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LAYING A DEEP SEWER IN BAD GROUND.

By GEO. PHELPS, C. E. *

On one section of the sewerage scheme which has recently been carried out in North Toronto, and which was designed by T. Aird Murray, consulting engineer, Toronto, Ont., a part of the main trunk sewer is laid at a depth of about 30 feet. The following account of the work shows some of the difficulties which were encountered and the methods adopted in overcoming the same.

The sewer has a total length of nearly two miles; about 2,200 feet of this consists of 20-inch diameter pipes, and 7,000 feet of 24-inch, laid at a grade of 1 in 700. It passes through ground of varying character and at depths for the most part between 20 and 30 feet. Some of the deep work presented no special difficulty beyond hard picking and digging, but towards the lower end of the sewer, water and running sand interfered considerably with the progress of the work. The 20-inch pipes were laid during the summer weather, the greatest depth being about 24 feet, and the soil for practically the whole length of this part consisted of very hard clays and shale. Most of the trenching was done by short open cuts and tunnels about 20 feet long. The sides were so firm that no timbering beyond the stages for shovelling were required, and no water was encountered.

The sewer crosses a creek near where the 20-inch and 24-inch pipes join, and a little further on the ground quickly changes from the hard clay and shale to sand. The following section was laid during the fall of 1911; the greatest depth is about 24 feet, and although the greater part of the work was in sand, no timbering of any importance was required and the trench was free from water. A large part of this section also was carried out on the open cut and tunnel principle.

At the time these two sections were laid there was no outlet for the water at the lower end of the sewer, but pumping was not found necessary, as the trench was dry throughout the whole of the length.

The remainder of the 24-inch sewer, about three-quarters of a mile in length, passed through some bad ground and proved a difficult and costly piece of work. In November, 1911, although the main outfall sewer to which this section joins, was not completed, it was decided to proceed with this part of the work or, it was feared, a large part of the sewer system would be held up for want of an outlet. It having been ascertained by sinking trial holes that there would be water to contend with, a pit was sunk at the point of junction with the outfall sewer. A steam boiler and pulsometer were provided for dealing with the water, which was met

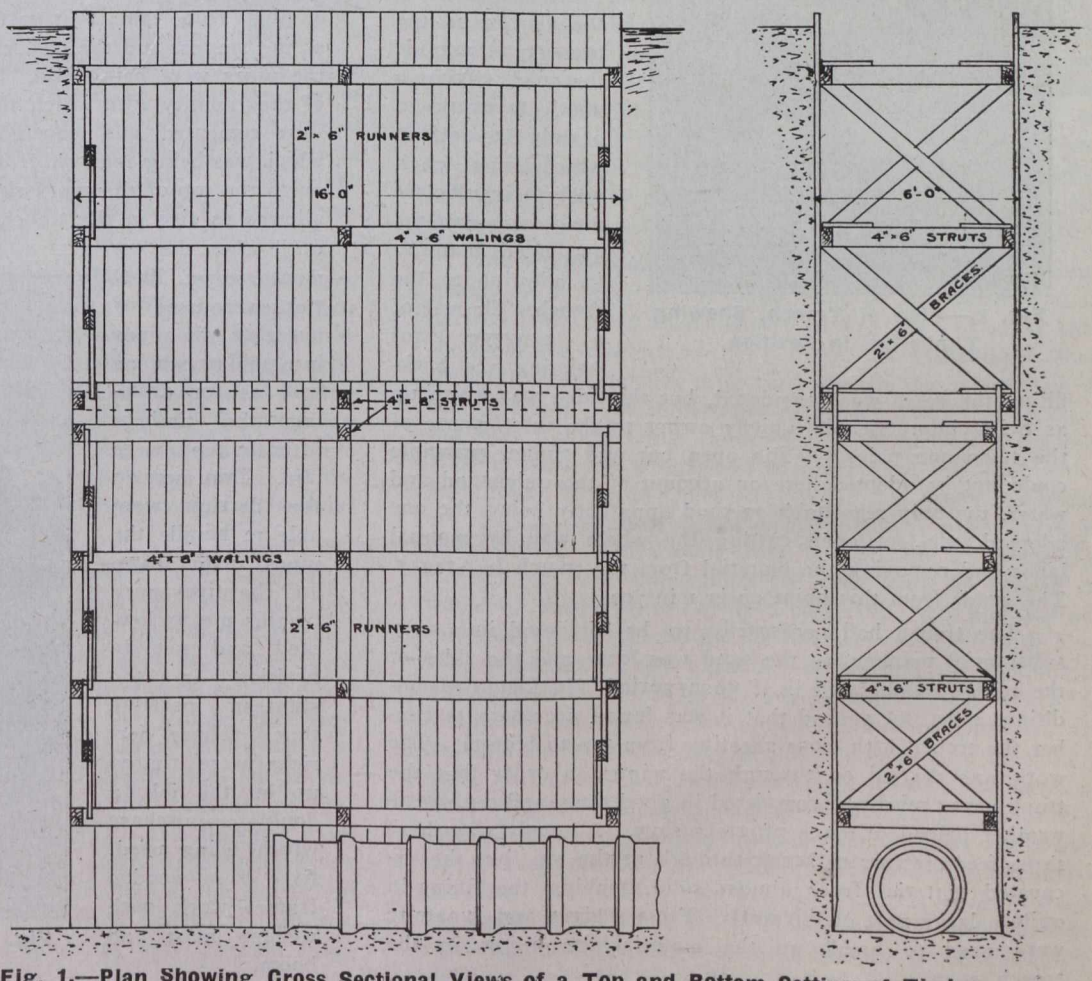


Fig. 1.—Plan Showing Cross Sectional Views of a Top and Bottom Setting of Timber.

* Engineer in charge of North Toronto sewerage system.

with at a depth of about 16 feet. The sewer here is 30 feet deep, the trench being in sand the whole depth. From this point to the next manhole there is a fairly steep grade, sufficient to carry the water and fine sand which came with it through the sewer as it was laid to the pump sump.

It may here be said that the pulsometer did not give entire satisfaction for the work. In capacity it was found to be more than sufficient to deal with the water from the trench, and it only required to be worked intermittently. For this reason the sand which was carried by the water settled down on the valves during the periods of rest, and there was often a delay in getting the pump to start again.

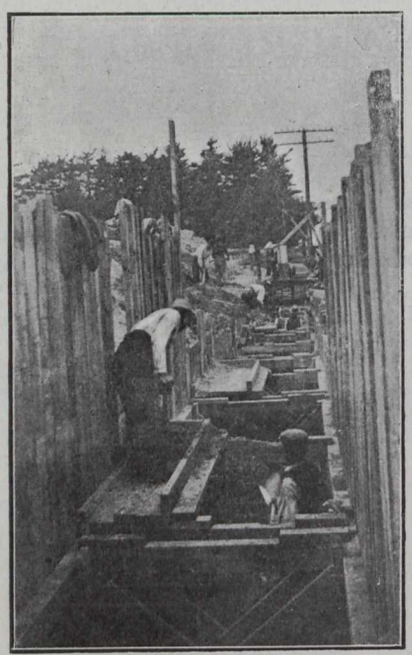


Fig. 2.—View of Trench, Showing Timbering in Position.

After passing the first manhole to the south of this point, the line of the sewer lay between a row of telephone poles and the fences of the property alongside the road, giving a width to work in of only 8 to 10 feet, which was obviously insufficient to accommodate the excavated material in addition to the trench. The use of a conveyer for hoisting and backfilling the earth was considered, but this idea was given up as being impracticable, chiefly owing to the interference of the telephone poles. The open cut and tunnel principle could not be adopted here on account of the quicksand and water, the only reasonable method apparently being the one adopted, viz., of open cutting the whole way by manual labor and removing the material from the trench by stages. The grade from this point on is 1 in 700.

The trench had necessarily to be timbered in a very substantial manner, as the sand was loose and the sides of the trench quickly fell in if unsupported. In fact, the conditions soon got so bad that it was found necessary to timber the trench with close sheeting from top to bottom. The work was carried on through the winter in order that the trunk sewer might be completed in good time, and the severe weather helped to make progress slow. Not only was there three feet of frost to break through at the top, but the excavated material froze almost solid, making the filling-in quite a large part of the work. Frost wedges and dynamite were used to break up the material for filling in the trench.

Although it was found possible to continue the laying of this sewer right through the severe weather of last winter, except for a few odd days, there is little doubt that from an economical point of view the laying of a deep sewer in ground where quicksand and water are met with had better be stopped in the winter, unless, as here, it is a case of being pressed for time. If such work must be carried on in severe frost, some kind of conveyer should, if possible, be used for backfilling the excavated material over the pipes laid as soon as it is removed from the trench, not allowing it time to freeze at the top of the ground.

Shortly after the commencement of the work on the flat grade it was found iupossible to keep the sewer free from the sand which was carried in suspension in the water, and which, being very fine, quickly settled down in the pipes and formed an obstruction. Attempts were made by means of rods and chains drawn through to keep the pipes clear, also by flushing from a hydrant. But the level of the water could not be kept down sufficiently to make good joints, and pumping in front of the pipe-layers had to be resorted to. A four horse-power vertical gasoline engine and a belt-driven centrifugal pump were provided for this purpose, the pump being set down in the trench about 10 feet above the invert of the sewer; 35 feet of flexible suction hose was attached to the pump, making it possible to lay about 70 feet of pipe before moving the pump further along the trench. The gasoline engine occasionally gave a little trouble, but the centrifugal pump proved quite satisfactory for dealing with the very sandy water, which was raised to the surface and discharged on the other side of the road.

The pipe joints were made in the usual way with cement mortar, gaskets being first put into the sockets of the pipe. Only a few pipes, about eight or ten, were laid at a stretch, the method of procedure being to excavate a length of trench, except a foot or so at the bottom, sufficient for the length of pipes to be laid; that part of the trench was then cleared of the stages, and the last level of the bottom got out while the pipes were being laid. This was necessary on account of the rapidity with which the trench silted up. The joints were cemented and covered over with sods, and the sand which was being removed from the bottom of the trench filled on to the top of the pipes shortly after. The water was not allowed to rise in the trench again or flow into the pipes until after the cement had set. Derricks were used for lowering the pipes into the trench, as well as for drawing the timbers after the pipes were laid. Two men on the derrick were able to handle the pipes with ease, and the pipes were by this means lowered and set in position in the shortest possible time. These derricks were rigged up on the job, a double purchase winch being used, fixed to a wooden frame - work with wooden mast and boom.

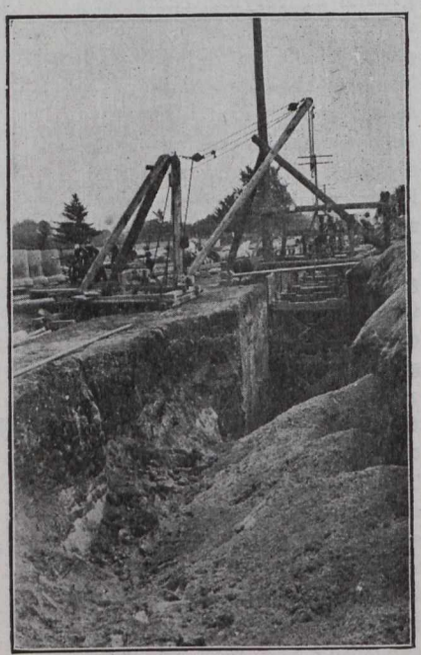


Fig. 3.—View of Trench After Removal of Timbering.

It is generally recognized to be a matter of some difficulty to make good cement joints in a wet trench, but that this can be done providing great care is taken in the jointing, and the water kept well pumped out in front of the pipe laying, is demonstrated in the present case.

Before leaving at the end of the day a stopper was put in the last pipe laid, to prevent the sand washing into the pipes at night. The sand flowed so freely into the trench that often, after standing over the week-end, it had filled the trench up to the level of the top of the pipes. The bottom

of the trench was, as a rule, good, the quicksand coming from a few feet higher up. In some places, however, where the bottom was soft, timbers were put in to give a firm bearing for the pipes. As a result of the flow of sand into the trench, caves were formed behind the sheeting, and when for any reason a delay occurred causing the trench to be left open a little longer than usual, big falls of sand took place, due to the cave and the weight of earth above. These often pulled down the top setting of timber a few feet with it and causing the walings to snap. This constituted a great danger and the work was delayed on several occasions by the caving in of the sides of the trench from this cause. The system of cross braces shown in Fig. 1 was adopted to prevent the occurrence. Extra diagonal braces were often put in as well, but even this did not always prevent the settling down of the timber work with the falling sides. The timber consisted of two settings of 2-in. x 6-in. pine runners, the top setting being 12 feet deep and the bottom 16 feet deep. The walings and struts were of 4-in x 6-in. pine, and the cross braces of 2-in. x 6-in. pine. A uniform width of trench was kept, and each setting was 16 feet in length, this being the length of walings used. The walings were about four feet apart vertically, three on each side for a top setting, and four for a bottom setting. The cross braces and 4-in. x 6-in. struts were placed at each end of the walings, in addition to 4-in. x 6-in. struts in the middle, the timbering thus being divided up into 8-foot bays. After the bottom setting of timber had been driven down to the full depth, the joints of the runners were covered with short lengths of 1-in. boards to keep back the sand as much as possible. This helped considerably, but did not entirely prevent the sand from washing in.

