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CONSTRUCTION OF A CONCRETE SEWER TUNNEL THROUGH DIFFICULT GROUND.

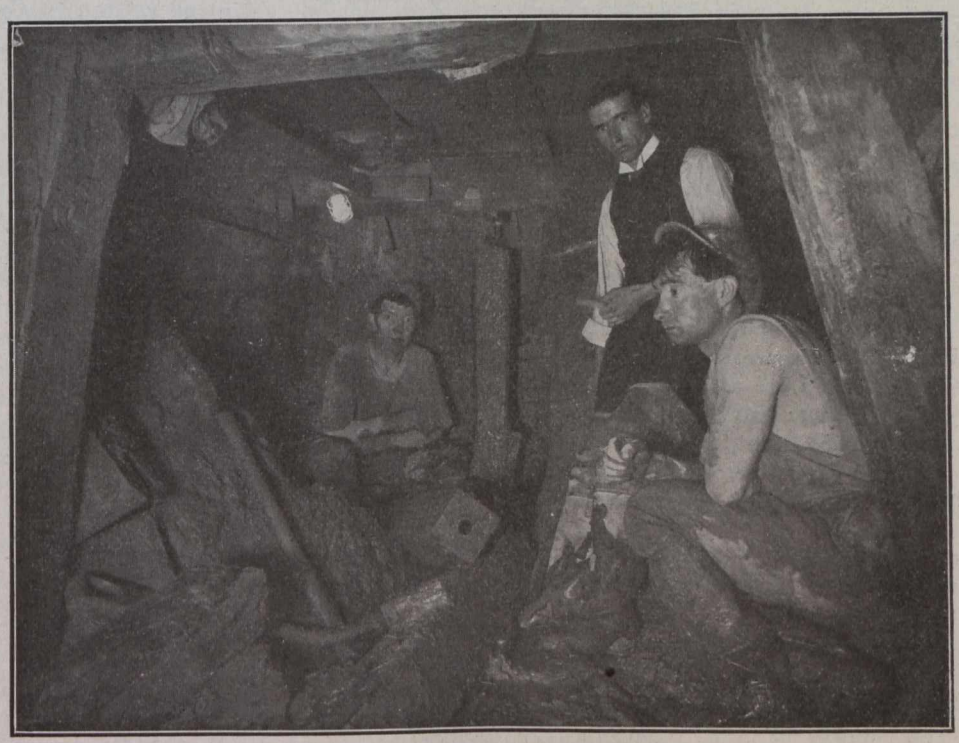
By H. S. PHILIPS, Resident Engineer.

The sewer described in this article, and known as Barton Section 1, forms part of a system of storm overflow sewers provided to relieve the congestion of the existing sewers in the western section of the city of Toronto, known as the Garrison Creek drainage area.

The existing sewer for which relief is provided by this storm sewer is that running along Bloor Street easterly from the Garrison Creek (at Willowvale Park) to Huron Street.

Floodings were experienced in cellars of houses and stores during heavy rains, and in view of the immediate addition of the northern districts, the necessity for relief became more urgent.

The general scheme of existing drainage of the area in question is that of tributary sewers extending from south to north, with main sewers running east and west. These main sewers discharge into the Garrison Creek, which runs practically north and south, discharging into the lake at the south end.



Heading at Station 28 + 00, Abandoned at Station 28 + 28.

The question of paralleling, in order to relieve Bloor Street Sewer, was considered out of the question on account of the busy nature of the street, and the presence of the street railway tracks. Other utilities underground were numerous and formed obstructions. The geological formation was found to be bad for sewer construction in tunnel, involving running sand, clay and water pockets, boulders, etc. The idea of open cutting could not be entertained owing to the obstructions and street traffic. On these accounts it was decided to place the sewer on Barton and Lowther Avenues, to the north, although the subsoil, as indicated by borings, was equally bad, being of glacial deposit formation, as in Bloor Street, but the streets were not so hampered with excessive traffic, and in the event of open cutting having to be resorted to, would inconvenience little.

The total area drained by the Barton Avenue sewer is 701 acres, and extends some 670 feet north of the C.P.R. northern line. The whole area has a fall from north to south and is practically level from east to west.

The existing sewers and those new sewers required for future drainage run along the north and south streets, discharging into Bloor Street at the south end. The system is the "combined."

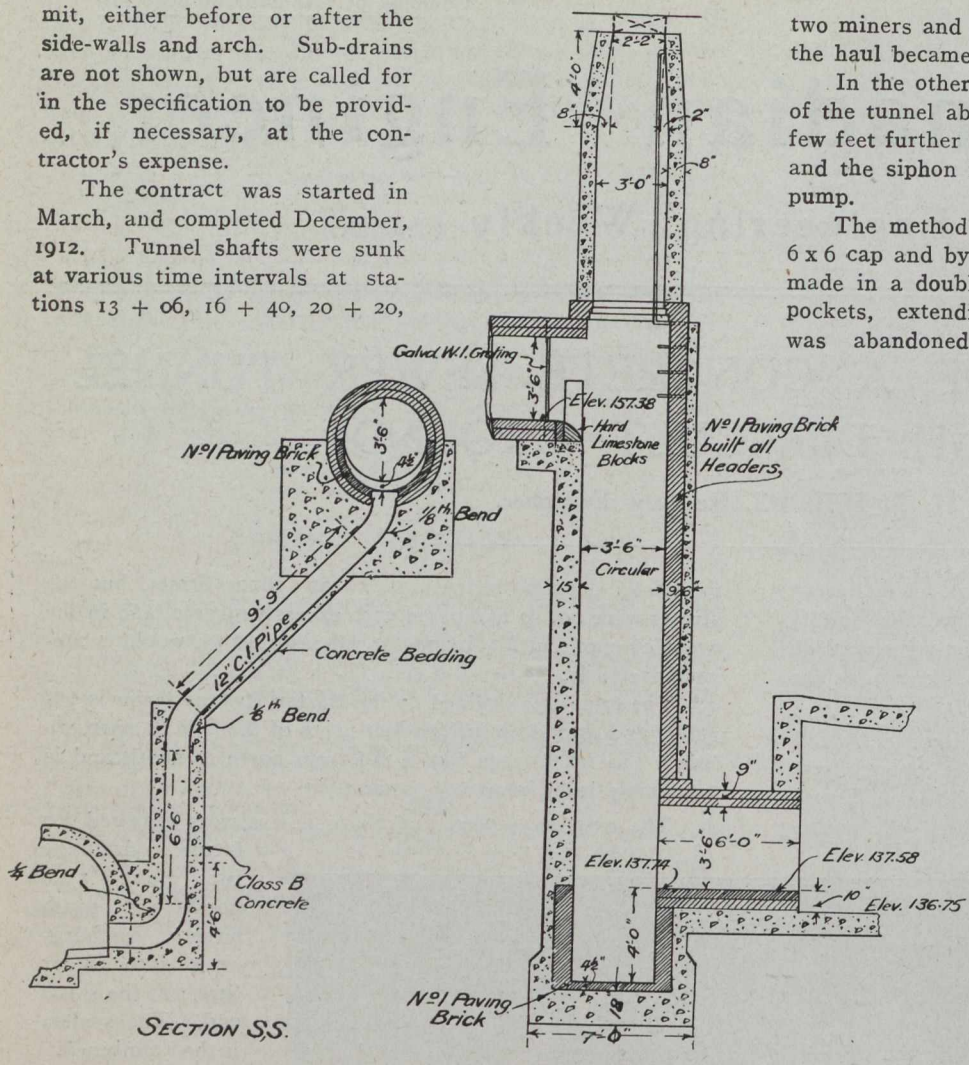
The method of interception is that of tumbledown shafts, as shown in Fig. 2, with tumbledown C. I. pipe shoots for the smaller sewers and the sanitary flow of the larger ones. The whole flow, sanitary and storm, is intercepted and carried in the storm sewer. Separation of the sanitary and storm water is provided for at Bloor Street on the Garrison Creek sewer. The channel provided for the sanitary flow in the storm sewer is shown in Fig. 2.

The total length, including section 2, is 7,741 feet; section 1, to which this article refers, is 3,345 feet long and is at the outlet end of the sewer.

Fig. 2 shows the typical cross section of the sewer as carried out. The flat section was designed to same height across the low-lying land of Willowvale Park, so that mounding would not be necessary. The remaining sections gradually increasing in size towards the outlet, are designed for tunneling so that the invert can be placed, as conditions per-

mit, either before or after the side-walls and arch. Sub-drains are not shown, but are called for in the specification to be provided, if necessary, at the contractor's expense.

The contract was started in March, and completed December, 1912. Tunnel shafts were sunk at various time intervals at stations 13 + 06, 16 + 40, 20 + 20, 23 + 06, 26 + 00 and 31 + 20, numbered respectively 6, 5, 4, 3, 2 and 1, and headings were driven east and west from all shafts. The depths of the shafts are as follows: No. 1, 34 feet; No. 2, 35 feet; No. 3, 35 feet; No. 4, 37 feet; No. 5, 35 feet; No. 6, 31 feet deep. The shafts for manhole and tumbledown shafts at Christie Street were 33 and 44 feet deep respectively. The open cut part has a varying cover from two to eight feet.



Details of Drop Manhole and Junction Chamber at Christie Street.

Shaft No. 1 was sunk through very hard clay, containing several springs, and tunneling (the invert being excavated after the side-walls were placed) progressed at a daily rate of 8 to 10 feet eastwards, from 5 to 8 sticks of dynamite being required to loosen the material. A full shift was required by two miners and one mucker—two muckers being required as the haul became longer.

In the other direction quicksand appeared in the bottom of the tunnel about 150 feet in, and rose above the crown a few feet further on. Water became troublesome at this point and the siphon in the shaft had to be replaced by a 4-inch pump.

The method of excavating was now altered, and with 6 x 6 cap and by timbering an advance of only four feet was made in a double shift. After several runs of semi-liquid pockets, extending almost to the surface, the heading was abandoned and bulkheaded at station 29 + 62.

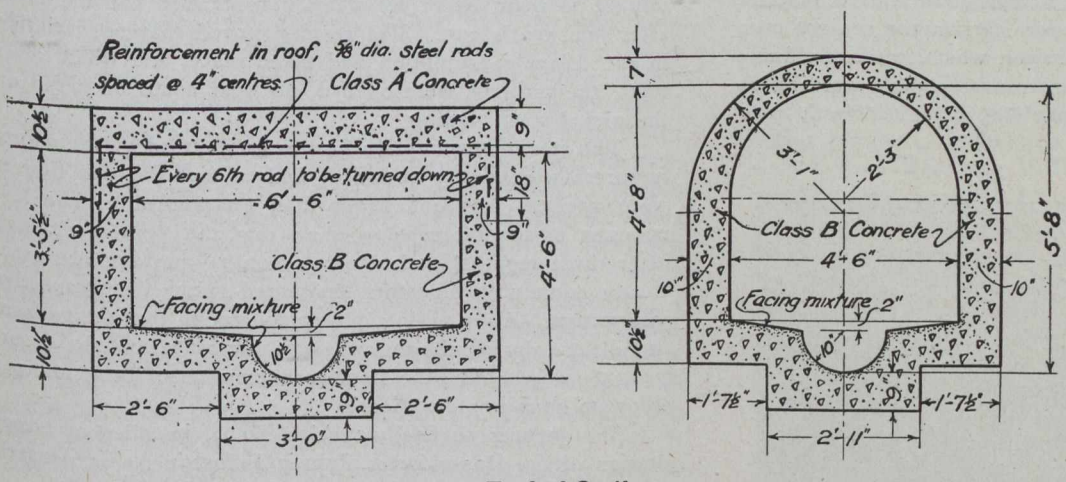
Junction Chamber at Christie Street.

No. 2 shaft was sunk through firm clay to sand water appearing at a depth of 27 feet. This shaft had to be lined with 1¾ tongued and grooved sheeting, in addition to the 2-inch boarding with 6-in. by 6-in. walings. The ground eastward soon became hard and dry, and good progress made for 200 feet, when soft pockets appeared in the roof and sides. This necessitated the heavy timbering, but after a run of about 20 cubic yards from the roof at station 28 + 28 the contractors decided to abandon tunneling and to open out the part to connect the two tunnels.

In the other heading fine and coarse sand were encountered, the timbering here being 1-inch close-boarding up to springing line with crown and quarter planks in roof. This became hard, stoney clay about 180 feet in with occasional soft pockets in roof causing slower progress. After going another 28 feet this heading was stopped owing to grade going with the tunnel

and the sub-drain not being able to carry off the water.

The most expensive shaft to sink was No. 3, quicksand being found 15 feet below the surface, requiring tongued and grooved sheeting, in addition to two inner sets, the ground becoming very hard clay two feet above the crown. To meet the tunnel from No. 2 shaft only 86 feet were necessary and only 14 feet were excavated westward before meeting from shaft No. 4, the soft pockets appearing in the roof, while up to springing line the clay was exceedingly hard, but was not blasted on account of disturbing the caps and lagging or causing a cave-in of the roof.



Typical Sections.

From Station 0 + 00 to 6 + 15. From Station 6 + 32 to 26 + 12.

Progress from shafts 4, 5 and 6 was made at an average rate of 10 to 14 feet per shift in firm clay.

The shallow section in the park was completed during hot weather across the bed of the old Garrison Creek, water bearing sand being met with for 250 feet from the end. The invert was laid immediately after excavation, the walls then being built in the dry. At the foot of the slope (Sta. 5 + 40) tunneling was started to meet the one from shaft 6. The ground was dry sand and was timbered with cap and legging as far as the flat-topped section extended. This was left unlined until the headings met and were lined in order to have headroom.

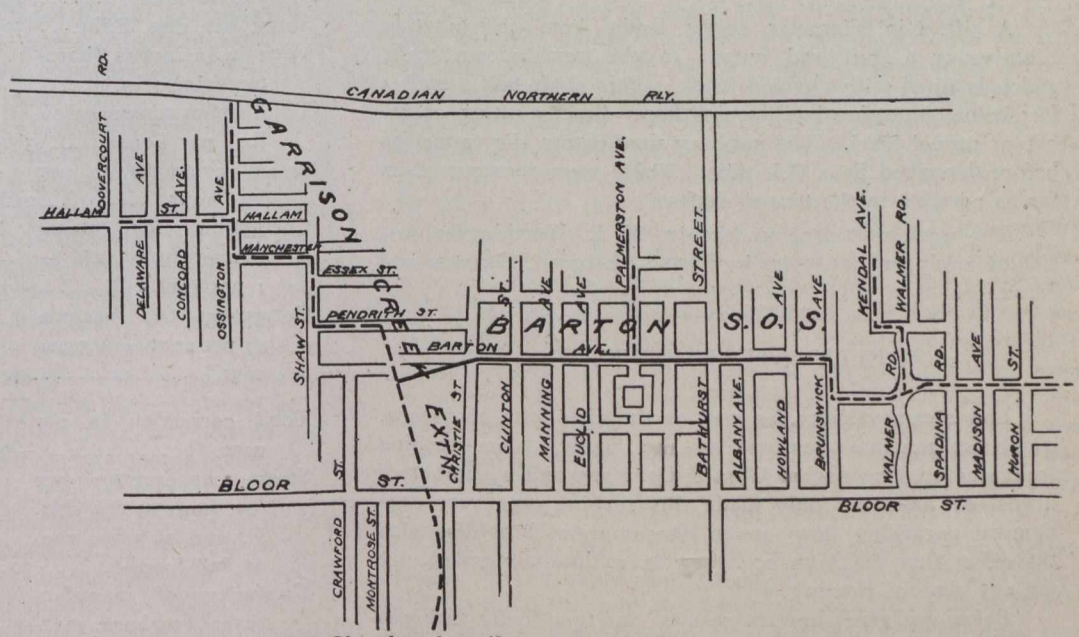
For about 300 feet the arch section only required crown and quarter planks in a 12-ft. length. At this point the ground became clayey with soft pockets in roof, and gave trouble for about 90 feet. In the portion between the abandoned headings the contractor sunk a shaft midway and essayed tunneling both ways. On finding quicksand at a height of 10 feet above the invert, they gave up the attempt, and opened 70 of the 134 feet to be done. Two sets of timbering and one set of tongued and grooved sheeting were required in excavating to sub-grade. The walls and arch were completed before excavating for invert. In the remaining 30 feet and 34 feet at the ends, the excavation was removed up to the hard ground and the roof lightly timbered. The timbering was braced from 12-in. by 12-in. needles, one end resting on the old concrete and the other on the more recent arch. After concreting the walls and arch, the sheeting was cut off at springing level and the voids at the back filled up. After the concrete had set the needles were removed, the roof being braced directly from the concrete until the back filling was done. Voids in the roof and settlements of backfilling were made good with sand through 12-inch auger holes bored from the surface.

The concrete lining was done each night by a gang supervised by two inspectors. The concrete was hand-mixed and sent down the chute directly into the tunnel cars.

The forms were originally 5-in. by 4-in. built-up lumber ribs with 2-in. by 2-in. dressed laggings. The ribs were set on footblocks and braced at the bottom from the rail ties. The lumber ribs were dispensed with after some time and replaced by 2-in. by 2-in. T iron ribs in one piece, and bent to conform to the arch. These gave 6 inches extra clearance for the cars and where not damaged by the blasting.

The laggings joined up badly and did not leave a good finish, which necessitated the surface being plastered.

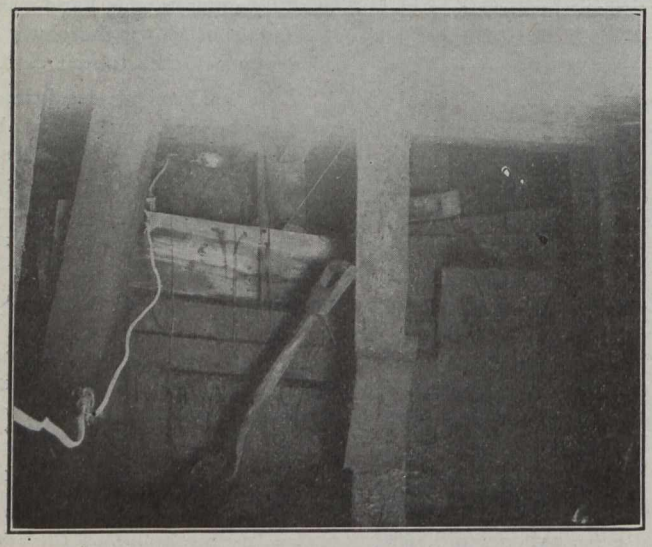
In bad ground, where centre posts supported the roof, the posts were concreted round, the holes being filled up when posts were removed. The invert, with sub-channel, was laid in 12-foot lengths, the channel in the rough being formed by 2-in. by 2-in. laggings with half-round blocking pieces braced from the roof. The facing mixture was applied to the channel under drums placed in position as soon as the laggings were removed. At one or two places the wall became undermined while excavating for sub-channel in soft places owing to want of braces, and broke away from the arch. These breaks were repaired after invert was set.



Map Showing Location of Barton Avenue Sewer.

The Garrison Creek extension sewer is still undergoing completion, and to avoid cumbersome by-pass channels, the connections to the intercepted sewers had to be built so that the sewage could take up its old course until the new sewer was entirely in commission.

At Christie Street, the invert of the existing 2-in. by 3-in. egg-shaped sewer, 16 feet below the surface, is diverted into a new junction chamber, which provides a connection for an additional 4-ft. diameter sewer relieving the Christie Street drainage area. A flume at present carries the sewage over the diverted invert into the old sewer, which, when the flume is removed, will be closed by an iron stop plate working in iron grooves. An inspection manhole is built directly over this connection.



Abandoned Heading at Station 29 + 62.

A 3-ft. 6-in. diameter sewer leads from the junction chamber on a 40-ft. rod, curves to the tumbledown shaft, which is lined with vitrified brick. This shaft has a well 4 feet below emptying level, which flows directly into a chamber at tunnel level. The sanitary flow enters the tunnel as before described by a C.I. pipe. These were constructed as far as possible in the tunnel shafts.

The work was done under Mr. W. R. Worthington, assistant engineer for sewers by Messrs. Lehman, Graham and Jeron.

ZOELLY STEAM TURBINES.

Low steam velocity, as well as the simplicity of design, which are the main features of the Zoelly steam turbine (manufactured by Escher Wyss & Company and a number of licensees) have not only made this turbine type very economical regarding low steam consumption, but have also the effect that the high economy is maintained practically for any time of running.

Below we give the test results on two Zoelly turbines supplied by Escher Wyss & Company to the Dusseldorfer Rohren Industrie A. G., Germany. These turbines were installed in August, 1910, and have since been running continuously. The main data are as follows:—

Output ..... 1,500 h.p.
Speed ..... 3,000 r.p.m.
Gauge pressure ..... 170 lbs. per sq. inch.
Superheat ..... 662 deg. Fahr.
Vacuum ..... 90 per cent.

Each turbine is fitted with surface condenser with rotary air and centrifugal cooling water pump, the cooling water being recooled in a cooling tower. After three months running the first tests were made (November 1st, 1910); after a further run of 13 months, each turbine being run for 4,000 hours and having generated 450,000 kw. hours, the second tests were made (December 27th, 1911); no inspection or cleaning was done before the test. The results of these two tests are tabulated below.

The second tests were made with the purpose of ascertaining to what extent the steam consumption had increased after one year's run. The results proved that no variation in the steam consumption had taken place, and when, after tests, the turbines were opened, no wear could be found on the nickel steel blading.

The steam consumption figures guaranteed by the manufacturers were easily obtained, and in fact the test figures were several per cent. lower than guaranteed. The last columns of the table below show that the figures obtained after three months' and after 16 months' running are practically equally good when compared with the respective guarantees. When taking into consideration that the vacuum at full load during the test was 92.1 per cent., and the superheat 580 deg. Fahr., the steam consumption of 15.15 lbs. per kilowatt hour is very good.

Test results on Zoelly turbine No. 2, installed at power station of the Dusseldorfer Rohren Industrie A. G., Dusseldorf, supplied by Escher Wyss & Company:

	Nov. 1st, 1910.			Dec. 29th, 1911.		
Duration of test, mins...	70	54	57	61	120	60
Rev. per min.	3000	3000	3000	3000	3054	3036
Output in kw., excluding excitation	277	541	781	1047	1044	547
Efficiency of generator, per cent.	73.6	84.6	88.9	91.0	91.0	84.6
Gauge pressure in front of stop-valve, lbs. per square inch	190	187	182	181.1	170.5	172.4
Superheat, deg. Fahr. ..	505	540	556	579	480	458
Vacuum in inches (barometer 29.2 in.)	27.94	27.68	27.3	26.9	26.78	27.54
Total steam consumption, lbs. per hour	5840	9620	12820	15880	17320	10510
Steam consumption per kw. hour	21.82	17.40	16.83	15.15	15.52	19.2
Correction for steam temperature (12½ = 1 per cent.) %	—12.4	—9.5	—8.0	—6.9	—14.14	—16.1
Correction for vacuum (1 per cent = 1.5 per cent.)	+3.2	+3.2	+3.2	+3.7	+2.5	+2.5
Total correction in per cent.	—9.2	—6.3	—4.8	—3.7	—11.9	—13.9
Steam consumption per kw. hour at 662 deg. F. and 26.3 in. vac. at full load	20.1	16.58	15.63	14.58	14.58	16.5
Guarantee of manufacturer (without margin)	20.6	17.5	15.74	14.97	14.97	17.06
Better than guarantee (%)	3.7	2.8	.7	2.6	2.6	2.8

An order-in-council has been passed amending the harbor regulations of Canada and prohibiting the discharge or disposal of oil, tar or other dangerously inflammable material in the water of any harbor of the Dominion. The order provides for a fine of $50 for violation of its provisions, with a further penalty of $10 for every twelve hours during which the offence continues.

