where there was an excess of coarse gravel and stone. The material was run through the crusher, screened and separated in the bins. The cost of operating, including the cost of handling stone and gravel in the pit, was about $25 per day. An average of about 60 cubic yards of metal per day was turned out, making the cost about 42 cents per cubic yard.

The gravel-screening plant was used in a pit where there was an excessive amount of sand intermixed with the gravel. This was screened out and the fine and coarse gravel which was left was separated in the bins ready for the roads. The cost of operating was about $10 per day, and the amount of screened gravel obtained about 28 cubic yards per day, making the cost of screening about 36 cents per cubic yard.

The Highway Improvement Act has done much to demonstrate to the people of Ontario the advantage of good roads, and has given an impetus to road building on scientific principles in many parts of the province. It has, however, been generally admitted that for obvious reasons the aid given to counties under the Act is not sufficient for main roads which have to be kept up for through traffic. And it now seems that in the orderly course of progression the time is ripe for a further step in the shape of a provincial system of highways, to be built and maintained by the province, with the aid of the subsidy to be given by the Federal Government for the improvement of highways. These roads would be object lessons in the scientific construction and maintenace of highways, and would do much for the cause of good roads in an educational way. Besides, the best results should be achieved at a minimum cost, as the roads could be constructed and maintained on the most approved principles under experienced supervision.

In selecting the roads for a provincial system of highways the object in view should be the greatest benefit to the greatest number, and in carrying out this very wise maxim the farmers, who are the backbone of this agricultural province of ours, should get the first consideration. In fact, it seems to me that if we do what is in the best interests of the farmer in this matter, we will not require to go much further, as the interests of the farmer are so interwoven with the interests of the business man and the prosperity of the urban municipality depends so much on the prosperity of the rural municipality, that their interests cannot be separated.

Now, I do not think any general scheme can be laid down for this system of roads in old Ontario that is more practicable and will answer all purposes better than a connected interurban system having at least one main road through each county. This would provide a system of trunk roads for tourist traffic, as well as the roads for interurban traffic. This system of roads built and maintained by the province, with well constructed lateral roads or feeders built by the counties, would give us a system second to none on the continent. It would require, say 2,200 miles of road, to cover this system and would cost, say $15,000,000. This amount would necessarily be spread over a number of years, as it would be required only as the roads were built, and would be a small amount compared with the enormous sums expended on roads by other progressive counties.

BUILDING STONE FROM BLAST FURNACE SLAG.

The manufacture of building stone from smelter and blast furnace slag is an industry of considerable importance in Germany, and is carried on to a greater or lesser extent at nearly all these furnaces. The process is not patented and is very simple in details. Practically all blast-furnace and smelter slag is suitable for stone-making. Slag for this purpose must, however, be in a granulated state. After it has been allowed to harden it is unsuitable. All attempts to utilize slag that has been crushed or ground, after having once hardened, have failed to produce solid stone.

The slag is granulated by the addition of water as it flows hot from oven or furnace. The granulated slag after being thoroughly mixed with the required proportion of lime is allowed to stand one hour before being put through the press. After being pressed, the stones are stacked in the open air, where, after three or four weeks, according to the weather, they are ready for use. Under low temperature they harden slowly. If subjected to frost before thoroughly hardened, they are crumbled and destroyed. Operations may, however, be continued in the winter, the stones being hardened in steam-heated drying rooms. These stones grow constantly harder with time and after several years show a resistance of 100 kilos. per square centimetre.

THE BRITISH COLUMBIA ELECTRIC RAILWAY.

The report of this company up to the 30th of June, 1911, has been published in London, England. The net profits for the year are shown by this statement to be $1,363,461.00; this is an increase of 17% over the net earnings of the preceding year. The company now have 233.65 miles of track and 647 cars in operation. The number of passengers carried during the year was 46,541,448. The report shows that the company are planning for considerable development work in the near future.

TESTS ON THE STRENGTH OF NAILED JOINTS.*

J. H. Thornley, B.A.,Sc., '08.

In this day of steel and concrete, a discussion of anything pertaining to timber construction may seem somewhat out of place, but to the Canadian hydraulic engineer at least timber is still a building material of prime importance.

The brief nail test here reported was made in connection with the design of the Porcupine Power Company's Hydro-Electric plant at Sandy Falls on the Mettagami River, built by H. D. Symmes, of Niagara Falls, Ontario.

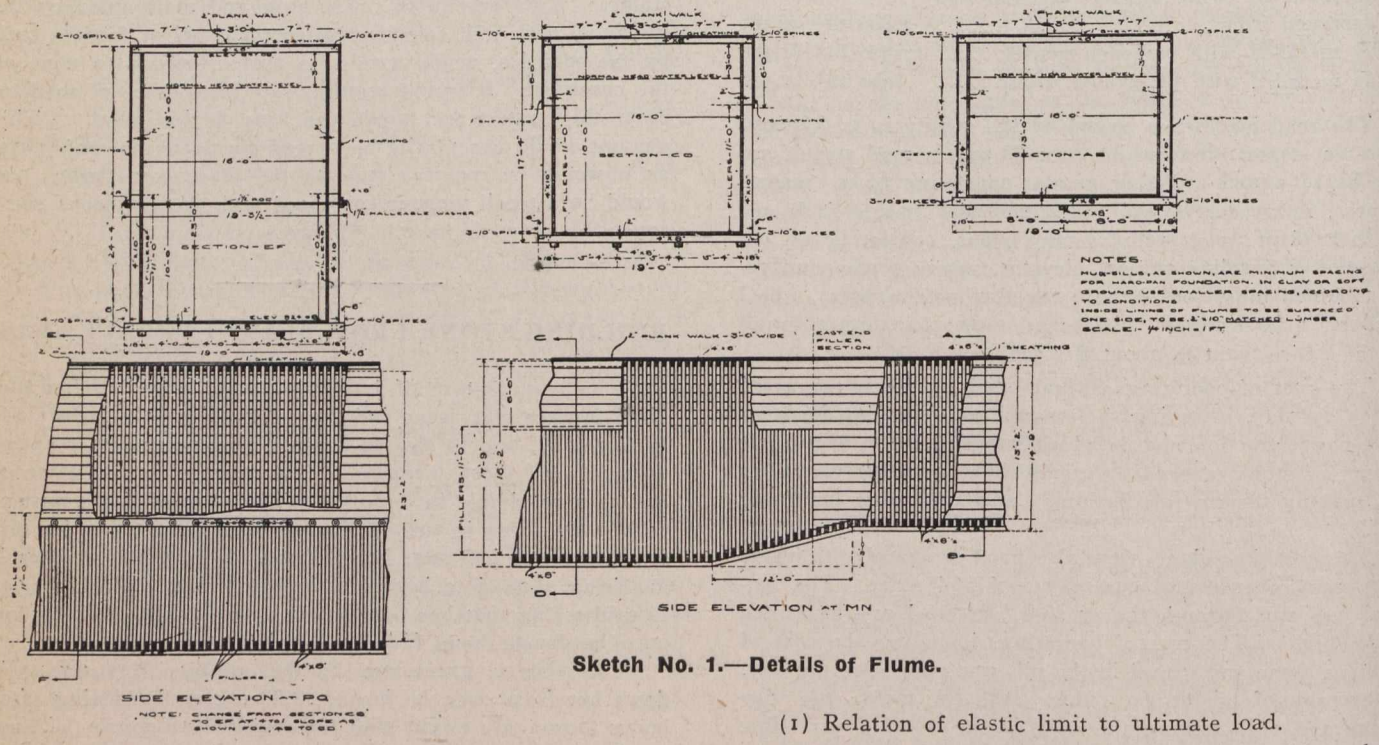
A word or two regarding this plant may be in place since the qualities sought in the joints tested can only be understood by a consideration of the special construction conditions.

Since the generating plant, a 4,500 h.p. hydro-electric station, was at the time of construction more than forty miles by bush road from the nearest station, and since it was essential that the plant should be constructed with the utmost speed, it was desired to cut to a minimum the use of steel, concrete or other bulky materials requiring to be brought in from the railroad. It was, moreover, desirable to use none but the simplest timber construction on account of the difficulty of turning out carefully sized lumber from a temporary sawmill, and also because it was the intention to avoid labor trouble by using lumberjacks rather than carpenters for the bulk of the work,—an obvious impossibility on work demanding careful framing.

A rock filled corn crib and stop log dam and timber power house would satisfy conditions both in the matter of construction and material, but the flume offered difficulties. The standard types demanded a great deal of steel in the form of bolts and tie rods and the use of these bolts and rods demanded a fair average degree of skill, in the gangs erecting the work. Finally, after getting out several designs, that shown in Fig. No. 2 was suggested. As will be noted, the construction consists of a corn crib, such as is used in a crib and stop log dam, only that in the case of the flume the crib is turned on its side and sheeted on the inside instead of the outside. This construction called for the use of a minimum of steel, and since practically no skill was needed beyond the ability to drive nails, the flume could be built by lumberjacks quite as well as by carpenters. The one question in doubt was that of the possibility of constructing a nailed joint sufficiently strong to withstand the hydrostatic pressure. It was to determine this point that the tests, the results of which follow, were run.

Purpose of Test.—To ascertain the transverse holding power in pine lumber of nine-inch spikes (4½ to the pound), and in particular to find the permissible load on a nailed joint as used at lower corner of a corn crib flume of construction as shown in Sketch No. 1, and to find what nailing will give maximum strength for such a joint, that is, to find a nailing with which failure will be equally likely to occur by cracking of the timbers or by drawing of the nails.

Three characteristics of any timber joint of great importance are:



Sketch No. 1.—Details of Flume.

(1) Relation of elastic limit to ultimate load.

(2) Extreme permanent deflection possible without lessening of ultimate strength. This point is of prime importance since, owing to the inequalities in size of commercial lumber, more particularly in unplaned material and to unavoidable inaccuracies in work fabricated by carpenters, joints are often called upon to undergo very considerable deflections before the theoretical distribution of loads occurs.

(3) Effect of moisture and frost. The present test would have no bearing upon this point.

Method of Test.—The specimen was made by nailing together three pieces of 4 in. x 8 in., 4 in. x 10 in., 3½ in. x 8 in., or various combinations of these sizes, as shown in Sketch No. 3.

Sketch No. 2 shows the nailing used for the most of the tests.

Sketch No. 1 shows the nailed joint as used in the flume.

In Sketch No. 3—

"A" is a ½-in. steel plate used to distribute the load applied to the end of the 4 in. x 8 in. piece marked "F."

"B" is a universal head of the ball and socket type.

"G" and "H" are piles of blocking.

* From Applied Science, Feb., 1912.

"C" is a wedge-shaped piece of steel attached to the upper or movable head of a one hundred ton testing machine.

In several of the experiments the universal head "B" was dispensed with and the load applied directly to the steel plate "A." This had no apparent effect on the results.

Analysis of Nailing in Accordance with the General Laws, as Deduced from Previous Experiments.—Referring here to Sketch No. 2, which represents a joint at the lower corner of a 13 ft. x 16 ft. section of the flume, the effect of nails Nos. 1, 2, and 3 on the elastic limit load of the joint is obtained thus:

Since "grip" has no effect on elastic limit of joint, the elastic limit load of nail No. 1 should be $Cd^2 = 5500 \times (3/8)^2 = 770$ pounds. The effect on the ultimate load of the joint will be $2\,Cd^2 \times \frac{\text{grip}}{\text{⅓ length of nail}} = 2 \times 5{,}500 \times 9/64 \times ⅓ = 518$ per nail if failure result from drawing of the nails.

The effect of nails Nos. 4, 5, and 6 on the elastic limit of joint must be considered for the points "A" and "B." Each nail will be effective at these points. Elastic limit load on No. 4 $= Cd^2 \times 2 = 5500 \times (3/8)^2 \times 2 = 1540$ pounds. The ultimate load of No. 4 at "A" will be 1540 pounds and at "B" 513 pounds.

Each of Nos. 7, 8, and 9, will effect the elastic limit load to the extent of 770 pounds and the ultimate load to 1540 pounds.

Nails Nos. 10, 11 and 12 will have no effect on either the elastic limit or the ultimate load of the joint, except as they may effect a possible failure by cracking of the timbers.

Theoretical Elastic Limit Load of Joint as Shown.

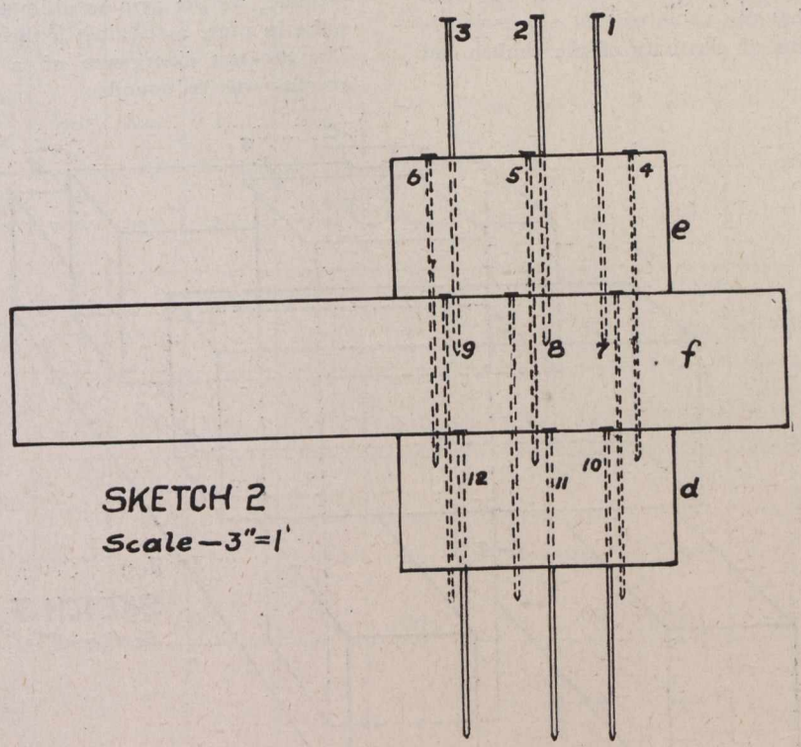
From No. 1, No. 2, No. 3	2310
From No. 4, No. 5, No. 6	4620
From No. 7, No. 8, No. 9	2310
From No. 10, No. 11, No. 12	00000
	9,240

Theoretical Ultimate Load of Joint as Shown.

From No. 1, No. 2, No. 3	1540
From No. 4, No. 5, No. 6	6160
From No. 7, No. 8, No. 9	4620
From No. 10, No. 11, No. 12	00000
	12,320

Summary of Results of Previous Experiments Bearing on Strength of Nailed Joints.

In as far as could be ascertained, no experiments have been made on the transverse strength of the nailed joints made with nails larger than 60d. (6 in.), but from experiments with 60d. and smaller sizes of nails the following general laws have been deduced:—



SKETCH 2
Scale—3"=1'

1. Permissible deflection of a nailed joint 1/16 in. for 60d. nails.

2. Elastic limit of joint will be one--half ultimate strength.

3. Strength of joint is directly proportional to the number of nails used and is independent of relative position of nails when failure does not occur by cracks in timber.

4. The holding power of a nail at the elastic limit is expressed by the equation Cd^2 where C is a constant dependent on the material (5500 for pine, fairly dry) and d. is the diameter of the nail in inches (⅜ in. for 9 in. spikes 4½ to the pound). This holding power is independent of the length of the grip (that is, that part of the nail between the point of application of a shearing load and the point of the nail). It will be noted that according to this equation the elastic limit is entirely dependent upon the material, under a crushing load of the timber.

5. The holding power of a nail at ultimate load varies directly with the length of the grip up to a grip of one-third the length of the nail when it becomes practically constant and is expressed by the equation,

$$\text{Ultimate load} = \frac{2Cd^2 \times \text{grip}}{\text{⅓ length of nail}}$$

In consideration of the fact that wooden joints show a deflection of an inch or more before reaching ultimate load, a brief study of Sketch No. 2 would suggest that the ultimate load on the joint shown must be taken up by the nails in two ways.

(a) By a resistance to withdrawal from the wood.

(b) By a bending of the nail resulting from the shearing force and the resistance to crushing of the wood. Since nails with a grip of an inch or better are bent into very similar curves, this second element does not vary with the grip but is constant. A more reasonable equation for ultimate load for a nail as governed by grip would appear to be

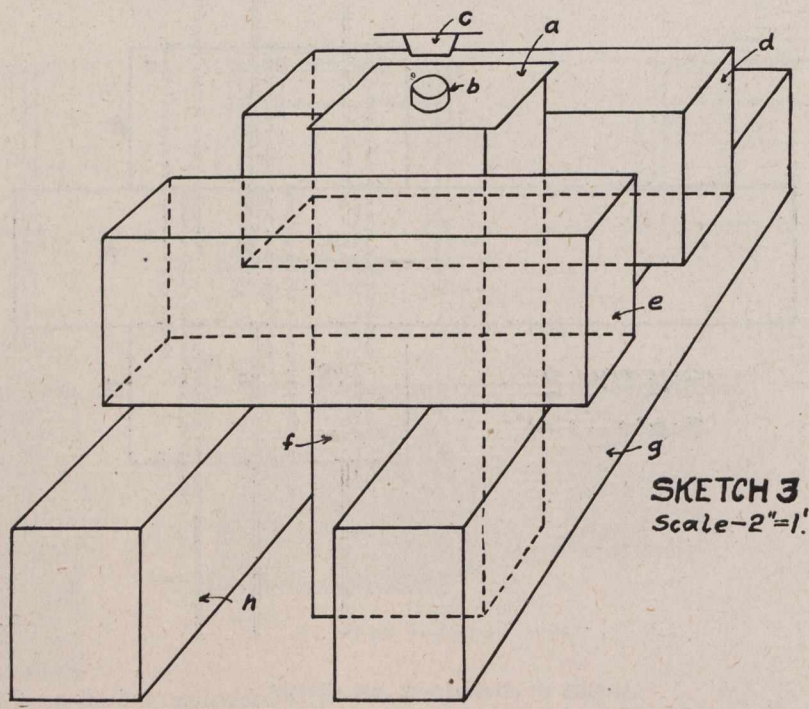
$$\frac{(2\ Cd^2 \times \text{length grip plus X times } Cd^2)}{\frac{1}{3} \text{ length nail}}$$

The value of X as assumed in these experiments was two-thirds. It will be noted that the value of this expression is dependent upon the modulus of elasticity of the timber and the steel in the nails.

failure of the timbers, this was in agreement with the observations.

In experiments Nos. 6 and 7 the nailing was as before, but the timbers were of an intermediate size 4 in. x 8 in. Failure occurred at about the same average load per nail as in experiments Nos. 1, 2 and 3, but while in No. 6 failure occurred by breaking of the timbers, in No. 7 the failure was due to bending and drawing of the nails. The proportioning of nails to timber was, therefore, about correct.

Omitting experiment No. 8 and averaging the values of a 9-in. spike as found in the remaining four experiments where failure took place by drawing of the spikes and using number of nails as found by equation, $\frac{\text{grip in inches}}{\frac{1}{3} \text{ total length}}$ —const., we get 1570 as ultimate load value in shear of 9 in. spike in pine, as against a theoretical value of 1540 pounds. The greatest divergence of a single experiment from the average was 60 pounds.



SKETCH 3
Scale-2"=1'

Notes on Results of Experiment.

To design a well proportioned joint it was necessary first to ascertain the laws governing the holding power of a 9-inch spike in cases where the failure took place by drawing of the spikes, that is, to find the value of one spike, and second to find the limiting number of spikes which would develop their full load (that is, would not cause failure by splitting) in a joint made up of 4 in. x 8 in. pieces. The 8 in. dimension was fixed by the load on the side of the flume under consideration.

Specimens Nos. 1, 2, and 3 were made with 4 in. x 10 in. used as cross pieces (failure by cracking would occur in the cross pieces if at all) and with two, three and four nails per piece respectively. In every case the failure of the joint took place in the nails, and since the results were quite uniform (1580, 1590, 1570 average per nail respectively) it may reasonably be concluded that these values would hold for 9-in. spikes in pine regardless of the dimensions of the timbers.

In experiments Nos. 4 and 5 the number of nails was as before, but the timbers were reduced from 4 in x 10 in. to 3½ in. x 8 in. Failure occurred at a much lower value per nail than with the 4 in. x 10 in., which would suggest a

Supposing the effect of the relation of grip to total length to be as suggested by Merriman, that is, the efficiency of the nail varies as $\frac{\text{grip in inches}}{\frac{1}{3} \text{ total length}}$ up to a grip equal to ⅓ of the length, the average value of a nail as found by the experiments would be 1920 pounds, and the greatest variation from this shown by any experiment would be one hundred and fifty pounds.

Therefore the equation introducing a constant for the effect of the bending of the nails seems, both from the standpoint of theory and observation, to be somewhat the nearer to the truth, though the experiments were far too few in number to in any sense settle this point. The constant assumed, ⅔ Cd^2 where C for the lumber used = 5500, and d = diameter of nail in inches, was in all probability somewhat excessive.

In the light of subsequent experience in actual field construction, the writer would judge that the value of C should be, for commercial grades of pine, somewhat higher than 5500, while the fraction two-thirds might with advantage be reduced to one-third or less.