The drawing of the timbers after the pipes had been laid was attended with some danger. The bottom setting was first drawn, often exposing big caves in the sides of the trench where the material had washed away. These, with the trench, were filled up to the bottom of the next setting before any of the top timbers were disturbed. On removing the struts from the top setting the sides of the trench often fell in from several feet back to the great danger of the timbermen, but fortunately the work was completed without any serious mishap from this cause.

In passing the telephone poles, which came immediately on the side of the trench, the top setting of timber was left in for safety. In addition, stays were placed on the poles and left there after completion of the work to protect them from heeling over or sinking until the trench settled down quite firm. In some places, where the ground was very bad, particularly at a point where the trench passed close to a grove of trees, the whole of the timbering was left in the trench, and after filling such places a large amount of surplus earth remained to be hauled away. The trenches have shown very little sign of settling down since being filled and it is likely that the caves left behind the timbering where it was not drawn will silt up from underneath quicker than the filling material will find its way through from above.

After completion of the sewer it was found necessary to do a certain amount of flushing to remove the sand from the pipes. The sewer is now in satisfactory operation.

It is interesting to note that during the excavation of the trenches, which were situated some six miles from Lake Ontario and at a level of about 250 feet above the lake, a number of boulders were continually being met with, some of them over a ton in weight. The rocks from which these came were of a very varied character, and many of the boulders showed by their scored surfaces unmistakable signs of having been ice borne. No doubt many of them had been brought from long distances and deposited here when the lakes covered a larger area than they do at the present time.

In the fall of 1911 this work was taken out of the contractor's hands and conducted by myself under the direction of E. A. James, the engineer for North Toronto, Ont.

ROADS OF SASKATCHEWAN.*

By A. J. McPherson.†

I have to express my gratification at being allowed the opportunity of laying before you some information regarding Saskatchewan roads and also at being able to attend your convention, as I am very much interested in learning the objects and aims of your association. I can say for the Highway Commission of Saskatchewan that they will do what they can to further the aims of the association, and from what information I have had up to the present is should be done without any confliction with our present policy, as we appear to be trying to arrange our provincial affairs entirely in accord with the ideas expressed by those of your officers whom I have had the pleasure of meeting. I understand that one of the objects of your association is to bring into existence a national highway leading from coast to coast across the Dominion. I propose to show you before I am through how this can be accomplished as regards that part of it lying within Saskatchewan. I will also try and outline the general policy regarding roads which we have been following for the last five or six years with more or less success.

Importance and Benefits of Good Roads.—It hardly seems necessary to refer to the importance or the benefits to be derived from good roads before such a convention as this, the members of which are all more or less enthusiastic, their presence here showing that they realize the importance of the question. The importance of proper means for facilitating easy transportation, however, cannot be over estimated. Man is naturally gregarious in his nature and everywhere he is found living in tribes and flocks. He attains his greatest success and most advanced development when living in communities. If a man lived in isolation and depended entirely on his own efforts for everything he needed he would be compelled to live in a very crude way and any advancement he made during his lifetime would die with him. This is an age of specialization and we find one community will confine its efforts to the production of one article of commerce and another to another. Other communities are engaged solely in the manufacture of one class of machinery while still others will devote all their time to the development of ideas, education, etc. It is necessary that articles thus produced or manufactured be interchanged and transported to where they are needed, and we find a commerce resulting in articles grown or manufactured in all parts of the world. The whole fabric of our modern civilization depends on the interchange of ideas and the gradual improvement on them by succeeding generations. It is thus that advancement is made. Means of communication are essential that this commerce of ideas and commodities be carried on, and the railways and highways with the navigation of the waters form these means of communication. The first trail between the haunts of two savage tribes was the beginning of civilization. We thus see that our modern

* Read at convention of Canadian Highway Association, held in Winnipeg.

† Chairman of the Board of Highway Commissioners of Saskatchewan.

civilization has a close dependence on the state of the highways. I once heard it said that three of the most important questions affecting mankind were religion, education and transportation, and as one could neither go to church nor to school without roads leading to these places when we undertook to improve the roads we were really engaged in the most pious work.

A farm adjoining a good road will sell for a higher price and is worth more than one on a poor road. There is a great advantage in having a farm within reasonable distance of a railway station. So much so is this the case that the matter of the distance from the railway has a very material effect on the price of land. Anything grown on a farm has little value unless it can be transported to a market, and many homesteaders look to the improvement of means of communication to give a value to their homesteads which they have not now. Anything that will facilitate the ready access to market from the farms cannot help but add to the value of them, and good roads are as essential a part of the machinery for doing successful business in the country as suitable houses, stables and other improvements which farmers recognize as being absolutely necessary.

So much money is wasted in transportation over bad roads that it is cheaper to improve the roads than to leave them as they are, and money invested in roads will give a return of the greatest dividends.

In many sections at certain times of the year the condition of the roads prohibits people from getting about and people lose their interest in current events, become dissatisfied and are not in a position to carry on their business with the enthusiasm which is so necessary to make a success of it. Bad roads react in this way so as to affect all the departments of life and improving the roads indirectly raises the standard of living all along the line.

History and Development.—For many years such traffic as existed in Saskatchewan followed along the historic Hudson Bay trails, which had been used by the supply trains of the Hudson Bay Company voyageurs for more than two hundred years. These trails led across country in various directions following the highest and most suitable land, and skirting the rivers between the various forts of the company. When arrangements were made between the Hudson Bay Company and the Dominion of Canada, whereby the latter took over the lands of the West, one of the provisions of the agreement was that the company were to be allowed to carry on their trading operations at their various forts. Later the Dominion passed laws whereby any public travelled road or trail which existed prior to the subdivision of the land could thereafter be reserved for highway purposes and surveys made of the same. In a few cases surveys have been made and rights-of-way have been retained, thus fixing them for permanent roads.

On the advent of the Canadian Pacific Railway in the early eighties several trading centres and towns developed, such as Moose Jaw, Qu'Appelle, Regina, Moosomin, Swift Current, Maple Creek, etc., and for a number of years trails led out from these places in every direction, in many cases replacing the old Hudson Bay trails.

About 1890 there commenced an immigration which has gradually grown larger until in the last few years it has become a regular flood, and has had the effect of covering nearly the whole of the southern part of Saskatchewan with settlers. This has been attended with considerable railway development with the resulting coming into existence of new towns and market places. As the settlers commenced to break up the land many of these old trails have been ploughed up, as in most cases they run across country in the most direct and suitable lines, no attempt having been made to follow surveyed allowances provided for roads. In the rougher parts of the country, which are sparsely settled, many of them are still in existence and are being used, but the traffic is adjusting itself to new conditions brought about by settlement and railway development, and follows the most suitable road allowances.

When a railroad is constructed through a new section of country a new string of towns or shipping points is created. It is found that traffic immediately abandons all its old lines and around each shipping point a new system of roads develops and is immediately necessary. The lines along which traffic will develop are the most direct lines that are suitable leading to these new towns, and immediately a lot of improvements are necessary to facilitate traffic over these new lines. I have heard it boasted that the Canadian Northern Railway have averaged more than a mile of railway brought into operation per day for the last seven or eight years. As this means a new town or shipping point about each week, and as the other railroads are carrying on a similar development, and as each new town or shipping point necessitates the improvement of a system of roads leading to it fit for the traffic, one gets some idea of the problem the various authorities having in hand the improvement of the roads have to cope with.

Traffic on these new systems may be divided into two classes, that between the towns which is ordinarily light traffic, and that from the country to the town. The first usually follows approximately parallel to the railway, while the more important lines followed by the latter are the most direct lines from each town out into the country, and as nearly as possible at right angles to the railway. In some cases both kinds of traffic follow the same lines as from a town on one railway to a town on another railway, and in these cases a very heavy traffic may develop and an important road come into existence. In many of the more advanced and wealthy parts of the country a new phase of traffic is developing. Many of the farmers and townspeople now use automobiles, and the traffic from town to town by this means is increasing and rendering these roads more important. There is thus a traffic developed that is not so local in character as the ordinary traffic of the country and the lines which it seeks to take are more of the nature of through lines between the larger towns, cities, summer resorts and other such objective points.

Organization.—The authorities provided for undertaking road improvement work in the province of Saskatchewan are the provincial government and the local authorities, such as councils of cities, towns, villages, rural municipalities and local improvement districts. There is no well defined limit to the jurisdiction of these various authorities. In practice the local councils, which collect taxes for the purpose, direct their expenditure of these taxes within the limits of their municipalities. The provincial government build nearly all the bridges required and attempts to confine its expenditure to construction of main roads, and the construction or reconstruction of important works that are beyond the means of the local authorities. The maintenance of all the roads devolves on the local authorities.

There is no recognization of a statute labor system in the province, but in many municipalities the farmers are employed by the councillors to work on the roads for a few days in the year and the payments made for this work are returned in lieu of paying taxes. This is practically equivalent to a statute labor system. In the newer parts of the province, where the settlers are just commencing, if the local authorities are going to do anything on the roads, this is about the only feasible plan, as these settlers are not in a position to pay their taxes in cash. In many of the older

districts the farmers cannot be got to work on the roads, being so busy on their farms, and many of the muicipalities have gangs organized to commence in the spring and work on the roads through the full season, thus making a business of constructing roads to the exclusion of other interests, and securing much better work and more value for the money expended. Some of the rural municipalities have issued debentures and have spent considerable sums from capital account in constructing roads.

The provincial government does road improvement work by two methods: first, by gangs directly under the supervision of the government officials, and by assisting the municipalities.

In determining the location of the roads where improvements paid for by the province are warranted, the provincial authorities recognize that roads should be classified as to their importance. The destination of most of the traffic over the roads is some point on a railway or a market town thereon. The traffic collects from the outlying districts where traffic exists or where it is purely local, and forces itself along certain well defined lines until, as it nears the town, there are certain lines along which it becomes very heavy. The nearer the town one gets the heavier it becomes. These certain lines then develop into main roads for traffic. The local authorities are called upon to maintain a road with a very heavy traffic, much of which is derived from a part of the country outside their jurisdiction. It is quite as beneficial, necessary and important to the people of these outlying districts that the part of the road nearest the town and furthest away from themselves be in as good shape as that nearest their own front doors. It is more expensive to construct and maintain a leading road carrying a heavy traffic such as this than one that simply carries the local traffic of the immediate district, as the road has to be wider and it wears out sooner. Is it, therefore, entirely fair to ask these local authorities to stand this extra expense for the benefit partially of outlying peoples who bear no share of it? I do not think it is, and as an evidence that many of these authorities insensibly object to it, we find that often the nearer one comes to a town the worse the road becomes, until the last mile into the town is the worst of all. As the improvement of roads such as this will benefit a large number of residents scattered over an area that is larger than the usual local district it would seem to be a field where provincial funds could be employed to advantage and with fairness to all concerned, and accordingly the provincial authorities have been pursuing a policy of confining as much as possible the expenditure of provincial funds to the improvement of main roads.

In a new country such as Saskatchewan, where development has taken place so rapidly, many improvements are urgently required which are so large and expensive as to be beyond the means of the local authorities, even when located on purely local roads. Nearly all bridges of any size, long grades across marshes and sloughs, side hill roads across ravines, etc., come in this class and the provincial authorities could not but recognize that if these much needed works were to receive attention it must be from provincial funds. As a result, practically all bridges of 20-ft. span and over, and many culverts and small bridges have been constructed by the provincial government and in most cases the maintenance has also devolved on the provincial authorities.

Systems for the administration of the provincial funds available for road improvement have been tried and a system gradually evolved which seems to meet the conditions as they exist throughout the country.

In 1906, the year after the province was formed, the method that was theretofore in force was followed. When it was decided to carry out an improvement in some certain locality one of the local residents who was known to have ability in that kind of work was appointed to organize the local labor and do it. The result of this system was that the improvement of roads was always considered a secondary matter and the work was attended to or not, depending on whether the appointee found time to undertake it after attending to his own business, and as a result, in many cases, the work was not done or the money was spent at a season of the year when the most value could not be obtained for the amount expended.

In 1907 the system of administering the vote was changed with the idea of overcoming the defects observable during 1906. Instead of local men being appointed, the best men that could be selected from the list of foremen employed in 1906 were appointed as road foremen to act during the full season and to go around from place to place where it was decided to make improvements, organize the local labor, and see that the work was properly done. A great improvement was noticed under this system as the season advanced. These foremen rapidly became expert at laying out the work and directing how it should be done, wasted less in misdirected efforts, and the quality and style of the work throughout the province became more uniform.