THE ROAD QUESTION IN MANITOBA.*

By A. McGillivray.†

I have wondered several times if the municipal men who had charge of the construction and improvement of roads during the past year have looked back over the season's work, and could there see something that had been done during the past year which tended to give Manitoba some mileage of good roads; that is, if they could see something that had been done which might be counted as a permanent improvement towards the foundation of building up a system of roads for Manitoba. No doubt many of the municipal men will say that they have, that something has been done; others may be a little doubtful of the matter; but, for myself, when I looked back over the season's work, I cannot say that a great deal has been done towards giving Manitoba a system of good roads. I cannot say that there has been any great construction of mileage, but I will say that a great step has been taken by securing good legislation in this connection. At the last session of the Legislature, legislation was secured by the efforts no doubt of this Association of Rural Municipalities towards this end, and, as you all know, there are at present on the statutes of the Province two Acts which were placed there at the last session. One is known as the Good Roads' Act, which this Convention, in conjunction with the Manitoba Good Roads' Association, has been instrumental in putting into force. That Act, as it appears on the statutes to-day is, in my opinion, a workable Act, and one quite applicable to the conditions that exist in the municipalities of this Province. From the amount of correspondence that I have had during the summer from municipal men in regard to these Acts, I believe that there has been, and is still, some confusion and confliction as to the intent and meaning of both these Acts, and in that event I would just like to take a little of your time in explaining the Acts as I interpret them, or as I believe they are intended to be interpreted. The Good Roads' Act, which was put on the statutes last session with the recommendation of this Convention, provides for the improvement of municipal roads, that is, roads in the municipality that will benefit all the municipality as a whole, and not pertain to any special or particular part of the municipality. The idea was to get the municipalities to undertake a system whereby they could start some plan to improve a certain mileage of roads. While it naturally follows that these roads should be the main roads of that municipality—(roads leading from the towns and market places and villages into the country districts, allowing the farmer to haul his grain to and fro, and putting them within reasonable distance of all ratepayers), it is apparent to everybody that such roads could not be constructed to every man's door, but the intentions and the objects should be to construct these roads so as to place them as near as possible, in order that they will benefit the municipality as a whole to the greatest extent.

Now, under that Act the Government provides for the guaranteeing of the bonds of the municipality; that is, if a scheme is drawn up and presented to the Department of Public Works undertaking a plan such as I have mentioned that is and will be a benefit to the whole municipality, then the provisions of the Act provide that of a municipality raises sufficient debentures to cover the cost of the work, the Government will guarantee the bonds, insuring a probably cheaper rate of interest, and also extending the terms of those bonds over a longer period of years than is prescribed in the Municipal Act. The extent of the bond to be raised is 3 per cent. of the total assessed valuation of the municipality. As I said before, the Act is workable and very applicable to the conditions of this Province, and I believe that if the municipalities of this Province would consider that and take it up, a step would be made in the right direction towards securing better roads.

The Highway Improvement Act, which is another Act which has been placed on the statutes, was put there for probably a different purpose, and it is the confliction of these two Acts, I believe, that has caused a great deal of the confusion in the minds of some of the men of the Province. The Highways Improvement Act was intended to construct provincial roads, or a provincial road—that is, to connect the larger centres of population of this Province. For instance, a road from Winnipeg to Portage and Brandon and to the western portion of the Province. Then another might be considered running from Winnipeg to Emerson. The idea was to get the larger centres of population to endeavor to induce the municipalities of this Province to construct a higher class of road than it would probably be necessary for them to construct in the municipal system. The idea is prevalent all over the Dominion of constructing provincial roads. We hear a good deal of a transcontinental road—that is, a road connecting all the Provinces from ocean to ocean. But, aside from that, in the different Provinces at the present time there is an idea to construct these roads and join up the centres of population, the larger towns of the different Provinces, and to build a road of a higher standard than would be necessary in a municipality itself, and probably the municipality would be able to construct another municipal system of their own, which would be taken care of under the Good Roads' Act.

I have no doubt that many of the applications which have come in for municipalities to be placed under this Highway Improvement Act have been done probably from a desire, no doubt, to participate in the Government grant, and the desire, of course, to build up the roads in their several municipalities, and no doubt some disappointment has been met by some of the municipalities in not knowing the true meaning and intent of the Act, and probably being refused to be allowed to come under this Act at the present time. But, Mr. President and gentlemen, in connection with this Act, as I said before, the Good Roads' Act in my opinion is a good Act, good in name as well as in terms, and should be taken up by the different municipalities with the Provincial Government. There are a few recommendations that I have been making to the Government of the Province in regard to both these Acts, which I have the privilege to submit to you this morning, and would ask you to consider them and find out what they are worth. There may be probably other changes that would appear to you to make these Acts more applicable to the conditions here in the Province, but there are a few that I thought would be necessary to the proper working out of the Act, and, as I said before, I have laid them before the Government, and have their permission to lay them before you for your consideration.

In regard to the Good Roads' Act which, as you know, is the Act by which the Government guarantees debentures for the main roads of the municipalities, independent of any provincial scheme or idea that may be in mind, this was passed at the last session of the Legislature. In my mind, it fills all the requirements to insure construction, except that no Government aid is provided, which to a very considerable extent is responsible for its provisions not being more largely availed of by the municipalities. I would suggest amendments as follows: (1) Provision enabling the Government to contribute towards the cost of any work performed under the Act to the extent of, say, 25 per cent. It is for the municipalities to consider whether that is enough or too much. It may be too much; in my mind it is the maximum. In making this suggestion I have given the maximum, and I

*Address delivered before Ninth Annual Convention of Union of Manitoba Municipalities, Winnipeg, Man., Nov. 26—28, 1912.

†Highway Commissioner for the Province of Manitoba.

would further recommend that this sum be provided by Parliament yearly to meet the expenditures for the ensuing year. Secondly: Provision that any work performed and aided under this Act shall be maintained and kept in good repair by interested municipalities to the extent and manner satisfactory to the Highway Commissioner failing which such repairs may be performed by that official and paid for and levied by the Municipal Commissioner against the respective municipalities in default.

There is a word I would like to say on the maintenance question before I go any further. Is there any use of us thinking of building roads in this Province and leaving them to deteriorate from lack of maintenance, we might as well not build them at all. A good road that is built and laid down in this Province requires certain attention to keep it up to the standard at which it was put down. If we neglect to do that we are working a hardship on the taxpayers of this country, because if we build roads by money that is borrowed on terms extending over a long period, say, for twenty-five or thirty years, the burden would fall on the people who are coming afterwards in later years, and who must assume their portion of that taxation; we must give them something for their money. What I mean by maintenance is this: that a grade should not be allowed to deteriorate and disappear, as grades certainly will do if not looked after very carefully. The great percentage of our roads in this Province are earth roads and no matter how well you build the roads to grade or dig the ditches, if you have not proper drainage, if you allow the ditch to become silted up or become defective and left without any care at all, as many of our ditches have been in the past, in five years they will be useless. I know ditches that have been built fifteen or twenty years ago that have been allowed to deteriorate, and to-day they are only a mark in the ground. So it would be wrong, in my opinion, for the municipalities of the Province to borrow money at long terms and to perform work and let it go to rack and ruin. That is what I mean by proper maintenance; preventing the work from deteriorating.

In regard to the suggestion toward the Highway Improvement Act. This Act, I believe, is a commendable one also. We should have in this Province a mileage of roads of a better class than earth roads, if it is possible to at all get them. Other Provinces are striving to get them. We can't get away from the fact the automobile is the mode of locomotion that is going to stay. People are taking to the automobile. There is no better way in which the value of the farm can be observed than in travelling along a good road, and there is no way in which the development and worth of a country can be more lost sight of than in travelling over a bad road. I believe it is up to the old established municipalities to bring into existence what might be called a few provincial roads of gravel or macadam in the not too distant future. It was for this end that this Act was placed on the statutes. The Government are anxious to see this done, and they are willing to contribute largely, so largely, indeed, as to leave themselves open to extend that assistance to two-thirds of the actual cost.

I would suggest under the Highways' Improvement Act, in order to avoid confusion with the provisions of the Good Roads' Act, that it be determined by legislation to what leading highways in the Province, describing the routes, it is intended that the Act should apply, and shall be constructed and aided under it; with the further provision that the Lieutenant-Governor-in-Council shall have power to add to the number of roads from time to time.

I believe that the Government should indicate where they want the municipalities to take up this work, because the Government would not and do not intend to build those provincial roads themselves. They want the co-operation of the municipalities through which those roads are to pass. The Government could advance a plan to certain municipalities of this Province that they would be first in line for this road. It would be then up to them either to come forward and accept their proposition or reject it. We cannot build these highways through every municipality in the Province; it would be out of the question for the country to do so but if the government would come forward and say where they intend these roads should be, the municipalities through which they are going to pass would be in a better position to take up the work. I believe it would be a valuable provision of the Act.

Further, I would suggest that an amendment should be made so as to permit a municipality to assess its portion of the cost of works performed under the provisions of the Act partially over the lands abutting on both sides of said highway or highways. Because, however anxious a municipality might be to participate in the provisions of this Act, they might be defeated in such a project by having to submit a by-law to the whole municipality, whereby they would raise a portion of the cost of the work over that whole municipality. I believe a road of that nature running through any municipality would be a certain benefit to the whole municipality, but it would particularly benefit the land immediately adjoining the road, and I believe that the land that is particularly benefited should be particularly assessed to pay for it.

HEAVY RAILROAD CONSTRUCTION.

By Sir Thomas Shaughnessy, C.V.O.

Notwithstanding the large amount of railway construction in Canada during the past year, there is every indication that quite as much will be required during the coming year. This means a great deal for the country because, besides giving employment to many thousands of men in the making of the railways, it naturally stimulates manufacturing in the rail mill, iron and steel works, lumber mills and a large number of other establishments, and keeps the wheel of national prosperity spinning.

Speaking for our own company, the rail requirements for the next year will approximate 250,000 tons, and these, with the requisite fastenings, will represent an expenditure of over $8,000,000.

During the past year, in addition to keeping our own manufacturing shops occupied to their capacity, we have taken all the cars and locomotives that we could have built in Canada, and have also made large contracts with manufacturers in the United States. At the present time our outstanding orders for cars and locomotives, to be delivered before the end of 1913, aggregate $30,000,000, and a very large proportion of this amount will be spent in Canada.

Then there are the other works, to which reference was made in the annual report. The extension of our double track system East and West, the important terminal works at Montreal, Toronto, Winnipeg and Vancouver, and the large locomotive and car works at Ogden, near Calgary, that will involve the employment of very many men, and the use of a great deal of material.

We fully recognize the transportation necessities and claims of the country and it is our anxious desire to meet them in so far as the obligation rests with our company, but our operations are frequently delayed by conditions that we cannot overcome, such as an unfavorable season and a shortage of men and material.

My own feeling is that, surveying the situation conservatively, the year 1913 will be replete with development, progress and prosperity for Canada.

INSTALLATION OF ROTARY CONVERTERS AT C. P. R. DOCKS, FORT WILLIAM.

The following installation of two 600-kw. Westinghouse rotary converters with necessary accessory equipment of transformers, equalizing generator, etc., was made during the past summer for use by the Canadian Pacific Railway at their new coal handling docks, Fort William.

Power is received at 25,000 volts from a 3-phase, 60-cycle line and transformed through two sets of three 200-kw. single phase transformers, oil-insulated, water-cooled, 60-cycle star connected primary 14,500 volts, delta connected secondary 178 volts.

At the latter voltage it is delivered to the two 600-kw., 6-phase rotary converters shown in Fig. 1. These machines give 250/280 volt D.C. 2,400 amp. at 600 r.p.m., and are connected in parallel to the D.C. bus bars.

As the load is a rapidly fluctuating one, special provision had to be made to handle the peak loads. This has been very successfully taken care of by the use of a fly-wheel direct connected to a D.C. machine which alternately operates as a generator or motor across the D.C. bus bars. This is perhaps the first application of this system to the unloading of coal.

The D.C. equalizing machine is rated at 400 kw., 250 volts compound wound, and is capable of handling heavy overloads for short periods. The direct connected fly-wheel weighs 15 tons, made up of solid steel plates which gives a high factor of safety and is enclosed by heavy steel plate cover. This machine has a speed variation of from 450 to 600 r.p.m., depending on what load is being taken from the D.C. bus bars.

On light load the set automatically speeds up, taking power from the line, but with a heavy load on the line the speed tends to fall off and the generator feeds back on the line taking power from the fly-wheel. This speed variation is obtained by changing the shunt field resistance through a water rheostat, which is operated by a special torque motor.

Lightning protection is afforded by air-cooled choke coils and a three-phase type "A" electrolytic lightning arrester designed in this case for use on a 25,000-volt line. In Fig. 2 the arrester tanks are shown mounted in the gallery. This picture also gives a good idea of the open nature of the high-tension bus bar arrangement. The bus bars are connected to the incoming line and to the transformers through type "E" 35,000-volt, three-pole, hand-operated, automatic, oil circuit breakers.

Besides the transformers supplying power to the converters there are two 3-phase transformers for A.C. power purposes. They are rated at 100 kw. and transform from 25,000-volt primary to 2,200-volt secondary.

The switchboards are of black marine finished slate, mounted on angle iron frame. A total of 17 panels has been installed. The control panel for the incoming line is shown in Fig. 2 in front of the transformers, while on either side of it are the panels controlling the A.C. side of the rotary converters.

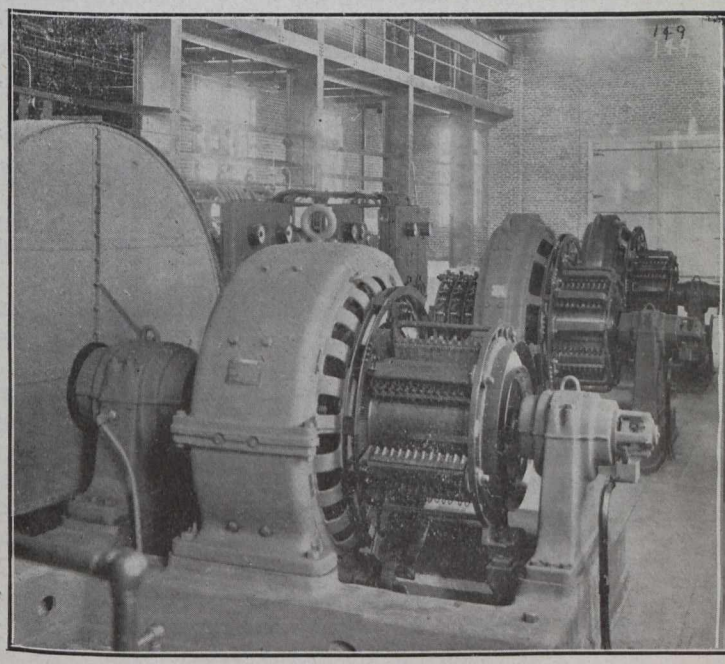


Fig. 1.

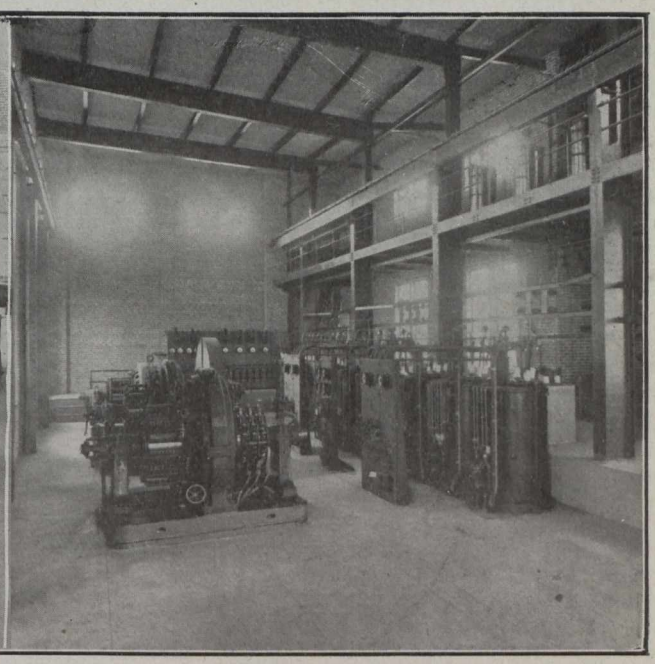


Fig. 2.

Mr. R. S. Kelsch was consulting engineer and the equipment was manufactured by the Canadian Westinghouse Company at their Hamilton works.

WATERPROOFING AND ACIDPROOFING CONCRETE FLOORS.

Where water is coming through concrete because of porosity, the Aberthaw Construction Company, of Boston, have found that a treatment of boiled linseed oil thinned down with gasoline will do much to cure the trouble. They have built roofs which were to cover delicate instruments in fortification range finders. These roofs proved porous, but a treatment with boiled linseed and gasoline cured the trouble permanently. It is a thoroughly good treatment for porous brick walls, has the merit of being very cheap, and the materials are reasonably available, and the most ordinary laborer can apply it intelligently enough. Besides this method, paraffine can be dissolved in gasoline and applied in a similar way with good results.

There is probably nothing that can be done to make a cement floor acid-proof. The treatment with linseed oil will retard the effect of acid, and of course particularly dense concrete will deteriorate more slowly than porous concrete. Where acid is to be used it is economical to give the floors several good coats of linseed oil and gasoline, and if possible during shut-downs to repeat them.

SOLVING CANADA'S TRANSPORTATION PROBLEM.

By J. L. Englehart.

The progress and development of Canadian railways has been marvellous. In 1835 there was not a mile of railway in the Dominion, there were only 16 miles in 1845. Ten years later, 1855, this had been increased to 877 miles. In 1865 there were 2,240 miles. While forty years later, 1875, there were only 4,804 miles in the whole Dominion.

The year 1885 was that in which the Canadian Pacific Railway completed the initial portion of that monumental labor, the Canadian Pacific Railway, and the mileage mounted to 10,733 miles. In 1895 the total was 15,977 miles, which in 1905 had increased to 20,487 miles, and in 1910 to 24,831 miles, while in 1911 no less than 25,400 miles of railway were completed and operated.

In addition to this there were many miles in the hands of contractors, being graded, and laid, or being laid.

Add to this 1,610 miles for double track, 5,550 miles of yard tracks and sidings, and a total of 44,193 miles of railway completed and under construction is obtained. Surely this is a record of which even our own grand Dominion has a just right to be proud.

The earnings of the railways were as follows:—

Year.	Earnings.	Expenses.	Per cent.
1905	$106,467,198	$ 79,977,573	75.2
1911	188,733,494	131,033,785	69.4

The capitalization amounted to the following amount, which is so large as to be hardly understandable:—

Stocks	$ 749,207,687
Funded debt	779,481,514
Total	$1,528,689,201

	Passengers carried.	Freight tonnage carried.
1909	32,683,309	66,842,258
1911	37,097,718	79,884,282

The following amounts were paid to employees of railways for labor:—

	1911.
Maintenance of way and structures.....	$18,157,696
Maintenance of equipment	15,544,057
Traffic expenses	1,564,399
Transportation expenses	36,832,034
General expenses	2,515,552
Total	$74,613,738

In 1909 the total was $63,216,662, and the ratio of gross earnings and operating expenses of total wages is shown below:—

	1910. Per cent.	1911. Per cent.
Ratio of gross earnings.....	38.61	39.53
Ratio of gross expenses.....	55.8	56.9

and is still mounting upwards.

The number of employees operating railways is 141,224 —not including construction work.

Are the developments of the Dominion, and this construction of railways, are the efforts put forth, the efforts of the past ten years, to continue? If so, then we are justified in asking for co-operation.

Transportation is largely the question of the to-day of the to-morrow. Statistics show that railways have been practically re-built, rails, engines, rolling stock, ties per mile, telegraph and telephone, augmented to an extent that is hardly understood by even those who are interested in the matter. Stations, terminals, sidings, and buildings being enlarged, rails increased in weight, with these the other manifold demands that are made upon transportation companies of the day, call for largely increased capital expenditure; in very many instances, an addition of half, if not doubling the original capital.

Have tariff rates, passenger and freight, been increased? The answer is no.

Co-operation is permitted in trades, in labor, in every line. That is right, as it is equitable, for the reason, if none other, that it largely replaces wastefulness engendered by unfair competition, which has spelt ruin to so many enterprises.

In the present-day rush much of this has been forgotten by capital, labor, producer, consumer, manufacturer and the farmer. Each and every one has been enabled to improve their position, as well as the surrounding conditions. Then why not enlist, and work for the common weal, or accept the common woe, that transportation is sure to fall into, unless better counsels prevail?

Why cry out against the good work that has been, is being done by those who labor, and it is a labor, a ceaseless labor, of those who are in charge of transportation?

Consider what it would mean to you, to every one, in the face of the statistics that have been noted, if the problem of transportation were to be dealt with upon the narrow lines that appear to appeal to many. Instead of playing the game of clamor, why not aid and assist in improving the conditions?

Every transportation official knows there are shortcomings, every official is alive, as never before, to bettering the conditions. With passenger rates to-day averaging per passenger per mile, 1.94c., less than two cents per passenger per mile. With freight rates averaging per ton per mile 7.77 mills, less than eight-tenths of one cent for moving a ton (2,000 pounds) one mile.

Under these conditions, how are transportation companies to exist, if they cannot meet expenditures by receipts?

Transportation to-day means facilities that were not in vogue in days that are gone, rolling stock of every class and kind, engines of abnormal power, to which must be added the hundred and one requirements to-day demanded, which were not thought of in the past.

Transportation can be materially assisted by good roads, by diagonal roads. Expend millions, yes millions, upon diagonal roads. With sufficient good roads, you will largely solve that all-important question, transportation.

The motor vehicle of to-day is as essential to the farmer, the merchant, as to the reaper, the mower, or the thresher. The use of the motor would materially assist in arresting congestion. Many merchants to-day utilize motors for deliveries, saving dollars and cents.

The delivering of merchandise direct to the merchant or consumer by motor cars means a saving all round. With good roads, producers, farmers, manufacturers, can deliver less than carload lots, as well as carloads to central points, where the less than carloads could be transferred into carloads, transported with less transhipment, without breaking bulk and without transfer from one car to another. The motor car would largely serve the necessity, arresting congestion, if not removing it entirely.

That is the problem, to handle the many cars. That is the question that worries transportation men. Transportation companies have enlarged—are enlarging—every possible facility—terminals, sidings, motive power—but it is becoming a physical impossibility to transport the products of to-day within the time expected.