Adverting to the summary of the results of previous experiments:

(1) The permissible deflection value of 1/16 inch, that is, deflection which can be caused without weakening the joint, is altogether too small. Joints tested to deflections of an inch and more seemed to be in no way weakened. This is a very strong point in favor of the nailed timber joint.

limit, but for practical purposes there can be no doubt that it is at least fifty per cent.

(3) The relation stated between the strength of a joint and the number of nails used, that is, that strength of joint is proportional to number of nails and entirely independent

TABULATED RESULTS OF EXPERIMENT

Number.	DESCRIPTION OF SPECIMEN. CONSTRUCTION. NOTE: See Sketch No. 3.	METHOD OF NAILING NOTE: See Sketch No. 2	REMARKS ON LUMBER USED	Load in pounds at which first signs of failure were noted.	Load in pounds at ultimate failure.	Number of 100% effective nails equivalent to nailing as used. Equation: Ult. L = (grip / 1-3 length)	Number of 100% effective nails equivalent to nailing as used. Equation: Ult. L = (grip / 1-3 length) constant.	Observed average ultimate load in pounds per 9 in. spike 100% effective grip. Equation: L = (grip / 1-3 length)	Observed average ultimate load in pounds per 9 in. spike 100% effective grip ___ constant. Equation: Ult. L = (grip / 1-3 length)	Calculated ultimate load per 9 in. spike 100% effective. Equation: Ult. L = 2 Cd²	Calculated load elastic limit in pounds Equation: El. L = Cd² x No. nails. No consideration taken length grip.	Observed load in pounds at elastic limit of joint.	REMARKS
1.—	D. & E: 4 in. x 10 in. F: 4 in. x 8 in.	8 NAILS 2 to each piece of specimen	Pine rough. Fairly dry. Material fair	8200	9500	5 1-3	6	1770	1580	1540	6160	See Foot Note	The values of the joint are the values as governed by the nails
2.—	D & E: 4 in. x 10 in. F: 4 in. x 8 in.	12 NAILS 3 to each piece of specimen, driven as indicated in Sketch No. 2	Pine rough Fairly dry Good condition	14000	15960	8	10	1990	1590	1540	9240	.. ..	The values obtained are the values of the joint as governed by the nails for in this case failure resulted from the drawing and bending of the nails.
3.—	D & E: 4 in. x 10 in. F: 4 in. x 8 in.	16 NAILS 4 to each piece of specimen, driven as indicated in Sketch No. 2	Pine rough Fairly dry Good condition	19000	21000	10 2-3	13 1-3	1950	1570	1540	12320	.. ..	The values observed are the values of the joint as governed by the nails for in this case failure took place by the drawing and bending of the nails.
4.—	D, E & F: 3¼ in. x 8 in.	12 NAILS 3 to each piece of specimen, driven as indicated in Sketch No. 2	Pine planed Fairly dry Fair condition	12000	16070	10	12 2-3	1600	1320	1540	9240	.. ..	The values obtained are the values of the joint as governed by the wood for in this case failure resulted from the cracking of the nails of the piece lettered "E" in Sketch No. 3.
5.—	D, E & F: 3¼ in. x 8 in.	8 NAILS 2 to each piece of specimen	Pine planed Fairly dry Weather cracked	9840	11550	6 2-3	8	1750	1440	1540	6160	.. ..	Failure as in No. 4
6.—	D, E & F: 4 in. x 8 in.	12 NAILS 3 to each piece of specimen, driven as indicated in Sketch No. 2	Pine rough Fairly dry Fair condition	14400	16350	8	10	2040	1630	1540	9240	.. ..	The values obtained are the values of the joint as governed by the wood for in this case failure resulted from the cracking of the nails of the piece lettered "E" in Sketch No. 3
7.—	D, E & F: 4 in. x 8 in.	12 NAILS 3 to each piece of specimen as in Sketch No. 2	Pine rough Fairly dry Fair condition		16000	8	10	2000	1600	1540	9240	.. ..	The values of the joint are the values as governed by the nails since in this case failure resulted from the drawing of the nails, therefore 1600 represents the holding power of the nail.
8.—	D, E & F: 4 in. x 8 in.	9 NAILS 3 Nails with 1 in. hold omitted	Pine rough Fairly dry Extra Good material	13000	16500	7	8	2360	2060	1540	6930	.. ..	The results from this specimen, as will be noted, show very poor agreement with the other theoretical values or with the observed values of the other seven specimens. This is probably, in part at least, a result of the extra good lumber used. It is included as showing a probable limiting maximum value for the nails.

NOTE:—Observations of Elastic Limit Load were entirely unsatisfactory since the specimens showed large permanent deflections under the first 25% or less of the load but even when the specimen had been stressed almost to the point of failure with corresponding deflections of an inch or more the load could be released and again brought about above the previous high point without causing any material increase in deflection beyond that which had resulted from the first loading.

(2) As has been pointed out, no satisfactory results were obtained regarding the relation of elastic limit to ultimate load. The percentage relation of elastic limit to ultimate load would depend on the definition assumed of elastic

of arragemet of nails where failure does not occur by cracking of the timbers, was entirely borne out by the experimental results. Various arrangements of the nails were tried, the nails of almost every specimen being differently spaced, but as will be noted, no material difference in holding power resulted.

COST OF WATER PURIFICATION.

Filter operating costs at the water purification plant at Wilmington, Del., during 1911, averaged $1.08 per million gallons. Preliminary treatment of the water from the Brandywine River by rapid filtration through beds of sponge clippings cost 47.4 cents per million gallons, making a total cost of $1.554 per million. The slow sand plant comprises six units which are washed by a Blaisdell sand-washing machine. The distribution of cost for the slow sand filtration, according to figures given out by Mr. John A. Kienle, chief engineer of the water department, is as follows (in cents per million gallons of water filtered): Salaries, 53.6; additional labor, 10.3; supplies, 6.6; light and power, 16.6; repairs and renewals, 3.5; other operations, 5.0; recaulking groined arch seams, 12.3. During the year 3,680,000,000 gallons passed through the plant. The above charges do not include interest on first cost or laboratory charges. The purification process, on the same basis, cost 49.1 cents per million, distributed among the following items (cents per million): Salaries, 25.3; additional labor, 2.1; supplies, 2.1; light and power, 0.7; repairs, 10.0; other operations, 8.3. Samples of raw and treated water are analyzed daily, the laboratory charges amounting to 47.4 cents per million.

BOILER EXPLOSIONS.

Statistics of the Board of Trade Report of Great Britain for the year 1910 and up to the 22nd of June, 1911, show a total of one hundred and five explosions and sundry mishaps to boilers. A considerable percentage of these explosions occurred in marine boilers at docks or in British waters, the balance are distributed amongst chemical works, engineering works, iron works, copper works, collieries, electrical works and cold storage plants. The chart shown in Fig. 1 illustrates the variety of explosions since the year 1859, when statistics were first compiled. The chart shows the year 1910 to be among the heaviest seasons.

The following tables give the description of the boilers which have exploded or collapsed during the twenty-eight and a half years from June, 1882, when the first Boiler Explosion Act came into operation, to December, 1910, and the causes of these explosions and collapses; and the numbers of explosions, collapses, and mishaps reported on by the Board of Trade, and the total and average number of deaths resulting therefrom during the twenty-seven and a half years ending 31st December, 1909, with the corresponding figures for the year 1910:—

Type of Boiler.	Land Boilers		Boilers Afloat.	
	Number of Explosions.	Number of Collapses.	Number of Explosions.	Number of Collapses.
Plain cylindrical	68	0	0	0
Locomotive and portable.	43	37	0	2
Cornish	40	66	0	0
Vertical, with internal fire-box	25	154	8	35
Lancashire	20	32	0	0
Galloway	0	10	0	0
Chimney	1	6	0	0
Marine	1	0	5	77
Return flue	0	0	7	10
Water-tube	15	0	1	0
Multitubular, externally fired	1	0	0	0
Miscellaneous	25	4	0	3
Hot-water	89	4	0	0
	328	313	21	127

From this report we select a description of a boiler explosion and gas engine explosion rated by the report as a sundry mishap.

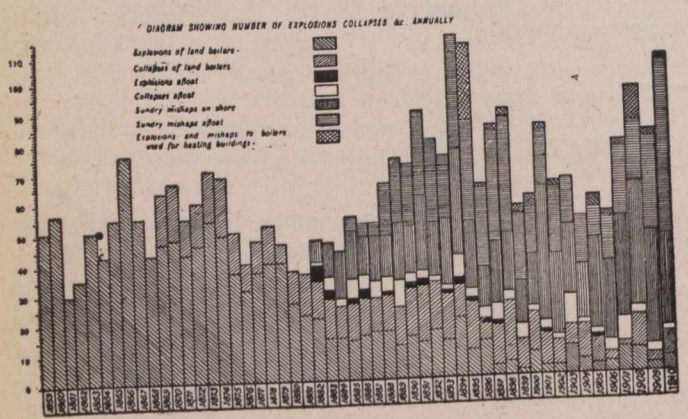


Fig. 1.

On the 18th September, 1910, four Lancashire boilers exploded out of a group of eleven, and displaced the remaining seven from their seats.

The boilers were numbered 1 to 11. Nos. 1 to 7, made in 1880, were of iron, 30 ft. long by about 7 ft. 10 in. diameter. Nos. 8 and 9, made in 1882, were of the same dimensions, but of steel, and Nos. 10 and 11, made in 1894, were also of steel, 7 ft. 6 in. diameter and 32 ft. long.

No. 7 boiler exploded first. Its shell was made up of nine rings, each containing four plates, 7-16 in. thick, lap jointed, double riveted longitudinally, and single riveted circumferentially. The end plates were ½-inch thick, and were stayed by four gussets at each end above the flues, two at the front end and one at the back end below the flues. The internal tubes, 3 ft. diameter, were made up of one furnace ring, 8 ft. long, and six shorter rings, the second, third, fourth, and sixth being stiffened by cross tubes. The plates were 7-16 in. thick, lap jointed and single riveted longitudinally and circumferentially. The end plates were attached to the shell and flues by rings of angle iron, 3 in. by 3 in. by ½ in. There was a manhole, 20 in. by 16 in., with its major axis placed longitudinally on the top of th fifth ring of the shell, strengthened by a cast iron frame. Nos. 1 to 6 boilers were practically the same, also Nos. 8 and 9, except that their shells contained ten rings and their flues seven rings without cross tubes, but stiffened at the circular seams by bowling hoops. Also the manholes were circular instead of oval.

Cause of Explosion or Collapse.	Land Boilers		Boilers Afloat.	
	Number of Explosions.	Number of Collapses.	Number of Explosions.	Number of Collapses.
Corrosion	106	150	11	18
Grooving	29	4	0	0
Excessive pressure	33	27	3	9
Outlets frozen	70	4	0	0
Failure of stays	15	13	0	4
Deficiency of water	19	68	0	53
Structural weakness	15	29	1	4
Fractures	14	2	0	0
General deterioration	5	0	4	0
Seam rips	7	0	0	0
Deposit	13	12	0	35
Not ascertained	2	4	2	4
	328	313	21	127

Each of these boilers had one safety valve, 3½ in. diameter, fitted on a branch on the junction valve casing, loaded by a lever and weight to 45 lbs. per square inch. Nos. 10 and 11 were stronger boilers, and each had two independent safety valves fitted directly to the boiler shell.

The boilers were fed with good water and fired by waste gases from blast-furnaces. They were in good condition and well looked after.

No. 7 boiler was laid off for cleaning on the evening of the 16th September, and set to work again by turning on the gas at 1.45 p.m. on the 18th September. At 3.30 p.m, the pressure gauge indicated 45 lbs. per square inch, and the stop valve was opened to put the boiler in communication with the other boilers. At 5.15 p.m. the explosion occurred—fortunately, during the temporary absence of the attendant.

The boiler was torn into more than forty pieces, some of which were blown to a great height. Two of the pieces struck Nos. 6 and 8 boilers, and caused them to explode,

and in like manner the explosion of No. 6 caused the explosion of No. 5. The rest of the boilers, with the exception of No. 1. were crushed out of shape, and all were displaced from their seatings. The order of the proceedings is described with admirable lucidity in the report of the Board of Trade surveyors, who made the preliminary enquiry after the explosion, but the description is unfortunately too long to be inserted here.

It is shown that the cause was excessive pressure, probably about 150 lbs. per square inch, and that rupture commenced at the manhole and extended from it in three main lines, one longitudinally backward, the other two diagonally forwards, at about 30 deg. on each side of a line drawn along the top of the boiler, parallel to its longitudinal axis.

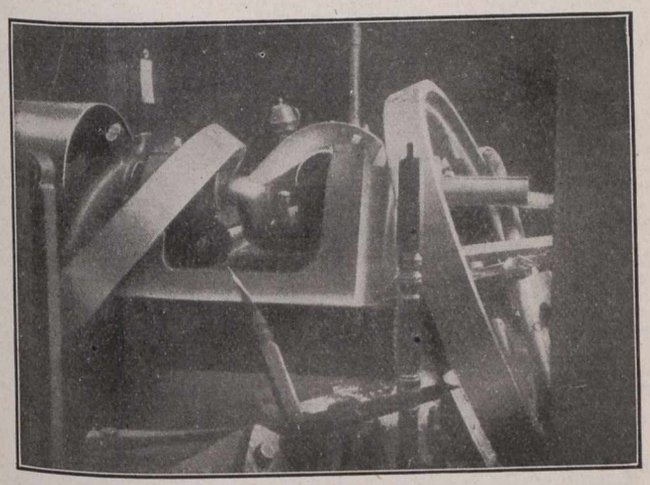


Fig. 2.

The cause of the excessive pressure was the insertion of a plug in the opening for the junction valve, which was leaking, to prevent the hot water dropping on to the men who were cleaning the boiler. By plugging the outlet for the steam the safety valve, which was attached to the side of the stop-valve casing, was cut off from the boiler and rendered inoperative.

The boiler was insured and inspected by the National Boiler and General Insurance Company, who had pointed out the dangerous position of the safety valve and the possible occurrence of what actually happened.

After the enquiry the No. 1 boiler, which, though displuaced from its seating, was uninjured, by the explosion, was tested to destruction to ascertain the pressure at which the manhole would give way. The pressure was found to be 145 lbs. per square inch.

The gas engine explosion occurred in a horizontal engine of unknown age, with cylinder 8½ in. diameter by 15 in. stroke, running at 160 revolutions per minute, with gas from a town main. The air for the cylinder charges was drawn from the interior of the bedplate, to which it was admitted through slots in one side. If by any means, such as leakage past a slightly open gas cock, gas should be forced into the cylinder during a stoppage of the engine, and if the engine should be stopped with the exhaust valve open, the space inside the bed would be filled with a combustible mixture of gas and air which might easily be fired when restarting. Something of the kind evidently occurred in the present instance. The engine had been stopped about an hour to repair the driving belt, and on restarting an explosion occurred inside the bedplate. The bedplate and a large casting on which it stood were shattered beyond repair, all the arms of both flywheels were broken, and the rims detached from them, besides minor damage. A photograph of the engine after breakdown is reproduced by Fig. 2.

A BEAM AND GIRDER SYSTEM vs. MUSHROOM.

Lockwood, Greene & Co., Boston and Chicago, architects and engineers for industrial plants, recently had occasion to make comparative estimates on the cost of reinforced concrete for a 10-story warehouse 580 feet long by 109 feet wide, using beam and girder construction and a mushroom system. Unit prices were obtained from the records of work done in the vicinity in question and were as near correct as was possible to obtain for a preliminary estimate. It should be noted that the figures below do not include plant and tools or any items that would be common to both systems, and therefore should not be taken in any way as an estimate of the cost of the building. The quantities in the following table are based on one strip of floor 19 feet 3 inches wide and the height of the structure. It will be noted that the total cost per strip for the beam and girder system is $12,616, while for the mushroom design $12,432, leaving a net saving in favor of the mushroom system of $184 per strip, or $5,520 for the entire building.

The cubic yard price on 1:2:4 concrete is obtained as follows:—

Cement, 1⅔ at $1.10 net	$1.80
Sand, ½ yard	.40
Stone, 1 yard	1.00
Labor	1.00
Sundries	.10
Total	$4.30 yd.

Columns cost 70 cents per yard more for labor.

1½:3 concrete cost $1 more per yard for cement, making cost of $5 per yard for columns.

Mushroom Estimate.

Concrete 1:2:4 interior cols. = 97 cu. yds., at $5.00	$ 485
Concrete 1:1½:3 wall cols. = 34 cu. yds., at $6.00	204
Concrete in floors, including slab, capitals and wall beams = 675 cu. yds. at 4.30	2,902
Forms for columns. 6,000 sq. ft. at 12c	720
Forms for column heads, 40 sq. ft. at $3.00	120
Forms for interior wall, 20 sq. ft. at $2.00	40
Forms for floor including slab and wall beams, 21,850 sq. ft. at 8c	1,748
Steel reinforcement (cost includes facing, 51 tons at 34c.)	1,734
Steel lattice columns, 58 tons at 52c	3,016
Erecting lattice columns, 32 tons at 5c	160
Brick work, 11 M at 18c	198
Windows, 2,990 sq. ft. at 30½c	897
Royalty	208
	$12,432

Beam and Girder Estimate.

Concrete 1:2:4 interior cols., 75 cu. yds. at $5.00	$ 375
Concrete 1:1½:3 wall cols., 32.5 cu. yds. at $6.00	195
Concrete in floor inc. beams, girders and slabs, 550 cu. yds. at $4.30	2,365
Forms for columns, 6,300 sq. ft. at 12c	756
Forms for floors, inc. beams, girders and slabs, 30,600 sq. ft., 9c.	2,754
Haunches, 80 sq. ft., $1.00	80
Steel reinforcing (cost inc. placing), 63 tons at $37	2,331
Bethlehem steel cols., 54 tons at $45.00	2,430
Erecting, 32 tons at $5.00	160
Brickwork, 20 M, at $18.00	360
Windows, 2,700 sq. ft. at 30c	810
	$12,616

A NEW HYDRAULIC VALVE.

A new type of hydraulic valve has recently been installed in the Ontario Power Company power house at Niagara Falls. The valve was designed and the principle patented by Mr. R. D. Johnson, the hydraulic engineer of the power company. Fig. 1 shows the section through the valve. The common type of sluice valve now in use works very well for low pressure and small dimensions. Such a valve is operated by hand wheel or spindle fitted with appropriate gearing. The larger types of gate valves under high pressures, are usually fitted with a by-pass and may be operated either hydraulically or by electric motors. The gate valve, however, for high pressure and large diameters is very difficult to operate.

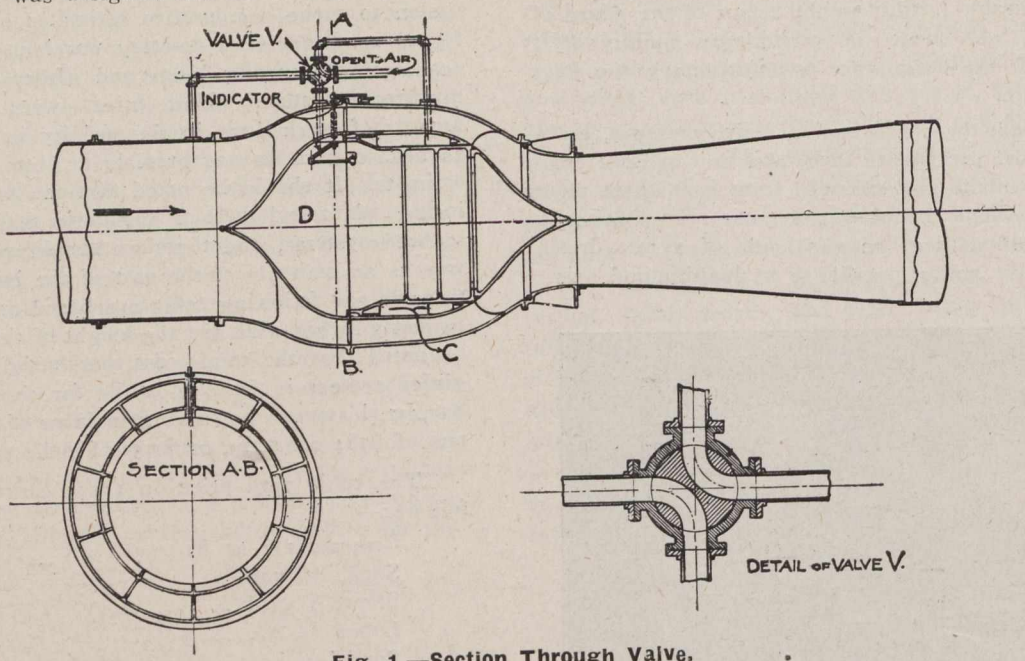


Fig. 1.—Section Through Valve.