The same policy, with slight modifications to meet changing conditions in different years and in different parts of the country, was followed in 1908 and 1909, and regarding a large part of the expenditure on roads up to the present time. Conferences of these foremen have been held, many manuals and publications regarding road matters have been distributed to them and to the local authorities, and a force of skilful inspectors has been constantly kept visiting them during the progress of their work, the result being that we have now a large number of men scattered over the province in all parts who have an excellent idea of road building and of what is necessary in this regard to meet varying local conditions.

In 1910 this policy of education was extended more directly than heretofore to the local authorities by asking them to work out their own problems and sending what assistance was possible to them in doing so. This was effected by making grants, under regulations approved by the Lieutenant-Governor-in-Council to all municipalities who had completed their organization under the rural municipality act whereby the work had to conform to a certain standard, and they had to collect certain information, thus ensuring a certain amount of study of conditions in the municipality before they would be entitled to the grant. This system has produced a good effect and has given satisfaction where properly worked out.

A large number of bridges, deemed advisable to construct as steel bridges on concrete foundations or of reinforced concrete, have been treated as permanent structures and paid for out of capital, but all the road work and the majority of the bridge work has up to the present been met from the current revenue of the province. Many of these improvements are an undoubted permanent asset to the province, and should be considered as capital and treated accordingly, while a great deal of the work, such as grading, minor improvements in filling holes, maintenance of bridges, etc., the result of which will disappear in a few years, should properly be met from the current revenue.

It is considered that there is a necessity of a more rapid development regarding works which are of a more purely capital nature, and with this object in view provision was made by legislation in 1912 for meeting the cost of these improvements to the extent of $5,000,000, and it is the intention to proceed as fast as is considered advisable, consistent with economy, efficiency and the resources available in the way of labor and equipment, with the prosecution of

the work. This is additional to the ordinary expenditures undertaken as in the past, but the latter will be made to cover works of a more purely maintenance character with the tendency constantly existent to spend the money in such a way as to produce permanent results.

A commission was provided for by legislation to administer the funds available for road improvement from various provincial sources, and this commission has had the matter in hand during 1912. The commission have followed the same methods in the distribution of the funds, i.e., in enlisting the interest and co-operation of the local authorities in various ways and in the recognition of principles as already outlined regarding works of a provincial nature, such as main roads, large and expensive works beyond the means of the local authorities, etc. They have, however, extended the idea somewhat, consistent with the larger amount of money available, and have endeavored to select roads in each municipality which, while being main roads, will also form a system of roads joining up properly with systems in surrounding municipalities and giving proper means of access from all parts of the country in the most direct manner possible to the market places and towns and between the towns.

The roads forming these systems thus become through-roads between the towns, as well as serving the local traffic, and by linking up the more important of these main roads a provincial system is developed which warrants the expenditure thereon of a larger proportion of provincial funds. The most important roads of this provincial system lead between the cities and other places where large numbers of the population wish to go, and the section of the national highway within Saskatchewan will be made up of those roads from the provincial system leading in the proper direction and properly located to join up with the parts of such a proposed road in Manitoba and Alberta, and a little concentration on such a through-road where gaps may occur will make it a through-road suitable for traffic. A further concentration of attention will gradually raise the standard from the usual earth road to a good hard gravel or macadamized road in a few years. This will be brought about by the macadamizing or gravelling of the parts of it through the more wealthy and populous districts and where suitable material is readily available at first, and the extending of this out to the parts in more outlying territory.

The local authorities have been asked to take these things into their consideration and have spent a great deal of time and thought in working out proper systems. The commission, under regulations adopted by order-in-council, assists municipalities in the improvement of any part of such a system, when approved, to the extent of 50 per cent. of the amount expended and have a large staff of inspectors constantly engaged in examining these roads as to their importance, advising and helping the local authorities and giving a general supervision to the work being carried on. Nearly all the inspectors have been recruited from the staff of foremen that have had experience under the system for the last four or five years and are well acquainted with the objects and aims of the commission. It is found that they not only have an effect on the work being carried out by the commission, either by their own gangs or through the organization of the municipalities, but indirectly on the work done by the local councils with whom they are constantly conferring. The amounts being spent on the works are constantly increasing from year to year.

Amount of Funds Available.—In 1907 there was spent in the province on road improvements from provincial funds $881,000.00 and from local improvement district sources $575,000.00, or a total of $1,456,000.00. In 1912 there was available for road improvement from provincial sources:

Chargeable to current account:	
For bridges	$ 140,000.00
For roads	225,000.00
Aid to municipalities	172,000.00
Ferries and inspection	62,000.00
Chargeable to capital account:	
Bridges and ferries	303,000.00
Road improvement	1,300,000.00
	$2,202,000.00
Raised and spent by rural municipalities from taxes and debentures approximately	1,500,000.00
	$3,702,000.00

In addition to this the cities are spending large sums in permanent pavements and the towns and villages in improving the streets within their limits. This looks like a large amount of money to be spent annually on the roads, but when it is remembered that south of Prince Albert, which is almost wholly settled, there are approximately 250,000 miles of road allowances, a large part of which must receive some attention, to enable the settlers access to markets from their farms it is easily seen where it is absorbed.

Class of Roads and Details of Construction.—Up to the present there are very few places in the province where anything more than improvements to make the best possible earth road are undertaken and it is only where gravel is easily available that short stretches of gravelled road have been constructed. In some of the older towns their main streets are gravelled and are kept in very good condition, but so far as the country roads are concerned almost without exception they are simply earth roads.

There are many places throughout the province where the country has developed to a high degree and where, in order to be consistent with conditions, some better form of road than an earth road is warranted.

Settlement in other places has taken place rapidly, with the result that the necessary attention to the roads has not been possible, and many obstructions exist and long stretches of almost, or, at times, impassable, roads prevent ready access to markets. The standard of road to be aimed at must necessarily, therefore, vary for different localities, but it is exceedingly advisable that as high a standard as possible should be set. In some localities gravel and broken stone roads should be constructed, while in others the removal or overcoming of obstructions and the construction of the best earth road possible is immediately advisable with the possibility of a better grade of construction in the near future kept constantly in view.

For many years the highest class of road that will be attainable generally over the country will be the best earth road that can be made. In this age, where every proposal is put to the acid test of the question "Will it pay?" it is proper that it be applied to the construction and improvement of roads. In the more populous cities we find large sums spent in paving the streets with pavements regardless of cost, and their expenditures are no doubt warranted by the results and the amount of the traffic. On the other hand, we find where there is very little traffic that no attempt at improvement beyond making the roads passable is attempted. The amount of money that we are warranted in spending to improve the roads must be in some measure proportionate to the traffic or to the resulting traffic after the improvement is made. It will be found that we do not always cheapen the cost of transportation by spending extravagant sums in improving roads with little traffic and the most expensive road may be one that has been improved beyond the needs of the traffic on it. There is no doubt but what loads

can be hauled much cheaper over gravel or macadam roads than over ordinary earth roads, but if we consider the cost of constructing such roads and then apply the interest and a sinking fund that will pay back the cost of the improvement in five or ten years as a charge on the traffic, we will find that the cost of hauling may be by no means lessened. The cost of hauling farm products over our ordinary earth roads, as it is usually done in this country, is from twenty to thirty cents per ton mile. One way of reducing the cost of hauling is to increase the size of the load, use a wagon and a trailer and put four or six horses to draw seven or eight tons in a load. This is the method followed in the mountains, where a great deal of freighting is done hauling supplies to the mines over very indifferent roads. If loads can be hauled both ways, so that there is no unremunerative trip to make, very cheap hauling is done over roads that, in comparison with our ordinary graded prairie roads, would be considered impassable.

I had occasion to have some packing done some years ago in the Yukon district. I found packing on pack horses at that time cost about ⅓ cent per pound per mile, or about $6.00 per ton mile. This was with hay and oats at 8 cents per pound and other prices corresponding. By brushing out the trails and grading the side hills so as to make a road passable for a wagon at a cost of $2,000 to $3,000 per mile, this haulage cost was reduced to $1.00 per ton mile. The interest on the cost of improving in this way and a sinking fund that will pay back the cost in seven or eight years, which is considered about the life of a placer mining camp, comes to about $400 per mile per year. The reduction in the rate for freighting, according to the above figures, is $5.00 per ton mile. If 80 tons per year were hauled over this road the reduction in cost would therefore pay for the improvement, and when, owing to the reduction in the cost of supplies for mining, many otherwise unproductive properties became paying propositions, and by this means a traffic of more like 80 tons per day resulted, it is seen how well warranted the expense was.

The same principles may be applied to the matter of improving ordinary prairie roads. Suppose by gravelling a road at a cost of $2,000 per mile the saving in hauling over it would be five cents per ton mile. This would likely be in the shape of the larger load that could be taken over it or the greater speed with which the same load can be hauled. With interest at 5 per cent. and the principal paid back in 5 years this improvement would be warranted if 10,000 tons or 350,000 bushels of wheat came over it each year, without other traffic. If the road materials can be obtained and assembled at less than $2,000 per mile, a less amount of traffic will warrant the improvement. It will be seen from the above that an earth road in its best condition may be the cheapest road for the traffic, no matter how much money is available for road improvement. On the other hand, it is also seen, especially if considerations that cannot be put into figures in this way are taken into account, that many of our leading roads would well warrant the expenditure of large sums in improving them to a higher standard than simply the best earth roads.

Maintenance.—The maintenance of any road, no matter of what material it is constructed, is a definite case of "a stitch in time saves nine." The nearer the roads come to receiving constant attention the better and more economically will they be maintained. As the local authorities are in the better position to give the roads this constant attention, being, as it were, constantly on the ground, it naturally follows that the maintenance of the roads and bridges should devolve on them, and they should recognize this and provide for it. It will, in most cases, cost far more for any provincial employee to get to a place where some maintenance work is required than the actual cost of doing it when he gets there, and the provincial employees should, therefore, be asked to confine their attention to the work of construction and reconstruction alone.

As nearly all of the highways in the province must continue for years to be simply earth roads, and as even at their best they cut up easily at certain seasons of the year, the government have been experimenting to find out the best methods of maintaining earth roads in their best condition. The experiments performed with road drags indicated that an ordinary road can be kept in its best condition after being properly constructed by running one of these drags over it periodically about six to eight times each season, and a large number of them are now coming into use. It is found that the operation of the drag must be changed to suit different qualities of earth going to form the roads in different parts of the country, but use of them on any road will in a short time indicate the most successful way in which to operate them.

Future Developments.—The highway commission of the provincial government are endeavoring to have the local authorities give special attention to their main lines of traffic and develop systems of roads which will enable any person living in the province to have a good road direct into town from a point within a few miles of his place and to go directly from town to town. They give a tangible incentive to the local authorities to do this by assisting them or contracting with them to make improvements on roads that are considered part of such a system at the expense of the commission. They also make improvements on roads that will form such a system with their own road building organization.

By linking up the main roads in these systems in the proper directions a provincial system will be evolved on which every person wishing to go from one point of the province to another will have a ready means of doing it. The commission have this in view and the local authorities are in many cases showing their accord with it.

There is no reason why in some parts of the country the improving of the main roads in these systems to a higher standard cannot be undertaken and especially this provincial system gradually be constructed as gravel or macadam roads where the material is available.

It is the intention of the commission to take such steps as to give an incentive to do this whenever suitable, and to concentrate efforts as much as possible without sacrificing other considerations along this line so as to work out a proper provincial system of high-class roads in a few years. Where proper material is scarce and expensive this may not be possible. With the object of overcoming this, they are having experiments carried out to see if the ordinary gumbo clay, scattered so widely, cannot be treated in some way whereby it will have a greater resistance to traffic during wet weather and will not form into mud so readily. These experiments would indicate that there is some chance of success along these lines and they are having a sample piece of road built at present to try out a process of burning with straw which has been suggested.

Any information that is obtained from these efforts will be distributed, as fast as it is found reliable, to the authorities who are interested or may be able to use it.

The commission proposes to make a special effort regarding the maintenance of roads in their best condition, and feel that much can be done along this line.

The local authorities are becoming much interested in the work and are giving every evidence of taking hold of it with greater intelligence and knowledge each year, and as

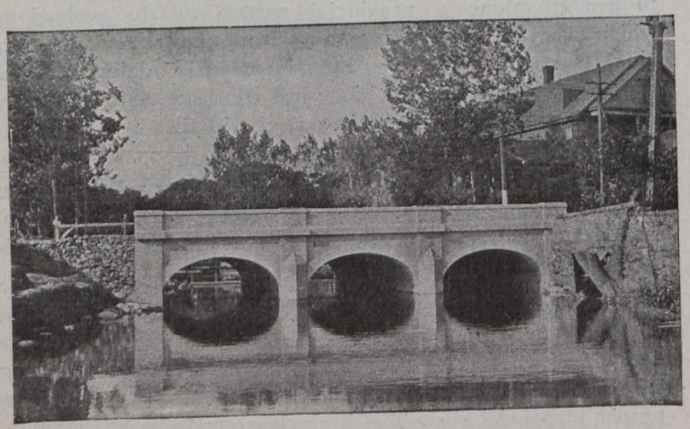
they form almost the only means by which any improvement along these lines can be carried out it is very encouraging.