No more can shipments in less than carload lots nor for that matter in carload lots be delivered to the markets, in

the time that shippers demand. Neither power, rolling stock, terminal facilities, or tracks are adequate to meet such conditions. But with good diagonal roads, with motor cars, a revolution in transportation will be affected, largely decreasing less than carload shipments, lowering rates of freight, improving the facilities of transportation, removing, largely, the necessity of railways furnishing their cars for warehousing purposes, either to shipper, or merchant, who delay their orders for supplies until about the last day, if not hour, then clamor for delivery, while their own shortsightedness, their own pockets have all but forced the railways into a state of congestion.

Notwithstanding the largely increased number of miles of sidings, and terminals, enlarged warehousing facilities, extra trains, heavier engines, larger cars, congestion is a burning question and will be until the merchant, the shipper, the farmer, the producer, as well as the consumer, in fact till every one pulls his pound not for personal requirements but for the general good.

CONDENSATION UNDER CONCRETE ROOFS.

During the last year there has been considerable discussion in regard to the prevention of condensation under concrete roofs and it is, therefore, interesting to note the remarks in this connection of Leonard C. Wason, president of the Aberthaw Construction Company, of Boston. Mr. Wason states that under concrete roof, if the air is moist and hot, as it is in the principal part of a paper mill when the weather is cold outside, provision must be made to prevent condensation. Even with the best provision it is necessary in some places to provide for adequate ventilation, as dripping will occur whenever the air reaches the dewpoint. A thick concrete slab requires some insulation, even under only moderately bad conditions of dampness inside the building. Some of the roofing companies provide roofing felt, which goes on under the regular waterproofing of the roof surfaces. The disadvantages of this felt come from the fact that it is soft, and walking on the roof or particularly moving any heavy weight about on it will cut the roofing very readily. There is also the question of the permanence of the materials used in the felt. The cheapest and one of the most efficient methods of insulation that Mr. Wason knows of is to use on top of the roof slab a filling of porous concrete made up of screened cinders and cement. W. H. Ham, of the engineering office of French & Hubbard, of Boston, specifies as follows for such filling. His object is to get as spongy, porous material as possible and one that will have some cohesion, enough so that the roofing felt can be mopped down onto it, with the hope of its setting in position.

"Cinder Fill.—Concrete roofs shall be covered with a cinder concrete fill of thickness as shown. This fill to form crickets and other grades as indicated, minimum thickness, however, to be not less than three inches.

"Concrete for this work shall be mixed with one part by volume of Portland cement, fulfilling specifications required for other portions of the building work, and not more than ten parts by volume of clean, steam boiler cinders.

"The fill shall be placed as carefully as possible, so as to be left porous. After the fill has set up sufficiently to work over, the top surface shall be trowelled over with a flat coat of mortar to give a proper surface for the tar and gravel or other rolling material."

Difficulty develops with roofs on which furnace slag has been used and covered with an inch or more of sand finish, as the finish has expanded in the heat of the summer and has cooked up in big blisters.

BUILDING PERMITS

The following table, showing the value of building permits issued in 1912, compared with 1911, has been compiled from returns supplied to The Monetary Times by the various cities and towns direct:—

City.	1911.	1912.	Increase.	Increase per cent.
Berlin	$ 358,095	$ 842,613	$ 484,518	132.5
Brandon	1,024,529	1,166,214	141,685	13.7
Brantford	613,860	1,167,105	553,245	90.2
Calgary	12,907,638	20,394,220	7,486,582	58.0
Chatham	355,147	201,591	153,556(5)	43.1
Edmonton	3,660,327	14,446,819	10,786,492	294.7
Fort William .	3,077,860	4,211,285	1,133,425	36.8
Galt	282,334	506,130	223,796	79.0
Halifax	508,796	579,775	70,979	13.7
Hamilton	4,255,730	5,491,800	1,236,070	29.0
Kamloops	530,860	559,703	28,847	5.4
Kingston	314,569	645,774	331,205	105.4
Lethbridge ..	1,033,380	1,358,250	324,870	31.3
London	1,036,880	1,136,108	99,228	9.5
Macleod	96,400	220,500	124,100	128.7
Maisonneuve ..	1,195,120	2,685,828	1,490,708	124.8
Medicine Hat .	743,272	2,836,239	2,092,967	281.5
Montreal	14,579,952	19,641,955	5,062,003	34.7
Moose Jaw ...	2,475,736	5,275,797	2,800,061	113.1
Nanaimo	159,461	321,422	161,961	101.2
Nelson	167,000	275,000	108,000	64.6
New Westminster	1,124,587	1,634,528	509,941	45.2
North Battleford	240,080	896,970	656,890	273.3
*North Bay ..	157,406	462,675	305,269	194.2
Ottawa	2,997,610	3,621,850	624,240	20.8
Peterborough .	345,372	465,905	120,533	34.7
(4)Point Grey .	.....	1,755,115	.....	....
Port Arthur ..	595,180	2,494,179	1,898,999	318.9
Preston	244,375	337,160	92,785	37.7
Prince Albert ..	921,595	2,006,925	1,085,330	117.7
Prince Rupert .	265,771	316,717	50,946	19.1
Red Deer	237,220	387,640	150,420	63.2
Regina	5,099,348	8,047,309	2,947,961	57.7
St. Catharines .	265,435	811,335	545,900	205.6
St. John	572,700	647,200	74,500	13.0
Saskatoon ...	5,004,326	7,640,530	2,636,204	50.6
(3)South Vancouver	2,500,000	2,600,000	100,000	4.0
Stratford	103,500	367,233	263,733	255.3
Sydney	495,642	656,111	160,469	32.3
Toronto	24,374,539	27,401,761	3,027,222	12.4
Vancouver	17,652,642	19,428,432	1,775,790	10.0
Vernon	202,982	446,142	243,160	120.2
Victoria	4,260,315	8,208,155	3,947,840	92.4
Welland	342,808	469,744	126,936	33.9
(2)Weyburn ..	.....	766,760	.....	....
Windsor	739,595	1,098,063	358,468	48.4
Winnipeg	17,716,750	20,475,350	2,758,600	15.5

*Value of permits from May 17th to December 31st, 1911. No record kept previously.

(2) Figures for 9 months—building permit by-law brought into force in April, 1912.

(3) Estimated—no record kept previously to November 23rd, 1911.

(4) From May 13th to December 31st. No record kept previously to May, 1912.

(5) Decrease.

The value of the permits of 44 cities in 1911 was $135,000,000, and of 46 cities last year $196,000,000, an increase of $61,000,000.

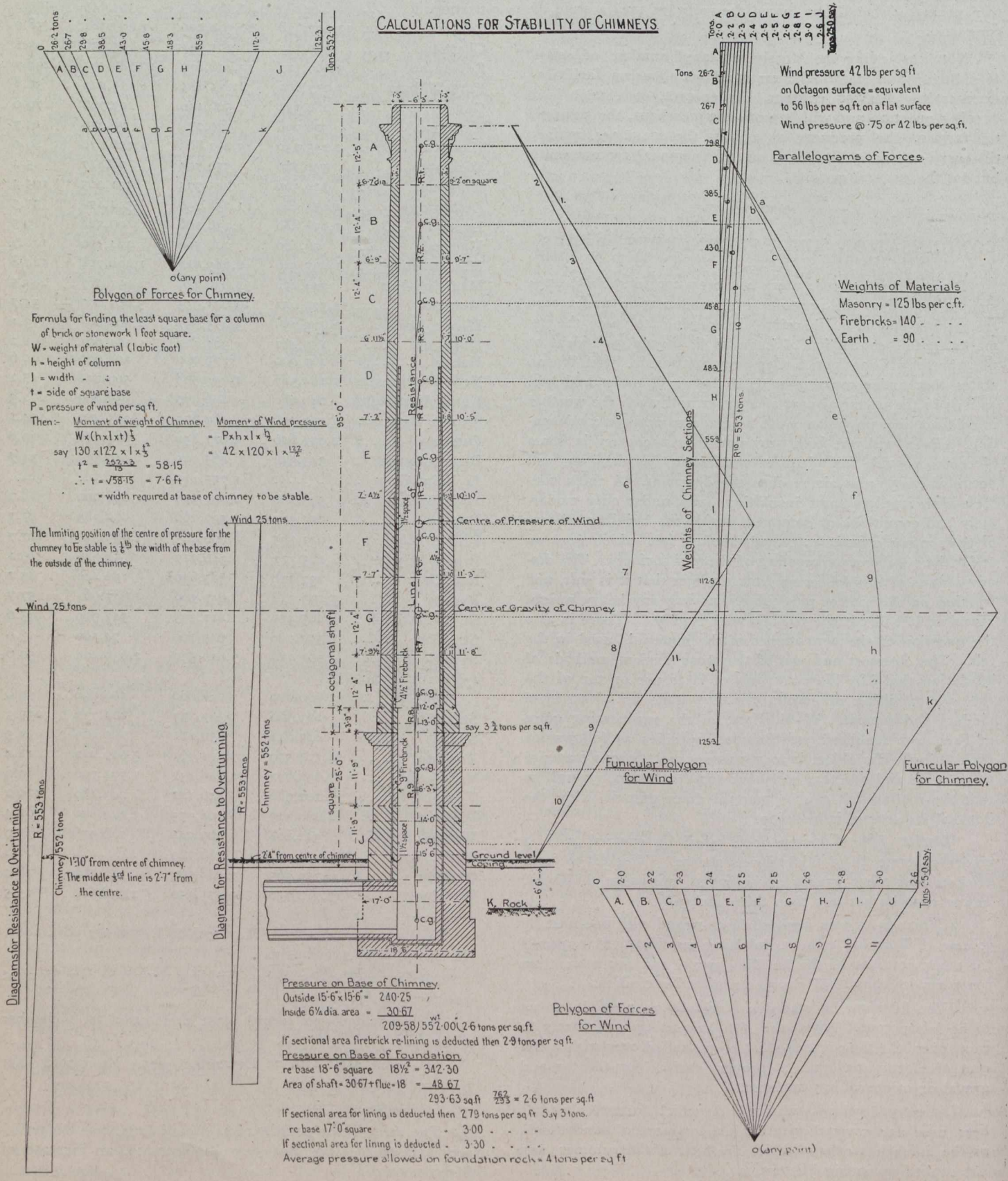
CALCULATIONS FOR STABILITY OF CHIMNEYS.

By Leonard Goodday, C.E. and M.E., late of the British Admiralty.

Calculations for the stability of chimneys are from time to time given, but as a rule simply for the turning point at the base, and level with the ground, and this is not sufficient of itself, when it is so essential to have it perfectly safe in every way, especially when the chimney is high; such, for instance, as one for a factory or engine house.

The one which it is proposed to illustrate fully is one for an engine house which was carried out some years back in the east, and which I will now explain step by step in detail

To commence the design, determine the height of the stack necessary for the draught, etc., and by moments, as shown to the left, find the required base t which, in this case,



is 7.6 ft. for a column of brick or stonework 1 ft. square to be stable. As the wind may come from any quarter, the base, when constructed, must be at least 7.6 x 2 square, i.e., 15.2 ft. x 15.2 ft. Of course, the greater the weight of stack, the safer the structure, and the sectional area of base will be, comparatively speaking, very little more than this for the same height.

This chimney is octagon in section, and the assumed pressure of wind 56 lbs. per square ft. on a flat surface; and the average pressure in this case becomes .75 of 56 lbs., or 42 lbs. per square foot, as given in sketch.

The chimney which is found necessary to be 120 ft. in height from the ground may now be designed in the usual proportion, and for the facility of calculation divided in equal sections of, say, 12 ft. 4 in., each section being lettered A, B, C, etc., as shown.

The next step is to find the pressure of wind at 42 lbs. per square foot on each of the above sections, the total result of which is found to be 25 tons, as shown on the right hand of diagram.

Next, by parallelograms of forces, find graphically their resultants in the following way: Draw the vertical line to scale representing the weight of section A, viz., 26.2 tons, and the horizontal force of wind, viz., 2.0 tons, and draw in the line R 1, which gives the resultant force for that section. Produce the vertical line representing A until it equals A plus B, then with the combined weights of the two sections A and B, viz., 26.2 plus 26.7 tons, and with the wind pressure, viz., 2.0 and 2.2 tons on the two sections A and B respectively, draw the resultant force R 2 and continue in this way until the total resultant force R 10, viz., 553 tons, is obtained at the base of section J.

It will be noticed that the lettering of the sections A, B, C, etc., of the chimney, with their weights, are shown on the left side of the parallelograms of forces, so that mistakes will be avoided.

Now put in the centre of gravity of each section, and draw in the lines R 1, R 2, etc., from the centre of gravity of A, B, C, etc., to the bottom of each section respectively, and parallel to R 1, R 2, etc., shown on the parallelogram of forces, and connecting these points by a line which is the line of resistance, and well within the middle third of each section.

The result of this investigation shows graphically that if this chimney were built up in sections placed one upon the other, only with their bases horizontal, and without being bonded together, there would be no danger of it being "crippled."

The next step is to determine the resistance to overturning of the whole chimney, first, when the centre of pressure of the wind is taken, and secondly, when the total pressure is taken at the centre of gravity of the chimney. It will be necessary to first find these points, the method of which is as follows:—

For the centre of pressure of wind: Draw the horizontal line, as shown, to the right, representing the pressures on the sections A, B, C, etc., by the pressures of each, viz., 2.0, 2.2 tons, etc., making a total of 25 tons. Take any point O, and connect the lines representing the pressures to this point, as shown by the numbers 1, 2, 3, etc. This figure represents the polygon of forces for wind, the letters A, B, C, etc., being the sections of chimney opposite each line of pressure respectively.

Next draw in the horizontal dotted lines from the centre of gravity of the sections A, B, C, etc., and also the line shown where the wind is assumed to commence to take effect.

Now draw the lines 1 and 2 from this last line parallel to the lines 1 and 2 on the polygon, the line 2 being drawn until it cuts the horizontal line from the centre of gravity of section B. From this point of intersection draw the line 3 parallel to line 3 on the polygon, until it cuts the horizontal line from the centre gravity of section C, and continue in the same way until line 10 is drawn, letting it cut the ground level. From this point of intersection draw line 11 parallel to line 11 on the polygon until it cuts line 1 produced. From this point draw a horizontal line until it cuts the chimney, and which is the centre of pressure of the wind. The figure just completed is called the Funicular polygon for wind.

In the same way the polygon of forces for the chimney may now be constructed as shown to the left, and from this can be obtained in the same way, the funicular polygon and centre of gravity for the chimney, the only difference being that this last polygon is commenced from the line from the centre of gravity section A, and finished from the line from the centre of gravity of section J.

On the line for the centre of pressure of wind draw a line representing 25 tons total wind pressure, and a vertical one representing 552 tons the dead weight and centre line of chimney, and complete the resolution of forces. The resultant R works out to 553 tons, and is the resistance to the overturning at ground level. This line is found to be 2 ft. 4 in. from the centre of chimney.

In a similar way construct another diagram, but from the line for the centre of gravity of chimney. The resultant R or line of resistance is found to be 1 ft. 10 in. from the centre of the chimney.

Now, the chimney at ground level is 15 ft. 6 in. square, and consequently its middle third is 5 ft. 2 in. or 2 ft. 7 in. on either side of the centre, and as the two resistances to overturning are 2 ft. 4 in. and 1 ft. 10 in. respectively, the chimney is perfectly safe.

The last and equally important step is for the foundation which should be made perfectly solid and of concrete, the strength of which should be according to the total pressure, including everything, on the base of the foundation.

The trial sectional area was taken at 21 ft. 6 in. square, which gave too much over the load allowed per square foot. Then 17 ft. 6 in., which was found to be too light, and lastly 18 ft. 6 in. square was adopted.

It will be seen that the greatest weight per square foot on base of foundation is 3.0 tons, and that the safe load allowed on the rock is 4.0 tons in that locality.

For every important and heavy structure borings should always be taken, and the ground thoroughly tested, so that there will be no chance of settling, and causing continual trouble and expense, and which can be avoided by having the advice of an expert on foundations.

It is hoped that this article will be of service to those seeking advice on this subject.

WASTE OF NATURAL GAS.

Much has been written about the saving effected by using natural gas in gas engines to generate power, instead of burning the gas under boilers to generate power from steam. Experiment has shown that the amount of gas required per hour, for the development of one horse-power, varies from 9 cubic feet, with the highest type of large internal combustion engine, to 130 cubic feet with the ordinary steam engine. In other words, the efficiency of the gas is over fourteen times as great when used in gas-engines as when used for generating steam under boilers.

The province of Ontario has reduced the waste of natural gas to a minimum by causing all abandoned wells to be plugged and by levying a tax of two cents per thousand feet, with a rebate of 90 per cent. when the gas is used.

ABUSES IN WATER FILTRATION.

The success of a water filtration plant depends, first, upon the selection of the method of purification best suited to local conditions, and second, upon the proper operation of the works after they have been installed. This subject was discussed at the last meeting of the New England Water-works Association by Mr. Gilbert H. Pratt, chemist of the Rhode Island State Board of Health, who pointed out some of the things which contribute to the production of unsatisfactory results.

Slow sand filtration for a water high in algæ is not to be recommended, he said, because of the undue clogging of the beds, but by the use of aeration and prefilters conditions may be greatly improved. Plain sand filtration should not be relied upon to treat a very highly colored water. Rates of filtration should not be changed quickly, for such practice tends to disturb bacterial action at the surface of the bed.

A slow sand filtration plant which would handle a given water satisfactorily might, as was the case in Providence, be installed without covering the beds. As soon as a hard winter struck the plant the beds would become covered with ice, and it would be impossible to get at the surface to clean without removal of the cakes of ice. This condition occurred in Providence for a short time during 1907, finally necessitating opening the river gate, and the use of raw water for about two weeks or so before the weather moderated and before the ice could be removed. This experience resulted in steps immediately being taken to cover the beds. This experience, Mr. Pratt believes, should serve as a lesson against such open installations in New England.

One of the easiest ways to abuse a plant is to put it into the hands of inexperienced operators, especially in the case of rapid sand filters, where the supervision must be particularly close and where tests for color and alkalinity must be made to regulate the doses of chemicals used. One plant had operated for a number of years satisfactorily in a bleachery. When Mr. Pratt was consulted with regard to difficulties which were occurring he found that the parties in charge did not have an understanding of the question of alkalinity control of the plant ,and the residual alkalinity of the effluent had dropped to a point where the water was passing the plant at times in an acid condition, or at best with an extremely low alkalinity, resulting in after-coagulation in the vats and throughout the system. This condition had been caused by a mill above discharging a larger amount of acid wastes in the river than at the time the formula for operating the filters was figured. The addition of alkalinity to the water put the plant back into its former good condition.

At another installation the man in charge of the plant, for some reason or other, was assigned to night duty, and he was attempting to make his control tests for color and alkalinity at night by artificial light. This, of course, gave far from accurate results. Another trouble at this plant was that the one man was expected to operate the flow of chemicals from the tanks, which were located in the pump house, and at the same time attend to washing the filters in a filter house which was located about one-eighth of a mile away. This spreading out of the plant made it impossible for the lone operator to properly attend to the dosing, and the result was that the flow of chemicals varied from time to time, with resulting poor output from the plant.

At another plant trouble due to low residual alkalinity was found to exist, and the output contained undecomposed sulphate of alumina. Investigation showed that this operator was using an indicator solution many times too strong and the alkalinity tests which he was obtaining were absolutely inaccurate.

At still another plant the biggest difficulty discovered when troubles arose seemed to be with the application of the chemicals, which required an extremely close control on account of an influence on the color of the filtered water, as the residual alkalinity became too high. The engineer was a man who had been for years pumping water out of the reservoir under the old system, and could not be made to realize that careful supervision was necessary. He grossly neglected controlling the flow of the chemicals. These operating troubles immediately ceased when a new, competent engineer was put in charge of the plant.

The effect of an abnormal amount of organic matter or algæ in comparison with the color of the water sometimes has resulted in an under-dosing with coagulant, as this additional amount of organic matter has seemed to prevent proper coagulation with resulting incomplete removal of the constituents which it was intended to remove, and the effluent has contained alumina and abnormal amounts of color and algæ. Proper dosing in view of the above-mentioned conditions has resulted in excellent work from this plant.

Another abuse oftentimes is attempting to operate a plant with every possibility for good results, by methods which some man of limited experience may have used at some other plant, meeting entirely different conditions. Such cases have been capable of adjustment when instructions have been given which had in mind the type of plant and the raw water to be handled.

In connection with the operation of plants of the mechanical type, it is essential that the night man should be one who can be depended upon to stay awake, as a nap for an hour or two may result in throwing the whole operation of the plant out of adjustment for several hours.

CANADIAN RAILROAD EARNINGS.

The following are the approximate gross earnings of Canadian Railroads month by month.

	Canadian Pacific Railway.			Grand Trunk Railway.			Canadian Northern Railway.		
Month.	1911.	1912.	Increase.	1911.	1912.	Increase.	1911.	1912.	Increase.
	$	$	$	$	$	$	$	$	$
January	5,650,000	7,201,000	1,551,000	3,381,239	3,422,286	41,049	822,600	1,228,100	405,500
February	6,210,000	8,773,000	2,563,000	3,103,166	3,259,943	156,777	803,100	1,202,500	400,400
March	8,648,000	10,389,000	1,741,000	3,909,773	4,080,230	170,457	1,270,600	1,572,700	302,100
April	8,458,000	10,484,000	2,026,000	3,747,251	4,135,202	387,951	1,345,400	1,607,600	262,200
May	9,111,000	11,133,000	2,022,000	3,942,055	3,303,374	361,319	1,445,600	1,822,100	376,500
June	9,040,000	10,848,000	1,808,000	4,437,438	4,653,475	116,036	1,465,300	1,769,500	304,200
July	9,291,000	11,641,000	2,350,000	4,237,383	4,641,868	404,485	1,475,950	1,829,700	353,800
August	10,073,000	11,886,000	1,813,000	4,502,674	5,066,415	563,741	1,420,650	1,745,800	325,200
September	9,834,000	11,322,000	1,488,000	4,409,559	4,758,777	349,218	1,576,400	1,671,500	95,100
October	11,113,000	12,960,000	1,847,000	4,468,768	4,901,954	433,186	2,028,900	2,351,200	322,300
November	10,399,000	12,145,000	1,746,000	4,101,244	4,622,308	521,264	2,001,500	2,509,700	508,200
December	10,568,000	12,108,000	1,540,000	4,147,769	4,843,965	695,196	1,831,400	2,131,700	300,300

ELECTRIC RAILWAYS IN CANADA.

During the next few years, there is likely to be considerable development in electric railways in Canada. The large railroad corporations are considering the advisability of electrifying certain existing steam lines and building new electric roads for suburban service. Capitalists and charter holders are estimating the cost of linking small towns by electric roads. The present appears to be a time of preparation for the inauguration of an electric railroad era, especially in the older provinces of the Dominion. It is most marked in Ontario. The accompanying table shows to what extent the electric railroad is already in vogue in that province. The statistics are for the year 1911, the latest for which official figures are available.