Mr. Johnson designed this new type of piston valve to get over these difficulties. The operation of this valve is due to the difference of pressures causd by the changes in velocity of the water in the valve case. The valve, it will be noted, is composed of an enlarged and contracted section of pipe following each other closely. Inside the enlarged section is placed a stationary plunger, or bobbin, with the lower section moveable and telescoping into the upper section. When closed, the lower portion of the bobbin seats itself on a brass ring (shown in Fig 1) at the beginning of the restricted section of pipe. The opening of the valve is due to the static pressure on the submerged surface of the plunger above the valve seat. The closing work of the valve equals the static pressure inside the moveable plunger. As shown in Fig. 1, an indicator may be attached to control valve to exclude possibility of the main valve creeping from any desired opening. Valve V is a four-way valve by means of which different connections, as shown in Fig. 1, may be made. The annular chamber C is a leakage chamber. If the water is free to flow when the main valve is open, chamber C may be omitted by merging it into chamber D. Its presence is desirable as an efficient factor of safety. The valve V, in the position shown in Fig. 1, reduces the pressure in the annular chamber C to atmospheric, and the main valve closes due to full pressure transmitted into chamber D. Reversing the control valve reverses the pressure, and the main valve opens. This valve has many advantages over the ordinary gate valve, for it is simple in operation, possesses great strength, all of the parts being circular, and it is absolutely safe in operation. The valve can be designed for any dimension and any head.

Fig. 2 illustrates a 48-inch valve of this type installed at the Ontario Power Company, Niagara Falls. Two of these are placed on the exciter penstocks there. These valves are to be operated by electrical control from the power house. They have already been placed in operation and they work most satisfactorily. The two valves at the Ontario Power Company were manufactured by the Böving Company, of London, England, who hold the British patents and have offices in Toronto.

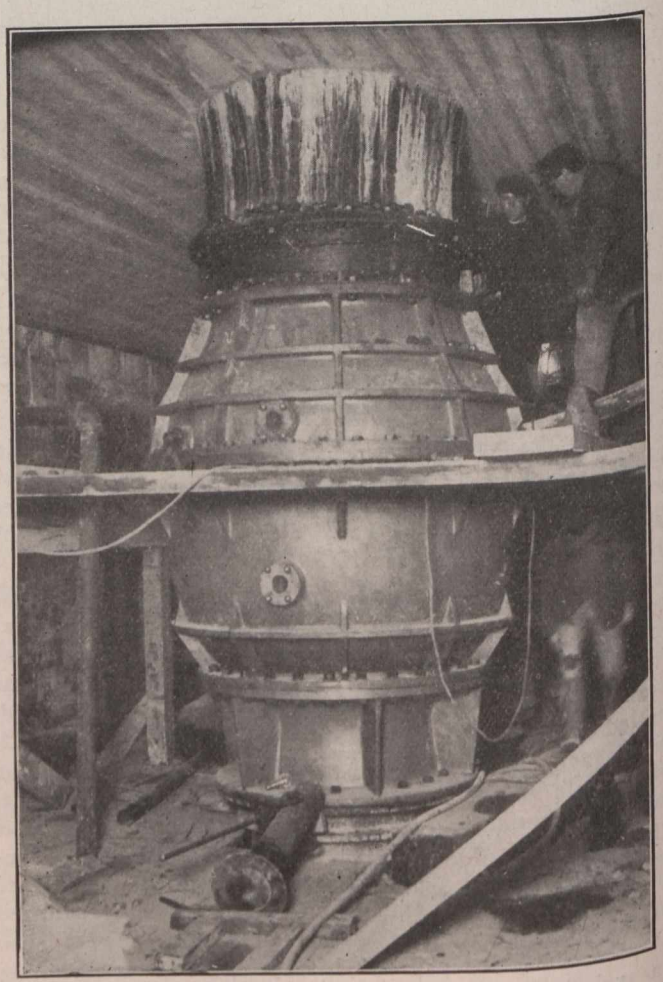


Fig. 2.—Erection of 48-inch Exciter Penstock Valve.

The Canadian Engineer

ESTABLISHED 1893.

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CONTENTS OF THIS ISSUE.

PREVENTION OF INDUSTRIAL ACCIDENTS.

At different times we have referred to the number of accidents occurring, and which appear to be on the increase. The majority of these accidents can be traced to carelessness, thoughtlessness, or selfishness on the part of some one, and it is, therefore, refreshing to hear that certain companies are taking measures to reduce the number of industrial accidents. Industrial accidents are those which result from the use of machinery. The Pennsylvania Railroad began a vigorous campaign of education among their employees a little over a year ago. In January, 1911, the percentage of serious injuries per month per thousand employees was 8.7. This has been reduced in less than a year to 3.5. In November, 1910, when this campaign of education was begun, experts were employed by the company to inspect the shops with a view to the installation of safety devices for the prevention of accidents. The results obtained from following the suggestions of the experts were so marked that the continuation of these inspections has become a fixed policy. The installation of the necessary protections for the machines was not very costly, in some cases the improvements being made with practically no expense to the company. Standing safety committees were formed from among the employees, for it was appreciated that the prevention of accidents depended largely on the care exercised by the individual workman. By this means many of the common and preventable accidents were avoided. The recommendations of these committees cover a wide variety of subjects, and have been the means of preventing many of the accidents so prevalent heretofore.

So successful has been the work during the past year that the Pennsylvania company are redoubling their efforts to reduce industrial accidents during the coming year. This same policy, if taken up by the small manufacturing companies and shops throughout the country, would do much towards wiping out this stain on our industrial life. In most cases there is little excuse for the numberless accidents, many of these occurring as a result of carelessness on the part of employer or employee. By the installation of safety devices and protection, the class of unavoidable accidents is reduced, and by the education of the employee the preventable accidents are avoided.

THE PUBLIC AND THE STREET RAILWAYS.

The hostility of the public towards public utility corporations has been on the increase during the past few years. In our larger cities a constant warfare is being waged between the companies operating under franchises voted by the citizens and the citizens themselves. It is hardly possible to pick up a daily newspaper without seeing column after column devoted to this conflict of corporation interests and public demands.

This is a good reason for much of the public objection to the carrying on of companies operating under municipal charters, for the companies have not as yet recognized the necessity of meeting the municipalities and co-operating for mutual benefit. Publicity of the methods of operation would no doubt do a great deal towards dissipating the constantly developing irritating points of contact. In one of the addresses at the convention of the American Electric Railway Association, held in New York during January last, the benefits of a consistent policy of publicity were outlined. Some of

the ideas expressed, if taken up and carried on vigorously by our Canadian street railway companies, would engender a different public sentiment. The ignorance of the public in the fundamental requirements necessary for successful electric railway operation is productive in many cases of unfavorable feeling on the part of the citizens. In regard to the actual details of service the people are in ignorance. Very few men know the cost of equipment, the cost of operation and the cost of maintenance, and as a result are unable to appreciate the reasonable limitations of service.

It must be appreciated that electric railway operation in the cities provides almost unlimited opportunity for disatisfaction, and this is all the more intensified by the lack of knowledge of conditions. To quote from the address referred to above, it is no longer a matter of opinion, but a demonstrated fact that it is quite possible so to educate the public that it will be almost reasonable; that it will not always expect the impossible, and will not, owing to ignorance, insist upon the enactment of punitive legislation, fares below cost of operation, overtaxation and onerous regulation.

The increase in the efficiency of equipment and operation of electric railways in our large cities has not been accompanied by a decrease in the volume of criticism, and for this condition the companies must blame themselves. The managers of these companies, instead of striving to promote a feeling of co-operation and friendship with the citizens, have taken the position of antagonism and demanded the full equivalent their franchises allowed them.

By consistently educating the public in the different elements necessary for the success of the system, both in returns to the company and in the maximum of efficient service to the people, this feeling of antagonism will be gradually dissipated and the companies will find that their position in the community has become one of benefit. The public will also appreciate the fact that the companies are entitled to their reasonable demands in order to provide efficient service and fair returns to the investors. This policy of education on the part of the companies must come, or their present attitude of antagonism will force the increase of public ownership of these utilities.

EDITORIAL COMMENT.

A notable increase in the production of stone, brick and other structural materials was recorded during 1911 in the Province of Quebec. This increase in a measure is due to a more thorough collection of data and returns, but nevertheless it is sufficient to consider the development, the increase and the progress of the industries in general in the Province of Quebec, to realize that the market for structural materials has increased tremendously in the last few years, and will continue to do so for many years to come.

* * * *

The Chicago Drainage Canal is again the subject of controversy. There is now a proposal before the United States Senate to increase the flow by 6,000 cubic feet per second over the amount now used. This is a most difficult question to decide, for many interests, both Canadian and American, will be affected if the request is granted. It is generally accepted that the increased diversion will mean a drop of some three or four inches in the lake levels, and will thus affect navigation, and by the decreased flow over the Niagara Falls will affect the power question there.

There is a movement under foot to secure funds for the illumination of Niagara Falls. A bill has been introduced in the New York Senate to provide an appropriation of $50,000 for construction and installation and $2,500 for one year's operation of an illuminating plant for this purpose. The Province of Ontario have also been asked to provide a like sum. This scheme has been advocated for some years back, and it looks as if it were at last to be realized.

* * * *

There is a bill now before the Ontario Legislature to regulate the width of tires on wagons and other vehicles. The bill provides that after the 1st of January, 1914, no vehicle shall be driven on a public highway in Ontario unless its tires are the width prescribed. We are glad to see that the provincial government have begun to appreciate the necessity of taking measures to prevent the destruction of the highways. There is little use in putting down good roads if no restriction is placed on the loading of vehicles and the width of tires used. It is to be hoped that the bill will be passed and become law.

GENERAL NOTES.

In Quebec, Prince Edward Island, and very locally in Northern New Brunswick and Ontario, the total precipitation was in excess of the average, while in other parts of Canada it was deficient, and in the Western Provinces only amounted to about one-third of the usual quantity. At the close of the month the ground was snow-covered throughout Canada, except on the Pacific Coast and the Lower Mainland of British Columbia, where the snow had disappeared. Considerable snow has been deposited on the mountains of British Columbia, but the depth is, in most places, less than last year. In the Western Provinces the depth is generally about five inches, but in Northeastern Saskatchewan and in Keewatin the snow on the ground is from fourteen to twenty-four inches deep. The snow covering in Ontario varies in depth with the district, the Highlands and eastern part of the upper country and the Ottawa Valley being covered by from twenty to thirty-six inches, while in other districts the depth is from six to ten inches. In Quebec, a depth of twenty-six inches at Montreal increased eastward to about sixty inches in the Gaspé Peninsula.

The table shows for fifteen stations, included in the report of the Meteorological Office, Toronto, the total precipitation of these stations for February, 1912:—

	Depth in inches	Departure from the average of twenty years
Calgary, Alta.	0.1	—0.45
Edmonton, Alta.	0.2	—0.54
Swift Current, Sask.	0.4	—0.25
Winnipeg, Man.	0.2	—0.09
Port Stanley, Ont.	2.8	—0.18
Toronto, Ont.	1.67	—0.65
Parry Sound, Ont.	2.6	—0.63
Ottawa, Ont.	2.9	+0.40
Kingston, Ont.	1.1	—0.99
Montreal, Que.	4.3	+1.07
Quebec, Que.	2.2	—0.86
Chatham, N.B.	2.7	—0.09
Halifax, N.S.	2.8	—1.72
Victoria, B.C.	3.1	—0.47
Kamloops, B.C.	0.5	—0.31

THE RELATION OF THE PUTRESCIBILITY OF THE SETTLING AND NON-SETTLING SUSPENDED MATTER IN SEWAGE.*

By Dr. Arthur Lederer.

When we speak of a raw sewage being "strong" or "weak" we have, ordinarily, factors in mind which are furnished by the chemical determinations of total organic nitrogen, organic carbon, chlorine, and possibly fats. To one who is dealing continuously with one and the same sewage the suspended matter will give a fairly good idea of the strength of the sewage. It is likewise apparent that certain relations can be established between some of the chemical constituents from a long series of analyses. However, in different localities all these factors and relations will be subject to modifications, the chief cause for which lies in the varieties of trade wastes likely to be present in the majority of American sewages. In a general way a stronger domestic sewage will require more dilution in a water course than will a weaker, as expressed by any of these factors above.

Up to the time of the introduction of the methylene blue putrescibility test, we have lacked a definite expression for the strength of a sewage from the standpoint of a prospective nuisance. Since the vast majority of sewages reach the surface water in an unpurified or partially purified state, it is clear that any determination in which the natural agencies participate (as is the case in the putrescibility test of Spitta and Weldert) must of necessity come closer to the actual changes occurring in water courses than a purely chemical test, such as the determination or "oxygen consumed." This is the more apparent when we consider that the different methods in vogue of determining "oxygen consumed" give rise to very perceptible differences in the results. The methylene blue putrescibility test, as is well known, depends upon the formation of a colorless leucobase as the oxygen in the sample becomes exhausted. The test has been made more valuable by Phelps, who worked out relative stability figures which serve as a numerical measure of the relation between the available oxygen and the oxygen required for complete oxidization. Since the reaction is a biologic one, an incubation temperature of 20° C. will favor the development of bacteria likely to take part in the self-purification of rivers, while a temperature of 38° C. will favor the development of a bacterial flora not likely to take part in nature. The methylene blue test is at present almost universally used in sewage purification plants, and serves its purpose well. The main objection to the test, however, has been the time which is consumed to obtain results. This is the chief reason why sometimes an incubation temperature of 38° C. is preferred t othe more desirable temperature of 30° C.

Recently interest was awakened in the test for the loss of dissolved oxygen in a sewage mixture on incubation for a definite period of time under anaerobic conditions. The loss of oxygen, as determined quantitatively, serves as a measure of the stability of the sewage or the sewage mixture. This test is a more direct measure of the probable effect upon the stream than the methylene blue test. The test is not a new one. On looking over German literature repeated mention is found of "Sauerstoffzehrung" among the analytical data, the result of which is obtained by methods substantially the same as described above. Mention was first made of the results obtained with this method in this country in the report of the Lawrence Experiment Station for the year 1900 (Mass. State Board of Health). The test was also referred to recently as a good measure of stability by the writer, and by C. B. Hoover, of the Columbus Sewage Works. Hoover likewise recognized that the analytical results usually employed to show the degree of purification effected by sewage treatment do not reveal quantitatively the relative stability, and hence can not be looked upon as reliable indices of the deoxygenerating properties of sewages, sewage mixtures or effluents. As a result of a long series of tests he obtained certain definite relations for sewages, septic effluents and filter effluents as determined from a modified "oxygen consumed" test and the loss of dissolved oxygen on incubation, described previously. It may be possible to establish such a relation in dealing with one and the same sewage for a long time, but the relation is bound to differ in various places to a great extent. The method does not lend itself to a ready expression of the stability. Hoover measured his loss of dissolved oxygen by incubation at 37° C. for 24 hours. There is a possibility, as Phelps has pointed out, in certain effluents, particularly those from rapid filters, of oxygen becoming lost at this temperature without being consumed. The saturation point of oxygen at 37° C. is not over 7 p.p.m., and consequently there is a tendency for some of the dissolved oxygen to escape. Tight stoppers are not likely to prevent the escape of the released gas, nor are mercury seals adapted for routine work.

Recently Phelps introduced his method of calculating quantitatively the stability of a sewage mixture from determinations made by anaerobic incubation at 20° C. for a

Table I.

Serial No.	Solids in Crude Sewage.		Suspended Matter. Original.		After Four Hours Settling.		Oxygen Consumed			Organic Nitrogen.			Per Cent. Permissible Sewage.		
	Total.	Volatile.	Total.	Volatile.	Total.	Volatile.	Crude.	Settled.	Filtered.	Crude.	Settled.	Filtered.	Crude.	Settled.	Filtered.
1	493	222	68	50	37	30	13.	5.5	46.	7.5	5.1	4.6	24.6	27.5	42.
2	629	313	266	124	91	55	29.	17.	11.	9.5	..	11.0	18.3	19.2	51.
3	594	295	118	84	45	43	30.	25.	20.	7.1	..	20.	4.2	5.0	11.1
4	630	335	162	119	52	40	37.	33.	23.	13.7	11.3	23.	2.6	5.5	9.4
5	680	385	194	126	75	55	52.	33.	26.	11.9	7.1	26.	5.0	7.3	11.8
6	654	344	227	127	67	44	51.	28.	23.	12.3	3.3	23.	4.7	10.3	21.3
7	592	322	187	120	65	57	52.	37.	29.	10.5	5.5	29.	3.0	5.4	13.3
8	642	318	206	107	65	50	45.	31.	21.	13.0	..	21.	10.1	18.3	29.4
9	547	270	76	52	51	44	27.	25.	24.	5.9	4.8	24.	17.7	19.1	29.8
Avg.	607	311	167	101	61	46	37.	26.	20.1	10.1	..	20.1	10.0	13.1	24.3

*A paper read at the annual meeting of the American Public Health Association at Havana, Cuba, Dec. 4 to 9, 1911.

given period of time. The sewages are mixed with water saturated with oxygen, and the total amount of oxygen is determined directly. The sample is then stored in a tight bottle for a suitable period of time and the oxygen redetermined. The rate at which the oxygen disappears under these conditions is a direct measure of the probable occurrence upon a stream. Under given assumptions, other than those actually occurring in a specific test, the following formula derived by Phelps may be used:

$$C = \log (O^1/O) \div Kt$$

In this formula C represents the percentage of sewage permissible in the water used for dilution under the assumed conditions. O^1 is equivalent to the dissolved oxygen in the mixture before incubation expressed in parts per million, O the dissolved oxygen after incubation. K is a constant which defines mathematically the rapidity with which the oxygen is used up in a mixture of water and sewage. From a specific test K is determined. The formula can then be applied to other cases. According to Phelps K depends upon the character of the sewage matter and the concentration of that material in the sewage, and is independent of the extent of dilution or the character of the diluting water. Subsequent experiments made by the writer on crude sewages at the Sewage Testing Station of the Sanitary District of Chicago have proven, however, that the factor K is not independent of the amount of dilution. t represents in the formula the time which is allowed for the contact of water and sewage to produce the change in the oxygen of the mixture.

It occurred to the writer to utilize Phelps' quantitative expression of the stability of sewages to demonstrate the improvement of the liquid by the removal of the settling suspended matter and complete removal of all the suspended matter. The laboratory technique employed for these experiments was the same as employed by Phelps. Two dilutions were made as a rule on one and the same sewage. A dilution of 1 part of sewage to 8 and 10 parts of water from Lake Michigan has given satisfactory results. The time of incubation was 24 hours, and the temperature of incubation employed 20° C. The sewage was mixed with the lake water in a glass cylinder by a specially devised stirring apparatus to insure the least possible aeration. A portion of the same sewage was also filtered through a single layer of Swedish filter paper, which removed all suspended matter and pseudo colloids. The same dilutions were made as with crude sewage and the initial dissolved oxygen determined just as in the crude sewage mixtures. The same dilutions were also made on another portion of the sewage after the suspended matter had been allowed to settle for 4 hours. Citrate of magnesia bottles. with patent stoppers, obtainable at any drug store, have proven very efficient for these incubation experiments. They do not permit air to enter as do some of the bottles provided with ground stoppers.

All the results obtained were calculated on the basis of preserving 30 per cent. residual oxygen after a 24-hour period of contact or flow. Besides this test other tests were carried on, such as total solids, oxygen consumed, and organic nitrogen, in order to bring out the relation of the volatile organic carbonaceous and nitrogenous matter in solution and suspension to the calculated permissible dilution. As mentioned previously, the factor K in Phelps' formula has not been found to be independent of the dilution. Special experiments carried on with three different dilutions on the same sewage have clearly shown that K will decrease with a lower dilution, and the factor C of course will be found to be correspondingly higher. It was further found that the difference in K between the lower dilutions is greater than the difference between the two higher dilutions. As yet the results have not demonstrated a constant difference between C (the percentage of sewage) resulting from the various dilutions, consequently an exponent has not been introduced in the original formula. The highest C value has been used to compare results. Values of one and the same dilution only are given for a comparison of the permissible percentage of crude, settled and filtered sewages in Table 1. On the whole, the differences in the factor K in the different dilutions have not been materially different, and are hardly large enough to interfere with the intelligent interpretation of the results (Table 1.) The striking feature of this table is the last column, indicating the ratio of dilution or the "per cent. permissible sewage" (C) of the filtered sewage as compared to the raw and settled sewage. The remarkable result is still more apparent in Table 2, which indicates the improvement in percentages.

Table II.

Serial No.	Suspended Matter. Per Cent. Removed by Settling. Total.	Volatile.	Additional Per Cent. Removed by Filtration. Total.	Volatile.	Per Cent of Volatile Matter Left in Solution After. Settling.	Filtration.	Per Cent. Reduction of Oxygen Consumed. Settling.	Filtered.	Per Cent. Improvement in Permissible Sewage. Settling.	Filtered.
1	46	40	54	60	91	78	58	65	11	71
2	66	56	34	44	78	60	41	62	5	179
3	62	49	38	51	86	71	17	33	19	164
4	68	66	32	34	76	65	11	38	111	262
5	61	56	39	44	81	67	37	50	46	136
6	71	65	29	35	76	63	45	55	119	353
7	65	53	35	47	80	63	29	44	80	343
8	68	53	32	47	82	66	31	53	81	192
9	33	15	67	85	97	81	7	11	8	68
Avg.	63	54	37	46	82	68	30	46	31	143

Looking over the average of the nine experiments in Table 2 we note, for instance, that on removal of 63 per cent. of the total suspended matter, or 54 per cent. of the suspended volatile matter, the actual improvement in the sewage from the standpoint of a prospective nuisance is but 31 per cent. Results similar to this have been obtained by C. B. Hoover. The sewages with the low suspended matter (experiments 1 and 9) have the low percentage improvement. One exception is found in experiment 2 with a high suspended matter and a low improvement from a dilution standpoint. Now, when we turn to the results obtained by filtration we will note in Table 2 that the removal of only 37 per cent. of suspended matter, or 46 per cent. volatile suspended matter additional to sedimentation has shown an improvement of 143 per cent. for dilution purposes, or nearly five times the improvement gained by merely settling the sewage. Similar is the case with the carbonaceous matter as expressed in "oxygen consumed." A reduction of 30 per cent. of "oxygen consumed" is equivalent to an improvement of 31 per cent. in dilution, while an additional removal of 16 per cent. in "oxygen consumed" gives an actual additional improvement of 112 per cent.