It is hoped by the co-operation of the various authorities in all this work and by keeping up the interest of the general public that the standard condition of the highways in Saskatchewan will be gradually raised, and that eventually the state of the highways will be such that it will be a pleasure at all times to travel over them; that they will entice people to go afield and become acquainted with their fellows, and that they will thus be one of the means of ensuring to Saskatchewan a broad-minded, prosperous and happy people.

AN ATTRACTIVE CONCRETE BRIDGE AT METHUEN, MASS.

The recently completed "New Broadway Bridge," which spans the Spicket River on the road between Lawrence and Methuen, Mass., is an interesting example of what may be accomplished in bridge design with concrete when both utility and aesthetic appearance are of importance. The bridge is a gift to the town of Methuen from Edward F. Searles, its most prominent citizen.

In designing the bridge the Aberthaw Construction Company, of Boston, Mass., who also built it, followed the suggestions of the donor. It was desired to erect a structure that would serve the traffic needs of the town to the best advantage and at the same time add as much as possible to the appearance of that section. Mr. Searles did not desire anything elaborate or ornate, so the bridge was designed with almost severe plainness. It is to its very severity of architectural treatment that much of the attractiveness of the bridge is due.

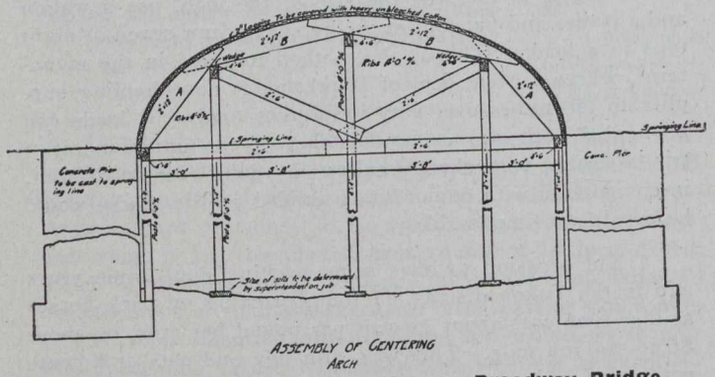


Broadway Bridge at Methuen, Mass.

The bridge is 80 feet long from the end of one abutment to the other, and 74 ft. 2 ins. overall width. It has three arches, each 18 ft. wide, placed on 22-ft. centres. The forms for these arches were detailed at the contractors' office, so that there was no confusion or delay on the job. The details of these forms are shown in the accompanying cut. The concrete footings are 5 feet wide and the piers themselves 4 feet thick. A 1:2:4 mix was used.

Across the central portion of the bridge run the double tracks of the Bay State Street Railway Co. On either side of the car tracks is a roadway, and flanking the roadways are two sidewalks 8 feet wide. The width of the roadway from one sidewalk curb to the other is just 50 ft. The road is of macadam, and between it and the concrete bridge floor is a three-ply waterproofing of felt and asphalt.

As will be seen from the photograph, the parapet on either side of the bridge is without ornamentation, being simply a wall with plain capping. The parapet was chosen in preference to an iron railing, as it added enough to the artistic appearance of the bridge to pay for the extra expense. At either end of the piers is a small buttress of uniform cross section which, despite its plainness, adds considerable to the appearance of the bridge. The surface of the spandrel and parapet walls are picked, while the edges of the arches, the floor, and the parapet capping were rubbed smooth.



Showing Assembly of Centring on Broadway Bridge, Methuen, Mass.

Provision has been made for four electric light posts, one at each buttress. When these are installed, they will add to the general attractiveness of the bridge.

In putting in the piers a small coffer dam of 3-inch matched sheeting was sunk into the gravel bed of the river, and the pier centring was hung from the horizontal sheeting braces.

A 16-inch water main that crossed the river at the bridge was provided for in the following manner: The pipe was carried on a 4-inch I-beam which rested on two trench braces at each pier. The braces placed side by side were expanded until the pipe was brought to the proper level. Then the concrete was poured around the braces and a permanent support at this level was assured.

NEW ENGINEERING LABORATORIES.

The new engineering laboratories at University College, Dundee, are now in use, though they have not been formally opened. The block is two stories in height. On the ground floor there are an hydraulic laboratory, small lecture room, library photographic rooms, and engines and generating plant. On the second floor are accommodated the principal lecture room, the drawing offices. the staff rooms, the workshop, and the stress and cement testing laboratories. Water is supplied to the hydraulic laboratory from a tank at the top of a tower, about 60 ft. above floor level, through an 8-in. main, and is returned to the tank by a motor-driven centrifugal pump which lifts 475 gallons a minute.

The heat engine laboratory is divided into an engine room proper and a boiler and producer house, and the engine plant consists of a horizontal tandem compound engine, with drop and Corliss valves and surface condenser, capable of developing 150 b.h.p. at 100 r.p.m. There are also a Babcock and Wilcox boiler with an auxiliary electric-driven feed pump and economizer, the boiler being fitted with a separately fired superheater, and working up to 250 lb. per square inch; a 30 h.p. gas engine with suction gas producer; a motor-car engine with appliances for quantitative measurements of its power and heat efficiencies, and a 50-ton testing machine.

THE UTILIZATION OF PEAT FUEL.

By H. Poynter Bell.*

The report on the utilization of Peat fuel for the production of power, issued by the Dominion Department of Mines, was mentioned in the columns of *The Canadian Engineer* some weeks ago; it is, however, of such importance that it calls for further mention than could then be given to it. The report is so written as to be useful to power users in general, as well as to engineers, and contains an account of the actions and processes which take place in the producer, and of the construction and manner of operation of the gas engine. A full description is given of the plant and testing apparatus at the fuel testing station at Ottawa, and of changes in the gas-producer and gas-cleaning plants, made during the series of tests in order to obtain better results.

The nature and the results of the tests which were made are simply described for the use of non-technical readers, but, besides this, details of all observations are given in full for the information of engineers and those who have special knowledge of the subject. The very encouraging results which were obtained may be commended particularly to the notice of those whose ideas on the utilization of peat are founded on the failure of some previous attempts in the same direction. Many such attempts were made at a time when the nature and proper methods of using peat were very imperfectly understood in both America and Europe. They were made with unsuitable appliances and often without regard to the differences between Canadian and European peat. Since that time very great improvements have been made in Europe in the methods of treating and using peat, while knowledge about Canadian peat has been considerably advanced, chiefly through the work of the Department of Mines.

The present report shows clearly that with suitable conditions power can be obtained from peat by the use of gas-producers and gas-engines, at a cost which compares favorably with that of power from coal, and may even, in some cases, be at least as low as the cost of hydro-electric power. It is not pretended that this can be the case in all places and for all purposes, but if the power can be raised at or near the peat bog, and more especially if it is required for a fairly uniform load, peat producer gas is clearly a very economical fuel.

It is found that peat in a suitable condition for use in the gas-producer can now be delivered f.o.b. at the bog—that is, at the producer if it is on the spot—for not more than $2 per ton, which is equivalent to $4 or even less per ton for high-grade coal. On this basis electric power can be produced, as shown in the report, at a fuel cost of $8.40 per horse-power per year of 3,000 hours. The whole of the work required on the plant used at Ottawa (60 horse-power) could be done by one man.

The tests were evidently made under fair working conditions, and with the use of only such plant and appliances as are obtainable by everyone. A producer and engine were chosen of a type which had proved successful with European peat. As a result of the experience gained in the earlier tests, changes were made in the producer which, as completely described in the report, may be taken as a type suitable for use with Canadian peat.

The results given, satisfactory as they are, need not be considered to be the best that can possibly be obtained. Apart from improvements which may be made in the getting of the peat, there are various other gas-producers and engines designed for use with peat and it is possible that with some one or more of them even better efficiency may be obtained than that which is shown in the report.

The report gives, further, a description of some heaters intended for utilizing the exhaust heat of gas engines. Tests with these heaters had not been made when the report was written, but particulars are given of tests made elsewhere with heaters of this kind. It appears from these tests that not less than 40 to 50 lbs. (4 to 5 gallons) of water can be heated by the engine jacket and the heater to 190 deg. Fahr. per brake horse-power of the engine, and that the power of the heat so obtained are together equal to from 74 to 80 per cent. of the heat value of the gas supplied to the engine—a very remarkable economy.

In the estimate of cost here given no account has been taken of the savings to be made through the recovery of by-products, and particularly sulphate of ammonia—from the producer-gas. There exists already a demand for sulphate of ammonia in Canada, and its manufacture is very profitable if it is made in large enough quantities, that is to say, if large enough quantities of producer gas are made. The plant originally used for the recovery was rather large and expensive, but it has been found that the process can be greatly simplified and cheapened.

As stated above, the use of peat is economical when the conditions are suitable. One of the most important of these conditions is, of course, the nature of the peat which is to be worked. To start work on a peat bog which has not been properly investigated is mere gambling. The work of investigating Canadian peat bogs is making steady progress under the Department of Mines; a number of good results have been obtained and there can be no doubt that many of the numerous bogs in central and eastern Canada will be found to give peat well suited for making fuel.

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NEW WESTMINSTER IMPROVEMENTS.

Definite announcement has now been made that the Great Northern Railway, or rather the Vancouver, Victoria and Esquimalt Railway, will establish their Canadian freight terminals adjoining the eastern boundary of New Westminster within the municipality of Coquitlam. At the last meetings of the New Westminster and Coquitlam councils the railway company asked for the co-operation of these bodies and also that of Burnaby in building a high level bridge over the proposed freight yards. The acreage purchased by them is apparently large, extending into Burnaby municipality.

With this development all the railways operating on the lower mainland of British Columbia have located their yards and freight terminals on the Fraser River. These include the Canadian Pacific Railway at Coquitlam, the Canadian Northern Railway at Port Mann, the British Columbia Electric Railway at South Westminster, and now the Great Northern Railway on the Brunette River, practically in New Westminster.

The mayor and council have recently been taking stock of the large amount of work accomplished on the city streets during this year. The board of works has had $500,000 for grading and macadamizing streets, laying wooden sidewalks and other various improvements, while contracts for $761,000 for paving, cement sidewalks and other permanent improvements have been let. The delay in selling the city bonds, which were finally disposed of at 92½, has prevented all the contracts from being completed this year and held up other work.

The city is starting on the sewer system for Sapperton at the east end. Contracts for the first section of the work, totalling over $200,000, have just been let.

TESTS OF LONG-LEAF PINE BRIDGE TIMBERS.

In line with the past policy of the American Railway Engineering Association to collect and disseminate useful information pertaining to the objects of the association, there has been edited and published recently under the board of direction, a bulletin containing the results of tests of long-leaf pine bridge timbers made by H. B. MacFarland, engineer of tests, for the Atchison, Topeka & Santa Fe Railway System. An abstract of the bulletin is given herewith.

The purpose of these tests was to fully investigate the effect of the full-cell creosote treatment on long-leaf yellow pine bridge timbers. The United States government engineers have demonstrated quite conclusively that the boiling process weakens timber to a very marked degree. Their explanation of this is that the high temperatures used in the steaming tend to break down the cell wall structure and thus weaken the timber.

Each of these sticks was sawed in half, numbered and weighed. One-half of each stick was then creosoted by the full-cell process. The details of the treatment are given below:

Somerville cylinder No. 5.
Run No. 1761, December 2, 1910.
Oil transferred, 11:50 a.m.
Pump started, 12:10 p.m.
Temperature of oil in tank, 200 degrees Fahrenheit.
Temperature in cylinder, 170 degrees Fahrenheit.
Maximum pressure, 150 lbs. per sq. in.
Time of maximum pressure, 1:40 p.m.
Oil dropped to ground tank, 2:25 p.m.
Vacuum started, 2:45 p.m.
Maximum vacuum, inches, 26.
Vacuum broken, 4:15 p.m.
Run closed, 4:30 p.m.
Time consumed in run, 4 hours and 40 minutes.
Process, Full-Cell Creosote.

Specimens Tested in 1911.