The subscribed capital of twenty-eight roads in Ontario is $16,000,000. The paid-up capital totals $14,000,000, and the outstanding bonds $12,000,000. Their total liabilities are $36,737,000 and total assets $36,711,000. The operating results are interesting. With the exception of five, they all showed a surplus. The largest deficit, amounting to $421,967, was that of the Hamilton Radial. The total receipts of the twenty-eight were $8,009,000, and the total expenses $6,620,000, giving a total surplus of $1,430,000.

Passenger fares accounted for the greatest share of receipts, revenue from freight and other sources being comparatively small. It is for passenger traffic that our transportation interests are apparently agreed that electric traction is most suitable. The receipts may be summarized as below:—

Receipts from	Amount.
Passenger fares	$6,811,493
Freight	238,557
Mail service and express	8,809
Other sources	163,415

The actual operating figures are of significance to railroad men and to investors particularly. The street car systems in the large cities naturally show the largest car mileage run, Toronto leading the way in Ontario with a mileage of more than 16,000,000. The cost of operation per car mile shows some striking contrasts. The lowest figure is that of the Cornwall Street Railway, $07.5. The highest is that of the Hamilton and Dundas Railway, $43.1. Of 22 roads, the cost of operation per car mile in 14 cases exceeded $20, and in eight cases was under that amount.

The smallest length of track is that of the Huntsville and Lake of Bays Railway, which has only one mile. It serves a holiday traffic, connecting boats. Last year it carried 14,000 passengers. The greatest mileage, 110.88, is that of the Toronto Street Railway. The number of passengers carried by the electric roads of Ontario in 1911 was 181,259,748, and the year before 157,539,893.

Among the important electric roads in other provinces are the following:—

Company.	Mileage.
Halifax Electric Tramway Company	13.15
Montreal Street Railway	230.97
Quebec Railway	17.00
Winnipeg Electric Railway	119.46

Electric roads are also operated or contemplated in several cities west of Winnipeg, including Brandon, Moose Jaw, Regina, Saskatoon, Calgary, Edmonton, Lethbridge, Vancouver and Victoria. The system in the two latter cities, as well as in smaller British Columbia municipalities, is operated by the British Columbia Electric Railway. It has 234 miles of railway.

In the entire Dominion the mileage of electric roads in 1911 was 1,223. The growth of first main track mileage since 1900 is as follows:—

1902	557.59
1903	759.36
1904	766.50
1905	793.12
1906	813.74
1907	814.52
1908	992.03
1909	988.97
1910	1,047.07
1911	1,223.73

The capital liability of electric railways in Canada was increased from $102,044,979 in 1910 to $111,532,347 in 1911.

The following statement will show the facts with regard to capital liability for five years:—

	1907.	1908.	1909.	1910.	1911.
Stocks	$43,491,746	$50,295,266	$51,946,433	$58,653,826	$62,251,203
Funded debt	31,166,976	37,114,619	39,658,556	43,391,153	49,281,144
Total	$74,658,722	$87,409,885	$91,604,989	$102,044,979	$111,532,347

The gross earnings from operation for 1911 were $20,356,951.70—an increase of $3,256,162.22 over 1910.

The income for 1911 came from the following sources:—

Car earnings: Passengers, $19,130,376.22; freight, $744,179.11; mail and express, $88,233.13; other car earnings, $100,930.12. Total car earnings, $20,063,718.58.

Miscellaneous earnings: Advertising, $66,147.33; rent of buildings, etc., $22,551.98; rent of tracks, $13,650.94; rent of equipment, $58,624.40; sale of power, $43,698.24; other earnings, $88,560.23. Total, $293,233.12. Gross earnings from operation, $20,356,951.70.

The following is a summary of statistical facts, compiled by Mr. J. L. Payne, comptroller of railway statistics, Ottawa, and relating to electric railways in Canada:—

	1909.	1910.	1911.
Total mileage	988.97	1,047.07	1,223.73
Paid-up capital	$91,604,989	102,044,979	111,532,347
Gross earnings	$14,611,484	17,100,789	20,356,952
Net earnings	$4,962,501	5,383,276	6,592,335
Earnings—			
Passenger traffic	$14,080,755	16,125,995	19,130,376
Freight	$386,092	575,537	744,179
Mail and express	$110,452	68,604	88,233
Other sources	$34,185	51,241	100,930
Total operating expenses	$8,885,235	10,121,781	12,096,134
Maintenance of way and building	$643,135	797,895	920,875
Cost of motive power	$1,445,227	1,586,927	2,001,543
Maintenance of cars	$1,184,287	4,814,762	5,768,085
General operat'g charges	$5,612,041	1,406,943	1,610,099
Total car mileage	60,152,846	65,249,166	72,618,806
Passengers carried	314,026,671	360,964,876	426,296,792
Tons of freight carried.	852,294	2,496,072	

ONTARIO HYDRO-ELECTRIC COMMISSION.

The total revenue of the Ontario Hydro-Electric Commission for the past year reached $511,801.88. These receipts were for power delivered, including charges for administration, general expenses, operation, maintenance and interest. The expenditure reached $456,635.43; the total for the fourth quarter, with a tremendous increase in power purchased, was but $28,000 above that of the first quarter. The surplus on the year was $55,166.45, half of which was rolled up in the last quarter. This has been nominally set aside as a "depreciation reserve."

ELECTRIC RAILWAYS IN ONTARIO

Name of Railway	Capital subscribed	Capital paid up	Bonds outstanding	Other liabilities	Total liabilities	Total assets	Receipts from passenger fares	Receipts from freight	Receipts from mail service & express	Receipts from other sources	Total receipts	Total expenses	Surplus	Deficit
	$ c.	$ c.	$ c.	$ c.	$ c.	$ c.	$ c.	$ c.	$ c.	$ c.	$ c.	$ c.	$ c.	$ c.
Berlin & Waterloo	.....	.....	114,152 84	33,119 15	147,271 99	147,271 99	32,607 02	.....	1,178 51	4,313 54	38,090 07	37,908 30	190 77	.....
Berlin & Bridgeport	17,400 00	17,400 00	2,400 00	14,673 92	34,473 92	34,743 92	7,029 26	.....	115 38	129 50	7,274 14	6,764 79	509 35	.....
*Brantford Street Railway	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Cornwall Street	200,000 00	200,000 00	.....	30,199 51	230,199 51	230,199 51	16,620 75	9,450 84	.....	3,062 62	29,134 21	22,212 35	6,921 86	.....
Galt, Preston & Hespeler	100,000 00	31,310 00	601,852 47	259,816 46	892,978 93	892,978 93	76,013 88	77,561 05	1,875 22	7,891 09	163,341 24	97,789 55	65,551 69	.....
*Grand Valley	1,100,000 00	1,100,000 00	688,800 00	.....	1,788,800 00	1,788,800 00	81,153 00	4,455 31	.....	2,324 58	87,932 89	79,824 40	8,108 49	.....
Guelph Radial	.....	.....	103,775 19	.....	103,775 19	124,585 93	28,338 16	1,070 85	.....	958 38	30,367 39	30,367 39	1,960 65	.....
Hamilton & Dundas	100,000 00	100,000 00	100,000 00	158,773 30	358,773 30	358,773 30	49,887 74	788 46	148 00	2,673 44	53,497 64	49,813 29	3,684 35	.....
Hamilton Street	205,000 00	205,000 00	500,000 00	270,812 97	975,812 97	975,812 97	405,030 57	.....	.....	5,404 08	410,434 65	323,789 48	86,645 17	.....
Hamilton, Grimsby & Beamsville	235,000 00	235,000 00	150,000 00	61,727 49	446,727 49	446,727 49	78,679 42	35,209 28	550 00	4,905 53	119,344 23	117,906 55	1,437 68	.....
Hamilton Radial	111,150 00	111,150 00	1,160,000 00	.....	1,271,150 00	1,271,150 00	152,985 44	.....	.....	.....	152,985 44	174,953 30	.....	21,967 86
Huntsville & Lake of Bays	50,000 00	27,800 00	.....	.....	27,800 00	27,800 00	1,825 45	2,692 44	25 00	.....	4,542 89	4,634 94	.....	92 05
International Transit Co	150,000 00	150,000 00	290,000 00	129,420 63	569,420 63	529,420 63	68,018 69	.....	.....	8,202 37	76,221 06	55,344 02	20,877 04	.....
Kingston, Portsmouth & Cataraqui	83,100 00	83,100 00	.....	106,910 00	106,910 00	100,000 00	30,959 60	.....	.....	1,139 63	32,099 23	36,597 10	.....	4,497 87
London Street	750,000 00	552,000 00	575,000 00	102,965 83	1,229,965 83	1,229,965 83	261,200 43	.....	.....	5,615 19	266,815 62	252,119 65	14,695 97	.....
Niagara Falls, Park & River	925,000 00	925,000 00	1,073,000 00	.....	1,998,000 00	1,998,000 00	151,249 57	.....	.....	18,225 95	169,475 52	115,235 57	54,239 95	.....
Ottawa Street	1,247,700 00	500,000 00	500,000 00	.....	1,747,700 00	1,747,700 00	.....	.....	.....	.....	787,573 27	532,311 64	255,261 63	.....
Peterboro' Radial	100,000 00	100,000 00	50,000 00	37,242 32	187,242 32	187,242 32	36,380 20	.....	.....	680 03	37,060 23	32,839 41	4,220 82	.....
Port Arthur & Fort William	.....	.....	838,147 20	101,065 01	939,212 21	939,212 21	140,058 31	12,226 50	379 16	3,584 44	156,248 41	136,297 18	19,951 23	.....
Sandwich, Windsor & Amherstburg	297,000 00	297,000 00	490,000 00	278,521 57	1,065,521 57	1,065,521 57	187,028 74	.....	800 00	37,150 92	224,979 66	128,609 25	96,370 41	.....
Midland Terminal	250,000 00	250,000 00	.....	27,321 72	277,321 72	277,321 72	.....	20,902 50	.....	.....	20,902 50	25,508 24	.....	4,605 74
Sarnia Street	90,000 00	90,000 00	.....	116,712 21	206,712 21	206,712 21	35,351 47	6,040 21	1,555 00	3,421 92	46,368 60	40,728 73	5,639 87	.....
St. Thomas Street	.....	.....	57,482 29	17,696 01	75,124 30	75,124 30	14,594 96	.....	.....	1,748 08	16,343 04	24,828 25	.....	8,485 21
Toronto Street	8,000,000 00	8,000,000 00	3,998,326 66	5,223 581 91	17,221,908 57	17,221,908 57	4,549,160 88	.....	.....	41,084 17	4,590,245 05	3,874,915 21	715,329 84	.....
Toronto Suburban	80,000 00	80,000 00	.....	135,638 92	215,638 92	215,638 92	53,967 12	.....	.....	10,062 13	64,029 25	52,174 64	11,854 61	.....
Toronto & York Radial	2,000,000 00	2,000,000 00	1,640,000 00	979,192 20	4,619,192 20	4,619,192 20	353,352 71	68,159 76	2,182 92	837 50	424,532 89	367,018 95	57,513 94	.....
Thurlow Railway Co	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
*Woodstock, T. V. and I.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	16,011,350 00	14,974,760 00	12,932,882 65	8,085,391 13	36,737,633 78	36,711,804 52	6,811,493 37	238,557 20	8,809 19	163,415 09	8,009,848 12	6,620,492 18	1,430,965 32	39,648 73

Name of Railway	Car miles run	Maintenance of way and buildings	Cost of motive power	Maintenance of cars and equipment	General operating expenses	Charges on income, including interest	Total expenses	Cost of operation per car mile	Length of track switches and turn outs		Car mileage		Passengers carried	
									1910	1911	1910	1911	1910	1911
		$ c.	$ c.	$ c.	$ c.	$ c.	$ c.	$						
Berlin & Waterloo	98,992	1,864 82	6,177 06	4,170 37	14,298 69	11,397 36	37,908 30	38.3	4.40	4.00	90,408	98,992	688,304	774,941
Berlin & Bridgeport	32,000	207 50	1,685 96	.....	3,873 59	997 74	6,764 79	21.1		3.20	not given	32,000	145,587	145,587
*Brantford Street	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Cornwall Street	286,466	1,020 83	2,764 64	3,124 45	15,302 43	.....	22,212 35	07.5	6.50	6.50	192,445	286,466	357,116	340,677
Galt, Preston & Hespeler	275,769	13,005 34	20,329 04	10,846 22	47,431 56	6,177 39	97,789 55	35.4	26.42	26.42	219,977	275,769	923,167	994.568
*Grand Valley Railway	333,417	4,787 00	20.534 60	6,405 82	45,581 49	2.515 49	79,824 40	23.9	40.43	40.24	358,593	333 417	1,026,354	1,095,488
Guelph Radial Railway	192 500	1,764 43	4,665 13	4,771 92	12,757 18	4,448 08	28,406 74	14 7	6.33	6.33	192,500	192,500	605,476	668,952
Huntsville & Lake of Bays	1,350	548 06	443 02	250 00	1,654 61	1,739 25	4,634 94	34.9	1.00	1.00	1,110	1,350	12,667	14,000
Hamilton & Dundas Railway	115,434	4,555 60	4,470 67	2,263 04	23,424 34	15,099 64	49,813 29	43 1	7.25	6.98	111,176	115,434	511,344	595,896
Hamilton Street Railway	1,652,498	11,734 55	42,451 63	40,172 62	161,246 22	68,184 46	323,789 48	19.6	22.29	22.29	1,647,524	1,652,498	9,123,699	10,625,054
Hamilton, Grimsby & Beamsville	347,054	14,873 84	13,163 20	14,040 88	50.308 71	25,522 83	117,909 46	33.9	23.00	22.60	291,212	347.054	508,091	622,915
Hamilton Radial Railway	513,712	.....	.....	.....	.....	.....	.....	.....	25.00	33.69	472,236	513,712	1,135,291	1,442,551
International Transit Co	314,806	3,195 72	6,999 88	4,548 22	23,989 44	16,610 76	55.344 02	37.4	3.90	3.90	305,170	314,806	1,159,789	1,650,540
Kingston, Portsmouth & Cataraqui	199,680	3,579 41	3,494 04	6,338 48	18,041 43	4,571 87	36.025 23	18.1	8.00	8.00	199,680	199,680	1,368,258	776,736
London Street	1,432,858	21,751 01	35,010 81	28,963 45	96,928 40	69,475 98	252,129 65	17.6	33.44	33.25	1,421,735	1,432,858	6,718,167	7,210,642
Niagara Falls, Park & River	333,195	24,075 92	5,971 64	4,691 33	47.101 08	33,395 60	115.235 57	34.5	24.11	24.11	350,512	333,195	1,295,485	1,331,645
Ottawa Street	4,171,449	.....	.....	.....	.....	.....	.....	.....	44.54	47.42	3,924,542	4,171,449	15,987.849	23,716,883
Peterboro' Radial	255,218	1,683 30	1,500 00	3,926 33	21,597 28	4,132 50	32,839 41	12.8	5.24	5.24	257,063	255.218	710,853	810,124
Port Arthur & Fort William	654,015	10,239 19	19,743 10	18,460 52	49,083 20	38,771 17	136,297 18	20.8	19.25	22.33	491,766	654,015	2,832,426	3,407,918
Sandwich, Windsor & Amherstburg	875,040	15,442 83	13,257 73	10,884 52	54,824 17	34,200 00	129,609 25	14.8	36.06	36.06	854,794	875,040	3,031,244	3,428,634
Midland Terminal	.....	.....	.....	.....	.....	.....	.....	.....	4 00	4.00	.....	.....	.....	.....
Sarnia Street	143,990	.....	5,670 11	2,654 90	22,579 32	9,824 40	40,728 73	28.3	9.25	9.25	143,990	143,990	723,566	800,210
St. Thomas Street	281,700	1,859 98	4,200 00	2,437 96	16,330 01	.....	24,828 25	08.81	7.70	7.70	267,502	281,700	353,026	534,562
Toronto Street	16,354,871	85,175 59	369,501 97	308,994 20	1,569,646 65	1,541,596 80	3,874,915 21	23.7	107.71	110.88	15,391,301	16,354,871	103,480,724	114,824,464
Toronto and Suburban	234,128	6,503 51	6,000 00	4,570 25	23,872 73	11,228 15	52,174 64	22.3	10.26	10.26	227,113	234 128	1,047,191	1,309,965
Toronto & York Radial	1,118,000	23,836 37	56,061 49	44,949 69	124,760 29	117,411 11	367,018 95	32.8	81.05	81.05	1,106,215	1,118,000	3,794,219	4,136,796
*Thurlow Railway	.....	.....	.....	.....	.....	.....	.....	.....	5.43	5.43	not given	.....	.....	.....
*Woodstock, T. V. & I.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	30,018,142	251,704 80	644.095 72	527,465 17	2,444,632 82	2,017,300 58	5,886,199 39		563.56	582.13	28,518,554	30,218,142	157,539,893	181,259,748

Grand Valley System operates Brantford Street Ry., 8.95 miles, Woodstock, Thames Valley and Ingersoll, 11.50 miles, Grand Valley Ry., 20.75: 41.20 miles.

The Canadian Engineer

ESTABLISHED 1893.

ISSUED WEEKLY in the interests of the CIVIL, MECHANICAL, STRUCTURAL, ELECTRICAL, RAILROAD, MARINE AND MINING ENGINEER, THE SURVEYOR, THE MANUFACTURER, AND THE CONTRACTOR.

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THE CHICAGO DRAINAGE CANAL DECISION.

In an elaborate opinion denying the petition of Chicago for permission to divert from Lake Michigan increased water, Secretary of War Stimson deals with the principal points of argument which have developed during the negotiations carried on in the past few months.

We treated this question of increased diversion of water for the Chicago Drainage Canal editorially in our issues of April 25th and July 18th, 1912, and we are glad to note that the arguments therein presented have been given due weight in the decision arrived at. Secretary of War Stimson states that he has reached the following conclusions:—

> That the diversion of 10,000 cubic feet per second from Lake Michigan, as applied for in this petition, would substantially interfere with the navigable capacity of the navigable waters in the Great Lakes and their connecting rivers.
>
> That being so, it would not be appropriate for me, without express Congressional sanction, to permit such a diversion, however clearly demanded by the local interests of the sanitation of Chicago.
>
> That on the facts here presented no such case of local permanent necessity is made evident.
>
> That the provisions of the Canadian treaty for a settlement by joint commission of "questions or matters of difference" between the United States and Canada offer a further reason why no administrative officer should authorize a further diversion of water, manifestly so injurious to Canada, against Canadian protest.

The opposition to the application of the Sanitary District for permission to divert 10,000 cubic feet of water per second, instead of the 4,167 feet, at present authorized, was pronounced, on the part of twenty-three cities and six States, the navigation interests of the Great Lakes, the Canadian Government and private interests, and Mr. Stimson states that this opposition marks a distinct change in the situation from the time the canal was projected.

The specious argument which formed the basis of Mr. Isham Randolph's report in behalf of the Sanitary District, that the reduction in depth on the lakes caused by the increased diversion would be of no consequence, in view of the fact that greater natural changes occur through winds and other conditions, is taken at its true worth, and Mr. Stimson states the fact that the oscillations would remain as before, that low water would fall lower and high water would rise less high, and the average draught of vessels would have to be diminished to that extent. He reiterates that every drop of water taken out of the lake at Chicago tends to nullify the costly improvements on the harbors, etc., as well as to inflict even greater loss upon the navigation interests.

Secretary of War Stimson is to be congratulated on this eminently fair and just opinion. It is seldom that a report comes to hand which shows such fair-mindedness and a desire to protect all the interests affected. From Canada's standpoint the decision could not be improved upon. Secretary Stimson notes the fact that the International Waterways Treaty of 1909 gives Canada certain rights which must be respected. We are glad to note that he has shown this respect in his decision.

THE PUBLIC HEALTH ACT OF ONTARIO.

In this issue under the heading, "Changes in the Public Health Act of Ontario," will be found the important changes in Public Health legislation which took effect at the beginning of this year in the Province of Ontario. We are in hearty sympathy with all of these, but we are sorry to note that as yet no provision has been made for the employment of an engineer to work in co-operation with the Provincial Board of Health. In the editorial columns of the issue of September 19th, 1912, we stated that the necessity for the securing of the assistance of expert sanitary engineering experience to co-operate with Provincial Boards of Health was very urgent.

We note that plans for the establishment and extension of waterworks and sewerage systems must be approved by the Ontario Board of Health before any debentures can be issued to raise money for these purposes. The Board may direct as to the maintenance, repairs and improvements of such systems, and upon the certificate of necessity from the Board, work may be undertaken in the interests of public health without a vote of the ratepayers.

There is little question that this legislation will aid towards placing the control of the pollution of waterways in the hands of the Board of Health, a result which will mean safer drinking water supplies, and, therefore, reduction in the number of cases of deaths from typhoid fever and other water-borne diseases.

We are unable to see how this legislation can be carried out with the present staff of the Ontario Provincial Board of Health. It is unfair to the engineering profession that their plans should be submitted to members of the medical profession without competent engineering advice available. If this legislation is to be effective, and it is the desire of everyone that it should be effective, the Board of Health must have on their staff a thoroughly competent hydraulic and sanitary engineer, or the advice of such a man must be available for them at such times as they require.

EDITORIAL COMMENT.

We wish to remind all members of the Canadian Society of Civil Engineers of the coming Annual Meeting, to be held in Montreal on January 28th, 29th and 30th. Every member should make a strong effort to be present.

* * * *

Quebec has made a distinct step forward in its treatment of the Good Roads question. It was announced this week that Mr. J. O. Mousseau, member of the Provincial Parliament for Soulanges, has been appointed Minister of Good Roads. This new provincial portfolio should be the means of concentrating the handling of the construction and maintenance of good roads throughout Quebec. The province has voted $10,000,000 for the construction of good roads. This, coupled with the fact that a Cabinet Minister will be directly in charge of the work, should do much to improve road conditions and to aid in opening up the province.

* * * *

The Board of Control in Toronto has recommended to the City Council that a by-law be passed to sanction the erection of a seventeen-story building on King Street. They very naively state that the building would be of fireproof construction throughout. This question of the height of buildings in this city should be settled once and for all, by taking it out of the hands of the Board of Control or the City Council to give permission to erect a building over ten stories high. Toronto streets are far too narrow to permit of the increased congestion of traffic and the evil effects on sunshine, incidental to the erection of such structures.

PROGRAMME OF ANNUAL MEETING, CANADIAN SOCIETY OF CIVIL ENGINEERS.

The annual meeting for the election of officers and members of council for 1913, and for the transaction of business, will be held as follows in the rooms of the society, 413 Dorchester Street West, Montreal.

Tuesday, January 28th.—10 a.m.—Meeting for the nomination of scrutineers; receiving the report of council; reception and discussion of reports of committees, and transaction of the general business of the society.

1 p.m.—Adjournment for luncheon, to which the visiting members are invited by the members resident in Montreal.

3 p.m.—Continuation of the business meeting for the discussion of reports, etc.

4 p.m.—An address by the retiring president, Mr. W. F. Tye.

8 p.m.—Smoking concert in the new quarters of the society, 176 Mansfield Street. Complimentary.