A thorough study of these two tables will clearly bring out the fact that the removal of suspended matter capable of settling in settling tanks constitutes an improvement from the dilution standpoint much less than the percentage of suspended matter removed. Since we have to consider the improvement of any sewage or effluent from the standpoint of the degree of dilution required rather than from the standpoint of the reduction of any chemical constituents (as shown by analysis), the improvement made by settling con-

sists mainly in the improvement of the physical character of the liquid by the removal of material which may cause deposits, and incidentally some improvement in the stability. However, the removal of an additional small quantity of suspended matter not capable of settling, by simple filtration will improve the liquid far out of proportion to the percentage of volatile matter removed. This permits of only one conclusion, that is, on a domestic sewage from a large area the finely divided slowly settling suspended matter and pseudo colloidal matter not capable of settling make up the greater part of the putrescibility, due to the suspended and colloidal matter. This fact has been recognized before. Spillner states that the organic sulphur compounds in sewages which afford the material for the development of hydrogen sulphide are found in much smaller quantity in the suspended matter capable of settling than in the dissolved colloidal and finely suspended matter which has been removed by filtration in these experiments.

In the present state of the science of sewage disposal we aim to destroy the finely suspended matters by oxidization. However, most of the sewage is discharged to-day either in a raw or settled state. If a device can be worked out to take care of the finely divided non-settling suspended matters without resorting to biologic treatment, a degree of purification may possibly be attained intermediate between settling and biological treatment, which in many cases may be sufficient to avoid the expense of the more thorough biological treatment.

In conclusion the writer wishes to express his thanks to Prof. E. B. Phelps, of Boston, and to Mr. Langdon Pearse, engineer-in-charge of sewage disposal experiments in Chicago, for valuable suggestions, and further to Messrs. H. B. Hommon and F. Bachmann for their conscientious analytical work.

CANADA'S MINERAL PRODUCTION

The total value of the mineral production in Canada in 1910, according to revised statistics now complete, was $106,823,623. Compared with the previous year's production of $91,831,441, that of 1910 shows an increase of $14,992,182, or 16 per cent., and, says Mr. John McLeish, B.A., in his report to the Department of Mines, Ottawa, is the largest increase that has been recorded in Canada's mineral production in any one year. The production per capita has also increased from $12.82 in 1909, to $14.26 in 1910, an advance of 11.2 per cent. The largest production per capita previously recorded was $13.35 in 1907.

The year 1886 was the first year for which complete statistics of mineral production for the whole of Canada were collected, and the production that year was reported as $10,221,255, or about $2.23 per capita. In ten years the production had increased over 100 per cent., to $22,474,256, or $4.38 per capita, in 1896. At this time the Yukon began to contribute largely to the gold production, and, during the next five years, an increase of nearly 200 per cent. is shown, the total reaching a value of $65,797,911, or $12.25 per capita in 1901. The next three years witnessed a slight falling off, but from 1904 the production again rapidly increased to its present high record.

The production of metalliferous products in 1910 was valued at $49,438,873, being 46 per cent. of the total mineral output; and an increase in value over the previous year of $5,282,032, or nearly 12 per cent. The value of non-metalliferous products (excluding structural material and clays) in 1910 was $37,757,158, being 35 per cent. of the total mineral output; and an increase of $6,615,907, or 21 per cent. in value over 1909. The value of the production of clay, lime and stone, and other structural materials in 1910 was $19,627,592, or 18 per cent. of the total production; and an increase of $3,094,243 over the 1909 output.

Amongst the more important minerals mined, coal occupied first place, contributing about 29 per cent. of the total production; silver, next in importance, contributed over 16 per cent. of the total; nickel was next in order with over 10 per cent; while gold occupied fourth place with 9½ per cent. of the total; clay products contributed 7 per cent.; copper 6.6 per cent.; cement 6 per cent.

The increased production was not confined to a few products, but was, on the other hand, fairly well distributed throughout the list of ores and minerals mined in Canada. Amongst the metallic products the principal increases were in silver, nickel, gold and copper; there being a falling off in the production of lead and of zinc. There was an increased production of pig iron from blast furnaces, but a smaller amount credited to Canadian iron ore.

The prices of metals upon which the value of the production directly depends did not vary greatly during the year, nor did the averages differ much from those of the previous year. Lead, silver and zinc averaged higher in price in 1910, while copper was fractionally lower and nickel remained practically at the same price level.

The total value of the exports of products of the mine, including direct mine products and manufactures, in 1910 was $51,856,862, as compared with $47,442,001 in 1909. This value includes for 1910 mine products to the value of $42,236,270 and manufactures valued at $9,620,592. About 93 per cent. of the value of the mine products exported is made up by silver, nickel, copper, gold, coal and asbestos. Manufactured mine products consist chiefly of iron and steel goods, coke, and aluminum, made from imported ore.

The United States is the chief destination of Canada's mine exports, about 83 per cent. having been exported to that country during the fiscal year 1909-1910, and about 9 per cent. to Great Britain.

The following table shows the mineral production by provinces for the year 1899 to 1910, inclusive:—

	Nova Scotia.	New Brunswick.	Quebec.	Ontario.	Manitoba.
	$	$	$	$	$
1899	6,817,274	420,227	2,585,635	9,819,557	
1900	9,298,479	439,060	3,292,383	11,258,099	
1901	7,770,159	467,985	3,759,984	13,970,010	
1902	10,686,549	607,129	3,743,636	14,619,091	
1903	11,431,914	580,495	3,585,938	14,160,033	
1904	11,212,746	559,913	3,688,482	12,582,843	
1905	11,507,047	559,035	4,405,975	18,833,292	
1906	12,894,303	646,328	5,242,058	25,111,682	
1907	14,532,040	664,647	6,205,553	30,381,638	898,775
1908	14,487,108	579,816	6,372,949	30,623,812	584,374
1909	12,504,810	657,035	7,086,265	37,374,577	1,193,377
1910	14,195,730	581,942	8,270,136	43,538,078	1,500,359

	Alberta.	Saskatchewan.	Yukon.	British Columbia.	Total.
	$	$	$	$	$
1899	17,108,707			12,482,605	49,234,005
1900	23,452,330			16,680,526	64,420,877
1901	19,297,940			20,531,833	65,797,911
1902	16,127,400			17,448,031	63,231,836
1903	14,082,986			17,899,147	61,740,513
1904	12,713,613			19,325,174	60,082,771
1905	11,387,642			22,386,008	69,078,999
1906	10,092,726			25,299,600	79,286,697
1907	4,657,524	533,251	3,335,898	25,656,056	86,865,202
1908	5,122,505	413,212	3,669,290	23,704,035	85,557,101
1909	6,047,447	456,246	4,032,678	22,479,006	91,831,441
1910	8,996,210	498,122	4,764,474	24,478,572	106,823,623

TURBINE PUMPS.

A paper on "The Evolution and Present Development of the Turbine-Pump," by Dr. Edward Hopkinson and Mr. Alan E. L. Chorlton, was read before the Institution of Mechanical Engineers of Great Britain recently.

To-day, they said, the turbine principle seemed the accepted ideal for almost all primary machines, and it would appear that the age of the reciprocating engine for the various work of mechanical engineering, was passing and that the rotary engine of the turbine type was steadily taking its place. In that of steam prime-movers it had, perhaps, already taken the lead over the reciprocating type, and the engine of Watt must now be relegated to second place. In other fields and duties its progress to date was so great as to warrant the surmise that at no distant time a similar comparison of precedence would be made. Perhaps in no domain had the turbine rotary principle achieved greater success in the last few years than in high-lift pumping, though probably the realization of its possibilities for such duties was as old or older than the steam-turbine itself. Still, its general acceptance as correct engineering practice had occurred only within the last five years.

At the present time the use of the turbine-pump had become so extended that it was difficult to find work to which it could not be applied advantageously. It would no doubt be a matter of interest to trace the evolution and development of machines of this design, and the authors, therefore, gave the history of such apparatus from the beginning of the 18th century.

Modern Practice.—The mechanical construction of a standard Mather - Reynolds pump as built in 1895 consisted of four chambers working in series. At the one end these were secured by bolts against the circular flange of a frame carrying the driving pulley or shaft coupling, this having the suction branch and entrance to the first chamber cast with it. At the other end the delivery chamber formed the final cover, and had the delivery pipe cast on the upper part connecting to the annular space into which the last set of guide-passages delivered, and at this end a suitable stay was attached to support the pump from the floor The chambers were secured to each other by bolts through external flanges, each chamber being recessed and spigoted so as to preserve correct alignment of the whole. This formed an inexpensive design and permitted accurate manufacture. In comparing such a pump with a modern one it would be found that it was in the form of its impeller and its delivery-casing that the original Mather-Reynolds pump differed most from the present design. The impeller was of the open type, with radial vanes, the roots of which were carried across the openings of the eye into the boss, necessitating the use of a modified form of Francis entrance. This form was probably adopted in order to secure sufficient strength to drive the vanes, necessitating them being carried through full width to the boss on the pump-shaft, and not starting level with the outer diameter of the eye as at present. The impeller was turned all over, and revolved a close fit in its casing, which was turned to a corresponding form. This prevented leakage and loss of efficiency by the return of the water from the tip to the suction along the impeller sides.

A considerable number of pumps of the 1895 form were constructed for installations in this country and abroad, and Messrs. Sulzer Brothers, of Winterthur, who began the manufacture of multiple turbine pumps about the year 1896, evolved various modifications in the Osborne Reynolds design, whereby both the efficiency and the lifting capacity were considerably improved. They established in 1898 an interesting and novel installation of these improved pumps at the Spanish mines of Horcajo, which attracted considerable attention. Two years later an agreement was concluded between Messrs. Sulzer Brothers and Messrs. Mather and Platt which provided for an interchange of future improvements, and due acknowledgment of the original work of Professor Osborne Reynolds and of the improvements made by the two manufacturing firms.

A comparison of a four-chamber pump of the Sulzer design with the 1895 design showed three important differences. First, the body casting of the pump was constructed in one piece, with the intermediate pieces, guide-vanes, and impellers put in from one end.. Secondly, the impellers were shrouded and had backward-curved vanes; and, thirdly, the impellers were arranged back to back to compensate for the increased lateral end-pressure set up by the higher heads worked against. This arrangement of the impellers involved the use of somewhat tortuous passages in the pump to bring the discharge of the first impeller to the eye of the second, and so on. Moreover, these passages passing several joints increased the probability of internal leakage from one stage to another. The agreement between Messrs. Sulzer Brothers and Messrs. Mather and Platt came to an end by mutual consent in 1904, and after that date each firm further developed their pumps on their own lines.

Proceeding to discuss later designs of four-chamber pump, the authors showed that constructionally this pump differed principally in that the extended suction-end was shortened and was similar to the delivery-end. This enabled various classes of drives—motor, belt, or steam-turbine—to be better negotiated with a standard pattern. Successive chambers, instead of being secured to their neighbors by bolts and flanges, were held together by long bolts extending the entire length of the pump body and held only at the two ends (suction and delivery).

The impeller was of the shrouded type, having vanes bent well backwards and the guide-passages longer and more correctly divergent, whilst the return way to the eye of the next impeller was of a curved form and more in line and continuous with the receptive ports, thus preventing the abrupt right angle turn through the casing obtaining in the Reynolds pump. The losses in the Reynolds impeller through side friction in its casing were obviated, and any leakage from the periphery back to the suction was prevented or greatly minimized by the outer circumference of the impeller eye running in neck bushes with a very small radial clearance, amounting to less than 0.005 in. The importance of preventing this leakage was very great if high efficiency was to be secured. The impeller was turned all over outside to reduce loss by skin friction, and with the same object it was usual to use as many wheels as the circumstances would otherwise allow. The end or axial balance of the impellers was obtained by an automatic device, which acted well in practice, and compensated for wear and variable leakage taking place in the pump. In other respects the arrangement, direction or flow of water, and assemblage of the pump were the same as in the original Mather-Reynolds pump.

The authors concluded the paper with some examples of the application of turbine pumps for various purposes.

Experiments with the centrally hung lamps which have been carried out in Cheapside, King William Street, and Cannon Street, have been so successful that a scheme has been prepared by the Streets Committee to adopt this system of lighting in all the streets of the city of London. Under the scheme the lighting of the city will be divided almost equally between gas and electricity. The illumination will be increased from 668,405 candle-power to 1,270,160 candle-power, whilst it is claimed there will be an annual saving of $33,200.

SPECIFICATIONS.*

By Fred. S. Sells.

The author stated that in his view the accepted commercial meaning of the word "specification" was the written, printed, or "understood" construction of an article, piece of plant, or works, or the enumeration of the detailed requirements for the execution of a certain performance. In Germany, France, and America a specification as a rule was identical with standard practice, and in this country the want of standards and of recognized and acknowledged authorities was a great drawback. If those who were engaged in the carrying out of specifications had grievances against those who drew them up it must be admitted that the specifying engineer was heavily handicapped by the absence of standards, and that he must at times guard against the introduction of something which had never been tried, or with which he was not sufficiently familiar. On the other hand, where "standards" had been set up during the last few years they had not been accepted unquestioningly by the profession, and therefore the manufacturers had to be cautious in adopting them.

The next grade of specification was that drawn up by a professional man for the purpose of obtaining tenders. Such a specification should contain a detailed enumeration of articles required, stating where and how they were to be fixed. Each article should be described by an accepted nomenclature which assumed the existence of printed, written, or catalogued descriptions for the benefit of the tenderer. Should these not be accessible, corresponding matter might be added to the specification. Once such a specification was issued no deviation should be permitted unless it was clearly added from the outset that apparatus of similar construction, design, or capacity would be accepted.

The Consulting Engineer.—It was the endeavor of consulting engineers to advise their clients to have the most up-to-date, the most economical, and the best manufactured plant, but, unfortunately, the number of interpretations of these desiderata was almost equal to the number of consulting engineers in practice. Why? Not because the engineers were incompetent; not because they had not each of them wide and valuable experience; not because they, or most of them, had not done similar work before; not because of the absence of standards, and perhaps because of the absence of some uniformity of education and experience. The trouble might also be partly due to the aloofness of the average consultant from the work-shops of the manufacturer, and he felt certain that a closer and more regular intercourse between the manufacturer and consultant would result in benefit to both purchaser and contractor. The majority of manufacturers now gladly threw open their works to consultants at all times.

As technical knowledge and experience had developed during the last 25 years, so had the standard of commercial honor and integrity, and he did not think it either right or necessary that specifications should contain anything which was originally meant to prevent dishonesty, by which he meant the intention of not carrying out a specification as it was meant to be carried out, the use of insufficient material, flimsy construction, disregard of proportion, and the introduction of makeshifts leading to unsightliness. A large number of leading consulting engineers had already adopted broader-minded methods, but this course had not yet become general practice.

Would it not be better if consulting engineers, instead of drawing up specifications, each of which was a masterpiece of originality, were to adopt standards where standards were in existence; to accept standard practice where standard practice was established; and to ask the manufacturers in their specifications to put forward their own suggestions? Their work would then consist of going through all the various manufacturers' recommendations and suggestions, and of deciding which was the best designed and most serviceable plant at the prices submitted.

Municipal Engineers.—With reference to municipal and supply company engineers, the circumstances were in many cases the same as with consultants. The great difference lay in the fact that the municipal engineer had more frequently to be prepared for the acceptance of the lowest tender, without having the same opportunity as the consulting engineer to explain the difference in the offers; and as long as municipalities were governed as at present their engineers would not, as far as "detail" was concerned, be able to alter the present practice in this respect. The municipal engineer was even more a specialist in his particular work than the independent consultant, and in many cases he had more experience of what was actually required than the manufacturer. Especially where large stations were concerned his experience was valuable, and, if fully expressed in his specifications, it would help the manufacturer. Would it be possible through the medium of the existing organizations of municipal engineers to arrive at something like standard practice? It had been done in other countries, and had been done successfully.

Large corporations who had big laboratories with elaborate testing apparatus and a highly trained expert in charge had, of course, no difficulty in making fair and reasonable tests, but it was regrettable to find what tests were being made in some central stations in order to determine the candle-power of incandescent lamps and carbons, and what tests were sometimes applied to determine their life. They forgot that the products of the leading manufacturers were made to comply with the standards established by authorities such as the Engineering Standards Committee, the Admiralty, Post Office, large railway companies, and others.

* Abstract of paper delivered before the Institution of Electrical Engineers, Manchester local section.

PROVINCIAL POPULATIONS.

A special report of the census presented to Parliament gives the population by provinces as follows:

Province.	1911.	1901.	Inc.
Alberta	374,663	73,622	301,691
British Columbia	302,980	178,657	213,823
Manitoba	455,614	255,211	200,403
New Brunswick	351,889	331,120	20,769
Nova Scotia	492,338	459,574	32,764
Ontario	2,523,208	2,182,947	380,261
Prince Edward Island	93,728	103,259	*9,531
Quebec	2,002,712	1,648,898	353,834
Saskatchewan	492,432	91,279	401,153
Yukon	8,512	27,219	*18,707
N. W. Territories	16,951	20,129	*3,178
Totals	7,204,527	5,371,315	1,833,212

* Decrease. Total decrease 31,416

The rural population is 3,924,083, and the urban 3,280,441. The increase in rural population is 555,065 or 16.48 per cent., and in the urban 1,278,147 or 63.83 per cent.

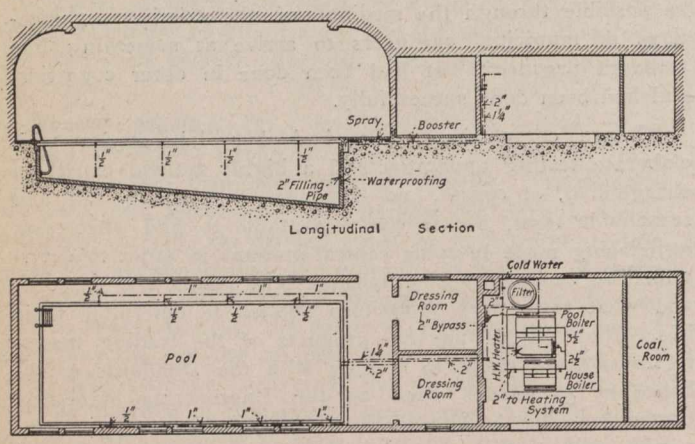
HEATING A SWIMMING POOL.*

By C. Teran.

A swimming pool is generally a luxury, not a necessity. For this reason not many are built, and a description of the system installed for Herbert Coppell at Tenafly, N.J., may prove of interest.

It is housed in a building of one story, and includes the pool room, two dressing rooms, boiler and coal rooms, all on the ground level. The pool is sunk below grade, is built of concrete, waterproofed and lined with English size enameled brick. It is 38 ft. long, 15½ ft. wide and 6 ft. mean depth below water level. The cubical contents are, therefore, 3,534 cu. ft.

The heating plant was designed to heat this volume of water in 10 hours, or at the rate of 353 cu. ft. an hour. Ten hours is a convenient length of time for heating the water, because the required apparatus is not specially large. If the apparatus was much smaller it would, of course, require a longer time to heat the water, and this time added to that necessary to empty and clean the pool would make the period of time which the pool would be out of commission too long. The time required to empty and clean this pool is 4 to 5 hours.



Plan.

The installation includes two cast-iron sectional boilers, a Berryman service heater and a filter. The water is reduced to 30 lb. pressure on entering the building. It is then heated in the Berryman heater by steam generated in the boilers, and then filtered and discharged into the pool. For filling, a main inlet is used; this enters the pool at the deep end near the bottom; there is also a nozzle above the water line which is used to produce a spray over the pool.

On account of the proximity of the walls of the pool to the outside ground a loss of heat in the water was anticipated and provision made to replace the loss. Careful consideration was given to the various methods that could be used to accomplish this purpose, and injecting water heated to a high temperature into the filled pool was decided upon. The reason for using a high temperature is that the water is not taken from the pool to be reheated, as this would necessitate a circulating pump, but fresh water is used, and by heating it to a high temperature a minimum quantity of water is required and less coal burned. The water is injected at four points on each side of the pool near the bottom, through nozzles passing through the brick lining and flush with it. This arrangement gives a good distribution, and is neat in appearance. It is found that during the winter months the water loses 2 to 3 deg. F. in 24 hours.

In filling the pool the water is heated to 75 deg. F., which, on account of heat losses in transit, etc., gives an ultimate temperature of 70 deg. F. The water injected to make up the heat loss is heated to 180 deg. F.