GENERAL DATA								TRANSVERSE TEST					COMPRESSION PARALLEL TO GRAIN				COMPRESSION PERPENDICULAR TO GRAIN			
Specimen Number	Weight in Lbs. per Cu. Ft. Before Treating	Weight in Lbs. per Cu. Ft. After Treating	Moisture Per Cent.	Rings, per inch	Size at Center Inches	General Character	Remarks	Elastic Limit Lbs. per sq. in.	Modulus of Rupture Lbs. per sq. in.	Modulus of Elasticity Lbs. per sq. in.	Deflection at Failure Inches	Maximum Horizontal Shear Lbs. per sq. in.	Elastic Limit Lbs. per sq. in.	Modulus of Elasticity Lbs. per sq. in.	Maximum Load Lbs. per sq. in.	Deflection for 2000 Lbs. per sq. in.	Elastic Limit Lbs. per sq. in.	Load in Lbs. per sq. in. for Deflection of		
																		1-10 inch	3-16 inch	3-8 inch
11	41.5	.....	17.1	17	16.20x7.05	Knotty.....	.....	3800	4980	1,429,000	0.82	387	3400	343,960	3996	0.07	900	700	900	1300
12	39.1	50.6	.....	17	16.40x7.19	Knotty.....	Treated	4200	5560	1,395,000	1.78	439	4700	707,410	5829	0.04	1100	700	1100	1400
17	43.8	.....	20.4	13	16.20x7.20	Clear.....	.....	2800	3880	1,882,000	1.38	410	5600	840,000	6397	0.03	1400	950	1600	2150
18	40.5	61.8	.....	10	16.00x7.00	Clear.....	Treated	5000	5050	1,749,000	0.93	388	4800	346,500	5279	0.08	1100	850	1300	1800
21	38.9	.....	16.6	12	16.12x7.05	Small Knots	.....	5000	6800	1,517,000	1.75	528	4200	385,000	4668	0.07	1500	1000	1700	2050
22	42.2	55.2	.....	12	16.00x7.10	.....	Treated	5400	5410	1,428,000	1.24	416	4300	556,850	5228	0.05	900	900	1200	1450
25	42.4	.....	15.1	19	16.00x7.11	Small Knots	.....	5800	6280	1,876,000	1.14	483	5700	758,720	6353	0.04	1200	700	1300	1850
26	46.5	57.5	.....	19	16.10x7.15	.....	Treated	4600	4880	1,600,000	1.00	378	5800	580,000	6860	0.05	1800	800	1400	2300
27	38.9	.....	16.7	8	16.25x7.22	Sapwood....	.....	3900	4500	1,505,000	0.98	352	5500	665,500	6754	0.05	900	550	900	1300
28	44.5	57.8	.....	8	16.20x7.08	Small Knots	Treated	3100	3280	1,417,000	0.70	374	5300	706,660	6064	0.04	1000	900	1250	1600
29	38.4	.....	13.5	8	16.06x6.98	Small Knots	.....	5000	6160	1,612,000	1.40	468	5000	666,000	6126	0.04	1400	600	1050	1500
30	41.3	60.5	.....	8	16.10x7.14	Small Knots	Treated	4800	6320	1,715,000	1.30	498	4800	720,000	5784	0.04	1000	750	1100	1500
35	39.5	.....	20.6	6	16.25x7.18	.....	.....	3800	5100	1,344,000	1.34	399	4600	693,000	5473	0.03	900	700	950	1400
36	42.9	55.0	.....	6	16.25x7.11	Small Knots	Treated.	5400	6040	1,639,000	1.19	467	4300	275,000	4595	0.09	900	600	900	1200
51	40.3	.....	8.5	9	16.25x7.42	Small Knots	.....	3600	4000	1,435,000	0.91	348	3100	464,000	3951	0.05	800	850	1100	1250
52	38.3	49.9	.....	9	16.60x7.35	Small Knots	Treated	3400	4160	1,718,000	1.16	332	4000	574,000	5177	0.04	800	650	900	1300
53	36.8	.....	13.7	20	15.90x7.10	Small Knots	.....	3800	4880	1,904,000	0.92	373	6200	786,000	7040	0.04	700	500	850	1100
54	37.8	48.5	.....	20	16.00x7.10	Wane.....	Treated	4200	4900	1,600,000	1.04	410	4400	664,000	5172	0.04	800	400	700	1150
55	47.7	.....	18.6	11	16.36x7.22	Knotty.....	.....	4400	5500	1,688,000	1.13	432	5800	772,000	6301	0.04	1100	650	1000	1550
56	50.7	59.8	.....	11	16.60x7.25	Shake.....	Treated	4000	4460	1,670,000	0.87	387	5700	690,000	6698	0.04	900	500	900	1150
57	47.2	.....	55.3	13	16.00x7.05	Clear.....	.....	4300	4670	1,636,000	0.94	395	6000	798,000	7248	0.04	1000	650	1100	1700
58	39.3	57.3	.....	14	16.10x7.00	Small Knots	Treated	3800	4990	1,880,00	0.92	386	5200	450,000	5999	0.06	1100	900	1400	1750
59	38.3	.....	5.1	13	16.25x7.03	Small Knots	.....	4600	5540	1,362,000	1.41	4 3	4800	618,000	6176	0.05	1000	800	1100	1400
60	38.3	49.2	.....	14	16.30x7.25	Cross Grain	Treated	3400	5210	1,359,000	1.44	409	4600	693,000	5876	0.04	800	700	1150	1550
61	42.7	.....	16.7	9	16.25x6.91	Heart Shake	.....	4600	4790	1,542,000	1.00	40	4000	283,000	4343	0.09	1000	800	1000	1300
62	45.8	58.6	.....	9	16.18x7.06	Clear.....	Treated	3800	4390	1,629,000	0.92	42	4000	405,000	4906	0.06	1300	600	1200	1850
Average Untreated								4260	5160	1,595,000	1.15	415	4920	621,000	5750	0.049	1031	727	1120	1530
Average Treated								4240	4980	1,600,000	1.12	408	4770	568,000	5650	0.052	1040	711	1107	1540

NOTE: Odd number is the untreated half of a stringer and the following even number is the treated half.

Inasmuch as there is no steaming process connected with the full-cell treatment used at the Santa Fe treating plants, it has been the opinion of the men in charge of this work that the timber was not materially weakened by the treatment. It was, therefore, decided to make a thorough test of the treated timber and thus determine the facts. It is very important that the strength of treated timber be known, for it is now being used very extensively in bridges, and if the strength is decreased by treatment, proper allowance should be made for this decrease.

Specimens.—The standard stringer for the Santa Fe System is 7 in. x 16 in. x 28 ft. long-leaf yellow pine. This size was, therefore, selected for the tests. Thirty-two such timbers were picked from the stock at the Somerville plant. The stock was at this time quite low and it was, therefore, impossible to get as varied a set of specimens as was desired. None of them contained a large per cent. of sapwood. No attempt was made to pick out the best pieces, though it may be noted that all were in first-class condition. They all had been seasoned for approximately ten months.

Each specimen was weighed after treatment, in order to calculate the amount of creosote absorbed per cubic foot.

The 64 pieces were loaded and shipped to the testing laboratory at Topeka immediately after treatment. It was desirable to study the effect of the creosoting on the timbers both immediately after treatment and one year after treatment. Therefore, the 34 untreated specimens and 16 of the treated specimens were tested immediately upon receipt at Topeka and the remaining 16 treated specimens were tested after one year, having been seasoned during the year by laying in an open pile in the yard at Topeka.

Two special specimens were prepared with the others, in order to compare the relative strength of the butt and top portions of the tree. Specimen 13 was the top end and 14 the butt end of one large stick. Both of these were left untreated. Specimen 40 was the top end and 39 the butt end of another large stick. Both of these were treated. All four were tested. It was impossible to determine which was the butt end of the regular specimens, but the two special sticks showed this by position of the sapwood and growth rings.

Methods.—In making the transverse test the stringer was supported on rocking knife edges placed 13 ft. apart on the bed of an Olsen 200,000 lb. testing machine. Six-inch flat plates were placed between the knife edges and the timber to prevent cutting. The load was applied at third points through knife edges and six-inch plates and rollers. An initial load of 500 lbs. was used in order to get a firm bearing on the plates. The deflections were measured by a mirror and adjustable scale and a fine wire, which was fastened at the centre of the beam directly above each knife edge. The load was applied with the machine running at a speed of 0.16 inch per minute.

The specimens tested in compression parallel to the grain were 5 in. x 5 in. x 12 in. A ball and socket plate was placed between the machine bed and the specimen in order that the load might be uniformly applied. Deflections were read by means of a deflectometer. The load was applied at a rate of 0.16 inch per minute.

In making test in compression perpendicular to the grain the specimens were 6 in. x 6 in. x 24 in., and the load was applied through a four-inch plate with slightly rounded corners. The machine speed used was 0.16-inch per minute. A deflectometer was used to measure deflections.

The moisture determinations were, in all cases, made immediately after transverse tests. The samples were obtained by boring nine one-inch holes, one-half inch deep, spaced uniformly, in the end of the specimen. The chips were carefully weighed on a balance and then placed in an oven and kept at a temperature of 200 degrees Fahrenheit for eight hours. The per cent. of moisture was calculated from the loss in weight The percentage is that of dry weight of specimen.

The data regarding number of growth rings per inch were obtained from the large specimens. The rings were counted, starting one inch from the heart and counting for a radius of three inches. The per cent. of sapwood was estimated from measurements of the end area.

The following formulæ were used in the calculations:

Transverse Test.—Load applied at third points.

Load in lbs. per sq. in.:

$$S = \frac{PL}{bd^2}$$ where,

P = Load in lbs.
L = Length of span in inches
b = Breadth of specimen in inches
d = Depth of specimen in inches
S = Stress in lbs. per sq. in.

Modulus of Rupture:

$$R = \frac{PL}{bd^2}$$ where,

P = Maximum load in lbs.
R = Modulus of rupture in lbs. per sq. in.
Other symbols as above.

Modulus of Elasticity:

$$E = \frac{PL^3}{4{\cdot}7bd^3D}$$ where,

E = Modulus of elasticity in lbs. per sq. in.
P = Load at elastic limit in lbs.
D = Deflection in inches at elastic limit.
Other symbols as above.

Horizontal Shear at Neutral Axis:

$$V = \frac{3P}{4bd}$$ where,

V = Horizontal shear at neutral axis, lbs. per sq. in.
P = Maximum load in pounds.
Other symbols as above.

Specimens Tested in 1912.