Wednesday, January 29th.—Visit to the Montreal Steel Works. The party will leave the Windsor Hotel at 10 a.m. sharp. By the courtesy of the Montreal Tramways Company special street cars will be provided to convey the party to and from the works at Longue Pointe.

3 p.m.—Business meeting. Discussion of reports.

8 p.m.—Annual members' dinner.

Thursday, January 30th.—10 a.m.—Meeting for the reception of reports of scrutineers. Continuation of the business of the annual meeting.

2.30 p.m.—The meeting will reassemble, if necessary, for the conclusion of business. On adjournment a meeting of the council will take place.

By the kindness of the railways of the Eastern Canadian Passenger Association, members and their families who have paid a full one-way first-class fare going to the meeting in Montreal, will be returned free on presentation of a Standard Convention certificate signed by the ticket agent from whom a ticket has been procured at the point of commencement of the journey. The certificate is to be endorsed by the secretary of the society, and to be vised by a special agent of the Passenger Association who will be in attendance at the meeting from 3 p.m. to 6 p.m. on Wednesday and Thursday, January 29th and 30th. A fee of 25 cents will be charged by the Passenger Association in each case. Tickets may be purchased and are available three days before the commencement of the meeting and the return journey may be made three days after its conclusion.

A further extension of time will be granted to persons residing west of Fort William, making the free return available for 15 days after the close of the meeting; the ticket to Montreal having been purchased at any time and receipt obtained therefor on the Standard Convention form as above.

Tickets to the luncheon on Tuesday and to the annual dinner on Wednesday may be procured at the rooms of the society. Prices: Luncheon, $1.50 to local members; dinner, $3.50. Secretary, Prof. C. H. McLeod.

DEVELOPMENT WORK ON THE C. P. R.

The Canadian Pacific Railway again enjoyed a period of progress and development during its past fiscal year, which ended on June 30th, 1912. Sir Thomas Shaughnessy, the president and chairman of the company, had a pleasing statement to submit to the shareholders. Most interesting to the country at large were the extensions and new connections, made and proposed by the company. For the purpose of securing a shorter and more expeditious route between Quebec and points in New England, served by a friendly connection, the Boston and Maine Railroad, the directors thought it advisable to lease the Quebec Central Railway, forming the connection between Sherbrooke and Levis, together with branch lines from Beauce Junction to St. Sabine, and from Tring to Megantic, all in Quebec, making a total of about 253.5 miles of railway, at a rental based upon the interest on the outstanding 1st, 2nd and 3rd mortgage bonds of the Quebec Central Railway Company, and a dividend on the outstanding capital stock of that company at four per cent. per annum for four years from July 1st, 1912, and thereafter at the rate of five per cent. per annum.

The Shuswap and Okanagan Railway, 51 miles in length, extending from Sicamous Junction, on the main line in British Columbia, to the head of Okanagan Lake, was leased to the company on its completion in 1892 for a period of 25 years, and it was a condition of the lease that the company should pay by way of rental forty per cent. of the gross earnings of the line, as defined in the lease, in quarterly amounts.

The Georgian Bay and Seaboard Railway, recently built under Canadian Pacific Railway auspices between Victoria Harbor, on Georgian Bay, and Bethany, Ontario, to provide a shorter and more economical lake and rail route between Western Canada and the Atlantic Seaboard, proved more expensive than was anticipated, due to the character of the line that it was finally determined to construct and to other conditions. The power conferred by parliament on the Georgian Bay and Seaboard Railway Company to issue bonds for the purposes of its undertaking was originally limited to $30,000 per mile, but at the last session of parliament this amount was increased to $55,000 per mile, and the directors have entered into a supplementary agreement with the Georgian Bay and Seaboard Railway Company to increase the limit of that company's bond issue, upon which this company has, by virtue of the lease approved October 3rd, 1906, agreed to pay interest by way of rental, from $30,000 to an amount not exceeding $55,000 per mile of railway.

Instead of continuing the double track from Glen Tay to Agincourt, on the Ontario and Quebec Railway between Montreal and Toronto, it has been decided to secure a line between these two points that will serve the territory further south, and will reach several important towns on the north shore of Lake Ontario. An agreement has, therefore, been made with the Campbellford, Lake Ontario and Western Railway Company for the construction, under the company's supervision and control, of that company's railway, 184 miles in length, between Glen Tay and Agincourt, both in Ontario, and for the lease of the railway when completed to the company for a period of 999 years, at a rental equivalent to four per cent. per annum on the bonds of the Campbellford, Lake Ontario and Western Railway Company.

The present route between points in the Kootenay and Boundary Creek Districts, of British Columbia, and the Pacific Coast is long and expensive, and the best means of securing a more direct route has engaged the attention of the directors for some time past. The Kettle Valley Railway Company, having a Dominion charter, covering the territory between Midway, the terminus of your Boundary Creek Line, and Merritt, on your Nicola Line, undertook to build the railway between these points, under the advice and to the satisfaction of the directors, upon condition that the company would lease the line, approximately 270 miles in length, and the branch line along the North Fork of the Kettle River, 24 miles in length, whenever and as soon as the Kettle Valley Railway Company is competent to make a lease, paying by way of rental the interest at four per cent. per annum on the bonds of the Kettle Valley Railway Company, any subsidy received from the Dominion or Provincial Government, or from any other source, to be applied on an agreed basis towards the cost of the construction of the railway and a corresponding reduction in the amount of bonds to be issued. This line will give access to a large and important section of the province in which development should quickly follow railway facilities.

The amounts appropriated for new works, exclusive of railway construction, were abnormally large, in the year under review. For the enlargement of terminals, additional shops, second tracks, sidings and improvements of every variety calculated to improve the efficiency of the railway system, and to facilitate the movement of the large and increasing traffic, the amount of $30,000,000 was authorized to be expended and orders for locomotives and cars, representing an expenditure of $25,750,000, were placed. Many of these works cannot be completed with the season, with the limited amount of labor available, but no effort is being spared to meet the convenience of the public and to strengthen the position.

The shareholders last year sanctioned a lease of the Kingston and Pembroke Railway, extending from Renfrew, on the company's main line west of Ottawa, to Kingston, on the St. Lawrence River, and from Godfrey village to Zanesville Mine, in Ontario, a total distance of 107.5 miles; a lease of the Alberta Central Railway, extending from Red Deer to Rocky Mountain House, in Alberta, a distance of 65 miles; an agreement with the St. Mary's and Western Ontario Railway Company cancelling existing arrangements and substituting a lease of their property for a period of 999 years at a rental equivalent to four per cent. per annum on bonds issued or to be issued by that company with your consent to an amount not exceeding $25,000 per mile of their railway; and a deed of conveyance of the Cap de la Madeleine Railway, about 4 miles in length, connecting the railway near Three Rivers, in Quebec, with Cap de la Madeleine, on the St. Lawrence River, and with the Wayagamack Pulp and Paper Company's works.

An indenture of lease from the government of New Brunswick, as lessor, to the company, as lessee, of the New Brunswick Coal and Railway for a term of 999 years at a rental of fifty per cent. of the net earnings of the said railway, as defined and calculated in the said proposed lease, will be submitted for your sanction. This railway extends from a point in the vicinity of Minto, in the County of Sunbury, to a point of junction with the Intercolonial Railway, near Norton, in the County of Kings, in the Province of New Brunswick, a distance of approximately 58 miles, and will form a portion of a connection between Canadian Pacific Railway and a coal mine in New Brunswick, now in process of development.

The following branch lines of railway in Manitoba, Saskatchewan and Alberta are being, or will be extended, viz., Boissevain to Lauder, 37 miles; Weyburn Lethbridge branch, 125 miles; Kerrobert northeasterly branch, 11 miles; Wilkie Englia branch, 4 miles; Swift Current Northwesterly Branch, 80 miles, Suffield Southwesterly Branch, 55 miles.

THE MONTREAL TUNNEL FOR THE CANADIAN NORTHERN.

S. P. Brown, M. Am. Soc. C.E., M. Am. Soc. M.E., managing engineer, Mackenzie, Mann and Co., and chief engineer, Canadian Northern Montreal Tunnel and Terminal Co., read a paper on tunnelling before the Canadian Railway Club in Montreal recently in which he dealt with the subject most exhaustively, covering its history and the questions of classificaton, surveying, design, ventilation, signals, tracks, construction, plant, excavation, and linings very thoroughly. Following are extracts which refer particularly to the C.N.R.'s Montreal tunnel.

Entries into cities, where natural surroundings make tunnels imperative where city ordinances prohibit grade crossings, where land values do not allow of a private right of way for an open cut with bridges at street crossings, or where grades or cost of construction and maintenance make an elevated viaduct inadvisable or impossible.

The Canadian Northern is just completing its transcontinental system, for which terminal facilities in Canada's principal city are essential, especially as this city is the main eastern seaport during the busiest half of the year. Montreal's natural location, between the St. Lawrence River and Mount Royal, made the problem of entry appear complicated. To enter from either end of this narrow strip meant a detour that was undesirable, and might possibly have resulted in two separate stations for the east and west-bound traffic. Grade crossings were out of the question. Cut, cut and cover subway, or elevated viaduct would have necessarily been of considerable length, which would have been difficult and expensive in many ways. The natural alternative was a tunnel; and as by developing the country back of the mountain, suburbanly, for Montreal's rapidly increasing population, much of the expense of the improvements could be covered, it was the only logical course. Furthermore, the topography of the city—combined with the distribution of business activity of different sorts—made the actual terminal location, yards, etc., equally logical and simple.

The line of the Canadian Northern Montreal Tunnel and Terminal Co., from its junction with the main line of the Canadian Northern Quebec Railway—near the Jacques Cartier Union Railway—is depressed through the new town of Mount Royal to the tunnel portal, where it passes under the C.P.R. belt line, about a mile from the latter's Outremont yard. From this point the tunnel goes down at a 0.6 per cent. grade, in an almost due easterly direction, to the McGill College grounds, where it curves into McGill College Avenue, which leads to the main passenger terminal, situated in the blocks between Cathcart and Lagauchetiere Streets and Ste. Monique and Mansfield Streets. The grades and elevations are such that this tunnel passes under St. Catharine Street, with ample room for a future rapid transit subway above it, and the tracks are able to be carried level through the station and over the lower town on the proposed viaduct, where a yard for light and perishable freight is contemplated, to connect with the proposed Harbor Commissioners' elevated and a possible bridge across the St. Lawrence River.

Two tracks will run both east and west from the main passenger station. The tunnel is something over three miles long, the viaduct about a mile long. The passenger station yard will be about a quarter of a mile long, with platforms over 1,000 feet long and an area of about nine acres. Local passenger stations will be situated down town and back of the mountain, as traffic demands. The main yard will be located near the Back River, where the electrical transfer yard will also be situated. There will also be a delivery yard in Mount Royal and an elevated yard in the commercial part of Montreal.

The designs for the Mount Royal tunnel are not yet completed, but it is probable that both twin tunnels and double track sections will be used, depending on the ground. Where the rock is of the proper character to permit it, the tunnel may be left unlined, although this cannot yet be determined. The minimum clearance has been limited to 16½ feet above the rail, but the standard tunnel clearance will be 17½ feet. The standard clearance in width is 6 feet off the centre line of track, which may be slightly reduced near the bottom as, for instance, at station platforms.

In the twin tunnel, centre walk-ways will be provided at about the level of the coach floors, and cross passages will be cut through the dividing wall, at intervals, for communication between the twin tubes. Refuge spaces are allowed for track men under the walk-ways. The ducts will be carried in the centre wall. The relation of the train cross section to the tube area will be approximately 50 per cent.

In the double track section the two tracks will be separated by the duct bench, which is the same height as the centhe walk ways in the twin tunnel, so that in case of a derailment one train cannot block both tracks.

The studies for electrification have not yet been completed, so that there is not much to be said on this subject. Owing to the climatic conditions outside the tunnel, it is improbable that a third rail will be used on the ground, which will probably force the adoption of some form of trolley. This means high voltage, either direct or alternating current. Great strides have been and are now being made in high voltage, direct current railway work and, until very careful and exhaustive studies have been completed, no decision can be made. This is important in the final design of tunnel cross sections, as the amount of head room for 10,000 volts alternating is quite different to that required for 1,500 volts direct current.

In the Mount Royal tunnel, where soft ground is encountered, a cap and post system of construction will probably be used, owing to the location of the rock surface; this running in general fairly near the roof line permits the full width timbering to be done without shifting posts, which rest directly on the rock. As fast as the roof excavation can be carried on in this manner, the arches will be built, so that the roof will be absolutely protected. After the arches are in, the lower excavation will be removed and arches underpinned, where necessary.

The plant for the Mount Royal tunnel will be quite complete. The compressor plants at each end consist of one direct connected cross compound unit of 2,200 cu. ft. per minute capacity, driven by a synchronous motor and three belt driven cross compound units of 1,100 cu. ft. per minute capacity, with induction motors. The power is three phase, 62½ cycles at 2,200 volts. Pumps, drills and some small motors are run by air. Most power used, however, is electrical. The drills used are the precussive type with the water attachment built largely of steel, to reduce their weight Horizontal bars are used to support the drills, and carriages are being made to handle the full drilling outfit for each heading.

The muck cars are 3 ft. gauge, very low and narrow. They are built with a 3 ft. wheel base, 18 in. wheels and springs on the axles. Both gasoline and electric locomotives will be used. Part of the tunnel muck will be crushed for concrete stone and ballast; part being used for fill and subfoundation work. The crushers are gyratory and roll hammer types, to give the desired grades, and both revolving and oscillating screens will be used over the bins.

The cages used at the shafts are of the counter balanced automatic dumping types, with electric hoists. These are designed for a capacity of about 800 cu. yds. per day.

The shops consist of a blacksmith shop, equipped with an air hammer, shears, punches, drill sharpening machinery and the usual forges; machine shops equipped with large and small lathes, a shaper, radius drills, saws, pipe machine, emery and grindstones, etc.; carpenters' shops, with band circular saws and drill repair and testing shops, as well as garage for the maintenance, storage and repairs of automobiles and auto trucks.

The method of excavation adopted in the Mount Royal tunnel is a bottom centre heading, with breakups at intervals where the full sized tunnel section will be developed. The heading is driven by the horizontal bar method. Later, a carriage and other auxiliary apparatus is expected to be used, as described under plant. At the breakups, jumbo timbers will be placed in the heading so that traffic can be maintained and the upper portion of the tunnel stoped down on the top of this and run directly into cars in the heading by gravity. As many of these breakups will be opened as are found necessary to keep up with the heading progress.

The firing is done electrically, but an effort is being made to get some special fuses with electric igniters, by which the cut may be fired electrically, at the same time igniting the time fuses of the relievers and line holes. This should give a better result than the ordinary time fuse method, without its accompanying risk, and will relieve the men from the necessity of going back into the smoke to load the later rounds.

In the Mount Royal tunnel, at present, the average progress at the west end is 20 ft. per day. In the east end, where the ground is rather bad, requiring timbering, and where no shooting is allowed at night, on account of public annoyance, the average progress for the last two months was 12 ft. per day. Heading 9 x 12 ft., 4 cu. yds. per foot. No drill carriage; precussive drills used with water attachment. 24 in. gauge temporary muck cars still in use.

THE RAT AND PUBLIC HEALTH.

By Lyman B. Jackes.

Doctors and health staticians have not as yet determined the position and rating of the rat on the list of disease conveyers and distributors. It is looked upon with suspicion and distrust by medical authorities in ocean ports and at other points of entrance for imports from foreign countries, but its exact facilities and adaptabilities for disease transmission are not understood.

Even aside from its supposed, and quite properly supposed, ability to transmit pathogenic organisms from district to district and from country to country, the rat is the source of immense annual losses in the industrial and agricultural worlds.

The word "rat" usually implies the brown rodent which we are accustomed to see in sewer approaches, barns, basements and stables, but this is but one member of the species Mus, which numbers about one hundred and fifty, all of which are known as rats or mice, according to the linear dimensions of the specimens.

The rat is indigenous to but a few portions of the earth, and this accounts for its non-mention in the Scriptures and other ancient writings with which we are acquainted, excepting the Chinese, and China would appear to be the starting point of rat migration and consequently for the introduction of diseases of a specific eastern nature into Europe. From Europe the pest only waited for the advent of systematic shipping to all quarters of the globe.

The brown rat's entrance into Europe was a comparatively recent occurrence, taking place about the year 1715, when an innumerable hord succeeded in swimming the Volga River, Russia, which is situate at the base of the Ural Mountains, in extreme Eastern European Russia.

This extensive migration of the rat is characteristic of the specie when pressed by hunger, and is an extremely dangerous aspect of the habits and tactics of the rodent.

Prior to the entrance of the brown rat into Europe, a smaller member of this order, known as the black rat, made extensive inroads to that continent about the year 1300. It may be a coincidence, but medical historians are not of that opinion, that the great Black Death which broke out in Europe a few years later and ravaged England from August, 1348, to Christmas, 1369. This loathsome affliction had carried off 66 per cent. of the population of Continental Europe before its introduction to England.

From historical writings, it is generally understood that this plague was of a bubonic nature, and as this is a disease, oriental in the strictest sense of the word, and has since been conveyed to European cities with frightful death lists resulting, there is probably strong grounds for such suspicion, but the most noted feature about this transmission is the well-grounded belief in the theory that it is introduced by rats carried in the holds and cargoes of ships coming from eastern ports. For this reason, during a recent outbreak of this loathsome disease in Continental Europe, all ships coming into British ports were held up before docking and a strong mixture of sulphur dioxide pumped into the hull in order that all rats might be suffocated.

If the rat were of an order that yielded easily and readily to death-dealing tactics, this would be a fairly good means of exterminating the pest, but such is not the case, for not only is the rat in itself difficult of killing, but the reproduction facilities of this animal are extraordinary in the extreme; one pair of rodents will on an average have about seventy-two young annually.

In the selection of food the rat is omnivorous and eggs, (which the rat can convey for very considerable distances unbroken) young birds of all varieties, fish, grains, cooked foods, small domestic animals, are all devoured with equal ease. Considering the facts connected with the rat and his properties of destruction, aside from his place in the medical health fields, the Canadian Government have decided that it would be beneficial to have this pest exterminated if at all possible, and with this end in view Mr. W. R. Reek, B.S.A., of the Ontario Agricultural College, Guelph, Ont., visited the Pasteur Institute in Paris in order that some experiments on rat extermination might be examined and witnessed.

The French scientists have been working for several months on a virus which would be contagiously deadly to rodents and harmless to other animals and man. The virus used for these experiments is of a bacteriological nature, and is contained in large bottles containing bouillon on which these organisms thrive. In actual use the contents of the bottle were diluted with water and scattered over oats and other foods which the rats were likely to eat. In a very short time a rat that has eaten of this grain dies suddenly of diseased throat, and this disease is transmitted with wonderful rapidity to other rats coming in contact with the dead one, and as it is a natural habit of the rat to maul and bite the body of a dead specimen of their own species, this would appear to be the great point in the application of the virus.

It is interesting to note that the French government is contemplating the enactment of a law which will enforce the usage of this material annually in every district. It has met with great success in underground railways, restaurants and

warehouses in London and Paris. In some of the banana plantations in Central America, where rodents have been attacking the roots, this virus has been used with satisfactory results.

Encouraged by the success which the French scientists have achieved, the Austrian government is going to carry on extensive experiments shortly, and there appears to be no reason to prevent its use in Canada.

BOOSTER PUMPS.*

By H. E. Cole.†

The determination of the proper presure to be maintained in any given waterworks system is often a very difficult one, and even when settled frequently results in general dissatisfaction for a large percentage of the consumers. It seems, therefore, that some time could profitably be spent in the study of ways and means of supplying the demand of those who are so located that the pressure of the system will not give satisfactory service.

There are at least three kinds of consumption requiring booster service:—

First—Tenants of tall buildings which are located on streets where the service is sufficient for ordinary requirements, but owing to the height of the building the normal pressure of the system is inadequate. In this class apparatus is usually installed by the owner of the building to boost and store a sufficient capacity for ordinary requirements.

Second—Small sections of a city's or town's population are frequently located on elevations higher than the reservoir or where the pressure is insufficient for their requirements. This is a condition which a great many companies have to face. It may be considered under seven heads.

(1) The number and class of consumers to be supplied determines the capacity of plant to be installed.

(2) The distribution of the population determines the location of the booster station and reservoir with reference to the main bringing in the supply. It furthermore makes necessary a careful study of first cost of large mains, low friction losses or of small mains, and necessary increase in pressure to overcome friction head.

(3) The presure to be maintained has a very important bearing, as it determines largely the character of the reservoir to be used as well as the type of pump to be installed.

(4) The importance of uninterrupted service has its effect on both the quality of apparatus and on the duplication of units as well as on the power employed and attendance.

(5) The amount of storage required usually determines the kind of reservoir which shall be used. If the pump is to operate automatically, then the storage required may usually be very much smaller than otherwise. The determining factor, then, is the amount of storage required for fire protection or to supply the sections during the probable shutdown of the pumps or loss of power from any cause.

(6) The kind of power available materially affects the cost of operation and the adaptability of the power.

(a) If steam is the power used and coal the fuel the coal must usually be hauled a long distance, and at a high elevation steam must be kept up most of the time. An attendant must be present practically all the time the pump is in operation. The smoke nuisance must also be contended with.

(b) Natural gas for steam, when available, is far better than coal, as hauling is practically eliminated, and there is no smoke. In such cases, however, a small amount of coal should be kept in reserve and the boiler equipped to use both gas and coal in order to be prepared for a shortage of gas or other interruption of the supply. The necessity for a constant attendant, however, still remains.

(c) Natural gas when used in an internal combustion engine to drive a power pump makes one of the best powers for this service, as the fuel cost is usually the least and mechanical efficiency of equipment is relatively high. The chief disadvantages are frequent attention required, although far less than for steam—cannot be operated automatically without serious complications, although it is not only possible, but entirely practicable to make the pump operate automatically, as required, by keeping the engine running continually. Whenever gas engines are used it is good policy to provide gasoline attachments so that the engine could be operated on gasoline or other liquid fuel on very short notice.

(d) Gasoline or other distillate when used in an engine is to be recommended when gas or electricity is not available and where the amount of water to be pumped is small, as the fuel cost is usually high. The advantage of this power is that, as a usual thing, the pumping unit can be started and operated at full capacity in a few minutes, ten minutes being a fair average. The objections are much the same as previously stated for gas, but there is the additional disadvantage of hauling and storage of the fuel and dangers of explosions in or near the buildings.

(e) Crude oil engines are rapidly being perfected and placed on the market which materially reduce the fuel cost, but require a little more time to start up than either the gas or gasoline engine.

(f) Electricity is very nearly an ideal power for this service, provided that an attractive rate can be obtained and the service is reliable for twenty-four hours each day.

A combination of any of the above powers may be used to advantage, depending upon the demands of the particular case.

(7) Accessibility by the attendant in charge materially affects the selection of equipment and cost of operation. If the amount of water to be pumped is only moderate, plant difficult of access, and electricity is available, it is desirable to keep cost of attention to a minimum; therefore make plant as nearly automatic as possible.