The large boiler is used to heat the water when the pool is being filled. This was computed as follows:

Contents of pool .....3534 cu. ft.
Water to be heated per hour.....353 × 62.4 = 22,027 lb.
Water to be heated per hour.....353 cu. ft.
Rise of temperature of the water.....40 to 75 = 35 deg.
Heat units transmitted to water per hour, 22,062 × 35.....771,000 b.t.u.
Coal necessary to be burned per hour 771 ÷ 8000.....96 lb.
Grate area, 96 ÷ 8 = ...12 sq. ft.

A boiler having a grate 40 in. wide by 48 in. long was installed. The other boiler shown is used to heat the building and the water injected into the pool to make up the daily loss of heat; by this arrangement, the necessity of keeping a fire in the large boiler is avoided. As there was no sure method of predetermining the loss of heat of the water in the pool, in selecting this boiler liberal allowance was made for this purpose above what is required to heat the building. The amount of direct radiation is 400 sq. ft., all behind screens; the boiler is rated at 1,000 sq. ft. and has a grate 21 × 27 in. or about 4 sq. ft.

The service heater was specified of proper size to heat 2,800 gal. of water per hour from 40 to 80 deg. F. with low-pressure steam, and it was left to the manufacturers who furnished it to design the proper size heater for this duty. The filter was specified in a similar manner. No automatic temperature control was installed, and none has been found necessary. An even temperature of the water is attained by maintaining a steady fire and regulating the flow of water by hand.

* A paper read before the American Society of Heating and Ventilating Engineers, New York City, Jan. 25th, 1912.

THE BRITISH ALL-RED WIRELESS TRANSMISSION SCHEME.

The proposal to connect all portions of the British Empire with wireless communication systems has at last taken definite form. A chain of 25 stations throughout the Empire are to be equipped with high power Marconi apparatus; the whole to be under the control of the General Post Office. The cost of construction is estimated at $6,000,000.00 and the yearly maintenance is placed at $1,000,000.00. The estimated revenue, according to predictions, will total $3,000,000.00 per year; considering 15,000 words a fair and conservative estimate to be transmitted from each and every station in the belt.

There is no other world power able to thus link up their overseas dominions, except Great Britain, as the lands of this empire lie in a continuous chain around the earth and sufficiently close together to overcome the problem of long transmission over water. There is one great advantage in this means of empire communication over the cable method, and that is the ability to reach and communicate with every ship on the seas properly equipped.

The stations are to be erected at Victoria, B.C.; Montreal, P.Q.; Glace Bay, N.S.; Jamaica, Barbados and other points in the West Indies; Bermuda; London, England; Bathurst and Sierra Leone, British West Africa; St. Helena, Capetown, Durban, Moneasa and Aden on the east coast of Africa; Mauritius; Cyprus; Malta; Bombay; Colombo; Adelaide; Singapore, and Hong Kong.

INDUSTRIAL ACCIDENTS IN JANUARY.

Industrial accidents occurring to 300 individual work people in Canada during the month of January, 1912, were recorded by the Department of Labor. Of these, 86 were fatal and 214 resulted in serious injuries. In addition 2 fatal accidents were reported as having taken place prior to the beginning of the month, information not having been received by the Department before January, 1912.

In the preceding month there were 84 fatal and 194 non-fatal accidents recorded, a total of 276, and in January, 1911, there were 91 fatal and 206 non-fatal accidents, a total of 297. The number of fatal accidents recorded in January, 1912, was, therefore 2 more than in the preceding month and 5 less than in January, 1911. The number of non-fatal accidents recorded in January, 1912, was 20 more than in the preceding month and 8 more than in January, 1911. Altogether there were 22 more industrial accidents recorded in January, 1912, than in the preceding month and 3 more than in the same month of the preceding year.

The following is a record of the accidents of the month by industries and groups of trades:—

Trade or Industry	Killed	Injured	Total
Agriculture	7	9	16
Fishing and hunting	2	..	2
Lumbering	4	7	11
Mining	14	15	29
Railway construction	9	12	21
Building trades	5	15	20
Metal trades	7	44	51
Woodworking trades	1	16	17
Printing and allied trades	..	..	..
Clothing	..	2	2
Textiles	..	1	1
Food and tobacco preparation	..	3	3
Leather	..	..	..
Transportation—			
Steam railway service	23	33	56
Electric railway service	..	8	8
Navigation	1	5	6
Miscellaneous	3	9	12
Public employees	1	13	14
Miscellaneous skilled trades	4	15	19
Unskilled labor	5	7	12
Total	86	214	300

ONTARIO'S PEAT BOGS.

It is announced by the Dominion Mines Branch that the associated manufacturers at Brantford, Ont., have become so convinced that the air-dried peat method employed by the mines branch can be made a commercial success that they have contracted with the government to continue the work at Alfred, Ont., and will spend over $50,000 in trying to improve peat machines. This action was decided on only after a thorough investigation. The machine to be used will have a capacity of 60 to 80 tons per day, as compared with the 30 tons the government turned out.

The government experimental plant at Alfred exhibited samples of machinery and of peat ready for market at the Ottawa fair. A thousand tons of peat were made up, which was sold at $3.25 a ton. The orders came with such a rush that the supply was soon exhausted. The peat was used in parlor grates, in kitchen ranges, and in furnaces. It burns to a fine ash, there being practically no residue, and is much cheaper than coal.

A NEW TUG FOR THE CITY OF TORONTO.

The city have under construction, at the Polson Iron Works, a new steel tug to be used in the various engineering works projected and under construction about the city's water-front. There are several points about the vessel which have a tendency to make it unique in many particulars.

The material of construction in the hull is the best quality of Siemens-Martin open hearth mild steel; near the bow the material has been laid in such thickness as will permit the ship to be employed for ice breaking purposes when so required.

The propelling mechanism consists of a six-foot screw and a single cylinder high-pressure type, non-condensing engine. The diameter of the cylinder is sixteen inches and the length of stroke eighteen inches.

The boiler is of the Scotch cylindrical type, seven and a half feet long, and containing one hundred and fifty-two three-inch tubes; it has been built to pass government inspection for a working pressure of 150 pounds per square inch.

The illustration was made by the photographer a few hours previous to the launching, which took place on 8th March last. Before the hull could take the water a crew of twenty-two men and one horse worked for several hours to clear a space in the ice covering the bay, which, at this point, was almost thirty inches thick.

The draught of the vessel is six and a half feet when the bunkers are half filled with coal. The length is 70 feet, extreme beam 18 feet, and the depth at side (lowest point) 9 feet.

Mr. W. E. Redway, of the Polson Iron Works, is the designer and supervisor of the work on the tug, which has been named the "G. R. Geary." It is expected that it will be completed and ready for work about April 6th.

BUILDING FIGURES FOR SASKATOON.

In The Canadian Engineer, issue of February 29th, the building figures in twenty selected cities and towns throughout Canada were given. We have just received a letter from the city of Saskatoon, Sask., drawing to our attention the fact that figures for that city are not quoted, although "lots of other towns much smaller than this city are given."

We are very glad to remedy this omission. The following are the building figures for the months of January and February for 1911 and 1912 for the city of Saskatoon:

	1911.	1912.
January	$13,500.00	$13,800.00
February	9,950.00	69,700.00

Metallurgical Comment

T. R. LOUDON, B.A.Sc.

Correspondence and Discussion Invited

THE IMPROVEMENT OF RAIL DESIGN AND SPECIFICATIONS.*

W. C. Cushing.

The period between 1893, the year of the adoption of the standard rail sections of the American Society of Civil Engineers, and the first annual convention of the American Railway Engineering and Maintenance of Way Association in 1900, was occupied by the railway engineers in the study of the behavior in the track of the rails rolled, according to the new designs, which were rapidly put into service by the different railways of the country.

A preliminary meeting of the railway engineers was held in Chicago on October 21, 1898, for the purpose of organizing the American Railway Engineering and Maintenance of Way Association, and at that meeting a committee was appointed to draft the constitution and by-laws.

On March 30, 1899, the permanent organization of the association was effected in Buffalo, by the adoption of the constitution and the election of officers.

As stated in the constitution, the object of the association was the advancement of knowledge pertaining to the scientific and economical location, construction, operation and maintenance of railways. The real and final object was, however, for the members to exchange information and experience with each other and to bring about the unification, as much as possible, of specifications for the purchase of the large amount of material and supplies used by railways, which ought to result in the mutual benefit of the manufacturers and the railway companies.

In order to hear the first reports of standing committees, the first convention was held in March, 1900, in Chicago, and among the standing committees was one on rail.

The report of the committee was largely historical, but it was developed at that and subsequent meetings that the subject was going to be one of the most important and most interesting of those to come before the association in the future.

The work of the committee of the American Society of Civil Engineers was undertaken with the object of improving the design or cross-section of rails, and did not undertake the preparation of specifications for their manufacture or inspection, but each railway issued its own specifications, which were not specifications for manufacture, but for inspection. These specifications differed from each other in various details, such at the method of testing, the allowable variations from the templates, the smoothness of the surface and the workmanship generally, while but little was said about the chemical composition. Indeed, this state of affairs must have been quite annoying and expensive to the rail manufacturers, and, as all railways were striving for exactly the same object, viz.: to obtain the best material which would make an absolutely safe steel rail, the unification of the specifications seemed to be very desirable, and if it could be brought about, the existence of the association would be entirely justified.

* Presented at the Indiana Railroad Commission's hearing on the rail question at Indianapolis.

At the annual convention in 1901 it was ascertained that the rail sections or designs of the American Society of Civil Engineers were in use by about 70 per cent. of the railways of the country, and it soon developed in the discussion that the rail steel in use by the railways was not giving very good satisfaction. This dissatisfaction pertained to all sections of rails, and the railway engineers thought that the trouble was largely due to the temperature of rolling being entirely too high, leading to the expression of one member that "the material was squirted through the rolls." The engineers of the rail manufacturers, who were also members of the association, contended, on the other hand, that the fault was due to the rail sections, and especially to the thin base designs of the American Society of Civil Engineers. It thus developed that the railway engineers believed the trouble was entirely due to improper processes of manufacture while the rail manufacturers' engineers placed the fault on the design of the rail cross-sections.

It was apparent, therefore, that the committee must study both the question of design and the question of rail manufacture, the latter with the special object of devising tests and methods of inspection which would more surely determine whether the material came up to the requirements of service or not. It was quite evident that this work would be of long duration, because it was necessary that more study than ever before should be placed upon both the question of rail design and its manufacture, and it would be necessary to proceed slowly and carefully, in order to avoid the misinterpretation of statistics and information. Sir Lowthian Bell is reported to have said, at the London meeting of the American Society of Civil Engineers, in 1900, that "as he had been 25 years a manufacturer of rails and 25 years a director in the North Eastern Railway, he represented both maker and user, and he had at his disposal 35,000 analyses to go upon in making deductions. From these he could prove and disprove everything that could be said for or against any composition of a rail—a facility beloved by the expert." It is well for any investigator not to forget Sir Lowthian Bell's remark. It has been brought home to the rail committee many times in its prolonged investigation.

Prior to this time, so much has been said by railway engineers about the necessity for rolling at lower temperature that, in 1900, the Kennedy-Morrison process of holding rails just before the final passes until they came to the desired temperature, after which they were put through the final passes at that temperature, was introduced by the Carnegie Steel Company, and great expectations of the value of the results were held. At the same time other rail manufacturers began rolling at lower temperature and claimed to accomplish the same results. The process did not, however, give the results expected, as the effect was only skin deep, for when the skin wore off, the ordinary metal was exposed underneath. The rails rolled after its introduction developed rather more failures than usual, and since that time the value of rolling at low temperature has been rather uncertain. This experience is mentioned to show that the value of many changes in process of manufacture can only be developed after long experience, which is one of the reasons why an investigation of this kind is bound to cover a long period of time.

In 1895, at Zurich, Switzerland, the International Association for Testing Materials was organized to bring about "the development and unification of standard methods of testing, for the determination of the properties of materials of construction, and of other materials, and also the perfection of apparatus for that purpose." On June 16, 1898, or but a few months prior to the organization of the American Railway Engineering and Maintenance of Way Association, there was formed, at Philadelphia, the American section of

the International Association, which, a few years later, was renamed The American Society for Testing Materials. The American section was composed of manufacturers as well as of consulting engineers, railway engineers and others, and had already begun the study of rail specifications. Therefore, at its annual convention in 1901, the rail committee of the American Railway Engineering Association submitted the rail specifications recommended by the American branch of the International Association for discussion, in order to get the subject under way.

Specifications for steel rails have always consisted of three general parts:

1. Chemical requirements or properties;
2. Physical requirements; and
3. Details of manufacture.

Up to that time the various railways emphasized one or more of these parts, according to their individual preference or experience. Some almost ignored the chemical requirements, others were more or less elaborate in their physical requirements, while some barely touched upon details of manufacture, and others treated the subject quite elaborately.

1. The chemical properties of those proposed specifications for bessemer steel rails were those of the Carnegie Steel Company, and they are to-day the standard chemical specifications of all the steel rail manufacturers, and of the American Society for Testing Materials, with scarcely any alterations. They were as follows:

	50-60 lbs.	60-70 lbs.	70-80 lbs.	80-90 lbs.	90-100 lbs.
Carbon	.35 to .45	.38 to .48	.40 to .50	.43 to .53	.45 to .55
Phosphorus, not over	.10	.10	.10	.10	.10
Silicon, not over	.20	.20	.20	.20	.20
Manganese	.70-1.00	.70-1.00	.75-1.05	.80-1.10	.80-1.10

The specifications for foreign use were practically the same.

The only changes which have been made in these specifications by the steel manufacturers and by the American Society for Testing Materials up to the present time, are to make the carbon for 60 to 70-lb. rail .35 to .45, and the manganese for 90 to 100-lb. rail .84 to 1.14.

With few exceptions, the railways of the United States have accepted these chemical constituents as recommended by the rail manufacturers, because they have considered that the chemical properties were only a minor part of the specifications for rail steel, compared with the physical requirements.

To show that the railway engineers have been justified in taking this view of the matter, the following quotation is made from an article in the Journal of the Franklin Institute by Captain R. W. Hunt, once a manufacturer of steel rails and now a steel rail inspector of wide experience:

"Rails made by John Brown & Co., of England, and put down on American railways some years ago, have been generally held up as ideal rails, and the American makers for a long time supposed that when these rails did wear out so that they could be analyzed the secret of their good service would be told. As an illustration of how little regularity or purity of chemcal composition influenced the wear, I call your attention to the analyses of thirteen of the John Brown rails, all of which had filled years of faithful service and have been selected as bright examples of what good rails should be,

	C.	Si.	Ph.	S.	Mn.	Cu.
1	0.35	0.08	0.128	0.068	0.742	0.048
2	0.39	0.071	0.156	0.155	0.662	0.32
3	0.36	0.103	0.125	0.060	0.815	Trace
4	0.70	0.306	0.111	0.008	0.681	0.016
5	0.36	0.069	0.153	0.131	0.621	0.043
6	0.44	0.208	0.098	0.059	1.046	None
7	0.45	0.102	0.128	0.105	0.616	0.056
8	0.36	0.087	0.148	0.181	0.625	None
9	0.24	0.068	0.131	0.104	0.645	0.005
10	0.37	0.051	0.096	0.050	0.639	Trace
11	0.32	0.089	0.145	0.077	0.745	Trace
12	0.35	0.069	0.077	0.099	0.945	None
13	0.28	0.032	0.084	0.053	0.312	None

"You will observe that carbon ranged from 0.24 to 0.70; silicon from 0.032 to 0.306; phosphorus from 0.077 to 0.156; sulphur from 0.050 to 0.155, and manganese from 0.312 to 1.046.

"These 13 rails, taken as a whole, were chemically a 'poor lot,' but physically, most excellent."

2. Two general methods for testing the physical requirements had been in use up to the year 1900, viz., a bending test of a small bar ½ in. to ¾ in. square and 10 in. to 20 in. long, and a drop test, which consisted in letting fall a weight of about 2,000 lbs. on a piece of rail with a span of 3 to 4 ft. Some railways used one method, some the other, and some both, but by 1900 the small bar test had been generally abandoned in favor of the drop test.

It was customary to make a test of every fifth heat of steel, and to let the weight fall from varying heights, according to the pleasure of the maker of the specifications. The proposed specfications of the American branch retained this method of testing the physical properties by dropping the weight of 2,000 lbs. on every fifth heat of steel, from a height of 16 ft. for rail weighing 55 to 65 lbs. per yard, 17 ft. for rail weighing 65 to 75 lbs. per yard, 18 ft. for rail weighing 75 to 85 lbs. per yard, and 19 ft. for rail weighing 85 to 100 lbs. per yard, but these conditions were not accepted by the American Railway Engineering Association, as there was a strong feeling among the railway engineers that more severe conditions of testing were necessary. They felt that the chemical properties could be left to the greater experience and chemical knowledge of the rail manufacturers, but that they must be the ones to prescribe the physical tests which the finished rails must stand in order to be accepted for such important service as carrying the railway traffic of the country. In 1904, therefore, the engineering association decided that each heat, instead of every fifth heat of steel, must be tested, and that the height of the drop should be increased.

It was also ascertained that the rail butts heretofore tested under the falling weight had been from the bottom of the ingot, and it was now made a part of the specifications that the test piece should be taken from the top of the ingot, on account of the probability that the metal would be less perfect at that end.

Testing every heat instead of every fifth heat, as formerly, was considered little short of a revolution in the method of testing at that time.

3. Except in the case of a few companies, the specifications in regard to details of manufacture were not elaborate, being confined almost entirely to allowing for variations from the standard template and from the length of the rail, to smoothness and perfection of finish, to branding, etc.

In view of the agitation for colder rolling, the Pennsylvania Railroad had introduced into its specifications, in 1900, a clause requiring that the rail at the last pass should be at a red heat, preferably a dull red, but in 1901 they replaced it with the so-called "shrinkage clause," which was intended to control the temperature of the rail when being finished, by prescribing that the shrinkage, after the rail was sawed, should not exceed a certain number of inches. This clause was also introduced into the proposed specifications of the American Railway Engineering Association, making an additional requirement in the details of manufacture.

Lately there has been a great deal of argument on the part of the rail manufacturers to have the railway engineers specify a definite percentage of discard from the ingot, in

order to cut off material which is more subject to segregation and more liable to have interior defects from the shrinkage cavity, gas bubbles, etc., but the railway engineers have rigidly set their faces against such a requirement, because they feel that they are much better safeguarded by the clause introduced into the specifications of the American branch of the International Association for Testing Materials, which was that "sufficient material should be discarded from the top of the ingots to insure sound rails."

When that clause was adopted, in 1901, and for a number of years afterwards, the positions of the rail manufacturers and the railway engineers were reversed, the railway engineers believing that it was best to specify a definite amount of discard, while the rail manufacturers took the opposite view. It was well expressed by an engineer of one of the steel companies, who said: "I do not think this association, nor any other should state definitely how much should be sheared from the bloom. The matter is entirely one-sided. If we agree here that 25 per cent. shall be sheared from the bloom, we might assume that would settle it, but it will not. The association will be perfectly safe in making the claim that sufficient shearing will be done to eliminate piping. If the manufacturers can remove the piping by shearing 15 per cent., they will not agree to shear 25 per cent. The object in shearing is to get rid of the piping, and the only matter of agreement will be to reach the point where sufficient shearing is done to remove the piping. For that reason, I think the association will make a mistake to demand that 25 per cent. be sheared off."

The railway engineers of to-day unanimously agree with that point of view, and their position has been further strengthened by an additional test, which will be described later. Furthermore, the records of rail failures which have been kept for a number of years disclose the incontrovertible fact that, where a 15 per cent. discard might do for one ingot, 50 per cent. would not be adequate for another.

In 1902 the American Society of Civil Engineers deemed it advisable, in view of the continual criticism of the sections of rail which they had previously designed, to take up once more the study, both of real design and specifications, and accordingly a committee was appointed for the purpose. The committee of the American Society for Testing Materials also continued its study of the rail question, and joint meetings of all three committees were held so that each would derive benefit from the work of the other.

On April 25, 1906, the committee on standard rail and wheel sections was appointed by the American Railway Association, and on October 24, 1906, the committee was directed to report in addition on the subject of specifications for the manufacture of steel rails, in connection with its report on standard sections. The rail manufacturers were asked to co-operate with the committee by sending representatives to study the question with it at its meetings, and in addition the committee employed disinterested men of national reputation for their knowledge of steel making and the properties of steel, to give expert advice on the subject. After many meetings together a report was submitted on October 30, 1907, containing the recommended rail sections and specifications, both for bessemer and open hearth steel.

Further advice was obtained from disinterested persons, who had a wide knowledge of the properties of steel and its manufacture, and a final report was submitted by the committee on April 22, 1908, with the recommendation that there were many details of the development and the following up of the results in service of the new types of sections, rolled under the new specifications, which would require considerable time and much careful study, and that they could be more efficiently and more appropriately handled by the American Railway Enginering Association. The sections and specifications were, therefore, referred to the American Railway Engineering Association, with the request that it follow up the question in its various details and keep a careful record of the results, with a view to determining whether any changes should be made, either in the specifications or designs.