GENERAL DATA									TRANSVERSE TEST					COMPRESSION PARALLEL TO GRAIN				COMPRESSION PERPENDICULAR TO GRAIN			
																		Load in Lbs. per Square Inch for Deflection of			
Specimen Number	Weight in Lbs. per Cu. Ft. Before Treating	Weight in Lbs. per Cu. Ft. After Treating	Weight in Lbs. per Cu. Ft. One Year After Treating	Moisture Per Cent.	Rings, per inch	Size at Center Inches	General Character	Remarks	Elastic Limit Lbs. per sq. in.	Modulus of Rupture Lbs. per sq. in.	Modulus of Elasticity Lbs. per sq. in.	Deflection at Failure Inches	Maximum Horizontal Shear Lbs. per sq. in.	Elastic Limit Lbs. per sq. in.	Modulus of Elasticity Lbs. per sq. in.	Maximum Load Lbs. per sq. in.	Deflection for 2000 Lbs. per sq. in.	Elastic Limit Lbs. per sq. in.	1-10 inch	3-16 inch	3-8 inch
1	42.2	.....	.....	18.2	8	16.00x6.68	Knots.....	.....	5000	5290	1,850,000	0.93	407	4200	360,000	6510	0.060	1100	925	1150	1625
2	43.8	54.4	50.4	.....	8	16.19x7.06	Checks.....	Treated	4775	6016	1,840,000	0.70	467	6000	630,000	7143	0.045	800	1000	1150	1400
5	45.5	.....	.....	18.5	8	16.30x6.97	Shakes.....	.....	4200	4880	1,480,000	1.24	383	5100	386,000	5904	0.072	1100	875	1400	1950
6	38.8	50.6	46.3	.....	8	16.40x7.24	Checks.....	Treated	4400	4517	1,380,000	1.12	356	5720	575,000	6460	0.042	700	1000	1100	1350
7	38.5	.....	.....	18.1	8	16.25x7.31	Knots.....	.....	4000	4760	1,416,000	1.40	372	4000	585,750	5070	0.040	1000	700	1050	1400
8	44.5	56.2	54.8	.....	8	16.13x7.38	Shakes.....	Treated	4600	6658	1,640,000	1.68	505	5400	648,000	5997	0.041	625	800	1050	1450
9	42.9	.....	.....	17.8	19	15.95x7.14	Knots.....	.....	5400	5480	1,591,000	1.22	448	5800	842,450	6571	0.035	1000	700	1050	1500
10	46.1	60.2	54.3	.....	19	16.00x7.10	Shakes.....	Treated	6000	6006	1,807,000	1.07	462	5800	703,000	6951	0.037	550	700	800	1000
15	46.2	.....	.....	18.4	7	16.20x7.20	Knots.....	.....	1800	4870	1,918,000	1.60	367	7300	674,000	7410	0.037	900	900	1200	1600
16	42.3	56.2	51.8	.....	7	16.30x7.55	Large Knots	Treated	3900	4406	1,690,000	1.03	346	5500	474,000	6263	0.052	700	900	1100	1350
19	45.8	.....	.....	8.5	21	16.25x7.11	Knots.....	.....	2000	3820	1,320,000	1.28	384	5200	451,300	5659	0.063	1100	625	1050	1650
20	49.6	58.5	52.1	.....	21	16.25x7.25	Shakes.....	Treated	4325	4477	1,875,000	0.72	350	6200	835,000	7721	0.038	1400	1000	1675	2275
23	45.8	.....	.....	19.0	10	16.50x7.07	Small Knots	.....	3800	4050	1,254,000	0.97	322	4600	551,310	5569	0.042	1000	675	1150	1550
24	37.2	52.2	52.2	.....	10	16.75x7.18	Shakes.....	Treated	3500	4850	1,206,000	1.39	392	5080	584,400	6410	0.044	1000	1000	1400	1825
31	47.1	.....	.....	16.4	14	16.00x7.17	Small Knots	.....	4000	5440	1,726,000	1.15	419	5600	423,000	6253	0.059	.....	.....	.....	.....
32	51.3	58.3	56.8	.....	14	16.87x6.94	Cross Grain	Treated	5100	5294	1,632,000	0.94	430	7000	736,000	7768	0.031	.....	.....	.....	.....
33	41.8	.....	.....	19.3	15	16.00x7.23	Knots.....	.....	4200	5390	1,660,000	1.21	415	5300	426,000	5918	0.062	900	700	1000	1300
34	45.5	64.2	61.4	.....	15	16.00x7.15	Checks.....	Treated	4425	6049	1,910,000	0.74	465	6300	711,000	6945	0.040	1250	1300	1600	2450
37	38.3	.....	.....	18.0	12	16.12x7.24	Knots.....	.....	2900	3410	1,034,000	1.40	265	3700	633,000	4720	0.041	900	450	900	1300
38	36.2	51.8	51.0	.....	12	16.25x7.32	Large Knots	Treated	4100	4035	1,090,000	1.20	315	5200	719,000	6012	0.037	1200	1400	1525	1750
41	41.8	.....	.....	35.6	6	16.60x7.37	Clear.....	.....	4500	4840	1,652,000	0.92	386	5500	734,000	6580	0.034	1200	500	900	1600
42	38.7	55.1	48.8	.....	6	16.25x7.38	Clear.....	Treated	4700	4800	1,576,000	0.99	375	3500	526,000	5604	0.048	1000	1000	1400	1750
43	43.0	.....	.....	18.3	17	16.20x7.35	Shakes.....	.....	2600	3640	1,433,000	0.88	263	5000	432,000	6063	0.060	900	600	850	1275
44	49.2	56.3	54.6	.....	17	16.10x7.15	Cross Grain	Treated	4700	6737	1,542,000	0.96	520	5800	776,000	6656	0.038	700	800	1050	1475
45	39.0	.....	.....	17.2	11	16.00x6.75	Pitch Pocket	.....	4800	6060	1,808,000	1.16	466	4700	380,000	5492	0.041	900	700	1000	1400
46	38.4	54.2	46.4	.....	11	16.25x7.24	Clear.....	Treated	2800	4014	1,416,000	0.62	314	5300	653,000	5759	0.041	1350	1300	1650	2250
47	37.5	.....	.....	6.2	10	16.20x7.19	Warped.....	.....	3500	3900	1,454,000	0.93	341	5400	720,000	6450	0.039	1100	600	1050	1600
48	41.6	55.4	46.8	.....	10	16.37x7.13	Cross Grain	Treated	3250	5312	1,470,000	2.90	412	6400	646,000	6905	0.040	800	950	1150	1400
49	38.4	.....	.....	18.0	7	16.00x7.15	Small Knots	.....	4200	5200	1,511,000	1.28	400	5600	558,000	6310	0.045	700	700	1050	1300
50	42.3	58.1	55.8	.....	7	16.06x7.09	Checks.....	Treated	5900	7114	1,586,000	1.20	550	5800	539,000	6150	0.050	1400	800	2350	2750
63	39.2	.....	.....	16.9	15	16.00x7.25	Large Knots	.....	4700	4985	1,322,000	1.24	375	4200	316,500	4856	0.085	1000	600	1000	1200
64	36.4	52.4	51.1	.....	15	16.25x7.36	Large Knots	Treated	2420	3737	1,055,000	1.40	365	3850	367,000	4292	0.064	850	900	1200	1400
Average Untreated									3850	4750	1,554,300	1.18	377	5075	529,400	5958	0.051	986	684	1052	1483
Average Treated									4305	5263	1,544,700	1.17	414	5553	633,000	6440	0.041	945	1056	1340	1691

NOTE: Odd number is the untreated half of a stringer and the following even number is the treated half.

Compression Parallel to Grain:

Load in lbs. per sq. in.:

$$S = \frac{P}{A} \text{ where,}$$

P = Applied load in lbs.
A = Area of section of test piece in sq. in.
S = Load in lbs. per sq. in.

Modulus of Elasticity:

$$E = \frac{PL}{AD} \text{ where,}$$

P = Load at elastic limit in lbs.
D = Deflection in inches at elastic limit.
E = Modulus of elasticity, lbs. per sq. in.
Other symbols as above.

Compression Perpendicular to Grain:

Load in lbs. per sq. in.:

$$S = \frac{P}{A} \text{ where,}$$

A = Area of compression plate in sq. in.
Other symbols as above.

The elastic limits were taken from the curves.

Data.—The results are shown in the tables. The summary sheets group the results of untreated specimens tested in January, 1911, with the treated specimens of the same timber tested in January, 1912. Specimens 13, 14, 39 and 40 were special tests made in January, 1911, and results obtained are not shown in the general summaries of specimens tested in January, 1911.

UTILIZATION OF SEWAGE SLUDGE.

It is only at rare intervals that an inventor has the good fortune of seeing a successful practical application of his idea within a few months of his experimental work. Among the few who may claim this honor is the name of Dr. J. Grossman, an eminent Manchester chemist.

His patented and simplified process for the utilization of sewage sludge (as described in some detail in The Canadian Engineeer of January 25th, 1912, page 210), has been installed in the Corporation of Oldham, near Manchester, and, as far as may be ascertained, is operating as a complete success, the sewage of the municipality being effectively disposed of and the by-products being not only marketable, but in brisk demand.

When this system is in operation the sludge is conveyed from settling tanks to the top of a three-story building by means of chain buckets, and is directed to six large cylinders on the top floor by the agency of several large sheet metal pipes. Each cylinder is encased with brick and heated, while revolving paddles within the cylinder move the sludge slowly along in order that the treatment may be effective. As the sludge moves along it is thoroughly dried, and may, if desired, be removed from the tanks at this stage as a dry, dark powder, highly inflammable, and entirely suitable for use as a crude fuel. The Corporation of Oldham do not consume their sterilized waste in this matter, but treat it further, and for this purpose each dryer has placed below on the ground floor a retort connected with the dryer by metal conduits. The dry matter falls to the retorts and is automatically mixed with a little acid and a quantity of superheated steam, which, in conjunction with the acid, removes the grease and escapes, grease laden, into two cooling towers, where it is condensed, and the grease, which floats on the water, is easily removed.

The process is automatic from the time the sludge is settled in the tank till the finished fertilizer leaves the retort, all the necessary labor consisting of a few men to attend the boilers and the fires under the drying machines and retorts. No fumes can escape into the atmosphere, and no features that might be considered a nuisance are found. The building in which the plant is housed has a length of 120 feet, a width of 45 feet and a height of 30 feet, and the cost of the plant for a population of 120,000 was only $60,000.

The matter removed from the retorts may be easily stiffened up into a high-grade fertilizer by the addition of potash and ammonia, and contains many advantages over raw sludge as a fertilizer, inasmuch as it is sterile and does not clog up the pores of the ground. Prize roses and other exhibition flowers have been grown in it with success in England, and other European countries are investigating sample shipments with a view of steady purchases. The grease recovered from the plant at Oldham has an estimated value of $6,000 per year.

THE BEARING POWER OF MOIST BLUE CLAY.

In a paper read before the Western Society of Engineers Mr. Edwin Hancock gives the results of tests in the Loop District of Chicago on the bearing power of moist blue clay.

The following tests were made in March, 1911, in the manner described:

Two openings about 8 ft. square were made in the concrete floor of the basement of the Federal Building, and the soil was excavated for a depth of 6 ft., so that there was a bearing on the original clay which had never been disturbed. On this clay a grillage was built up of planks 2 in. by 12 in., 2 ft. long. These planks were laid closely together so as to give a bearing of 4 sq. ft. This grillage was built up about 1 ft. high, and upon this was placed longer planks, upon which the load of pig iron was placed.

The settlement was taken by means of a wye level and rod. Readings were taken as soon as each load was put on, and then again after giving an hour for settlement. If no further settlement had occurred, a larger load was placed upon the plank. If the settlement had increased, readings were taken until they showed that the settlement had ceased.

The elevation above city datum of the street opposite this test was 14 ft., and the elevation of the clay upon which this test was made was 0.00. The lateral distance between the tests was 150 ft.

Following is a list of the loads and settlement:

Test No. 1.

Load per sq. ft. in lb.	Settlement.
1000	3/16 in.
2000	1/2 in.
3000	1 3/16 in.
4000	1 3/4 in.
One-half hour later, 4:30 p.m., same load.	1 7/8 in.
Next day; same load	1 7/8 in.

Test. No. 2.

500	No settlement.
1000	3/32 in.
2000	7/64 in.
3000	3/16 in.
4000	3/8 in.
One hour later	7/16 in.
Two hours later	29/64 in.
Four weeks later, 4:00 p.m.	5/8 in.
Next day, 9:00 a.m.	15/16 in.
4:30 p.m.	15/16 in.

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The Canadian Engineer absorbed The Canadian Cement and Concrete Review in 1910.

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CONTENTS OF THIS ISSUE.

WINNIPEG WATER.

It will be remembered that a short time ago Professor Slichter presented a report to the Public Utilities Commission on the water supply for the city of Winnipeg. An abstract of this report was presented in *The Canadian Engineer*. Professor Slichter, in a recent communication to the Public Utilities Commission, states that he will not be responsible for the increase of the city's water supply unless his recommendations as presented in his report are carried out. He adds that the City Engineer of Winnipeg is plainly aiming to extend the water system to Crystal Springs without regard to his recommendations.

Col. H. N. Ruttan has acted as City Engineer of Winnipeg for a number of years, and his administration throughout has been most able and efficient. It is, therefore, with a certain reluctance that we view Prof. Slichter's strictures on the City Engineer's course in the extension of the well system for the immediate supply of the city. Col. Ruttan points out many inconsistencies in the original report, and quotes from his own experience to show that the report is not based on facts. The question is too long and too involved to be taken up at any length here. It appears to us, however, that Prof. Slichter should proceed more cautiously and conservatively in his comments and criticisms of City Engineer Ruttan, whose past experience with the water situation at Winnipeg makes him eminently well qualified to deal with the question. The conviction is forced upon us from an analysis of the report and the comments of the City Engineer upon it, together with the added protests embodied in Prof. Slichter's letter, that the original report as presented by Prof. Slichter was hazy and contradictory, and his subsequent recommendations have not improved it.

TORONTO HARBOR IMPROVEMENTS.

The plans for the improvement and development of Toronto harbor have been prepared and presented to the Government and the City Board of Control. A description of the work to be done under these plans will be found in this issue.

The Commission, with its engineer and secretary, are to be congratulated on the very thorough and comprehensive manner in which the whole problem has been analyzed and presented in their report.

As everyone who is at all acquainted with the conditions in the present harbor knows, there has been a great neglect in the past to realize the potentialities of its location and natural advantages. Nature has been kind in providing a magnificent natural harbor, almost perfectly protected from storms, and of easy access. The city officials in the past have been farsighted enough to preserve the water front under public control. These facts, coupled with the conditions which exist at Ashbridge's Bay, where the shallow water and marsh provides an area easily reclaimable for industrial development, gave the Commission a magnificent opportunity, and this they have conserved to the full.

The Dominion Government grant, which has already been guaranteed, is $6,000,000. The city's expense, it is estimated, will total nearly $2,000,000; and the Harbor Commission will provide the balance, or $11,000,000, by issuing debentures. It is fully expected, and there is little question but what it will be realized, that the revenue from the rental for factory sites, dockage dues, etc., will be more than sufficient to carry the necessary interest charges and the expenses of administration.

The improvements fall naturally under two main divisions, industrial and aesthetic. The industrial development includes a uniform depth of twenty-four feet of water in the harbor, east and west end docks, piers, a most complete system of railway sidings at Ashbridge's Bay, and a ship canal and turning basin in the factory area. Facilities will be given for complete cooperation of railways and vessels in the handling and transhipment of freight.

The aesthetic features include boulevard drives, bridle-paths, eleven miles of sheltered waterways, parks, walks, terraces, and a magnificent lagoon treatment at the Island. From the extreme east side of the city to the extreme west, at the Humber, the waterfront will be protected, improved and developed to give the maximum of aesthetic and recreative features. The chairman of the Harbor Commission, Mr. Lionel H. Clark, has associated with him on the Board Mr. R. Home-Smith and Mr. T. L. Church, representing the city; Mr. R. S. Gourlay, representing the Board of Trade, and Mr. F. S. Spence, representing the Government. Mr. E. L. Cousins is the Engineer and Mr. A. C. Lewis, Secretary of the Board.

THE ST. JOHN RIVER IMPROVEMENT.