The location of the booster station depends entirely on local conditions. All things being equal, it should be located at the main reservoir from which the supply is taken. It is also preferable to have the pump so located that water will flow to it by gravity from the main reservoir. This insures the pump being primed at all times and eliminates the danger of getting air into the line.

When the section to be supplied is so situated that it is inadvisable to locate the booster pump at the reservoir, it should be located on a prominent main at a level which will positively assure a good supply on the level of pump intake.

A large vacuum chamber as well as an air chamber should be used on reciprocating pumps and a large air chamber would show good results even with a centrifugal or rotary pump.

In locating the booster plant attention should be given to the discharge. It is always preferably to use an independent line from pump to booster reservoir. Pulsations and noises are easily felt on lines from which service is given. Pulsations can be very materially reduced by the use of a large air chamber, depending entirely on the type

* Abstract of paper and discussion before the Central States Waterworks Association, September, 1912.

† Vice-President and Chief Engineer, Harris Pump Supply Co., Pittsburg, Penn.

and apacity of the pump and the velocity of water in the line. Greater efficiency can be obtained from this air chamber if air can be supplied to the chamber to increase the relative proportion of air to water.

Noises can be reduced by the use of special gaskets or lead nipples. In some very bad cases it can be cured by using a short section of hose in the discharge between the pumps and the discharge main.

In both of these respects the advantage of using an elevated tank or standpipe or hydro-pneumatic pressure tank near the pump is very evident.

Third—The third class of service is where the regular line pressure is sufficient for domestic consumption, but insufficient for proper fire protection to fulfil the requirements of the company's charter. The method of treatment, however, would be so nearly the same as for the second class that no additional suggestions will be given for this class.

Since the cost of attendance is one of the chief items of operating expense in a plant it is very desirable to reduce this expense to a minimum.

If an attendant is required all the time the pump is in operation it is generally good practice to install equipment of large capacity to reduce this item of expense. This means, however larger mains and larger storage capacity.

It would, therefore, seem desirable to keep line and reservoir cost down by pumping much of the day at a lower rate per hour, leaving only enough reserve to take care of ordinary increase in consumption or falling off of pump capacity and giving ample time for ordinary repairs. To do this and still keep down cost of attendance requires apparatus as nearly automatic as possible.

With steam equipment, an attendant is necessary on account of the use of boiler, but if steam is taken from some other source so that the pump is the only part requiring attention, then it should be the aim to provide a reliable source of lubrication and control speed of pump automatically. The simplest control is by a pressure regulator where the difference between starting and stopping pressures is fully 10 per cent. of the supplying pressure in the line and exclusive of the friction head. Where the line is a long one and the pump comes up to speed very rapidly it will be noticed that the pressure required to accelerate the water in the line from its state of rest to its regular velocity momentarily runs the pressure far above the maximum or stopping pressure of the system. Ordinarily this would cause the automatic control to act and stop the pump, and, this pressure being only temporary, the pump would again start, and the result would be a rapid alternation of stops and starts. This can be overcome by the use of a tank, of about 50 gal. capacity, to which pressure connection is attached. This connection should be made from discharge main to tank, so that the rate of flow from one to the other would be very small, namely, 1 or 2 gal. per min.; then with sufficient air compressed in top of tank so that it is ordinarily half full of water; it will be noticed that the pressure is very slow to respond to changes in the main line pressure and the temporary pressure due to starting is passed, and normal is restored before the tank shows any appreciable change.

Where the increase of pressure due to accelerating water in the line is high enough to endanger the pump or other equipment, a relief or safety valve should be installed to take care of the excessive pressure.

Where the difference in pressure between starting and stopping is less than 10 per cent., most regulators are unreliable, due to back lash and lost motion in the springs and other mechanisms. In such cases an artificial head can be produced, which, if the flow of water from the pump were constant, would cause sufficient difference in pressure to cause the controlling mechanism to operate, I believe, within 2½ per cent. of the shutting off pressure.

If this were carried out by the use of the tank described above and the introduction of sufficient friction in the discharge of pump to the discharge main, it would with regular line friction make the necessary difference required. This plan could not be successfully used with centrifugal pumps due to the varying capacity of pump under different conditions. In any case the power required for pumping would be increased by approximately the same amount as the increased pressure; still this amount would be very small compared with the saving effected.

The automatic control of steam pumps by float from the surface of the water in the reservoir is so complicated that circumstances would seldom justify it.

Electric pumps are by all means the easiest to operate automatically, first because an electric pump can be provided to operate continuously with practically no attention; and second, because electricity can be transmitted so easily. Stopping and starting can be easily performed by the rise and fall of water in a reservoir several miles away by means of a float and solenoid switches.

Pressure control is, however, always preferable, as the controlling apparatus is then under the same roof with the pump and the motor, and the danger from ice, storms, etc., which exists with floats, chains, etc., is eliminated.

Gas or engine automatic control is difficult, owing chiefly to the fact that most engines have to be started by some external power, and this is difficult to accomplish from a remote point. Partial operation, however, may be obtained by keeping the engine in continuous control, properly governed and well lubricated, and with an automatic pressure regulator, pressure being taken as previously described. This regulator would operate a control attached to level of a friction cut-off coupling so that the pump would, therefore, be started and stopped as desired. Float control would also be difficult by this method.

Another method of patrial control would be by connecting up the ignition circuit of the engine with a presure regulation or with a float switch. Then the engine could be stopped when the reservoir was filled, but could be started again only by an attendant. In this case a magneto should be used instead of batteries, for when the pressure fell to the starting point, it might short-circuit the batteries and run them down.

Discussion.—C. B. Salmon, of Beloit, Wis., said that experience with two or three booster installations, one at a mine in West Virginia had shown the electrical centrifugal pump to be easy to operate and very effective.

L. A. Tonkel, of Alliance, Ohio, gave substantially the following account of a booster station in his city:—

Our main pumping station is located about 240 ft. lower than the highest point in Alliance, and there have been days and days when everybody was sprinkling in extreme dry weather when the people at the highest point could not get any more than 10 lbs. pressure, although we had 240 lbs. pressure at the plant. The question arose of how to relieve that condition, which had existed for twenty years until people were getting tired of it. This hill was the finest location and best residence portion of Alliance, and they wanted water in those fine homes. I suggested years ago that we lay a 12-in. or 14-in. line from the town up to Mount Union, and put in a separate pump and pump to them direct just the same is if we were supplying two separate towns; that we have one pump for that hill and another for Alliance proper; but we found that would cost the city $300,000, and that was thought to be too much. So, instead of doing that, last spring we installed a booster pump just half way between the lowest point and the highest point.

At our lowest point we carry 125 to 130 lbs. at the pump house.

I start the pump at the booster station by electricity at 5 a.m., and at 7.30 p.m. it is shut down. I have a 12-in. valve between the inlet of this pump and the outlet. That gives them water in case of fire over night. When I start the booster pump I shut that valve off. When we get through with our improvements we are going to have two standpipes, one 60 ft. high, to supply the low pressure, and another one 100 ft. high, to supply the high pressure. When the standpipe is full on the high-pressure line the pump will shut itself down, and stay shut until we use 20 ft. After that the pump will start automatically. That is the way we have ours arranged. We ran it for one month for 3c. per kw.-hr.

Several who discussed the paper spoke favorably of electrically-driven pumps.

In response to numerous suggestions and requests Mr. Cole promised to supplement his paper with figures of costs and other data which would assist waterworks superintendents in deciding on the advantages of using booster pumps and aid them in choosing the best plan to meet local conditions.

RAILROAD EXPENDITURE WILL BE HEAVY

President E. J. Chamberlin, speaking of construction work on the Grand Trunk Pacific Railway, says the problem from now on to completion will be wholly one of labor. "We expect to have the line in operation for through traffic by the beginning of 1915. It is just a question of getting the requisite amount of labor into the territory in which we are building; it is simply a matter of displacing so many million tons of earth and getting enough men to do it expeditiously. At present we have about 10,000 men at work."

This year the Canadian Northern Railway will construct 978 miles of road to complete the Transcontinental line. This mileage includes 350 miles from the summit of the Rockies to Lytton, B.C., and 300 miles along the north shore of Lake Superior.

Work will be commenced by the Canadian Northern Railway between Toronto and Hamilton during the spring. The right of way between Hamilton and Niagara Falls is being secured.

The company hopes to finish the road from Toronto to Niagara at the same time as the Canadian Northern Railway transcontinental. Provision for through connection with New York, via an American line, and bridge connection at Niagara Falls, remains to be made.

Satisfactory headway is being made in completing the line between Toronto and Ottawa.

The line between Ottawa and Montreal will be ready next spring, and early summer should see a Canadian Northern Railway passenger service between Toronto and Montreal.

The Canadian Pacific Railway will shortly commence work on a four track system between Brandon and Fort William.

Forty million dollars will be expended in Montreal by the railways within the next two or three years. This large outlay is being undertaken by the Canadian Northern, the Grand Trunk, and the Canadian Pacific Railways, with the Canadian Northern assuming over half the expenditure. With the formal acceptance of the plans for the tunnelling of the mountain, the Canadian Northern Railway expect to commence operations early in the spring upon this task.

The Grand Trunk Railway expect to spend between $9,000,000 and $10,000,000 in the elevation of their tracks and in the building of a new station at Montreal.

The Canadian Pacific will apply for an act authorizing it to construct six new lines and extending time for completion of five others, already authorized.

It will also incorporate the Quebec, Portland and International Short Line, from La Patrie South to the International Boundary, following North River to Newport, Vt., to the main central in Eaton. This is supposed to be part of the plan for shortening the distance between Montreal and Portland over Main Central.

A new railway project is announced through application to incorporate the All Red Line Railway, from the Eastern boundary of the Province of Quebec westerly to Winnipeg, with branches to Ottawa, Port Arthur and Fort William.

CHANGES IN ONTARIO PUBLIC HEALTH ACT.

The important changes in public health legislation brought about by the new Public Health Act, as well as their likely effect on general conditions, in the estimation of Dr. J. W. McCullough, Provincial Medical Health Officer, are as follows:—

The supervision of sanitary conditions in the province by district officers of health (Sec. 13). Under this system the individual municipality will receive closer attention and first-hand advice from the district officers.

Local boards of health are retained, but the number of members reduced, and the medical officer of health is made a member—and the executive officer—of the board. Members of township boards are to receive $2 for each meeting attended. (Sec. 14-21). The medical officer of health, a qualified medical practitioner, to be appointed at a reasonable salary by the municipal council, and cannot be dismissed except for cause and with consent of the provincial board. He shall attend the annual conference of health officers and his expenses shall be borne by the municipality. (Sec. 35).

The work or local boards will, it is generally felt, be carried on in the better interests of public health, since the M.O.H. is a member, and since members in townships will be remunerated for attendance at meetings. By making the M.O.H. a permanent officer and paying him a reasonable salary, his services to the municipality will become more valuable, and interest in his duties will be still further increased by his association with officers in the same work at the annual conference each year.

Municipalities shall contract for the medical care of indigent sick (Sec. 52), and the M.O.H. may inspect lodging houses, etc., and if he deems a building unfit for human habitation, may placard it. (Sec. 86). The effect of these provisions will be obviously a step towards improved social conditions.

But the most important, owing to its far-reaching effects, is the legislation relating to waterworks and sewerage systems. Plans for the establishment and extension of any such system must be approved by the provincial board before any debentures can be issued to raise money for these purposes. In this way, the requirements of the board—as to proper treatment and disposal of the sewage, and the source of supply and process of purification of the water—must be carried out. The board may direct as to the maintenance, repairs and improvements of such system; and upon a certificate of necessity from the board, work may be undertaken in the interest of public health without a vote of the ratepayers. (Sec. 89-98). The final effect of this will mean the lessening of the pollution of our waterways, a safe supply of drinking water, and consequently a reduction in the number of cases of death from typhoid fever and other water-borne diseases.

WORKMEN'S COMPENSATION

BY C. W. I. WOODLAND.

While we have a so-called Workmen's Compensation for Injuries Act in force in Ontario, in reality it is not a compensation but rather an employers' liability act. There is a vast difference between the two. The term workmen's compensation as applied to the Ontario Act is a misnomer. In view of the wrong impression conveyed by the title, the employer of labor as a rule looks to the company in which he is insured for a great deal more than what his policy or contract calls for, and what he pays for. The employer pays for protection or to be indemnified "against loss from the liability imposed by law" upon him. He insures for his own benefit, and not for the benefit of his employees. Workmen's compensation insurance is a different proposition altogether. It is a form of accident insurance that calls for the payment to the injured workman of certain indemnities irrespective of how the accident occurred or who was to blame.

Under an up-to-date workmen's compensation law such defences as contributory negligence, common employment, assumption of risk, etc., etc., are done away with, and, subject to certain provisions and limitations, would entitle the injured employee, or in case of death his dependants, to compensation; the only proof of claim necessary being the fact that the employee met with an injury arising out of and in the course of his employment.

Under such a form of legislation the cost of insurance would be fixed by the insurance company commensurate with the obligations imposed upon the employer, and as the scale of indemnities would be provided for in the Act all the insurance company has to do is to make payments accordingly. This is an ideal condition and one that, provided the Act is carefully framed, practically does away with litigation, and from a humanitarian standpoint should meet with the cordial approbation of both employer and employee.

As I have already pointed out, in the province of Ontario to-day there is no such thing as a real workmen's compensation law. Under the present laws, the employer may not be held liable for accidents happening to his employees if

1. It can be shown that the accident was caused by contributory negligence on the part of the injured employee.
2. The accident was caused by a fellow-servant or workman in like employment.
3. The accident was incident to the injured man's employment and one over which he alone had control.

These are only a few defences to an action for damages. There are many others. Suffice it to say that when an employer delegates to a liability company his responsibility, or legal position, as it were, in respect to accidents happening to his employees, it is for the insurance company to decide whether to allow compensation or defend an action for damages, for and in the name of the employer, at the insurance company's expense. The employer pays a premium for indemnity against his legal liability only. He pays nothing for what is termed his moral liability. The insurance is for his protection and not for the benefit of his employees.

A workmen's compensation act, on the other hand, is for the benefit of the employees, and such being the case the employer would have to pay more for his insurance than under present conditions, but no doubt would cheerfully pay the extra premium knowing that his moral as well as his legal obligations would be as cheerfully cared for.

The tendency under present conditions is for the employer to expect a little more, and sometimes a great deal more than what he pays for. It often happens that when an employee is injured the humanitarian and generous employer sends the injured employee to the hospital, guarantees the payment of hospital, doctors', and nurses' bills, and pays the injured employee's wages during the period of his disability—this aside from the conditions of insurance—and then expects the liability company to reimburse him for his outlay, even though it may subsequently have to defend an action for damages brought by the employee.

The old stock argument of the policyholder who assumes the functions of the insurance company upon his own responsibility, notwithstanding the fact that the contract or policy expressly stipulates that

> "The assured shall not voluntarily assume any liability, nor shall the assured, without the written consent of the corporation previously given, incur any expense or settle any claim except at his own cost, etc., etc."

is that "it pays better to settle than to have to fight a lawsuit," overlooks the fact that his is not the only case the liability company is dealing with, and that thousands of claims are constantly in the course of adjustment.

It will be a progressive move when the province of Ontario adopts an up-to-date workmen's compensation for injuries act. The cost for insurance would then necessarily be more than it is to-day. The insurance company carrying a risk would have something definite to go by in the matter of paying compensation. Litigation would be a thing of the past, and instead of the iniquitous, or I should say the ubiquitous, lawyer getting his share of the spoils as he does to-day, the full indemnity would be paid direct to the injured employee. Until this new order of things comes about the employer of labor carrying liability insurance should recognize the difference in conditions and keep in view the fact that the insurance he is now carrying is for his protection, and not in any sense of the word for the benefit of his employees.

PAPER MANUFACTURING IN CANADA.

Canada has certainly made strides during the past year or so in paper manufacturing. Mr. E. B. Biggar, of Toronto, a Toronto pulp and paper authority, says that Canada's growth of the two industries has exceeded that of any single nation in the world since wood became a raw material for paper making. A remarkable feature of this development has been the number and capacity of the new mills devoted to news-print, these mills representing the last word in mill designing, in capacity of paper machines and in rapidity of production. The following is a list of these news-print paper mills:—

	Daily capacity in tons of paper.
Powell River Company, B.C.	200
Dryden Timber and Power Company, Ont.	40
Spanish River Pulp and Paper Mills, Ontario	155
Ontario Pulp and Paper Company, Sturgeon Falls, Ont.	45
Sault Ste. Marie Mill, Ontario	200
International Falls Mill, Fort Frances, Ont.	100
Ontario Paper Company, Thorold	120
Price Brothers and Company, Jonqueires, Que.	150
Edwin Crabtree and Sons, Quebec	20
Smaller new mills and additions to old mills, say	170
	1,200

Thus there has been an increase of 1,200 tons per day in news-print. It is not strictly correct to say that this is the work of a calendar year, for some of these new mills were

started in the latter part of 1911, while two of them are not yet finished and will not be in operation till the middle of 1913, but the increase which can be credited to 1912 will still be about a thousand tons per day.

STORES OF VANCOUVER ISLAND

BY ERNEST McGAFFEY.

As it is axiomatical that cities thrive as the surrounding country develops, so it follows that the railway and trunk road policy inaugurated by Sir Richard McBride and the provincial government has been of vital importance to Vancouver Island. The Premier of British Columbia has stimulated development in these lines so greatly that it is no exaggeration to say that railways and roads head the list of the factors leading to progress all over the island.

The advent of the Canadian Northern Railway not only meant the opening up of large areas of virgin territory, but it carried with it an immediate stimulus to the halibut and whale fisheries, with important capitalization and extension of these industries. It also made accessible vast timber tracts, iron deposits, etc.

The aggressive activities of the Canadian Pacific Railway through its island line of the Esquimault and Nanaimo Railways promises to revolutionize conditions along the east coast of Vancouver Island, and particularly along that portion of it represented in the rich Comax and Courtenay country, a district not surpassed on the island for excellence as a dairying and mixed farming centre. The entry of this line into the Alberni Valley and to Alberni and Port Alberni was also of great importance, as opening up a magnificent timber belt, and connecting with the west coast by way of the Alberni Canal. Coal, copper, and fisheries are also tributary to the Alberni district, and general tourist traffic has been increased by this branch.

All along the Alberni Canal the various communities as Uchucklesit, Bamfield, Sechart, Ucluelet, Clayoquot, and other settlements, have felt the impetus afforded by the incoming of the Esquimault and Nanaimo Railway to the Alberni district.

Development along the line of the Esquimault and Nanaimo Railway from Victoria to Nanaimo is shown at every point. Probably the most apparent results are at Duncan, Ladysmith, and Nanaimo. At Duncan, in the Cowichan Valley, much progress has been made recently in this model farming community.

At Ladysmith, there are from 3,500 or 4,000 people, and its future as a manufacturing and shipping point is assured, with its fine natural harbor, rail facilities, and adjacent possibilities as a fruit-growing district.

Nanaimo is awakening to its possibilities. Its pay-roll runs into the hundreds of thousands from the near-by coal mines, large sawmilling interests and fisheries. Other interests include stone quarries, timber, fisheries, manufactures, and an adjoining district of splendid possibilities for mixed farming, truck gardening, fruit growing, poultry-raising and stock-farming, and fine shipping facilities. The city has now about ten to twelve thousand population, and is increasing rapidly in numbers.

Cumberland is also evidence of Vancouver Island's advancement, and with the Esquimault and Nanaimo Railway's extension, it will have connection with this line through the present railways running from Cumberland to Union Bay. As the central city of a coal-mining district, Cumberland will grow. Fine water-power on the Courtenay River and lumbering districts are near it.

Comox, Sidney, Courtenay, Chemainus, and other towns on the east coast, Port Alberni and Alberni show steady growth. Port Alberni is the terminus of the Esquimault and Nanaimo Railway, and Alberni is only two miles further inland. Both towns have good harbors; they will merge in time.

Victoria is one of the leading ports of the Dominion. Her new outer harbor, to be built by the Dominion government, requires an initial outlay of $1,500,000, and will take $10,000,000 to complete it and the inner harbor improvements.

Victoria's harbor is practically free from fog, and easy of access and departure. Freight and passenger traffic has doubled in the past three years; in 1911 over 5,500 vessels berthed in its harbors. It is the coming terminal of five transcontinental railway systems, viz., Canadian Pacific Railway, Canadian Northern Railway, Grand Trunk Pacific, and Great Northern and Great Eastern Railway. As a manufacturing, commercial and residential city, its future is bright, and its tributary territory contains valuable natural resources, including the following:—

A supply of merchantable timber equivalent to about a billion feet per year for a hundred years. Then there is 1,500,000 acres coal deposit controlled by one corporation. Iron is found at Sooke, Bugaboo Creek, Sarita, Nootka, Campbell River, Quatsino and other points.

Vancouver Island produced, according to the Tyee Copper Company manager's estimate, "about one-half of all the copper that has come from the entire Pacific coastal district during the five years ending April, 1910. There is five hundred thousand horse-power of water-power available, though present development is less than 50,000 horse-power

There is a supply of marble, brick clay, fire clay, gold and silver, quicksilver, talc, and various other metals and natural products, sand, gravel and building materials.

There are two cement plants, one fully equipped and running, and the other soon to be ready.

Agriculture, horticulture, fruit and berry growing, poultry-raising and live-stock breeding are profitable and being developed.

Valuable fisheries are also among the island's resources; whale fishing is carried on at Sechart and Kyuquot, controlled by Messrs. Mackenzie and Mann. Salmon is abundant. Halibut is caught in large quantities on the west coast. At Nanaimo the large herring industry is under the control of Japanese.

BIG ORDER FOR RAILWAY EQUIPMENT.

The past year was an unusually busy one for the rail mills, locomotive works and car foundries. The Canadian Pacific, Grand Trunk, Grand Trunk Pacific and Canadian Northern Railways gave orders during 1912 for 727 new locomotives and 43,164 freight cars. These orders will keep the car and foundry companies busy well into the current year. The figures may be summarized as follows:—

Engines or cars ordered, 1912.	Canadian Pacific Railway.	Grand Trunk Railway.	Canadian Northern Railway.
Passenger	414	.....	150
Freight	29,442	7,650	6,072
Miscellaneous	194	.....	.....
Total	30,524	7,790	6,336
Locomotives	473	140	114

It is estimated that there were at least 20,000 more cars and 400 more locomotives available last fall than in the previous year.

The Canadian railways expended last season about $4,000,000 on improvements and enlargements of terminals.

COEFFICIENT OF SLIDING FRICTION OF CONCRETE ON CONCRETE.*

By Frank P. McKibben.†

In well designed masonry structures reliance is placed on something besides friction to resist sliding tendencies; but unfortunately not all structures can be classed in the above category, and a knowledge of the value of frictional resistance is necessary. In concrete or stone masonry dams, both in the structure itself and at the base, the horizontal pressure should be resisted not by friction alone but by shearing. Clearly this can be accomplished by bonding the masonry—stepping it at the base and interlocking in the body. However, to provide against errors in construction every structure in which there is a tendency to slide on any plane must be proportioned to have a proper factor of safety against sliding on that plane.