As the question of discard was dealt with in these reports quite fully, it is advisable to make quotations therefrom, because the earnest consideration given to the question led to the development of an additional test, which is considered of great importance in determining the quality of metal by eliminating a large number of the so-called "piped rails," or rails with interior defects:

"In the matter of discard, there was a desire on the part of the railway members to arrange for a greater discard, and a strong disposition to insist upon a uniform minimum percentage. The manufacturers, however, presented considerable evidence which tended to show that a fixed minimum percentage requirement would be not only unfair but unscientific, claiming that the extent of piping and segregation is influenced by the size of the ingot, the rate of pouring into the mould and other details of mill practice.

With regard to the discard question, the committee has always been of the opinion that it would be preferable to test the finished product rather than specify as to details of mill manufacture.

"In pursuing its investigation of this discard question, the committee received a suggestion from William Metcalf to the effect that it would be reasonably practicable to apply the above theory to the manufacture of rails by arranging to test to destruction a number of rail butts representing a certain portion of the total output and to base rejections on the results of these tests.

"In order to avoid the unnecessary waste of good material, the committee set about to devise means by which the rejection of defective material could be insured without requiring an arbitrary and definite percentage of discard in every case, and a committee of the Pennsylvania Railroad, pursuing the same line of investigation, adopted a tentative specification which provided for a physical test of this nature, and which further provided that when physical defects were discovered all top rails of the heat should be rejected. This would result in a discard of about 25 per cent. to 30 per cent. of the entire metal in the heat whenever physical defects were discovered, and it was felt that a requirement of this nature would not only provide for the rejection of defective material, but would insure the greatest care on the part of the manufacturer.

"A trial lot of the rails of a section corresponding to type 'B' was recently rolled under these specifications as to discard, and the results convinced the committee that a development of this idea would prove the best solution of the discard problem."

In connection with the details of manufacture, an important addition was made by requiring that the brand on the rail should also contain a letter marking the position which the rail originally occupied in the ingot, so as to enable a study to be made of the effect of that position.

On June 5, 1907, a committee of civil and mechanical engineers of the Pennsylvania Railroad System and two rail manufacturers was appointed to take up the study of the rail question, and design new rail sections and recommend new specifications, with the object of improving the quality of material used in rails manufactured for that system.

The first meeting was held on June 12, 1907, and the new rail designs, known as "P.S." sections, were adopted on September 20, 1907. Tentative specifications were recommended on November 15, 1907, and 10,000 tons of rail

rolled in accordance therewith. The specifications were subsequently modified, on criticism of the manufacturers, and issued February 4, 1908.

The new rail designs of the Pennsylvania and the American Railway Association provided for a more even distribution of the metal in the head, web and base and for a thicker base, to meet the views of the rail manufacturers, who believed that a better distribution of the metal would result in an improved quality, due to more favorable rolling conditions. All of these sections are still in service and are being closely watched to determine whether the expected improvement will be realized.

The Pennsylvania Railroad System specifications have been modified several times, in the light of additional experience, and contain the improvements which have been brought about from time to time through the experiences and researches of its own committee and the committees of the other associations. So far as the chemical requirements are concerned, they are practically the same as adopted by the rail manufacturers, and the other associations. The physical requirements are determined by the drop test with the standard machine, and, in addition, the test piece is nicked and broken to reveal the presence or absence of interior defect. In the details of manufacture, the discard is required to be sufficient to secure sound rails, and the shrinkage clause to regulate the temperature of rolling is retained. The rails are marked for position in the ingot, for the purpose of subsequent identification, in order to study the effect of that position.

Similar studies and investigations are being conducted by the New York Central Lines, Harriman Lines, Baltimore & Ohio, Norfolk & Western, Lehigh Valley, Reading, and other companies, and the specifications are being improved as new knowledge is obtained. The first-named company has been foremost in the study of the effect of titanium in steel making.

Through the assignment of the rail question to the American Railway Engineering Association by the American Railway Association, the work of the committee was given official character, and its real work commenced. The first thing of importance accomplished was the introduction of a standard drop testing machine at all the rail mills, so that the results obtained at any one mill were comparable with those obtained at any other. Up to that time, 1908, machines of different design and setting were used, and the results were unreliable. With the year 1909 began the collection of a large amount of information, obtained from research work, bearing on the disputed points of rail manufacture and on proving or testing.

In 1910 the specifications for bessemer rail, formerly adopted by the American Railway Engineering Association, were withdrawn, and new ones, for both bessemer and open hearth, were presented for consideration by the association, which embodied all the improvements in the methods of determining the physical properties and the details of manufacture which had been brought forward up to that time. It was recognized, however, that numerous disputed points could only be cleared up by experimental research conducted by a trained engineer-physicist, and accordingly such an investigator was added to the committee to devote all his time to that work. The engineer of tests, M. H. Wickhorst, since his appointment, has been constantly busy with research work, and has added a great deal to our knowledge of the subject.

He has made reports on the following subjects: Influence of Carbon on Deflection; Drop, Bending and Tensile Tests on Bessemer, Titanium Bessemer, and Open-Hearth Rails; rolled by different mills, including chemical analyses and etched sections; Investigation of a Split Head Rail; Segregation, as influenced by Fire Clay on the Ingot; Strength of Rail Head; Drop Tests of Rails—Effect of Impact Energy variously Distributed; Flow of Rail Heads under Wheel Loads; Segregation and Other Rail Properties as influenced by size of Ingot; Tests of Steel Rail Ingots and derivative shapes made at Watertown Arsenal; Influence of Rolling Temperature on the Properties of Bessemer Rails.

In all of this work Mr. Wickhorst has been afforded every facility by the rail manufacturers for carrying on the investigations, and their machinery, material and laboratory assistants have been placed at his disposal. In addition, their officers have been freely consulted by the committee and have attended some of its meetings.

While at the present time the American Railway Engineering Association has not adopted standard specifications for rails, yet it has had constantly before it for consideration and study a set of proposed specifications which have embodied the best knowledge of the subject, and they have been changed from time to time in the light of new experimental investigation. The most energy has been devoted to the improvement of methods of testing to determine the physical properties, and practically no changes have been made in the chemical requirements from the standard specifications of the rail manufacturers. The railway engineers prefer to subject the finished material to such tests as will cast aside the defective rails. Their specifications, therefore, include many additional tests over those in use ten years ago. The results of the work of the American Railway Engineering association have been closely followed by the railway companies and vice versa, so that the specifications of the railways have been improved from time to time, and now embody the additional tests devised. Rails have been rolled in accordance with these new specifications for several years, and it is believed that a marked improvement is apparent in the rails being laid in the tracks since their adoption.

DETERIORATION OF COAL IN STORAGE.

The amount of deterioration of coal in storage has been determined by accurate tests made by the Bureau of Mines of the United States. The results of these tests are presented in a paper to the American Chemical Society by H. C. Porter and F. K. Ovitz.

Moisture, ash, sulphur and calorific value determinations were made on each sample, the last by means of the Mahler bomb calorimeter and a carefully calibrated Beckman thermometer. The calorimetric work on all except the Sheridan, Wyo., tests has been done throughout by one man, Mr. Ovitz, and with the same instrument. All the calorific values have been calculated to a comparable unit basis, viz., that of the actual coal substance free moisture, sulphur and corrected ash.

The results show in the case of the New River coal less than 1 per cent. loss of calorific value in one year by weathering in the open. There was practically no loss at all in the submerged samples and fresh water seemed to "preserve the virtues" of the coal as well as salt. There was almost no slacking of lump in the run-of-mine samples and the crushed coal in all cases deteriorated more rapidly than run-of-mine.

TITANIFEROUS IRON ORES.

Some 3,789 tons of titanic iron ore were shipped from the St. Urbain mines, Quebec, during 1911. This ore is used as an ore of titanium, in the United States, in the manufacture of special rail steel, and also enters into the composition of special carbons for arc-lights.

BREAK IN LARGE WATER MAIN.

A thirty-six-inch water main caused considerable damage to property when it burst in Toronto on the morning of March 9th last. The cause of the rupture has not definitely been determined, but it is thought that water hammer is responsible for the damage. The flowing water quickly flooded many cellars in the vicinity and necessitated a call

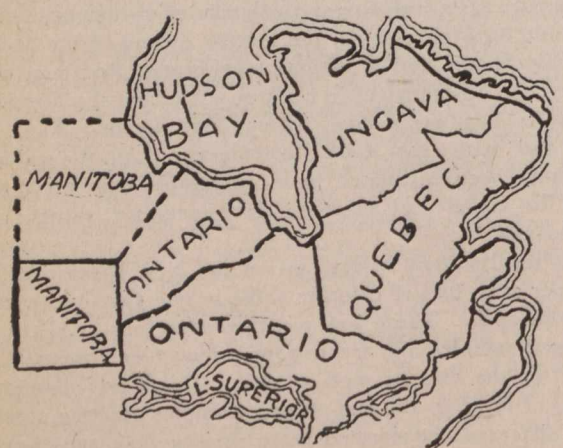
View Showing Flooding of Street Before Water was Shut Off.

being sent in for the steam fire pumps to remove the water from the damaged basements.

The break occurred at 11.30 a.m. and was flowing for about one hour, with the loss of about 1,000,000 gallons of water. The break was repaired by 8.30 a.m. March 11th, the total length of time the main was out of commission being less than 45 hours.

PROVINCIAL BOUNDARY EXTENSIONS.

The boundary extensions of Quebec, Ontario and Manitoba were discussed in the House at Ottawa this week. The government proposes that Ontario shall have a five-mile wide strip from the proposed boundary to the Nelson River; a frontage of ten miles along the east bank of the river for terminals, docks and elevators; a two-hundred-foot right-of-



way to the Hudson Bay Railway to connect with Fort Churchill; and exemption from taxes on land in Manitoba.

The boundaries of Manitoba and Quebec will also be extended. The subsidies to which Manitoba would be entitled apart from the present arrangement, on July 1st, 1912, would total for the year $883,438. This compared with the Alberta subsidy of $1,260,105 and Saskatchewan $1,551,820.

The present area of the provinces are about as follows:

	Square miles
Quebec	351,873
Ontario	260,860
Manitoba	73,732

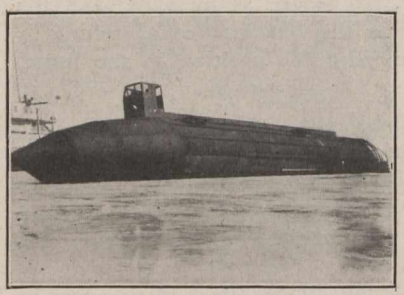
The additional territory would represent (roughly) the following areas:

	Square miles
Quebec	355,000
Ontario	140,000
Manitoba	180,000

The accompanying sketch shows the new territory proposed to be added to the three provinces. Quebec gets Ungava, Ontario that share of Keewatin shown between dotted lines and Manitoba the territory to the north of her present boundary.

THE WRECK OF THE KNAPP ROLLER BOAT.

Our photographer, while engaged about his business near the water-front of Toronto, came upon the wreck of the old Knapp Roller boat frozen in the ice off the foot of Frederick Street. Our readers will remember the stir caused among engineers when the operating principle of this ship was first made public, about the year 1896, and the many prophecies and expectations that arose just previous to the launching and trial trip, which took place in the year 1897.



The wreck is little better than scrap now, the plating being wrenched off in places and almost entirely at one end. The method of operation whereby the ship was expected to move may be briefly stated thus: A large central drum was free to revolve within the outer casing. At the ends of the drum or tube, the propelling machinery was geared to the outer casing, which was furnished with blades in a manner similar to a paddle wheel of a ferry steamer. The trial trip was sufficient to show the impracticability of the project and the ship, instead of making about thirty knots, was unable to make efficient headway, even in a comparatively smooth expanse of water. Shortly afterwards the ship was abandoned, and now lies as depicted in the illustration. The wreck is in the direct path of the proposed government dock to be erected at the Polson Iron Works; and this will doubtless in the near future necessitate its removal. The experiment is reported to have cost about $15,000.

ENGINEERING NOTES.

Montreal, P.Q.—The Engineers' Club of this city are considering the building of an addition to their quarters on Beaver Hall Square. The improvements contemplated will increase the value of the property to $500,000.

Ottawa, Ont.—Hon. Col. Sam Hughes, at a dinner given to the Cavalry Association, stated that the time was coming when military engineers would lay out the public highways, national harbors, etc.

Hamilton, Ont.—A report states that the first macadam pavement to be used as a pavement in Ontario was laid in this municipality. It was placed in position in 1880 and is still in use in certain sections of the city.

Ottawa, Ont.—A delegation waited upon the federal government asking that body to subsidize a proposed tunnel to be built across the St. Lawrence River near Montreal. The tunnel would be used for steam and electric roads.

Great Britain.—Owing to the recent disastrous submarine accident there has been devised a new means of raising sunken vessels. In the operation of this a number of canvas bags are sunk and secured to the wreck by hawsers securely fastened by divers. Compressed air is then driven into the canvas bags or cylinders and the ship raised by means of the air.

Toronto, Ont.—The Board of Control have presented a report on the municipal hydro-electric system wherein they state that the work accomplished up to December 31st, 1911, included the completion of the Duncan Street sub-station building, the building of the high level station, the West Toronto station and the St. Lawrence Market station. The report states that the electrical work in the above mentioned stations is in a very advanced condition, in many cases being 80 and 90 per cent. completed. 198,228 feet of cable were drawn in; 1,251 joints were made; 228 joints were wrapped with asbestos, and 700 transformers were installed. 23,016 concrete and 7,986 wooden poles were erected and 2,151,511 pounds of wire strung.

Regina, Sask.—The municipal Fire, Light and Power Committee have prepared a new set of building laws for the city. The new laws provide that during street track construction no materials shall be deposited nearer than eight feet to the nearest rail; that no permit for sidewalk obstruction shall be valid for more than one week prior to the commencement of the excavation, nor shall the permit be valid for a period exceeding four months; it may, however, at the option of the committee, be renewed for a longer period. The concluding clauses dealing with the protection of the city from responsibility in case of accident and the penalty for non-observance of the by-law were rather indefinite in detail, and the by-law was referred back by the council to the city solicitor for alteration.

Mr. J. A. Brodie, of the Liverpool municipal engineering office, has been recommended by the Liverpool Health Committee to lay out the new capital of India.

PERSONAL.

Mr. L. W. Morden has been appointed sales engineer of the Packard Electric Company; his headquarters will be in Toronto.

Mr. C. C. Owens has recently been placed in charge of the Detroit District Sales Office of the Westinghouse Electric and Manufacturing Company, with the title of district manager.

Mr. E. R. Mathewson has been awarded the gold medal of the Institution of Mining and Metallurgy, London, England. Mr. Mathewson is the general manager of the Anaconda Smelting Works. He is a graduate of McGill University, Montreal, his native city.

Mr. H. E. Grant, sales agent in the light and power department of the B. C. E. R. Co., Vancouver, has been invited by the executive of the National Electric Light Association to read a paper on the education of central station employees at the approaching convention of the body in Seattle.

Mr. H. A. Whiting, of Bellingham, Wis., U.S.A., has been appointed construction engineer of Edmonds, British Columbia. He will have charge and be held responsible for all outside municipal work, while the work of planning new improvements and inspecting subdivision plans will be undertaken by the present engineer, W. A. McPherson.

Mr. Mieville, resident engineer of Messrs. W. H. Allen, Son & Company, of Bedford, Eng. (who are represented in Canada by Messrs. Chapman & Walker, of Toronto), has just left for an extensive tour of the West, and will call at all the leading towns en route.

OBITUARY.

The death is reported of **Mr. John S. Metcalf,** president of the John S. Metcalf Co., Ltd. His death occurred at his home in Evanston, Ill., on the evening of March 4th. Heart trouble and complications were the cause of death. Mr. Metcalf had devoted his life to the designing and construction of large grain elevators. Many of the largest elevators in Canada were his work. He was born near Sherbrooke, Que., in 1847. He leaves a wife and three daughters.

Mr. F. J. L. Tytler, civil engineer, of Vancouver, B.C., is dead in that city. His death was due to heart failure and occurred on Sunday, March 3rd, last. Mr. Tytler was born in India, his father being an officer in the British army. He came to Vancouver in 1890 and was for some time in the employ of the Provincial Government in the superintendence of dyking operations, principally in the Matsqui district. He was married a number of years ago to a sister of the late Captain Livingstone, of Hatzic, and leaves one child. Mr. Tytler was principal of the Technical School of Civil Engineering and Surveying.

MEETINGS.

Victoria, B.C.—The Road Superintendents' Conference was held in this city; Premier McBride and Hon. Thomas Taylor extended a welcome to the delegates. Mr. R. H. Thomson, chief engineer of the Seattle Port Commission, delivered an address in the course of which he stated that it was impossible to lay down any hard and fast rules for road construction. He showed how road engineering had advanced since the days of Telford and Macadam. He showed several lantern slides of roads in Europe to his audience. A number of municipal representatives were present, including Mayor Beckwith and several aldermen, City Engineer Smith and members of his department.

* * * *

A meeting of the Canadian Society of Civil Engineers was held at their rooms on Dorchester Street, Montreal, when considerable discussion was had on reports put in by committees appointed to draft standard specifications and classifications for railroad and road construction. Mr. J. M. Shanley presided over the meeting, and at the close refreshments were served.

* * * *

The fourteenth annual meeting of the Canadian Mining Institute was held in Toronto recently. The occasion was the cause of one hundred and eighty mining engineers and mining men concentrating and conversing on the mineral conditions of this country. Hon. W. H. Hearst, Ontario Minister of Lands, Forests and Mines, read the address of welcome to the delegation and then followed the reading and discussion of various papers. Among these papers were "Manganese and Tungsten Deposits in Nova Scotia," "Accident Prevention or the Conservation of Human Life," "Sanitary Conditions in Mining Camps."

The meetings terminated by a banquet, which was held during the evening of March 8th.

The elections resulted in Mr. G. G. S. Lindsey, K.C., being the new president.

ELECTION OF DOMINION LAND SURVEYORS' ASSOCIATION.

At the annual meeting of the Dominion Land Surveyors' Association, held in Ottawa, March 6th, Mr. R. A. Belanger, of Ottawa, was elected president. The other officers will be: Vice-president, C. F. Miles, Toronto; secretary-treasurer, E. M. Dennis, Department of the Interior, Ottawa; Executive Committee, J. D. Craig, J. J. Steele, J. S. Nash, of Ottawa; auditors. C. Engle, E. L. Burgess, Ottawa; second vice-presidents, Ontario, C. F. Aylesworth, Ottawa; Quebec, G. F. Lonergan, Buckingham; Manitoba, C. H. Bayne, Winnipeg; Saskatchewan, R. H. Montgomery, Prince Albert; Alberta, J. N. Wallace, Edmonton; British Columbia, J. E. Ross, Kamloops; Yukon, F. H. Kitto, Dawson.

OTTAWA BRANCH CANADIAN SOCIETY CIVIL ENGINEERS.

An interesting lecture was delivered by Mr. A. A. Dion, superintendent of the Ottawa Electric Company, before the Ottawa branch of the Canadian Society of Civil Engineers, on March 6th. "The Choice of Current and Motors in Electrical Installations" was the subject. Mr. Dion lucidly described the properties of different currents, giving information of a most helpful kind for those who have to decide as to what systems to use in installation of light or power. The lecture was illustrated by charts and apparatus.

COMING MEETINGS.

NATIONAL ASSOCIATION OF CEMENT USERS.—March, 11th-16th. Annual Convention at Kansas City, Mo. Sec'y, Edward E. Krauss, Harrison Bldg., Philadelphia, Penn.

ALBERTA BUILDERS EXCHANGE.—Annual Convention to be held in Lethbridge, Alta., on March 16th, 1912. Business sessions will be brought to a close with a banquet.

CANADIAN INSTITUTE.—198 College Street, Toronto. Saturday Evening Lectures, 8 p.m. March 16th,—"The Relative Blood Supply to the Various Organs of the Body," by Prof. Brodie, Toronto University, March 23rd,—"Waste Land Problems,' by Dean Fernow, Toronto University.

ENGINEERING SOCIETIES.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—413 Dorchester Street West, Montreal. President, W. F. TYE: Secretary. Professor C. H. McLeod.

VICTORIA BRANCH—Chairman, F. C. Gamble; Secretary-Treasurer, R. W. Macintyre

QUEBEC BRANCH—Chairman, P. E. Parent; Secretary, S. S. Oliver. Meetings held twice a month at room 40, City Hall.

TORONTO BRANCH—96 King Street West, Toronto. Chairman, T. C. Irving; Acting Secretary, T. R. Loudon, University of Toronto. Meets last Thursday of the month at Engineers' Club.

MANITOBA BRANCH—Secretary E. Brydone Jack. Meets every first and third Friday of each month, October to April, in University of Manitoba, Winnipeg.

VANCOUVER BRANCH—Chairman, Geo. H. Webster: Secretary, H. K. Dutcher, 319 Pender Street West, Vancouver. Meets in Engineering Department. University.

OTTAWA BRANCH—
177 Sparks St. Ottawa. Chairman, S. J. Chapleau, Ottawa; Secretary, H. Victor Brayley, N.T. Ry., Cory Bldg. Meetings at which papers are read, 1st and 3rd Wednesdays of fall and winter months; on other Wednesday nights in month there are informal or business meetings,

MUNICIPAL ASSOCIATIONS

ONTARIO MUNICIPAL ASSOCIATION.—President, Chas. Hopewell, Mayor, Ottawa; Secretary-Treasurer, Mr. K. W. McKay, County Clerk, St. Thomas, Ontario.