The International St. John River Commission, a body of men appointed by the governments of the United States and the Dominion of Canada to investigate and report upon the conditions and uses of the St. John River, has received from its Board of Consulting Engineers a report on the possibilities of water storage and channel improvement on the river. As is well known, the St. John River forms an important part of the south-eastern boundary of Canada. For some years past there has been considerable trouble along the river due to the fact that the river is used to a great extent for the lumbering industry.

We hope to publish an abstract of the report in an early issue of *The Canadian Engineer*. The report covers the area comprising the watershed of the St. John River, and suggests a system of water storage and channel improvements which, if the report is acted upon, will doubtless do much to improve present conditions. If the plans outlined by the Board of Engineers meet with the approval of the Commissioners, an outlay of some millions of dollars will be required, which would be jointly met by the Canadian and the United States governments.

It is expected that the International Commission will make their final report to their respective governments in a short time, and this report of the Board of Engineers will form an important part of the final report.

THE ROAD BOARD OF GREAT BRITAIN.

We note in a recent issue of an engineering contemporary in the Old Country some rather severe criticisms of the Road Board and its consulting engineer. The facts as outlined appear to justify criticism.

In answer to certain questions raised in the House of Commons on October 17th, the Chancellor of the Exchequer replied that the salary paid to the consulting engineer to the Road Board is $3,300 a year, out of which he provides his own office and staff. It was also stated that he carries on his business as a consulting engineer on his own account; that he has no interest in the two road companies which were named, but that he frequently acts as consulting engineer for them; that he had invited a party of road engineers to inspect the work of road construction being executed by a certain company, which invitations were printed on paper with the heading, "The Road Board." The Chancellor explained that as consulting engineer to the Board, Colonel Crompton's advice was taken on technical questions, but that he had no executive or general duties.

As our contemporary holds, it is manifestly impossible to expect that an impartial judgment can be given by the Road Board regarding the experimental roads which have been laid by different manufacturers and contractors for the Board, now that it is known that the consulting engineer for the Board also acts for one or more of their competitors, that he is also a patentee for a road-surfacing method, and has, moreover, laid down a length of road to his own specification for the Board.

With the facts as stated, the journal in question is to be congratulated on giving publicity to the fact. It is quite probable that no intentional harm was intended is allowing such a state of affairs. At the same time, such irregularity of administration should be corrected at once.

EDITORIAL COMMENT.

A writer in The Saturday Evening Post describes the trials and troubles of a technical man whose stenographers, and he had several at one time and at different times, insisted on transcribing their notes incorrectly. He would say: "The tube wall is stressed circumferentially," and the letter would read: "The tube wall is dressed reverentially." Or, "A wattmeter in use" would come out as, "What's the matter with us." "Synchronizing force" appeared as "A singing icicle farce"; and "Helical reducing gears" showed up one day disguised as, "Hellish reducing tears." The editor of the paper has had his troubles with the rest of them, but he doffs his hat to the above.

* * * *

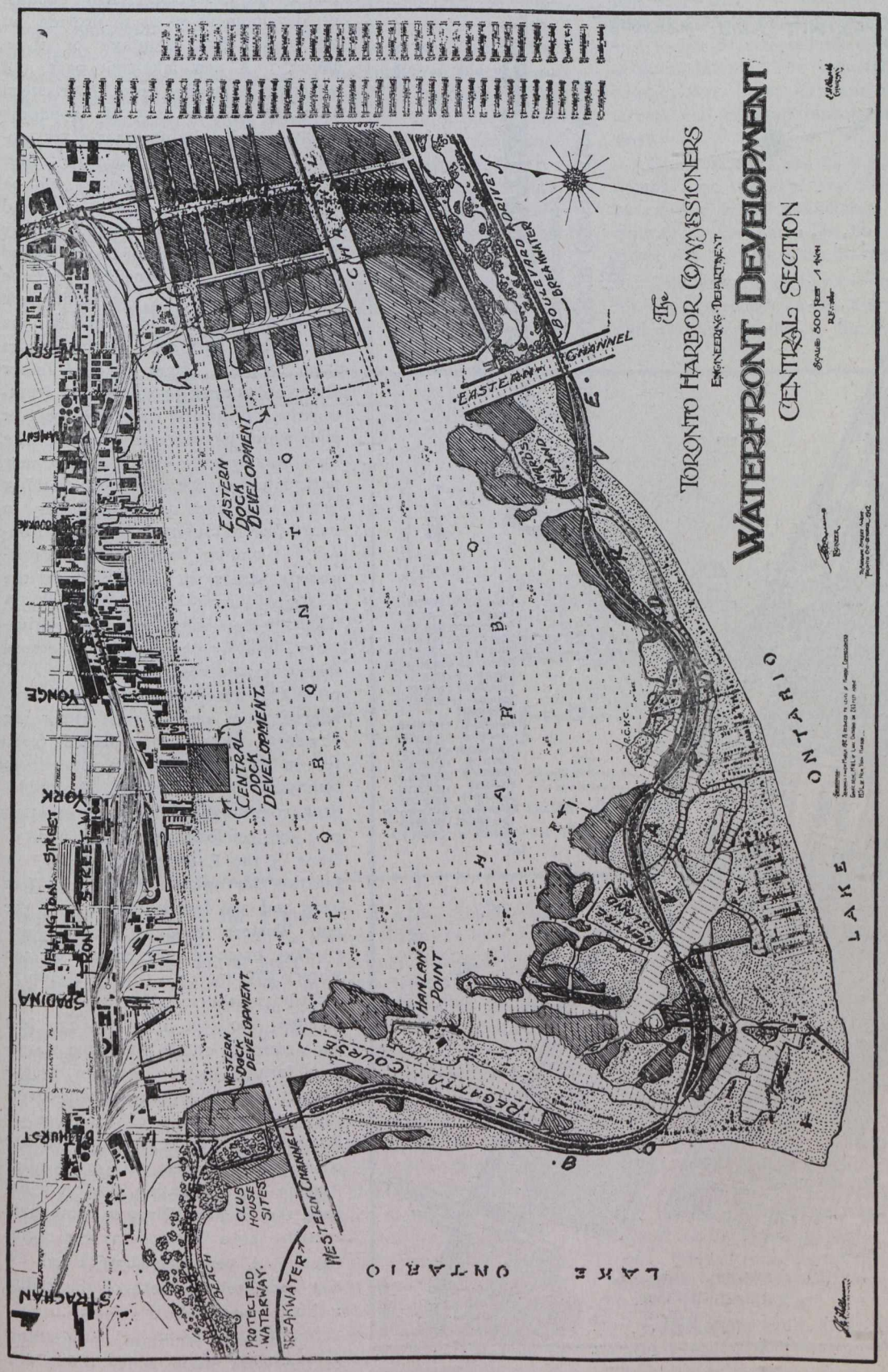
Two special offers deserving of editorial mention are those made by *The Canadian Engineer* to old and new subscribers. The balance of the copies of the paper for 1912 will be forwarded free of charge to all new yearly subscribers who mention this special offer. And, in conjunction with this, the book offer, outlined on another page, holds good. To present subscribers who send in new subscriptions, which may have the advantage of the above terms, will have their subscriptions extended three months without charge for each new subscription they add to the list.

INDUSTRIAL ACCIDENTS.

According to the record of industrial accidents maintained by the Department of Labor, there were 104 workmen killed and 324 injured during the month of October. Compared with the record for September, this is an increase of fifteen in the number killed and a decrease of ninety-five in the number injured. The greatest number of fatal accidents occurred in steam railway service, there being 28 employees killed. The building trades come next with 18 fatalities. Of the non-fatal accidents, the greatest number occurred in the metal trades, the number recorded being 85, followed second by building trades with 40 injured, and third by steam railway service with 37 injured.

TORONTO HARBOR IMPROVEMENT.

The Toronto Harbor Commissioners have presented to the city council the plan prepared by them for the improvement of the harbor and waterfront.



The plan, as finally adopted by the commissioners, provides for the proper treatment of the harbor, both from a commercial and industrial point of view, and also for the development of the aesthetic features of the waterfront.

The commissioners, on taking office at the latter end of the year 1911, found themselves in charge of one of the finest land-locked harbors in the world, certainly the finest natural harbor on the Great Lakes, of which natural position very little advantage has been taken, and for the development of which no equipment had been provided.

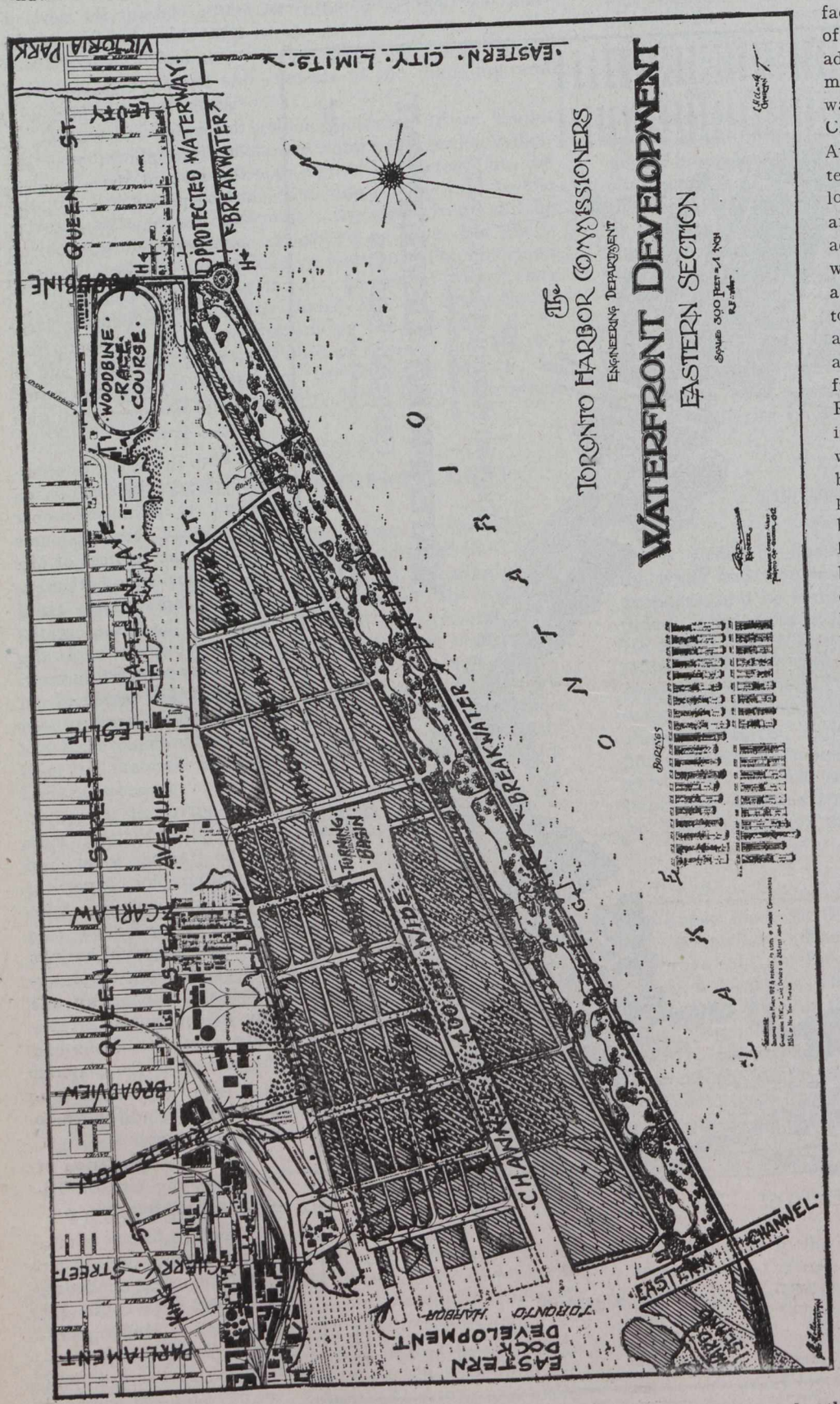
The one redeeming feature in the past history of the harbor was afforded by the foresight of your city council and those councils which preceded it in securing for the citizens the ownership of 80 per cent. of the entire waterfront within the boundaries of the city, including a large portion of the waterfront on the inner harbor and all of the beaches and waterlots to the east and west of the Island.

With the object of securing definite information on which to formulate proper plans, the commissioners secured the services of Mr. E. L. Cousins as harbor engineer, and since the 1st of February he has energetically pushed forward the necessary preparatory work, a large staff of engineers and draughtsmen having been constantly employed. The sum of $27,000 has been spent in securing a complete survey of the waterfront from Victoria Park to the Humber River, and a hydrographic survey of the harbor, including 8,000 soundings to show the depth of water and borings to rock all along the waterfront and throughout the bay to determine the ultimate depth available and the nature of the material in which the various projected works will have to be constructed.