The importance of this precaution is only too well illustrated in several recorded failures of masonry structures. It is further emphasized by the fact that in an ordinary masonry dam with a vertical upstream face and a curved downstream face, designed to keep the line of resistance just within the middle third, the factor of safety against sliding on horizontal planes, considering friction only, is about 1.1 to 1.5 at most. And this condition obtains where no upward pressure is assumed to act at these planes. When the upward pressure acts the factors on the same cross-section are less because the resultant normal pressures are less, while the tangential components remain unchanged.

If, as is sometimes the case through lack of supervision, such a dam be built with horizontal joints or with a horizontal base, the factor of safety is altogether too small. The question of what coefficients of sliding friction the above factors of 1.1 to 1.5 are based upon is then a very pertinent one.

A search of experimental data on the frictional resistance of masonry reveals the fact that as far as can be determined all tests have been made on separately moulded specimens, and practically nothing has been done toward determining the resistance of concrete to sliding on concrete with the upper body moulded directly on the lower. If two cubes of concrete be separately made and then superposed for testing, the resistance to motion can be called the friction of starting and the resistance during motion the friction of motion; but if one cube be moulded directly on another and later tested in that position the resistance to sliding is at first due to adhesion, and during motion the resistance is, of course, friction of motion. All published friction coefficients are seemingly those of bodies without adhesion.

It further appears that the coefficients of friction frequently recommended for masonry structures, namely, from 0.60 to 0.75, are those at which sliding actually starts—not the coefficients modified by a factor of safety but the actual values which cause the motion to begin. Assuming that the coefficient necessary just to start motion of concrete on concrete separately moulded is 0.66, and that a dam is built with that same relation existing between the horizontal sliding force and the resultant vertical component on the horizontal joint, then but one factor of safety against sliding exists at that joint, if the surfaces between the experimental blocks are the same as those in the dam and adhesion in the latter is neglected. A factor of one really means no factor at all; it means that the structure is just on the point of moving. If, on account of the upper mass of concrete in the dam being laid directly on the lower, adhesion is considered, then the factor of safety in the above hypothetical case is probably greater than one, possibly 1.5 or 2. The coefficient of friction must be considered an ultimate or breaking coefficient, and clearly the working factor should be considerably less than this. Its value should be found from the breaking coefficient by dividing the latter by a real factor of safety.

The only experimental determinations of frictional resistance of stone are those of Morin, made between 1813 and 1834, and of Trautwine. Morin's experiments were made on dry blocks of soft oölitic limestone sliding on the same material, the contact areas varying from 0.5 sq. ft. to 0.86 sq. ft., with total normal pressures ranging from 310 to 1,275 lb. For this material he gives 0.74 and 0.64 for co-efficients of friction starting and of maintaining motion respectively. Trautwine made a few experiments, but none of them was on concrete. The coefficient of friction for masonry is therefore based on stone, and nothing has been published regarding concrete.

Recently in the Fritz Laboratory some experiments were made by Messrs. S. C. Peters and I. A. St. John, and the following is a summary of the work accomplished up to the present time:—

Some 12-in. concrete cubes were separately moulded in wooden forms, and, after curing, the coefficients of sliding friction were determined by placing one cube upon another and finding the force necessary to slide the upper along the lower. The accompanying table shows details of the tests for low normal pressures.

The apparatus used in testing consisted of a bell-crank lever, the vertical arm of which was connected by a horizontal yoke to the upper cube. On the horizontal arm of the bell-crank was a vessel into which fine shot was carefully poured till motion took place. The forces determined in this manner, together with the pull due to the weight of the bell-crank, are those necessary to start the upper cubes. As the total motion of the cube was only a few inches no distinction could be made between the starting forces and those necessary to maintain motion. In some tests the normal force was increased by adding standard 50-lb. weights on the upper cube.

Results of Tests to Determine the Coefficient of Sliding Friction of Concrete on Concrete.

No. of Tests.	Total weight moved, lb.	Total pulling force, lb.	Friction coefficient per cent.	Condition of surface
	Mixture, 1:2:4 Concrete.			
1 to 6	146.35	105.72	72.2	Dry
7 to 14	147.81	101.09	68.4	Wet
15 to 20	148.75	99.26	66.7α	Dry
	Mixture, 1:3:6 Concrete.			
22 to 25	147.5	101.11	68.6α	Dry
26 to 28	147.5	100.05	67.8	Wet
29	197.5	140.63	71.2α	Dry
30	197.5	114.27	57.9	"
31 to 32	197.5	138.61	70.0	"
33 to 34	247.5	175.63	70.9α	"
35	297.5	176.63	59.4α	"
36	347.5	237.95	68.4α	"
37	397.5	251.27	63.2α	"
38	447.5	296.27	66.2α	"
39	497.5	321.63	64.6α	"
40	547.5	366.27	66.9α	"
41	597.5	377.95	63.3α	"
42	647.5	395.27	61.0	
43	697.5	423.27	60.7	

Average coefficient 29-43 65.6. Average of all tests, 67.7.

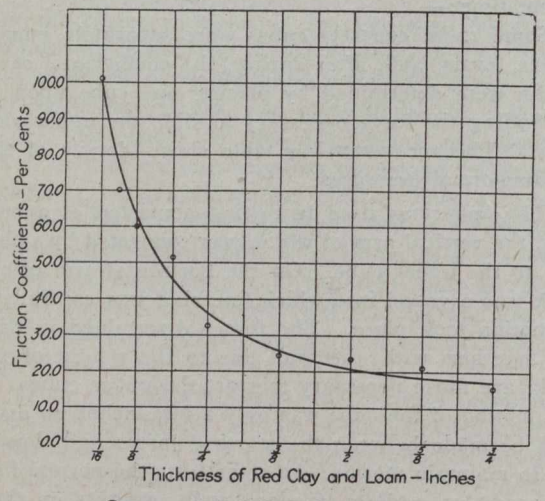
α Indicates surface cleaned.

* Abstract of paper delivered before National Association of Cement Users.

† Professor of Civil Engineering, Lehigh Valley

The average coefficient of all tests shown in the table is 67.7 per cent. There is no great difference between the values obtained for 1:2:4 and 1:3:6 concrete; but the former are slightly larger. Wetting the contact surface seems to lower the coefficients but very little. In tests numbered 29 and 30 the average coefficients are 71.2 and 57.9 per cent. respectively; the conditions in the two series being the same except that in the first the contact surfaces were cleaned after each test by removing the dust formed by grinding while in the latter the dust was allowed to remain. A similar effect was shown in other tests. From test 33 to test 43 the total weight moved was gradually increased from 247.5 to 697.5 lb., and this was accompanied by a decrease in the coefficient from 70.5 to 60.7 per cent. Since the surfaces were cleaned after each test this decrease was probably due to greater smoothness caused by rubbing and not to any change in coefficient resulting from increased pressures, except in so far as the increased pressures may increase the abrasion.

Another interesting test, though not conclusive, because it was only one test, was performed by moulding one cube directly on another that had previously hardened. After allowing the two to set for 20 days the sliding test was made



Curve of Friction Coefficient.

with the result that a total pulling force of 200.95 lb. was necessary to slide the upper cube, weighing 147 lb. In this case the adhesion caused the coefficient to reach 37 per cent. More tests of this character are now under consideration, as are some to determine the effect of laitance.

Of interest also is a set of experiments to find the coefficient of two cubes between which was placed a ¾-in. layer of wet red clay and loam. From this thickness the layer was gradually diminished till it reached about 1/16 in., the coefficient being found at each thickness. The accompanying curve showing thickness of clay and corresponding coefficients indicates that with a ¾-in. layer the coefficient was 15.3 per cent., while for the thinnest layer the coefficient was 101.0 per cent.

As all of the 42 tests recorded in the table were made on separately moulded cubes superposed on each other in pairs, the conclusion reached for this case is that for ordinary concrete the average coefficient for sliding friction is 67.7 per cent., corresponding to an angle of friction of about 34 deg. The minimum value obtained was 57.9 per cent. and the maximum was 79.4 per cent. It should be remembered that the values here given are those which cause motion and before being used in design should have a proper factor of safety applied to them. A determination of the effect of moulding concrete in contact, of the presence of laitance, and of increased normal pressures will throw further light on this question of frictional resistance.

SMOKE PREVENTION WORK IN CHICAGO.

The city of Chicago has for a number of years through its Smoke Department given considerable study to proper furnace design with reference to smoke production and has achieved much success through advising plant owners as to advisable furnace changes. The department has realized, however, that the smoke ordinance as interpreted was not elastic enough to take in all classes of offenders, and it, therefore, instituted in the spring of 1912 an investigation involving a great many chart readings to be used in comparing different plants in the same industry. An appeal could thus be made to the civic pride of the owners of plants which, even if not violating the law, were nevertheless producing large quantities of smoke. The plan was described by Mr. Osborn Monnett, smoke inspector, before the Western Society of Engineers, Nov. 4, 1912.

The ordinance, Mr. Monnett pointed out, says that only dense smoke constitutes a violation. Dense smoke, according to the Ringlemann method of reading, is No. 3 smoke or worse. If a plant makes a continuous No. 2 smoke the total amount of smoke made in a 10-hour run would be enormous, yet the plant would easily run within the smoke ordinance and the matter could not be taken into court.

The smoke density of a plant running a continuous No. 2 smoke on the Ringlemann chart would be 40 per cent., yet another stack might violate the smoke ordinance in seven minutes of continuous dense smoke, and be absolutely clear for the rest of the hour or the rest of the day, and the smoke density for the day would not figure more than 2 or 3 per cent., yet the second offender would be liable to prosecution while the first offender, who was really making the most smoke, would go entirely free.

According to the technical interpretation, the Ringlemann chart reading consists in reading the smoke density of a stack every 15 seconds for the period under observation; in this way a very close record of the behavior of the stack is obtained. The method of figuring the data on a chart of this kind is as follows. The number of observations of Nos. 1, 2, 3, 4 and 5 smoke are tabulated and reduced to smoke units as follows:

70 units of No. 1 smoke	=	70
34 units of No. 2 smoke	=	68
100 units of No. 3 smoke	=	300
29 units of No. 4 smoke	=	116
146 units of No. 5 smoke	=	730
Total		1,284

As the readings were taken every 15 seconds, this figure 1,284 divided by 4 gives the smoke units on a per minute basis, and as one smoke unit represents a density of 20 per cent., the calculation for the per cent. of density for the stack would be

$$321 \times 0.20 \times 100 \div 170 = 37.7 \text{ per cent.}$$

170 in this case being the number of minutes the stack was under observation.

The Ringlemann chart reading shows not only the per cent. density of the smoke for the day, which is in fact the measure of the desirability or undesirability of the stack, but it also gives the number of violations per hour of the stack, if any. Readings of this nature taken in the past 6 months have been classified according to industries and charted for closer study. A standard of 2 per cent. density for a day's observation was taken to represent good performance, anything under 2 per cent. being considered exceptionally good and anything above 2 per cent. being considered subject to criticism. This is entirely independent and separate of any consideration of whether or not a stack actually violated the ordinance.

The method of making use of this tabulated information is as follows: In working on, for instance, the clubs of the city, a copy of the chart is shown to the offender at the foot of the list and an appeal to his civic pride is made, which in most cases is sufficient to get satisfactory action.

In approaching an industry such as a piano factory for instance, which is making too much smoke, the department first picks out a factory in the same line of business which has as nearly as possible the same boiler equipment and lays the facts before the offending corporation, in effect, for instance, that whereas their piano factory is running, say, 18 per cent. or 19 per cent. smoke density on a day's observation, the piano factory across the street, a competitor of theirs, is running inside of 0.5 of 1 per cent. density, and that from the smoke department's standpoint there is no reason why their piano factory cannot be run as clean as another piano factory, provided they will put their plant in proper shape. This argument seldom fails to get the desired results without suit or threat of suit.

The information contained in the tabulated list is of great value, Mr. Monnett stated, in combating claims of plant owners when they make the assertion that their plants do not smoke. One of the most common statements made to the department is that the owners do not believe the plant is smoking and that, compared with a similar line of industry, their stack is much better than their competitors. In one instance a brewery manager made this statement, and if it had not been for the tabulated information on file it would have been very difficult to convince this party that he was not right. When this manager realized that of 44 breweries in the city, 35 or 36 of them were making less smoke than he was, he capitulated, and in the near future his entire boiler plant will be rebuilt in the effort to get to the top of the list.

The smoke department is holding every new plant built in the city of Chicago to a standard of 2 per cent. smoke density on 10 hours' observation before issuing a Certificate of Operation, as provided for in the ordinance. That this standard is not unreasonable, even in the hand-fired installations, may be realized when it is stated that with approximately 250 new plants which have been installed under permit since Jan. 1, 1912, practically all of them that have been put in operation are able to show this low density on a Ringlemann chart. Those which do not show this density are studied with a view to improving conditions, and no Certificate of operation is issued until this standard is reached. For the purpose of keeping track of this work, a form of Certificate of Operation Release has been prepared. This certificate, after giving the type of boiler and furnace, provides for a statement by the engineer of the district that he has personally seen the furnaces in operation, carrying their regular working load, and that he knows personally that the plant can be operated inside the ordinance. To this form is attached a Ringlemann chart reading showing a day's operation with 2 per cent. density or less; the certificate is then issued, a copy of the Ringlemann chart going to the plant owner with a statement that this is the standard which the smoke department will expect the plant to maintain in the future. As the Ringlemann chart is taken with the full knowledge of the operators, it really sets a mark for them to maintain, and any deviation from it is quickly noticed by the smoke department and followed up until the plant is clean at all times.

The same plan of using the good performance of one company to spur others to better work is being pursued in the railroad campaign. In the fall of 1910, series of railroad readings were made showing the smoke conditions at the various railroad centres, and a table showing the smoke standing of the railroads was prepared. In the fall of 1911 a similar set of figures was prepared. It soon became evident that there was an intense rivalry among the various railroads in their efforts to be at the top of the list. This has been taken advantage of with good effect by the smoke department. It has long been realized that railroad smoke appeared heavier in summer than during the cold weather, but it was not known how much the weather affected smoke densities. Taking the smoke readings of the fall of 1911 as a criterion, and assuming the same effort on the part of the railroads to keep down smoke, the summer readings of 1912 show that there is approximately 100 per cent. difference in the smoke density in the summer over the winter months.

The railroad readings are furnished in more detail than has been presented before, as it has been found that the more information the department can convey to the railroads the better the results. For instance, by giving the smoke densities for the various locations, a railroad may find that its per cent. density at a certain point is very satisfactory, whereas at another railroad centre it is not at all satisfactory. By analyzing these smoke density reports for the various localities, a railroad is enabled to determine the points where their engines need special attention and to discover why it is that they cannot have a uniform smoke density throughout the city. Theoretically, if one railroad is inside of 5 per cent. density there is no reason why all the rest of them should not be, but practically it does not seem to work out in this way; there is a difference in organization, difference in methods, difference in service performed, and difference in condition of equipment, which seem to have an immense amount of influence on the smoke densities of the various roads. However, it seems logical, Mr. Monnett believes, that if uniform methods of enforcing the anti-smoke rules were adopted by all the roads, and if standard equipment in various classes of service was provided, that uniform results can be obtained throughout the city and the smoke kept down to the minimum.

MUST INSTALL BRICK PLANTS

Lessees of Western clay lands in future must make bricks as well as stock sales. An order-in-council has been issued regarding the leasing and administration of lands containing limestone, granite, slate, marble, gypsum, marl, gravel, sand or any building stone, in the provinces of Manitoba, Saskatchewan and Alberta, and the Northwest Territories; within twenty miles on either side of the main line of the Canadian Pacific Railway in the province of British Columbia, and in the tract of three and one-half million acres acquired by the Government of the Dominion from the province of British Columbia. The order amends the existing regulation so as to include the leasing of Dominion lands containing deposits of clay, subject, however, to the following additional conditions:—

1. The lessee of a clay location shall, within two years from the date of the lease, erect upon the lands described therein, or on lands acceptable to the Minister, a plant suitable for the manufacture of brick or other clay products, and he shall, within the same period, furnish evidence, supported by affidavit, showing the character and value of the plant installed and the date of its installation. If the required plant is not installed within the time specified, and if evidence of its installation is not furnished within the same time, the lease shall be subject to cancellation in the discretion of the Minister. Provided, however, that the Minister shall not require that the value of the plant so installed shall exceed the sum of $10,000.

2. The lessee of a city location shall, during each year of the term of the lease after the second year, manufacture

from his leasehold and produce ready for shipment not less than 100,000 bricks, or their equivalent in some other form of clay products, to the satisfaction of the Minister. If during any year, after the second year of the term of the lease, the lessee fails to furnish satisfactory evidence of his having done so, the lease shall be subject to immediate cancellation in the discretion of the Minister.

UNITED STATES STEEL CORPORATION IN CANADA

The fact that the United States Steel Corporation has for several years been acquiring real estate at Sandwich, Ontario, led to the theory that at some time or another that corporation would establish a plant there. The time has apparently arrived, as, according to a dispatch from New York at a meeting of the directors of the United States Steel Corporation it was decided to build a new plant at Sandwich, costing approximately $20,000,000, to manufacture practically all classes of steel. The company has about 1,500 acres of land, with 1½ miles of waterfront opposite Detroit, Michigan. The corporation will probably erect a number of blast furnaces in addition to wire, rail, structural and bar mills. Tinplate and tube works may also be erected. All the details have not yet been arranged but it is likely that a bond issue to meet part of the cost of construction of the new plant will be negotiated. No date has been set for the beginning of construction, but work will probably be started as soon as all arrangements have been made. To operate the plant, a new subsidiary of the United States Steel Corporation will be organized in Canada.

Mr. J. H. Plummer, president of the Dominion Steel Corporation, discussing the above announcement, said:—

"There is room for us all in Canada, and it is certainly better from the general standpoint that the trade should be in the hands of strong people. The Dominion Steel Corporation is not afraid of competition from the United States Steel Trust or anybody else."

Mr. J. R. Wilson, a Montreal director of the Dominion Steel Corporation, and also identified with the Canadian Steel Foundries, said: "One may draw his own conclusions as regards competition. For instance, in the buying of ore the Dominion Steel Company pays about $1.75 per ton, while the United States Company pay $3 to $4 for the same, and yet the United States company, with their vast knowledge, experience and money, can and are selling their finished product at $5 per ton lower than any other company, even at the recent advance of steel prices.

"Though I believe the United States Steel Corporation will do us no material harm, it is true there will be a great deal sharper competition immediately the plant begins to operate at Sandwich. Any competition will be felt largely in the West, where the country is growing and the demand is large, but in the East I do not believe the competition will be felt for the present."

In the annual number of The Monetary Times, published this week, Mr. Thomas Cantley, of the Nova Scotia Steel and Coal Company, complains of the extent to which Canada was utilized last year as a dumping market, illustrated by the fact that of the entire export of pig iron by the United States in 1912, 90 per cent. was thrown into Canada, while of finished products an enormous tonnage was disposed of in the same market at prices in many instances 20 to 25 per cent. below that at which they were selling raw pig iron five years previously.

Canadian steel manufacturers are anticipating early revision of the tariff. Any changes made will be announced in the budget speech which is not due, however, for several months yet. Mr. Cantley says that notwithstanding the enormous home demand, coupled with good trade and high prices in Great Britain, Germany and other European countries, owing to the ill judged action of the United States producers last year and the inadequate customs tariff applying to a considerable percentage of steel products imported from the United States, Canadian mills and forges find their earnings much less than they should have been under normal conditions.

Sandwich, where the United States Steel Corporation will establish its Canadian plant, is the capital of Essex County, Ontario, on the Detroit River. About two miles northeast of the town is Windsor, the terminus of the great western division of the Grand Trunk Railway. The town is on the line of the Sandwich, Windsor and Amherstburg Electric Railway and has a population of approximately 2,300.

LAST YEAR'S GOLD PRODUCTION

The world's production of gold during 1912 was $5,500,000 greater than in 1911, the total having been $465,000,000, according to a preliminary estimate of Mr. George E. Roberts, director of the United States mint. Gold production in the United States amounted to $91,685,168, compared with $96,890,000 in 1911. California led with $19,988,486; Colorado was second with $18,791,710; Alaska third with $17,398,946; Nevada fourth with $13,331,680, and South Dakota fifth with $7,795,680.

Of the world's production the Transvaal and Rhodesia made a gain of about $20,000,000, and Canada gained nearly $3,000,000. The United States, Mexico and Australasia lost about $16,000,000, and in the rest of the world the production was about what it was last year. Since 1908, when the production of gold in the world was $442,475,000, the annual increase has been comparatively small.

The mint service of the United States during the year sold $38,000,000 worth of gold bars for consumption in the arts in this country and Canada, as against $35,000,000 in 1911. The net consumption of new gold, including coin for such uses, in the United States and Canada was about $35,000,000, and in the world, excluding Asia, probably between $100,000,000 and $115,000,000.

The absorption of gold by India, which has been attracting attention for several years, was again a noteworthy feature. The net imports of India in 1909 were approximately $50,000,000; in 1910, $90,000,000; in 1911, $116,000,000, and in 1912 approximately $140,000,000. The movement of silver to India also continues to be very heavy. The importations of silver, in ounces, during 1912 have been exceeded only once in the history of India in 1906.

The increase of gold in the monetary stock of the United States in 1912 was approximately $90,000,000. The gold holdings of the United States Treasury increased about $70,000,000, chiefly in bullion, represented in the circulation by certificates.

The production of silver in the United States during 1912 amounted to 62,369,974 fine ounces compared with 60,399,400 fine ounces in 1911, the chief gains in production having been made in Utah and Colorado. Nevada ranked first in production with 13,042,118 fine ounces, Utah second with 12,795,072 ounces, Montana third with 12,338,589 ounces, Colorado fourth with 8,350,316 ounces, and Idaho fifth with 7,703,121 ounces.

There is talk of double tracking the Temiskaming and Northern Ontario Railway.

NEW COMPANIES IN ENGINEERING AND OPERATING FIELDS.

The new White companies held their organizing meetings on January 6th, and announced the following boards of directors and officers:—

Of The J. G. White Engineering Corporation the directors are: Harry Bronner, of Hallgarten & Company; James Brown, of Brown Brothers & Company; F. Q. Brown, of Redmond & Company; Douglas Campbell, of Campbell, Harding & Pratt; Geo. C. Clark, Jr., of Clark, Dodge & Company; Bayard Dominick, Jr., of Dominick & Dominick; A. G. Hodenpyl, of Hodenpyl, Hardy & Company; T. W. Lamont, of J. P. Morgan & Company; Capt. Marion McMillan, of Emerson McMillan & Company; J. H. Pardee, president The J. G. White Management Corporation; E. N. Potter, of Potter, Choate & Prentice; Frederick H. Reed, vice-president J. G. White & Company, Inc.; Chas. H. Sabin, vice-president Guaranty Trust Company; Frederic Strauss, of J. & W. Seligman & Company; Moses Taylor, of Kean, Taylor & Company; George H. Walbridge, of Bonbright & Company; E. N. Chilson, and C. E. Bailey. And the officers are J. G. White, chairman finance committee; Gano Dunn, president; E. G. Williams, A. S. Crane, H. A. Lardner, vice-presidents; H. S. Collette, secretary, and R. B. Marchant, treasurer.