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

THE UNION OF CANADIAN MUNICIPALTIES.—President, W. Sanford Evans, Mayor of Winnipeg; Hon. Secretary-Treasurer, W. D. Lighthall, K.C., Ex-Mayor of Westmount.

THE UNION OF NEW BRUNSWICK MUNICIPALITIES.—President, Councillor Siddall, Port Elgin; Hon. Secretary-Treasurer, J. W. McCready, City Clerk, Fredericton.

UNION OF NOVA SCOTIA MUNICIPALITIES.—President, Mr. A. S. MacMillan, Warden, Antigonish, N.S.; Secretary, A. Roberts, Bridgewater, N.S.

UNION OF SASKATCHEWAN MUNICIPALITIES.—President, Mayor Bec, Lemberg; Secretary, Mr. Heal, Moose Jaw.

UNION OF BRITISH COLUMBIA MUNICIPALITIES.—President, Mayor Planta, Nanaimo, B.C.; Hon. Secretary-Treasurer, Mr. H. Bose, Surrey Centre, B.C.

CANADIAN TECHNICAL SOCIETIES

ALBERTA ASSOCIATION OF ARCHITECTS.—President, G. M. Lang Secretary, L. M. Gotch, Calgary, Alta.

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

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

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

BUILDERS' CANADIAN NATIONAL ASSOCIATION.—President, E. T. Nesbitt; Secretary-Treasurer, J. H. Lauer, Montreal, Que.

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

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Secretary-Treasurer, Wm. Snaith, 57 Adelaide Street, Toronto, Ont.

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

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

CANADIAN FORESTRY ASSOCIATION—President, John Hendry, Vancouver. Secretary, James Lawler, Canadian Building, Ottawa.

CANADIAN GAS ASSOCIATION.—President, Arthur Hewit, General Manager Consumers' Gas Company, Toronto; J. Keillor, Secretary-Treasurer, Hamilton, Ont.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, W. Doan, M.D., Harrietsville, Ont.; Secretary-Treasurer, Francis Dagger, 21 Richmond Street West, Toronto.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President, Dr. A. E. Barlow, Montreal; Secretary. H. Mortimer Lamb, Windsor Hotel, Montreal.

CANADIAN PEAT SOCIETY.—President, J. McWilliam, M.D., London, Ont.; Secretary-Treasurer, Arthur J. Forward, B.A., 22 Castle Building, Ottawa, Ont.

THE CANADIAN PUBLIC HEALTH ASSOCIATION.—President, Dr. Charles A. Hodgetts, Ottawa; General Secretary, Major Lorne Drum, Ottawa.

CANADIAN RAILWAY CLUB.—President, A. A. Goodchild; 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, 70 Bond Street, Toronto.

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

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

DOMINION LAND SURVEYORS.—President, Mr. R. A. Belanger, Ottawa; Secretary-Treasurer, E. M. Dennis, Dept. of the Interior, Ottawa.

EDMONTON ENGINEERING SOCIETY.—President, J. Chalmers; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alberta.

ENGINEERING SOCIETY, TORONTO UNIVERSITY.—President, W. B. McPherson; Corresponding Secretary, A. McQueen.

ENGINEERS' CLUB OF MONTREAL.—Secretary, C. M. Strange, 9 Beaver Hall Square, Montreal.

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

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

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

INTERNATIONAL ASSOCIATION FOR THE PREVENTION OF SMOKE.—Secretary R. C. Harris, City Hall, Toronto.

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

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

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, J. N. MacKenzie; Secretary, A. R. McCleave, Assistant Road Commissioner's Office, Halifax, N.S.

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, Major. T. L. Kennedy; Hon. Secretary-Treasurer, J. E. Farewell, Whitby; Secretary-Treasurer, G. S. Henry, Oriole.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, T. B. Speight, Toronto; Secretary, Killaly Gamble, 703 Temple Building, Toronto.

THE PEAT ASSOCIATION OF CANADA.—Secretary, Wm. J. W. Booth, New Drawer, 2263, Main P.O., Montreal.

PROVINCE OF QUEBEC ASSOCIATION OF ARCHITECTS.—Secretary, J. E. Ganier, No. 5. Beaver Hall Square, Montreal.

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

ROYAL ASTRONOMICAL SOCIETY.—President, Prof. Louis B. Stewart, Toronto; Secretary, J. R. Collins, Toronto.

SOCIETY OF CHEMICAL INDUSTRY.—Dr. A. McGill, Ottawa, President; Alfred Burton, Toronto, Secretary.

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

WESTERN CANADA IRRIGATION ASSOCIATION.—President, Wm. Pierce, Calgary; Secretary-Treasurer, John T. Hall, Brandon, Man.

WESTERN CANADA RAILWAY CLUB.—President, R. R. Nield; Secretary, W. H. Rosevear, 115 Phœnix Block, Winnipeg, Man. Second Monday, except June, July and August, at Winnipeg.

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.

PLANS AND SPECIFICATIONS ON FILE.

The following Plans (P.) and Specifications (S.) are on file for reference only unless otherwise noted at the office of The Canadian Engineer, 62 Church Street, Toronto:—

Bids close		Noted in issue of
3-18	Concrete reservoir (2,000,000 gallons' capacity), Moose Jaw, Sask.....(P. & S.)	2-22
3-18	Centrifugal pumps, motors, etc., Moose Jaw, Sask. .....(P. & S.)	2-22
3-18	Valves and Fittings, Moose Jaw, Sask. .....(P. & S.)	2-22
3-18	96,000 ft. of 18-in. Steel Pipe, Moose Jaw, Sask. .....(S.)	2-22
-15	Pavements, Welland, Ont. .....(P. & S.)	2-29
3-25	Prime mover equipment, electric lighting equipment, etc., Moose Jaw, Sask.....(S.)	3-7

TENDERS PENDING.

In Addition to Those in this Issue.

Further information may be had from the issues of The Canadian Engineer referred to.

Place of Work.	Tenders Close.	Issue of.	Page.
Belleville, Ont., concrete mixer.	Mar. 13.	Feb. 7.	59
Calgary, Alta., boiler feed pump and switchboards ...	Mar. 15.	Feb. 29.	59
Calgary, Alta., sewer and conduit pipe	Mar. 14.	Feb. 29.	59
Calgary, Alta., designs for aqueduct	May 1.	Feb. 22.	70
Calgary, Alta., electric machinery	Mar. 20.	Feb. 8.	68
Carp, Ont., church	Mar. 21.	Feb. 7.	59
Cheticamp, N.S., dredging	Mar. 20.	Feb. 7.	60
Columbus, Ont., 12 reinforced concrete bridges	Mar. 18.	Feb. 7.	59
Edmonton, Alta., steel highway Bridges	Mar. 15.	Feb. 22.	59
Fredericton, N.B., concrete substructure and approaches to bridges	Apr. 1.	Feb. 29.	59
Fredericton, N.B., bridge at Stone Ridge	Mar. 18.	Feb. 7.	89
Fredericton, N.B., culvert, McKenzie Hollow	Apr. 3.	Feb. 7.	89
Fredericton, N.B., culvert, Pokiok Embankment	Mar. 25.	Feb. 7.	59
Green Point, N.B., breakwater.	Mar. 18.	Feb. 29.	60
High River, Alta., schoolhouse.	Mar. 15.	Feb. 29.	59
Lorneville, N.B., extension to breakwater	Apr. 1.	Feb. 7.	60
Merid, Sask., road grader and scrapers	Mar. 24.	Feb. 7.	60
Moose Jaw, Sask., reservoir ...	Mar. 18.	Feb. 22.	66
Moose Jaw, Sask., pumps, motors, etc.	Mar. 18.	Feb. 22.	66
Moose Jaw, Sask., turbo-generating set; generator	Mar. 30.	Feb. 7.	60
Moose Jaw, Sask., prime mover equipments, etc.	Mar. 29.	Feb. 7.	68
Moose Jaw, Sask., valves and fitting;	Mar. 18.	Feb. 22.	66
Moose Jaw, Sask., laying steel water pipe	Mar. 18.	Feb. 22.	66
Point Grey, B.C., plans for University	July 21.	Feb. 7.	60
Prince Albert, Sask., sewer pipe.	Mar. 15.	Feb. 29.	68
Saskatoon, Sask., electrical equipment	Mar. 22.	Feb. 29.	68
Saskatoon, Sask., Portland Cement	Mar. 15.	Feb. 29.	70
Saskatoon, Sask., labor on storm sewers	Mar. 29.	Feb. 29.	72
Saskatoon, Sask., sewer and water construction	Mar. 29.	Feb. 29.	72
South Gloucester, Ont., brick veneer presbytery	Mar. 15.	Feb. 29.	60
St. Jerome, Que., hydro-electric installation		Feb. 7.	68
Toronto, Ont., electrical equipment	Mar. 26.	Feb. 7.	68
Toronto, Ont., work on T. & N.O. Rly.	Mar. 20.	Feb. 7.	60
Toronto, Ont., rails, ties and fastenings	Mar. 19.	Feb. 29.	68
Vancouver, B.C., water pipe ...	Mar. 20.	Feb. 29.	60
Welland, Ont., pavement	Mar. 18.	Feb. 29.	72
White Rock, B.C., quarantine station	Mar. 15.	Feb. 15.	59
Winnipeg, Man., drawings for Parliament Buildings	Mar. 31.	Jan. 25.	70
Winnipeg, Man., cables	Mar. 25.	Feb. 15.	60

TENDERS.

Calgary, Alta.—Tenders will be received until March 25th, 1912, for the erection of a modern business block, 125 feet by 130 feet, three storeys high, in Medicine Hat. Plans, etc., at office of the architect, Mr. F. J. Lawson, Norman Block, Calgary.

Calgary, Alta.—Tenders will be received up to noon of April 15th, 1912, for the design, manufacture and erection complete on piers to be provided by the railway company, of steel highway bridges for the C.P.R. Company. Full instructions may be had on application to A. S. Dawson, Chief Engineer, C.P.R., Calgary, Alta. (See advt. in Can. Eng.)

Halifax, N.S.—Tenders will be received until March 27th, 1912, for the construction of a garbage incinerator and accessories complete in accordance with specifications on file at the City Engineer's office, where forms of tender, etc., may be obtained. J. J. Hopewell, Clerk of Works, City Works Office, Halifax, N.S.

Hamilton, Ont.—Tenders will be received by Mr. J. Wall, general manager of British Canadian Canners, Limited, Lister Block, Hamilton, Ont., for the several works required in the erection of canning factories, warehouses, etc., at Cobourg, Bowmanville, Port Robinson, Merlin and Highgate, Ont. Tenders close at noon, Saturday, March 23rd. Plans and specifications may be seen at the residence of the local manager at above places, at the company's offices at Hamilton, and at the offices of Munro and Mead, architects, Chancery Chambers, Hamilton.

Kerrisdale, B.C.—The corporation of the municipality of Point Grey invites tenders for the supply of pipes and all material and for the installation of a system of sewerage for Eburne district. Drawings, etc., may be seen at the office of the engineers, Messrs. Cleveland & Cameron, 506 Winch Building, Vancouver, B.C. Tenders to be received until March 18th, 1912. H. Floyd, clerk of municipal council, Municipal Hall, Kerrisdale, B.C.

Lethbridge, Alta.—Tenders will be received up to noon of Thursday, April 11th, 1912, for approx. 2½ miles of sanitary sewers; approx. 3½ miles of cement walks (curb and gutter in addition); approx. 7 miles of grading. Plans and specifications on file at the office of the City Engineer, A. C. D. Blanchard, also office of Canadian Engineer, Winnipeg. G. W. Robinson, Secretary-Treasurer. (See advt. in Can. Eng.)

Oakville, Ont.—Tenders will be received until April 1st, 1912, for the construction of main sewerage and sewage disposal works in the town of Oakville. Specifications may be obtained at the office of the engineer, T. Aird Murray, 303 Lumsden Building, Toronto. C. A. Bradbury, town clerk, Oakville, Ont. (See advertisement in Canadian Engineer.)

Ottawa, Ont.—The Dept. of Public Works invite tenders for the interior fittings to Post Office, Customs and Inland Revenue, Campbellton, N.B. Tenders to be received until March 18th, 1912. Plans, etc., at the office of Mr. John Quin, Clerk of Ways, Campbellton; D. H. Waterbury, Clerk of Works, St. John, N.B.; and office of R. C. Desrochers, Secretary Dept. of Public Works, Ottawa.

Ottawa, Ont.—Tenders will be received until March 14th, 1912, for the purchase of the damaged machinery of dredge "New Brunswick," stored in the Custom House at St. John, N.B. Forms of tender can be obtained at the office of G. G. Scovil, Esq., Supt. of Dredges, Dept. of Public Works, St. John, N.B. R. C. Desrochers, Secretary Dept. of Public Works, Ottawa.

Ottawa, Ont.—Tenders for the erection of a frame schoolhouse on the St. Mary's Indian Reserve near Fredericton, N.B., will be received up to noon of April 4, 1912. J. D. McLean, assistant deputy and secretary, Department of Indian Affairs, Otttawa.

Port Arthur, Ont.—Tenders for paving will be received until Monday, April 8th, 1912. Specifications, etc., may be obtained from L. M. Jones, city engineer, Port Arthur. J. McTeigue, city clerk, Corporation Offices, Port Arthur. (See advertisement in Canadian Engineer.)

Prince Albert, Sask.—Tenders will be received by C. O. Davidson, secretary-treasurer of this city, up to noon of Friday, March 29th, for the construction of sewers, sewage plants, and water mains and materials. (See details of tender in the advertising section of this issue.)

Saskatoon, Sask.—Tenders will be received until March 20th, 1912, for all trades above ground level, also basement interior fittings, for the parish church of St. John, Saskatoon. Plans, etc., at the Builders' Exchange, Winnipeg, and at the office of Messrs. Thompson, Daniel & Colthurst, Architects, 410 Drinkle Bldg., Saskatoon.

Saskatoon, Sask.—Tenders will be received up to noon of April 5th, 1912, for the laying of approximattely 23,100 sq. yds. of sandstone block pavement. All information may be had on application to Geo. T. Clark, City Engineer, Saskatoon. (See advt. in Can. Eng.)

Toronto, Ont.—The Dept. of Public Works invite tenders for the erection of an addition to the Registry and Land Titles Office, North Bay, including separate tenders for plumbing, heating and electric wiring. Tenders to be received until March 26th, 1912. Plans, etc., at the Registry Office, North Bay, also at the office of H. F. McNaughton, Secretary to Public Works, Ontario, Dept. of Public Works, Toronto, Ont.

Toronto, Ont.—Tenders for the construction of Section No. 15 (Rosedale Creek Syphon) High Level Interceptor, will be received until March 26th, 1912. Plans, etc., at the office of the City Engineer, Toronto. G. R. Geary (Mayor), Chairman Board of Control. (See advt. in Can. Eng.)

Toronto, Ont.—Tenders for the construction of the Garrison Creek Extension, Section No. 1, will be received up to noon, March 26th, 1912. Specifications at the office of the City Engineer, Toronto. G. R. Geary (Mayor), Chairman Board of Control. (See advt. in Can. Eng.)

Toronto, Ont.—Tenders will be received until March 26th, 1912, for one 30-inch Venturi water meter for the waterworks department. Specifications, etc., at the office of the city engineer, Toronto. G. R. Geary (Mayor), chairman, Board of Control, City Hall, Toronto.

Winnipeg, Man.—Tenders for supply of asphalt required by the city for paving purposes during the year 1912, will be received up to noon, March 20th, 1912. Specifications, etc., at the office of the City Engineer, 223 James Avenue, Winnipeg. M. Peterson, Secretary Board of Control Office, Winnipeg. (See advt. in Can. Eng.)

Winnipeg, Man.—Tenders for the supply of labor and materials required in the erection of approximately 10,560 feet in length of 36-inch wooden stave pipe line, will be received until March 19, 1912. Specifications, etc., may be obtained at the office of the City Engineer, 223 James Ave., Winnipeg. M. Peterson, Secretary Board of Control Office, Winnipeg.

Winnipeg, Man.—Tenders for the supply of one or more deep well turbine pumps, driven by electric motor and capable of pumping one million Imperial gallons per 24 hours, will be received until April 1st, 1912. Specifications, etc., may be obtained at the office of the City Engineer, 223 James Ave. M. Peterson, Secretary Board of Control Office, Winnipeg.

CONTRACTS AWARDED.

Athens, Ont.—Public Building.—Contractor: John Dillon, of Seeley's Bay, Ont.

Brantford, Ont.—Mr. T. A. Cowan, of Brantford, has received the contract for the supply of sewer pipes required by the city during 1912. Among other tenderers were the Hamilton and Toronto Sewer Pipe Co. and the Ontario Sewer Pipe Company. T. Harry Jones, City Engineer.

Brooklyn, N.S.—Supply of 20,000 bbls. of cement.—Contractors: Canada Cement Co., Ltd., of Montreal.

Courtenay Bay, St. John, N.B.—Breakwater, Wharves, etc., etc.—Contractors: Norton Griffiths & Co., Ltd., of Montreal.

Hamilton, Ont.—The Hamilton & Toronto Sewer Pipe Company have been awarded the contract for the supply of sewer pipe required by the city for 1912.

Kingston, Ont.—Mr. Michael Sullivan has been awarded the contract to erect the new dormitory of the Royal Military College in this city.

Port Stanley, Ont.—Breakwater and Dredging.—Contractor: M. J. Hogan, of Port Colborne, Ont.

Saskatoon, Sask.—Contracts for the construction of Saskatoon pavements have been awarded as follows: 63,000 yds. at $2.90, to the Bitulithic & Contracting Co.; 20,000 yds. asphalt concrete at $2.80, to the El Oso Paving Co., and 40,000 yds. sheet asphalt at $2.85, to the same firm.

Saskatoon, Sask.—Contracts for the construction of concrete walk and curbing have been let as follows: 14 miles to Western Pavers, Limited, Winnipeg, Man., at 17 cents per sq. ft. on walk and 32 cents per lin. ft. on curb; 7 miles to Robinson & Foster, Spokane, at 16¾ cents on walk and 32 cents for curb.

Toronto, Ont.—The Steel & Radiation Co. have just closed a contract for Crittall Metal Casement windows in the new Canadian Pacific Railway office building, Toronto. This is one of the largest contracts ever let in this type of window. Contract was settled entirely on the merits of the window.

Three Rivers, Que.—Additional filling at new coal docks.—Contractors: J. J. Collins and V. W. Giroux, of Ottawa, Ont.

Vancouver, B.C.—Mr. Bedford Davidson, contractor, has been awarded the contract calling for the erection of a building to be known as the James Borland block. The exterior of the structure is to be faced with buff Clayburn, pressed brick and terra cotta. Parr, McKenzie & Day are the architects.

Vancouver, B.C.—The contract for the construction of the James Borland Block on Hastings Street, was awarded to Mr. Bedford Davidson, contractor. Steel frame work, concrete and brick will make up the construction of the building. Exterior of building is to be faced with buff Clayburn pressed brick and terra cotta. Estimated cost, $85,000.

Vancouver, B.C.—Six-story hotel on Cordova Street, 25 x 122 feet; concrete, brick and mill construction; cost, $60,000; architect, Mr. J. R. MacDonald; contractors, Messrs. Baynes & Horie. Two-story store and office building, Homer and Water Sts.; brick and mill construction; contractors, the Burrard Construction Company; estimated cost, $30,000.

Vancouver, B.C.—The tender of the H. V. Tucker Company for providing crushed rock for all projected road work in North Vancouver has been accepted. It was the lowest of three tenders submitted, as follows: The Producers' Rock & Gravel Company, $120,350; Granite Quarries, Ltd., $110,655; H. V. Tucker Company, $89,285.

Victoria, B.C. — The contract for the erection of the building of the New Method Laundry has been awarded to Messrs. S. and C. Carkreek. It is to be of brick, 114 by 48.

Winnipeg, Man.—Messrs. Seimans Bros. Dynamo Works have been awarded the contract to supply the transformers and switchboards for the city. This firm will install the above previous to June 30th, 1912.

Winnipeg, Man.—Erection of fender, Redwood Bridge; Messrs. Holmes Bros.; cost, $13,156.20.

Winnipeg, Man. — Twenty-four-inch disk rock crusher, Messrs. Mussens Limited; cost, $1,695.

RAILWAYS—STEAM AND ELECTRIC.

Province of Alberta.—The Grand Trunk Pacific Railway officials are desirous of completing the line to Lethbridge as soon as possible. The contract for the grading will be let March 15th, and the work is to be completed this fall.

Calgary, Alta.—The Canadian Pacific Railway are planning to construct fifteen additional sidings in a new yard to be opened adjoining the present one.

Medicine Hat, Alta.—Ald. Howland has made preparations for the introduction of a bill calling for the construction of a street railway in this city.

Port Arthur, Ont.—A report states that the Canadian Northern Railway officials are about to order the extension of their grain elevator at this point to a capacity of 24,000,000 bushels. The present capacity is 7,000,000 bushels. According to the report the work is to commence this spring.

Vancouver, B.C.—The municipal engineering staff under Mr. Fellowes, City Engineer, has been at work on the plans for the crossing projection of that city, in order to have them completed in time for presentation to the Railway Board when that body hold their meeting in Vancouver during the coming spring.

Western Canada.—The C.P.R. work on new stations in the West during the approaching summer will be extensive, and the officials at Calgary are making preparations for new erections at Webb, Namaka, Seven Persons, Winnifred, Danmore, Clive, Nevis, Lougheed, Aldersyde, Jaffray, Burmis, Galloway and Yahk.

LIGHT, HEAT AND POWER.

Berlin, Ont.—The Light Commissioners have decided to discard the gas producer plant and rely entirely on the power of the hydro-electric commission. The plant cost $80,000.

Brantford, Ont.—It is reported that the Lake Erie and Northern Railway will operate their system by means of the hydro-electric current, providing the prices offered are reasonable. This would mean that all towns between Brantford and Port Dover and Brantford and Galt would be along the line of the distributing cables.

Calgary, Alta.—During the month of February, 1912, this city used $8,149.20 of electricity for various power purposes. The receipts of the electrical department of the city for the month of February amounted to $21,417.75. This was made up as follows: Meter light, $20,110.62; flat rate light, $1,289.81; meter power, $9,879.32, and flat rate power, $138.

St. Marys, Ont.—The St. Marys Cement Company have signed a contract whereby that plant will in future be supplied with power from the hydro-electric commissioners. It is estimated the cost of the line and transformers will total $15,000. The original estimate of power rate to be charged was figured on the basis of the town using 500 horse-power. The estimated rate was $29.50 per horse-power. So far the town has been actually using only some 200 horse-power, and paying $38 per horse-power. With the Cement Company sharing the expense the rate will be reduced. It is anticipated that St. Marys will have a rate at least as low as $29.50.

Vancouver, B.C.—The British Columbia Electric Railway have started work on a new sub-station in the district of Collingwood. The cost of this with interior equipment is estimated at $100,000.

GARBAGE, SEWAGE AND WATER.

Montreal, P.Q.—Major Howard has recommended to the Board of Control, the building of about twenty miles of sewers as speedily as possible.

Port Stanley.—The by-law calling for the expenditure of $22,000.00 for waterworks improvement has been carried by the ratepayers.

Ridgetown, Ont.—Mr. F. W. Farncomb, C.E., of London, Ont., acting for the Town of Ridgetown has awarded the contract for the installation of the pumping equipment to the Canadian Fairbanks-Morse Company of Toronto for the sum of $7,500. The equipment will consist of one Fairbanks-Morse 60 H.P. natural gas engine, one Fairbanks-Morse 40 H.P. gasoline engine, two Smart-Turner double acting triplex power pumps and three Goulds deep well pumps. The installation to be complete June 1st, 1912. The contract for the power house and pump well has been awarded to Geo. Poag, of Ridgetown, Ont.

Regina, Sask.—City Commissioner McPherson has been investigating the municipal water supply, and has announced that there is available enough water for a population double that now in the city.

Victoria, B.C.—Ald. Cuthbert has made a motion in the council meeting that the city look for a new and additional source of supply for the water system of the city. Elk Lake has been mentioned as a probable site for a new intake. The Sooke Lake scheme will not be completed for two years at the least and the city's supply must be secured from Elk Lake unless it be augmented through the city's right to purchase water by the gallon from the Esquimalt Water Works Company.

Westmount, Montreal, P.Q.—The recent suit brought by the Montreal Water and Power Company against the municipality resulted in a decision being given in favor of the defendants. The dispute was in regard to the yearly assessment rate of water payment.

BUILDINGS AND INDUSTRIAL WORKS.

Guelph, Ont.—The Crowe Iron Works are about to make an important addition to their plant. Two new buildings and an extra story will be added to the core room, will be erected.

Hamilton, Ont.—The Gartshore Thomson Company are about to erect an addition to their plant. This has become necessary owing to the large contract recently secured from the municipality for cast-iron pipe.

Montreal, P.Q.—Mr. C. A. Reeves, architect, is at present preparing plans for a new school building for the Catholic School Commissioners of Maisonneuve. It will be three storys and basement; 186 x 70.

Montreal, P.Q.—Plans have now been completed for the utilization of the land recently given to McGill University by Sir William Macdonald. It is proposed to erect a gymnasium, swimming bath, a new grand stand to accommodate 8,000 people and new dormitories. The whole scheme is expected to cost about $250,000.

Ottawa, Ont.—The federal government have passed an order in council calling for the erection of the new department building on the Wellington St. site. The preparation of plans for the new building will be considered at once as the congestion existing in the different departments makes necessary the provision of additional accommodation as soon as possible. It is quite probable that either competitive designs will be asked or plans previously prepared on that basis utilized.

Port Moody, B.C.—The Port Moody Sand and Gravel Company has been organized to operate on these materials near this point. One of the largest hydraulic pumps in the province is to be installed by the company to lift the sand and gravel, which test borings have shown exist in immense quantities along the beach just below water level. The company will require 750 horsepower in electrical energy to operate the hydraulic pump and machinery at its bunkers.

Saskatoon, Sask.—Mr. W. R. Sherman of Calgary, has secured a lease of the building of the Star theatre, and announces his intention of spending a cosiderable sum of money to remodel the building.

St. Thomas, Ont.—The Hall and Market Committee of the city have been empowered by the municipal council to secure plans for a market shelter. The cost of this is estimated at $12,000. M. H. Baker, City Engineer.

St. Catharines, Ont.—A proposal to dispose of the present fire hall and erect a new structure has been approved by the council.

Stratford, Ont. — A movement is under way to secure funds for the erection of a $15,000 Salvation Army Citadel in this city.

Taber, Alta.—Messrs. W. W. Douglas, E. B. Tainter and J. T. Willard, are about to organize a company to erect a 200-barrel flour mill in this town. The capital will be all obtained from local sources.

Vancouver, B.C.—Mr. J. R. MacDonald is the architect for a new hotel now under construction on Cordova Street opposite the C.P.R. depot. The building material is to be concrete and brick and the plan calls for mill construction.

Vancouver, B.C.—Messrs. Summervell and Putnam are the architects for a large storage warehouse now under construction for Crane and Company. It is being built with a steel and concrete system of supports. It will have a height of seven stories and will present a face of buff pressed brick laid in an artistic manner. It is to cost $125,000.

Victoria, B.C.—Alexandra Lodge 116, Sons of England, have formed a committee to report on the building of a new hall. It is the intention to erect a handsome hall which will be for the use of the English societies of Victoria in general.

Victoria, B.C.—A site for the erection of a new Roman Catholic Cathedral has been purchased in this city. Bishop Alexander McDonald negotiated the property transaction. The plans for the new building, although worked out in the rough, do not call for the erection to proceed for a short time.

Victoria, B.C.—Messrs. Crompton and Barton are representing the promoters of a new steam laundry, to be known as the New Method. The contract for the erection of the building has been let to Messrs. S. and C. Carkreek.

Winnipeg, Man.—Messrs. Matthews-Laing & Company, of Toronto and Montreal, are planning to erect an eight-story building in this city.

BRIDGES, ROADS AND PAVEMENTS.

Bridgeburg, Ont.—Arrangements are being completed for enlarging the international bridge crossing the Niagara River between Bridgeburg and Black Rock, and a portion of the plant is already on the ground.

Coquitlam, B.C.—The provincial government announce that they will not construct a bridge over the Pitt River during the year 1912. They give as their reason that sufficient money was not appropriated in the estimates for this structure.

Fredericton, N.B.—The contracts for the construction of the following bridges have been awarded by the Provincial Board of Works: Hunter's Ferry Bridge, parish of Canning, Queen's County, awarded to Frank L. Boone, of St. Marys, price $23,000. Cole's Island Bridge, Queens County, awarded to Messrs. Robert and Charles Forbes, of Gibson, the contract price being in the vicinity of $10.000. Messrs. Forbes will also construct the Burpee Bridge in Queens County, the contract price being in the vicinity of $7,000; Mr. Boone has been awarded the contract for the construction of the Chase Bridge, also in Queens County, the contract price being about $3,500.

Province of Quebec.—The government programme of highway construction includes the building of main highways from Montreal to Quebec, Montreal to Rouses Point, to Sherbrooke, and from Quebec to Rimouski and other points, upon condition that the municipalities along the way agreed to pay one-half the interest charge.

Vancouver, B.C.—A conference will be held between the bridges committee and the officials of the Western Canada Power Company, regarding the construction of a bridge for railway purposes.

Welland County, Ont.—This community has prepared plans for road improvement, with the assistance of the government. The county expect to spend $100,000.

York County, Ont.—The York County Good Roads Commission have ordered the paving of the road from Humber Bridge to Mimico Asylum with tar surface concrete, at a cost of $10,000 per mile. The McKnight Construction Co., of Toronto, have secured the contract for the work.

FIRES.

Winnipeg, Man.—Fire damaged the premises of the Radford Wright Company, Ltd., sash and door manufacturers. Loss $50,000.

Winnipeg, Man.—Fire which broke out in the building occupied by Messrs. Gowan-Kent caused damage to the extent of $75,000. One half of the building was occupied by Messrs. Mason & Risch, piano merchants.

CURRENT NEWS.

Clayoquot, B.C.—Plans have been prepared for the construction of a gasoline-propelled cannery tender of about 100 tons register for use at Clayoquot. The power vessel is to be used to carry fish from the fishing grounds at the West Coast port to the cannery. It is expected that construction will be commenced in a few days on this vessel at one of the shipyards in Victoria.

Gloucester, Ont.—The council of this town have passed an order calling for the purchase of a quantity of dynamite to be used in breaking the ice in the Ottawa River.

Guelph, Ont.—The City Hotel was damaged by fire to the extent of $25,000 or more.

Prince Rupert, B.C.—A report states that Mr. D. C. Whiteford has discovered a valuable salt well on his claim at 46 mile, Grand Trunk Pacific Railway. A gallon of the water from the well when evaporated gives one-half pound of salt.

Medicine Hat, Sask.—This municipality will spend $200,000 on local improvements during the present year.

Province of New Brunswick.—A company is being formed to operate on the New Brunswick shales. They will apply for a charter from the legislative assembly. Messrs. Inches and Hazen, St. John, N.B., are the solicitors for the company.

Ottawa, Ont.—The proposed plan to appoint a city architect has taken definite shape. Ald. Nelson and Black are interested in the matter.

Owen Sound, Ont.—The ratepayers voted in favor of the three industrial by-laws as follows: The drydock and shipbuilding by-law, 1,794 to 85; the Aetna Rubber by-law, 1,863 to 28, and the cement by-law, 1,820 to 51.

Porcupine, Ont.—The Bank of Toronto have just completed a new banking office in this town. This is the first brick building in Porcupine.

Port Alberni, B.C.—The proposed erection of the new public school at Port Alberni will not be proceeded with immediately, all of the tenders received in response to the government's invitation for bids being found disproportionately high. Fresh tenders will probably be asked for.

St. Catharines, Ont.—The ratepayers will vote on a by-law calling for the purchase of the plant of the St. Catharines Gas Company for $38,000.

Vancouver, B.C.—The Great Northern Railway Company improvements have been undertaken and are now well started. Considerable work of a preliminary nature has been done on the dock site, next to the British Columbia Sugar Refinery Company, and contracts have been let for some of the grading and filling for the False Creek project.

Victoria, B.C.—Mr. Louis Coste has presented his report on the cost of improving the harbor of this city. A breakwater to cost $1,250,000 and a pier to cost $400,000. As to the outer harbor, Mr. Coste does not think it advisable to recommend for the present the construction of such a breakwater as would be required to afford protection from the south-west. Such a breakwater would cost $2,500,000. as it would have to be 3,000 feet in length and to extend into a depth of water of 250 feet. Moreover, while protection in that quarter is desirable, the large steamers are not greatly

inconvenienced by the south-west seas. Protection from the more frequent south-east gales is much more necessary, and much easier.

Victoria, B.C.—The officials of the Pacific Coast Steamship Company have had plans prepared for the construction of two new ships. They have called for tenders to be in by March 20th. This line operates from Puget Sound to San Francisco.

A company has been formed in Paris, France, to operate and develop Canadian resources, chiefly minerals. It is proposed to increase the French population in this country by these means.

TRADE ENQUIRIES.

The following were among the inquiries relating to Canadian trade received at the office of the High Commissioner for Canada, 17 Victoria Street, London, S.W., during the week ended February 12th, 1912. Fuller information may be obtained by communicating with the Department of Trade and Commerce, Ottawa.

A London firm desire to get into touch with Canadian importers of chemicals and oils.

A firm in Wales who specialize in zinc dross, zinc skimmings and sal skimmings, etc., wish to get into correspondence with a Canadian firm willing to enter into a mutual arrangement to work the business.

A London firm make inquiry for the names of Canadian importers open to appoint a buying agent in Great Britain.

From the branch for City Trade Inquiries, 73 Basinghall Street, E.C.:

A French manufacturing company seek supplies of Canadian balsam gum and invite prices and samples from producers.

A London firm manufacturing a specialty in desiccated yeast are looking for some suitable resident Canadian firm to undertake its introduction and sale.

ENQUIRY FOR "TIE PLATES."

Mr. F C. Gamble, Chief Engineer, Dept. Railways, British Columbia, desires to ascertain the names of firms manufacturing railway tie plates of all descriptions and the prices of the same.

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

Each week on this page may be found summaries of orders passed by the Board of Railway Commissioners, to date. This will facilitate ready reference and easy filing. Copies of these orders may be secured from The Canadian Engineer for small fee.

16053—March 1—Directing that G.T.R. install gates to be operated from tower at point where its railways crosses Hope and Woodstock Sts., Tavistock, Ont., 20 per cent. from "Railway Grade Crossing Fund," remainder by G.T.R., 15 per cent. of cost of maintenance and operation of gates to be paid by village of Tavistock.

16054—March 1—Refusing application of J. M. Morin, K.C., for an Order to compel C.N.Q. Ry. to macadamize and keep in good repair highways and abutments of bridge between Bout de l'Ile and Charlemagne, Que.

16055—February 29—Authorizing C.P.R. to construct spur to premises of Canadian Equipment & Supply Co., Ltd., Calgary, Alberta.

16056—March 1—Authorizing C.P.R. to grant special rate to mining students of McGill University from Montreal to Rossland, Phoenix, and Greenwood, B.C., at $40 and return, and side trip, if desired, from Slocan Jct., to some point on Sandon Branch at rate of ¾ cent per mile each way, and providing that any other parties desiring to travel to B.C. or other mining district, be granted equally favorable terms, etc.

16057—March 1—Directing that K. & P. Rly. jointly with C.P.R. file within 30 days from date of this Order tariff establishing a rate of 10¾ cents per 100 on ex-lake grain, in carloads, from Kingston to Montreal, including stop-over at Almonte for milling purposes. Application, Wylie Milling Co., Almonte, Ont.

16058—February 13—Authorizing G.T.P. Ry. to cross highway in Parish of St. Francois Xavier, and to divert highway, mileage 119 to 119.3, Dist. of Winnipeg, Manitoba.

16059—March 4—Directing that rate of 80 cts. per 100 lbs. charged by C.P.R. on lumber from Port Arthur and Fort William to Vancouver be disallowed; and that C.P.R. within 30 days of Order substitute in lieu a rate of 55 cents per 100 pounds on lumber (including flooring) in carloads of a minimum of 40,000 lbs.

16060—January 12—Authorizing C.N.R. Alberta Ry. to cross with its main line the G.T.P. main line in S.E. quarter of Sec. 31, Twp. 53, R.10, West 5th.M. Interlocking plant to be installed.

16061—March 2—Directing that express classification for Canada No. 2 be amended making certain changes in newspaper rates from Winnipeg to Calgary; complaint of the Manitoba Free Press Co. of Winnipeg, Man.

16062—March 4—Approving location and revised location of C.P.R. Wilkie Northwesterly Branch (formerly known as Manitou Lake Branch) as follows: location from mileage 0 to 12.86 and from mileage 26.85 to 32.15; revised location from mileage 12.86 to 26.85.

16063—March 1—Authorizing C.P.R. to construct an extension of 150 feet to siding on Lot 15, Con. 1, Twp. of Trafalgar, County of Halton, Ontario.

16064—March 1—Authorizing Council of Mun. of Bridgeburg, Ont., to carry street over G.T.R. and M.C.R. in village by means of an overhead bridge.

16065—March 6—Authorizing G.T.R. to reconstruct swing bridge over Lachine Canal, in City of Montreal, Que.

16066—March 6—Exempting Vancouver, Victoria and Eastern Rly. from use of "zinc covering over caps and intersections," as required by Order No. 11446 of Aug. 2nd, 1910, where oil burning engines alone are used.

16067—March 5—Authorizing White Pass & Yulon Route to publish tariffs (special) within less than statutory notice, for excursion business, etc.

16068—March 5—Authorizing James Bay & Eastern (C.N.R.) (Roberval Extension) to construct bridge over Iroquois River, Twp. of Ashuapmouchouan, County Lake St. John, Que.

16069—March 5—Approving plans for lowering of three foot pipe under M.C.R. tracks in Twp. of Wainfleet, Ct. Welland, Ont.

16070—March 5—Authorizing G.T.P. and C.N.R. Rlys. to operate trains over interlocking plant authorized by Order No. 14304 of July 20, 1911, without coming to a stop.

16071-72—March 5—16073—March 6—16074—March 5—Authorizing C.P.R. to construct spur for City of Winnipeg, Manitoba, for Messrs. G. P. Sherwood and Company, Montreal, Que.; for Stoneclough Quarry Co., near Coldwater (G.B. & S. Ry.) Twp. of Medonte, Ct. Simcoe, Ont., and for siding with spurs therefrom for St. Mary's Portland Cement Company and rescinding Orders 15667 and 15969 dated respectively Dec 15th, 1911, and Feb. 13th, 1912.

16075—March 5—Approving portion of C.P.R. Swift Current Southeasterly branch from mileage 40 to 45, and to construct across three highways.

16076—March 5—Authorizing C.P.R. to construct across highways from mileage 0 to mileage 35.25 as shown on location plan No. 1105.

16077—March 4—Authorizing C.P.R. (G.B. & S. Ry.) to divert public road between Cons. 7 and 8, in Twp. of Eldon, County of Victoria and to construct tracks across said diversion at mileage 56.4 by means of overhead bridge. Compensation to be paid John McArthur for injury sustained to property and rescinding Order No. 15987.

16078—March 7—Authorizing C.N.R. to cross and divert public road on its Maryfield extension.

16079-80—March 5—Authorizing C.P.R. to construct spur for Sidney Brick and Tile Co., at Sidney, Man., and for Guelph Stove Co., Ltd., Guelph, Ontario.

16081—March 5—Approving location of C.N.O. Ry. (Sudbury-Port Arthur Line) from mileage 2 at Current River in City of Port Arthur to a point in Lot No. 5E in Twp. of McGregor, at mileage 6.49.

16082—March 7—Approving revised location of G.T.P.B.L. Co., Regina Boundary Branch, mileage 84.22 to 91.13, Sask.

16083—March 5—Authorizing Mun. of Twp. of South Gower to construct highway across C.P.R. Twp. of Oxford, Ct. Carleton.

16084—March 7—Approving revised location of G.T.B. B.L. Co., Regina Boundary Branch, mileage 17.02 to 84.22.

16085—March 7—Approving by-law of Central Ontario Railway authorizing George H. Shaw to prepare and issue tariffs of tolls.

16086—March 6—Approving location of C.N.O. Ry. (Montreal-Port Arthur Line) through Twps. of Crerar, Dana, Janes and Davis, Dist. of Nipissing, mileage 386 to 406 from Montreal.

16087—March 6—Approving revised location of C.N.O. Ry. (Montreal-Port Arthur Line) through unsurveyed territory Sudbury District, mileage 191.6 to 193.7.

16088—March 7—Authorizing C.P.R. to construct industrial spur for Chinook Coal Co., Ltd., near Kipp, Alberta.

16089—March 8—Directing C.N.R. to cease from blocking lanes and streets in City of Brandon, Man., under penalty of $50 and that the company plank railway track before May 1st, 1912. Complaint, J. I. Parkin.

16090—March 8—Directing that rule be added to conditions of carriage and directions to agents in express classification for Canada No. 2, namely:—"A shipment tendered at a common point which cannot be carried to its destination except through a connecting company, which connecting company has also an office at the common point, must be refused, and the shipper be referred to the company which can give the through service; unless, having been notified of the charges by the joint route, he requests acceptance and specifies the route in writing, in which case the shipment may be forwarded at the sum of the local rates to and beyond the transfer point specified by the shipper." "The transfer point must be indorsed on the agent's receipt, and the shipper's written request attached to the way-bill."

16091—March 7—Authorizing South Ontario Pacific Ry. to operate connection of its Guelph Jct. to Hamilton Line with tracks of T.H. & B. Ry. for construction purposes only until 31st May, 1912.

16092—March 7—Authorizing Vancouver, Victoria & Eastern Ry. to open for the carriage of traffic its railway from Princeton to Coalmont, a distance of 13 miles.

16093—March 6—Authorizing C.P.R. to construct spur for City of Winnipeg, Manitoba.