During the year ending October 1, 1912, the departments of J. G. White & Company, Inc., which have just been organized into the above engineering company, were at work on contracts aggregating in cost over $28,000,000, and on appraisals and reports upon properties aggregating over $400,000,000. Many different types of engineering service were required throughout thirty different States and Canada, among them the complete rehabilitation of several public service properties, the construction and equipment of two high-speed interurban electric railways, one of which is eighty-four miles long and includes difficult tunnel and canyon construction in California. There was also engineering for the drainage of 118,000 acres in Florida, and the design and construction of a 124-mile 12-inch natural gas pipe line, which line is noteworthy because it is the first in California, and because it is to operate at a pressure of 450 pounds per square inch, the highest ever yet employed.

The hydro-electric developments include some of the most important in the United States, such as the Big Sandy, at the foot of Mount Hood in Oregon; the Deerfield, an important tributary of the Connecticut River; the Savannah River development near Augusta, Georgia; the Broad River near Columbia, South Carolina, and the Ocoee in the mountains of eastern Tennessee. In addition to these, there are the San Joaquin development in California, and that of the Beauharnois, on the Saint Lawrence in Canada. The aggregate capacity of these water powers is approximately 366,000 horse-power.

The J. G. White Management Corporation announces as directors Cecil Barret, of Spencer Trask & Company; F. Q. Brown, of Redmond & Company; P. M. Chandler, of Chandler Brothers & Company, Philadelphia; Arthur Coppell, of Maitland, Coppell & Company; Gano Dunn, president The J. G. White Engineering Corporation; George E. Hardy, of Hodenpyl, Hardy & Company; R. G. Hutchins, Jr., vice-president National Bank of Commerce; R. L. Montgomery, of Montgomery, Clothier & Tyler, Philadelphia; John T. Pratt, of Campbell, Harding & Pratt; Frederick Strauss, of J. & W. Seligman & Company; H. R. Tobey, of N. W. Halsey & Company, and J. G. White, president J. G. White & Company, Inc. And the officers are: J. H. Pardee, president; F. H. Reed and S. L. Selden, vice-presidents, and T. W. Moffat, secretary and treasurer.

The business of the Management Company was established some years ago as a department to supervise the operation of properties in which J. G. White & Company, Inc., was interested. This department, which has now been formed into a separate company, was, on December 31, 1912, acting as Operating or Consulting Operating Manager of public utility and railroad properties in the United States, Nicaragua and the Philippine Islands, including The Manila Electric Railroad & Lighting Corporation and subsidiaries; The Helena (Montana) Light & Railway Company, the Eastern Pennsylvania Railways Company, of Pottsville, Pa., and subsidiaries; the United Light & Railways Company and subsidiaries; the Associated Gas & Electric Company and subsidiaries; the Augusta-Aiken (Georgia) Railway and Electric Corporation and subsidiaries; Pacific Railroad of Nicaragua; Kentucky Public Service Company and subsidiaries; and other properties.

The parent organization, J. G. White & Company, Inc., controls the new companies and will continue as an active financing and owning company.

THE PORT OF PARA, BRAZIL.

The port of Para, Brazil, is described in the October, 1912, "Bulletin" of the Pan-American Union. Para is on the Para River, which belongs to the Amazon system, though not on the main outlet to the largest river bearing that name. It was established as a town as far back as 1700, and has taken its place as the largest rubber shipping port of the district. In 1910 the vessels entering the port of Para numbered 1,969 steamers and 1,668 sailing vessels with a total tonnage of nearly 1,500,000 tons. The opening of the Madeira-Mamoré Railway promises to add considerably to the use of the port. In November, 1907, work was begun on a system of docks with accessory appliances, which provide permanent facilities for the present traffic of the city of Para, as well as for the traffic present and to come from that immense area known as the Amazon Valley, and although addition must later on be made to the docks as they exist now, yet the unit of improvement has been established and further expense should be nothing more than a duplication of that unit. The work is being carried on under an American corporation holding its concessions from the federal government of Brazil. To it is given a monopoly of the port services, construction, and operation of quays, warehouses, and other works at Para within a zone of 18 miles toward the ocean and 12 miles in the other direction, for a period of 65 years, and this period is to extend to 90 years after the completion of the second section of the work. The main channel to the port has a depth of 30 ft., and a total width of about 400 ft. between channel-line buoys. This leads up to the dock, which consists of about one mile of quay wall for ocean-going steamers where there is a depth of 30 ft. at low water of ordinary spring tides. In addition, there is 722 ft. of quay wall for river steamers with a depth of water of 12 and 1,500 ft. of quay wall for still smaller river steamers with a depth of water of 9 ft. 6 in. The quay walls are built of large concrete blocks. Back of the quay is a well-paved platform or roadway on which are warehouses and freight handling machinery. Beyond the warehouses on the city side of the port works proper is a newly finished road about a mile long and 60 ft. broad, making both a boulevard and, with the trees which are being planted, a future park. In addition to the port works proper, the company is building a ship repairing depot with floating drydocks and necessary shops.

COAST TO COAST.

Niagara Falls, Ont.—A by-law to raise $3,900 for increased fire-fighting apparatus carried at the recent election. The by-law to bonus the Vermont Marble Company to the extent of $5,000 was defeated. The money is now being raised by private subscription.

Province of Alberta.—Mr. Charles Mohr, a civil engineer of Seattle, Wash., after an extended trip through northern Alberta, is endeavoring to interest Alberta municipal authorities into the possibilities of the asphalt deposits of this territory. In his estimation the civic authorities should take immediate steps to secure the mineral rights on these resources and then work them jointly.

Transcona, Man.—The second unit in connection with the large Grand Trunk Pacific shops and yards at Transcona, near Winnipeg, has recently been completed. The cost of the first and second units is $500,000, and they include car works foundries, locomotive roundhouses, and 110 miles of trackage in the yards. The shops are among the best on the continent, and all the G.T.P. freight from Western Canada will be handled at the yards there.

Vancouver, B.C.—The Minister of Public Works has received the report of Edward White, the British landscape artist engaged to suggest the location of new departmental buildings on Wellington Street in this city. The report is understood to be the direct opposite of what was proposed by Frederick Todd, of Montreal. The latter favored seven or eight buildings. Mr. White would group the structures and have them fewer in number. The government will decide which plan is preferable and then will likely ask for competition designs.

Prince Albert, Sask.—A report with reference to the civic administration and city development of Prince Albert is being made by Messrs. E. A. James and T. Aird Murray, of Toronto. The report will be made at the first meeting of the city council this year, will deal with the duties of the works commissioner and city engineer, and will incorporate certain suggestions regarding streets, park system, types of suitable pavements, railroad crossings, sewage and water supply, etc.

Ottawa, Ont.—The Ottawa city council have decided to engage two British experts, Sir Alexander Binnie, of London, Eng., water engineer, and Dr. Houston, scientific adviser to the Metropolitan Water Board of London, Eng., to report upon the best supply of pure water for this city. The arrangements for the engaging of the experts were made through Lord Strathcona, high commissioner for Canada, at the request of Premier Borden and Mayor Ellis. Sir Alexander Binnie and Dr. Houston were recommended by Rt. Hon. John Burns, president of the local government board in the Asquith ministry.

Toronto, Ont.—Works Commissioner Harris, in a report to the city council, states that the slow sand filtration plant finished last year for the city supply of water, leaks from five to six million gallons a day. The leakage into the clear water reservoir is nearly 3,000,000 gallons per 24 hours. A special meeting of the Board of Control will discuss the question of obtaining an independent expert's report on the whole question. The results of the test by Commissioner Harris do not coincide with the evidence as given before Judge Winchester at the recent investigation. It was stated then that the total leakage was not over 500,000 gallons a day.

Montreal, Que.—Plans are being prepared in Montreal for a structure, 56 by 75 feet, ten stories in height, to be erected next spring for the Bank of British North America at Edmonton, Alta. The cost of the building, which will occupy a double corner at Jasper Avenue and First Street, is placed at $1,000,000. It is given out that separate tenders will be called in Montreal and Edmonton within six weeks. The building will be steel and brick with ornamental stone facings and is to be fireproof throughout. The entire ground floor will be used by the bank, a portion of it being reserved as residence quarters for members of the bank staff. The rest of the building will be used as offices.

Saskatoon, Sask.—Following the announcement of the the selection of a site for the hospital buildings in connection with the University of Saskatchewan several of the daily papers have given publicity to a report which stated that the site was too low to provide suitable drainage into the present sewerage system without the expenditure of much money. It is learned that provision has been made, however, to have the design of the new traffic bridge, that is to be erected by the provincial government, altered in such a manner that the drainage from the hospital site may be carried over and connected with the intercepting sewer at 25th Street. The civic power cables will also be strung beneath this bridge.

Province of Ontario.—The Hydro-Electric Power Commission of Ontario, Continental Life Building, Toronto, propose some time before the end of January, to call for tenders for the various materials necessary in connection with the construction of approximately 125 miles of double circuit transmission line at 110,000 volts and the necessary equipment for sub-stations for the transforming of 20,000 h.p. from the line to 13,200 volts. Various types of apparatus will be considered; for instance, the different materials for conductors and different types of steel construction for supports. As mentioned above, specifications will be issued about January 15th, and the tenders will be called for in March.

Montreal, P.Q.—The city garbengers will take no more waste picture films to the incinerator in the west end of Montreal. A few days ago an explosion followed the throwing into the large oven of a quantity of the celluloid substance which contains guncotton in its ingredients. The picture films which were sent to be destroyed by one of the picture show establishments of Montreal, were regarded as ordinary garbage. This has been done before but the films were in smaller quantities and nothing was thought of the little puff and the report which followed. But this time a genuine explosion occurred, which set fire to the building. The electric light connections were also burned out. The fire was quickly under control, and Superintendent Chenevert informed the board that the total loss was only about $15.

Sandwich, Ont.—A new steel plant costing over $20,000,000 which will turn out practically all classes of steel is to be built shortly at Sandwich Ont., by the United States Steel Corporation on a property of 1,500 acres with a water frontage of one and a half miles opposite Detroit which it has owned for several years. It is understood that the plant will be built and operated by the Steel Corporation. The present intention is to build a wire mill, rail mill, bar mill and possibly several others. To operate the plant a new subsidiary of the United Steel Corporation will be organized in the Dominion. The corporation's business with Canada in the past has ranged from 350,000 to 400,000 tons annually, representing from $12,000,000 to $15,000,000. The average duty on its sales has been between $6 and $7 per ton. It is expected that a considerable part of the products of this plant will be marketed throughout the Empire.

Edmonton, Alta.—A ten-story building at a cost of $250,000 is being erected at First and May Streets, to be known at the Royal Alexandra Hotel. The foundation has been completed and six stories will be erected in 1913, four floors being added in 1914. The plans, prepared by Messrs. Van

Siclen and Macomber, of Edmonton, show an exterior in renaissance of the latter French period. The first two stories are to be faced with white sandstone, the upper floors being in terra cotta finished with sandstone. The side walls will be of brick, the mansard roof of slate. The main entrance to the rotunda is to be panelled in Canadian marble, the floor being laid in the same material. An elaborately wrought iron marquee will be erected over the main entrance. The rotunda will be spacious, with Canadian marble columns and Honduras mahogany, the panels being so set in as to provide space for trophies and game heads. The upholstering will be in leather, of a design corresponding with the rest of the scheme. There will be 26 rooms on each floor, all having outside light and ventilation, each room being fitted up with a shower bath and other conveniences, including telephones and the latest built-in features. The structure is fireproof throughout, while the staircases and elevator are so arranged that they can be utilized to the greatest measure to give aid in the event of fire.

WHEELER TURBO-AIR PUMP.

The Wheeler Condenser & Engineering Co., Carteret, N.J., announce that they have acquired the American license to build turbo-air pumps of the A. E. G. Type as manufactured in Europe by the Allgemeine Electricitaets Gesellschaft. This air pump is of the rotary water jet type, for motor or steam turbine drive, air being removed from the condenser by ejector action of a series of small water jets and also by positive entrapment of air between successive small slugs of water. A number of these pumps are now under construction at the works of the Wheeler Condenser & Engineering Company, Carteret, N.J.

CHANGING A C. P. R. BRIDGE.

The Canadian Pacific Railroad bridge across the St. Rose River, Canada, had several 160-ft. spans with pin-connected Phœnix trusses, spaced about 20 ft. apart on centres. They were recently replaced by a double line of 80-ft single-track deck-plate girder spans, supported on the old piers and on new ones built between them. The new super-structure was erected and the old superstructure removed without interfering with traffic and without the use of falsework.

The tops of the old piers were cut down to the required elevation to receive the new girders, and the old trusses were transferred to bearings on timber crib-work built to maintain them at the required elevation. The new girders of the Canadian Pacific Railway Company's standard type, weighing about 49 tons per span, were delivered on pairs of flat cars, run across the old bridge to the required positions, unloaded by derrick cars and suspended by tackles hung from transverse beams supported on the top chords of the trusses. The flat cars were released and removed and the floor system quickly removed, allowing the new girders to be lowered to bearings on the old and new piers.

After all of the new girders for one line of single-track spans had thus been erected, the old spans, weighing about 120 tons each, were supported from them and taken down by the derrick cars, after which the deck spans were shifted transversely to their required positions. The girders for the parallel line of single-track spans were delivered on them and erected in position by the derrick cars.

The plate girder spans were fabricated and erected by the Dominion Bridge Company, Montreal, in accordance with the requirements of the Canadian Pacific Railway Company. Mr. P. B. Motley, engineer of bridges, was in charge of the work.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

At the meeting of Section D, Engineering, on Friday, January 3rd, a programme of thirty papers devoted to highway engineering and related subjects occupied the morning and afternoon sessions. The titles of the papers and authors have been published in a previous issue of this journal. The sessions were presided over by Professor Arthur H. Blanchard as chairman and Professor George W. Bissell as secretary.

On Saturday, January 4th, many of the engineers in attendance visited the plant of the Deckman-Duty Company, at which Dunn wire-cut-lug paving brick are manufactured. The inspection trip of the morning, which was made with automobiles also included the examination of various sections of brick and stone block pavements in Cleveland. The tour of inspection was made through the courtesy of Mr. F. B. Dunn and the officials of the Deckman-Duty Company and the National Paving Brick Manufacturers' Association, who, on the preceding evening, entertained many of the engineers present at a dinner given at the Cleveland Athletic Club.

CANADIAN CLAY PRODUCTS MANUFACTURERS' ASSOCIATION.

The annual convention of the Canadian Clay Products Manufacturers' Association is being held in Toronto this week. The association are still pursuing their efforts to secure the establishment of a course in Ceramics in connection with the Faculty of Applied Science and Engineering of the University of Toronto. Mr. C. W. Raymond, of the Raymond Brick Machine Company, Dayton, Ohio, in a letter to the association, agreed to give full equipment necessary for the work of such a department, provided one were established. A joint committee, composed of members of the association, members of the Faculty of Applied Science, and representatives of the Engineering Alumni Association, will approach the Board of Governors of the University at an early date to impress upon them the desirability of the founding of such a department.

PERSONAL.

J. O. MOUSSEAU, the member of the Quebec Provincial Parliament for Soulanges, has been appointed to the new provincial portfolio as Minister of Good Roads.

SIR ALEXANDER BINNIE, consulting engineer for London, England, and Dr. Houston, of the Metropolitan Water Board, of London, have been asked to report on the water supply of Ottawa.

D. F. McLEOD, superintendent of public works at Ithaca, N.Y., has been appointed city engineer of New Glasgow, N.S., to take effect after the expiration on February 28 of his present contract with the city of Ithaca.

FRANK C. ASKWITH is at present acting city engineer of Ottawa. He has been attached to the city engineer's department of Ottawa for the past five years, and before that had several years' experience on railroad construction in the West.

N. J. KERR, until recently city engineer of Ottawa, has accepted a position with the Canadian Pacific Railway. He succeeds Mr. N. J. Carry, who resigned on account of poor health, in charge of Shaughnessy Heights, at North Vancouver.

HAROLD PARKER, M. Am. Soc. C.E., first vice-president, Hassam Paving Company, Worcester, Mass., on

January 10th delivered an illustrated lecture on "Specifications Covering Patented Pavements," before the graduate students in Highway Engineering at Columbia University.

LEE MURRAY has been appointed to the seat on the board of directors of Bruce Peebles & Company, Limited, Edinburgh, Scotland, recently vacated by Mr. Chas H. McKuen. Mr. S. E. Bastow and Mr. J. H. Bunting have been appointed joint managers in the place of Mr. Murray, who has retired from the position of general manager of the company.

COMING MEETINGS.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—Meeting of Mining Section will be held on Thursday, Jan. 16th, at 8.15 p.m., at the Society's Headquarters, 413 Dorchester Street West, Montreal. Sec'y, C. H. McLeod.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.—Third regular meeting of the Toronto Section will be held at the Engineers' Club, 96 King Street West, at 8 p.m., Friday Evening, January 17th, 1913. "Notes on the construction of Toronto Hydro-Electric System," Mr. J. G. Jackson; "Practicability of the Toronto Street Lighting System," Mr. W. R. Sweeney; papers illustrated with stereopticon views. Secretary, H. T. Case, 611 Continental Life Building, Toronto.

THE CLEVELAND ENGINEERING SOCIETY.—Informal meeting, Chamber of Commerce Building, January 21st, 1913. "The Practical Illumination of Factory Buildings (Illustrated)," by Ward Harrison. Illuminating Engineer, The National Electric Lamp Association. Secretary, David Gaehr.

AMERICAN WOOD PRESERVERS' ASSOCIATION.—Ninth Annual Convention will be held at Chicago. Jan. 21-23, 1913. Secy-Treasurer, F. J. Angier, Mount Royal Station, B. & O. R. R., Baltimore, Md.

AMERICAN INSTITUTE OF CONSULTING ENGINEERS.—Annual Meeting, January 14th, 1912, will be held at The Engineers Club, 32 West Fortieth Street, New York, N.Y. Secretary, Eugene W. Stern, 103 Park Avenue, New York.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—Annual Meeting will be held on Jan. 28th, 29th, and 30th, 1913, at the Society's new headquarters, 176 Mansfield St., Montreal. Secretary, C. H. McLeod.

THE CLAY PRODUCTS EXPOSITION.—To be held in the Coliseum, Chicago, Feb. 26th to Mar. 8th.

THE INTERNATIONAL ROADS CONGRESS.—The Third International Roads Congress will be held in London, England, in June, 1913. Secretary, W. Rees Jeffreys, Queen Anne's Chambers, Broadway, Westminster, London, S.W.

THE INTERNATIONAL GEOLOGICAL CONGRESS.—Twelfth Annual Meeting to be held in Canada during the summer of 1913. Secretary, W. S. Lecky, Victoria Memoriam Museum, Ottawa.

ENGINEERING SOCIETIES.

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

KINGSTON BRANCH—Chairman, A. K. Kirkpatrick; Secretary, L. W Gill; Headquarters: School of Mines, Kingston.

OTTAWA BRANCH—
177 Sparks St. Ottawa. Chairman, R. F. Uniacke, 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.

QUEBEC BRANCH—Chairman, W. D. Baillairge; Secretary, A. Amos; meetings held twice a month at room 40, City Hall.

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

VANCOUVER BRANCH—Chairman, C. E. Cartwright Secretary, Mr. Hugh B. Fergusson. 911 Rogers Building, Vancouver, B.C. Headquarters: McGill University College, Vancouver.

VICTORIA BRANCH—Chairman, F. C. Gamble; Secretary, R. W. MacIntyre: Address P.O. Box 1290.

WINNIPEG BRANCH—Chairman, J. A. Hesketh; Secretary, E. E. Brydone-Jack; Meets every first and third Friday of each month, October to April, in University of Manitoba, Winnipeg.

MUNICIPAL ASSOCIATIONS

ONTARIO MUNICIPAL ASSOCIATION—President, Mayor Lees, Hamilton. Secretary-Treasurer, Mr. K. W. McKay, County Clerk, St. Thomas, Ontario.

SASKATCHEWAN ASSOCIATION OF RURAL MUNICIPALITIES.—President, George Thompson, Indian Head, Sask.; Secy-Treasurer, E. Hingley, Radisson, Sask.

THE ALBERTA L. I. D. ASSOCIATION.—President, Wm. Mason, Bon Accord, Alta. Secy-Treasurer, James McNicol, Blackfalds, Alta.

THE UNION OF CANADIAN MUNICIPALTIES.—President, Chase. Hopewell, Mayor of Ottawa; 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 Bee, Lemberg; Secy-Treasurer, W. F. Heal, Moose Jaw.

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

UNION OF ALBERTA MUNICIPALITIES.—President, F. P. Layton, Mayor of Camrose; Secretary-Treasurer, G. J. Kinnaird, Edmonton, Alta.

UNION OF MANITOBA MUNICIPALITIES.—President, Reeve Forke, Pipestone, Man.; Secy-Treasurer, Reeve Cardale, Oak River, Man.

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.

BRITISH COLUMBIA SOCIETY OF ARCHITECTS.—President, Hoult Horton; Secretary, John Wilson, 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, A. A. Dion, Ottawa; Secretary, T. S. Young, 220 King Street W., Toronto.

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

CANADIAN GAS ASSOCIATION.—President, Arthur Hewitt, General Manager Consumers' Gas Company, Toronto; John Kelilor, Secretary-Treasurer, Hamilton, Ont.

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

THE CANADIAN INSTITUTE.—198 College Street, Toronto. President J. B. Tyrrell; Secretary, Mr. J. Patterson.

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, Patrick Dubee, Montreal; 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, J. B. Ritchie; Corresponding Secretary, C. C. Rous.

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 ASSOCIATION OF ARCHITECTS.—President, W. Fingland, Winnipeg; Secretary, R. G. Hanford.

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 ASSOCIATION OF ARCHITECTS.—President, C. P. Meredith, Ottawa; Secretary. H. E. Moore, 195 Bioor St. E., Toronto.

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, L. V. Rorke, Toronto.

TECHNICAL SOCIETY OF PETERBORO.—Bank of Commerce Building, Peterboro. General Secretary, N. C. Mills, P.O. Box 995, Peterboro, Ont.

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.

REGINA ENGINEERING SOCIETY.—President, A. J. McPherson, Regina; Secretary, J. A. Gibson, 2429 Victoria Avenue, Regina.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—President, H. C. Russell, Winnipeg, Man.; 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.—Wallace P. Cohoe, Chairman, Alfred Burton, Toronto, Secretary.

UNDERGRADUATE SOCIETY OF APPLIED SCIENCE, McGILL UNIVERSITY.—President, W. G. Mitchell; Secretary, H. F. Cole.

WESTERN CANADA IRRIGATION ASSOCIATION.—President, Duncan Marshall, Edmonton, Alta. Permanent Secretary, Norman S. Rankin, P.O. Box 1317, Calgary, Alta.

WESTERN CANADA RAILWAY CLUB.—President, R. R. Nield; Secretary, W H. Rosevear, P.O. Box 1707, Winnipeg, Man. Second Monday, except June, July and August at Winnipeg.