Upon the completion of the plans the city of Toronto will possess:

A modern harbor with a uniform depth of water capable of accommodating any vessel with a draught of 24 feet. Modern, permanent docks on the central waterfront served by 24 feet of water and equipped with the best of freight sheds, warehouses and appliances. A dock and industrial district at the foot of Cherry Street equipped with freight sheds, warehouses and the first of a series of factory buildings to serve the needs of the east end. A similar area at

the foot of Bathurst Street to take care of west end business. Proper co-ordination of rail and water traffic at all three of the above points in order to properly develop the port. An industrial area containing 644 acres of available land in



the Ashbridge Bay district, which will be known in the future as the Toronto Harbor Industrial District, capable of accommodating factory buildings with a value of $30,000,000 and producing a ground rent revenue of $500,000 per year. A ship-channel 6,800 feet long, 400 feet wide and 24 feet deep, with turning basin 1,000 feet square at its east end serving the Industrial District and the eastern portion of the city generally, and equipped with three miles of dockage. A dock area on the west face of the Industrial District capable of development so as to provide an additional dock frontage of three miles. A new lakefront park and waterway extending from the Eastern Channel to the foot of Woodbine Avenue, and containing 352 acres protected by a breakwater three miles long. Inside the breakwater will be ample accommodation for east end aquatic clubs. A protected waterway with an average width of 600 ft. behind a breakwater from Woodbine Avenue to the east city limits. Additional park areas on the Island totalling 352 acres. New park areas in the district from Bathurst Street to the Humber River containing 190 acres and fronting on a protected waterway 500 feet wide which is separated from the lake by a breakwater. A total area of new park lands of 894 acres. A bathing beach one and one-third miles in length, from Sunnyside to the Humber. A similar beach four and one-quarter miles in length from the Eastern Channel to Victoria Park. A lakefront boulevard system of driveways, bridle paths and walks across the waterfront for eleven miles. A protected waterway twelve miles in length, from east to west along the city front. A terrace promenade 6,880 feet in length and 55 feet wide, from Sunnyside to the Humber. A double-deck combined traffic and recreation pier 300 feet long and 20 feet wide in front of the Exhibition Grounds. A location for aquatic clubs 1,000 feet long and 300 feet wide north of the new Western Channel with an anchorage basin of absolutely protected water covering 42 acres. A similar location at the foot of Roncesvalles Avenue, 800 feet long and 250 feet wide fronting on the protected waterway formed by the western breakwater. A public playground covering 3½ acres east of the foot of Roncesvalles Avenue. A public square 600 x 300 feet west of Roncesvalles Avenue. A reservation, 80 feet wide, from the Humber River to Sunnyside crossing as a right-of-way for radial lines. A new Lakeshore Road, 66 feet wide, to the south of the radial railroad reservation.

In order to facilitate the handling of the work when active operations are commenced, the waterfront and harbor has been divided into three sections. The eastern section takes in the Ashbridge Bay district and the sandbar in front of it, the central section takes in the central

waterfront from Parliament Street to Bathurst Street, the inner harbor and bayshore of the Island, while the Western section covers the waterfront from Bathurst Street to the Humber River.

Eastern Section.—In the eastern section the development planned covers three phases, commercial and dock development, industrial development and park treatment on the lakefront. A breakwater will be constructed an average distance of seven hundred feet out in the lake from the present shore and reaching from the eastern harbor entrance to the east city limits at Victoria Park. To fill the space behind this wall up to eight feet above mean water level, including the 1,000 acres in the industrial district, will require twenty-five million cubic yards of material. This material can all be secured from the bay and the bed of the lake and outside the breakwater, and the two large hydraulic dredges will be employed on this work.

The dredging operations will be on a larger scale than ever before attempted in Canada. Each dredge will be capable of dredging either sand or clay from a depth of 50 feet and pumping it for a distance of 4,000 feet through pipe lines from which it will be distributed to the area to be filled. The dredge will be built of steel and will be propelled by twin screws, and controlled by steam steering gear.

The machinery will be of 2,000 horse-power of the latest improved type and complete electric light and search-lights will be fitted so that work can be carried on at night as well as day. Twenty-five thousand tons of sand and clay per day can be dredged and delivered a mile distant by this dredge. This will be the most powerful dredge in America. Up to the present the largest Canadian hydraulic dredge is the "Tarte," built in Toronto in 1901, and working on the St. Lawrence ship-channel below Montreal, but this new dredge to be built will be double the power of the "Tarte."

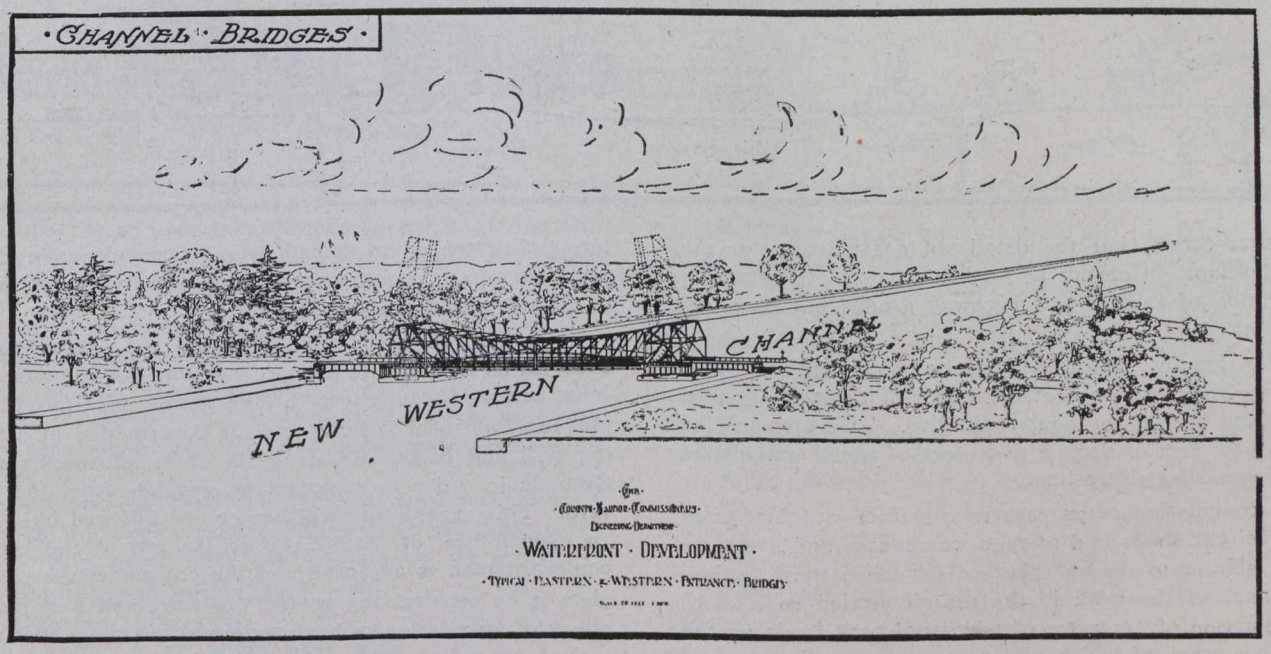
Notwithstanding its great size and power, the dredge with its machinery will be under the control of one man on the bridge deck. Here will be located not only complete apparatus for navigating the ship, such as steering wheel, binnacle, engine-room telegraphs, etc., but also a battery of levers controlling all the movements of the dredging apparatus, with gauges indicating the depth of working and the amount of sand which is being picked up.

The dredge will be built from the designs and under the supervision of A. W. Robinson, M.Can.Soc.C.E., the well-known dredge expert, of Montreal, consultant on dredging to the British Admiralty.

A ship-channel will be constructed for the purpose of extending the inner harbor into the new industrial district. This channel will be 6,800 feet long, 400 feet wide and 24 feet deep, and will terminate in a turning basin 1,000 feet square, and the sides of both the channel and turning basin will be so constructed as to form three miles of dockage accommodation. The industrial area, when completed, will contain 644 acres of land for factory sites, 235 acres of streets and railroad reservations, and 130 acres of waterways.

The roadways will have a minimum width of 75 feet and a maximum width of 175 feet. The district will be served by railway tracks connecting with all the railways and the railway layout has been so arranged that every alternate street will be free from tracks.

The western, or bay face of the district will be developed for dock purposes as the district grows, and will ultimately add 2½ more miles to the dock frontage of the areas, as shown on the plan. One large dock is now being constructed and will be equipped with modern freight sheds and one storage warehouse and the beginning of a series of factory buildings will be erected back of the dock.



The mouth of the Don will be diverted from its present outlet to a new outlet into a slip at the foot of Cherry Street, and the original Don Channel, now filled up, will be utilized as the location for a highway entrance to the industrial area.

The area north of the ship-channel will be reserved for light manufacturing plants, the area to the east will be the home of heavier plants which do not require direct water service, and the area south of the channel will be utilized for the heaviest class of manufacturers requiring a frontage direct on navigable water. The width of the channel, 400 feet, will allow a vessel of the largest type to safely pass through it between two vessels of equal size tied up at each side.

Along the south portion of the reclaimed land a park area 1,000 feet wide will be reserved, fronting directly on the breakwater. Immediately to the north of the breakwater will be the lakefront boulevard drives and walks with a park and lagoon treatment north of the boulevard, and a fine beach to the north of the lagoon. Bridges at reasonable intervals will carry traffic across the lagoon to the lakefront.

and forty-foot openings in the breakwater at intervals of 2,000 feet will allow seawall craft to pass through from or to the lake. Inside the breakwater fronting on the lagoon will be ample sites for aquatic clubs and a strip of land will also be laid out, north of the park area, as a location for summer homes.

East of Woodbine Avenue there will be no park treatment, but the seawall will be carried to the east city limit, leaving a protected waterway for the use of the residents of this district and the public generally.

Central Section.—In the central section the work planned consists almost entirely of commercial and park development with some industrial land provided at the foot of Bathurst Street. The commissioners plan to spend the sum of $2,194,000 in the construction and equipment of proper docks in the area from Bay Street to York Street, and at the foot of Bathurst Street, but the details of construction for the central development cannot be worked out until the question of separation of railway and highway grades has been definitely settled.

At the foot of Bathurst Street a dock and industrial area of 17 acres will be provided north of the new Western Channel and east of the boulevard drive. This area will be served by 800 feet of dock with 20 feet of water and will be accessible to all railway lines.

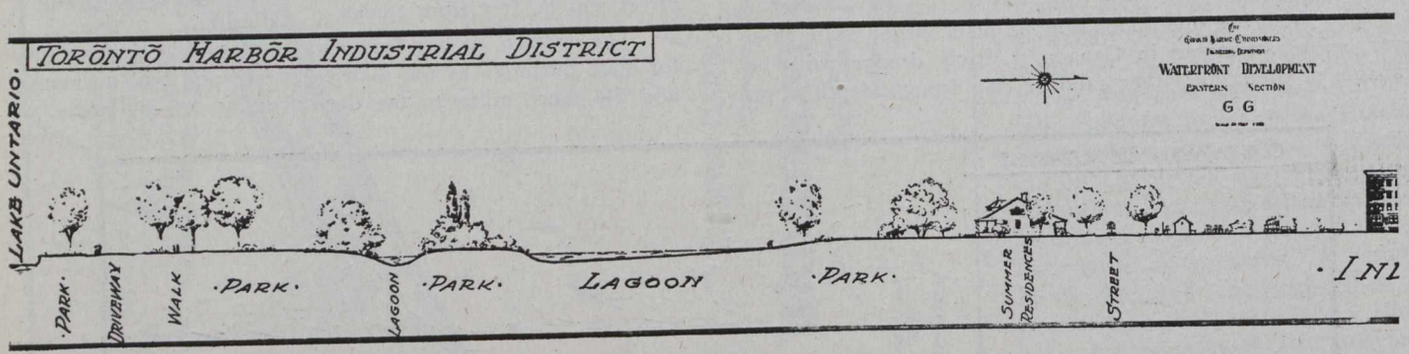
The commissioners propose to construct at this point modern freight sheds and storage warehouses and a factory building similar to the one planned for the eastern section. The balance of the work in the central section consists of the reclamation of 352 acres of additional park lands on the Island, a portion of which will serve as a location for the boulevard drive and the balance will improve the present unsightly portion of the Island. The boulevard drive will be carried from the east across the Eastern Channel by means of a roller lift bridge giving a clear entrance for boats of 200 feet.

Western Section.—From Bathurst Street to the Humber River the treatment is entirely along park lines, there being no provision for commercial development. A breakwater will be constructed from a point of 200 feet west of the new channel to a point at the mouth of the Humber River and distant an average of 900 feet from the existing shore line. Inside this breakwater will be a protected waterway with an average width of 500 feet reaching from the Humber to Bathurst Street and linking up with the Island lagoon system and the new lagoon system planned for the eastern section to form a complete protected waterway across the entire city front.

The western breakwater will be broken every 2,000 feet by forty-foot openings to permit of the egress or ingress of sailing or other craft.

From Bathurst Street to the Exhibition Grounds and from Cliff Road to the Humber the sand pumps will be utilized to reclaim areas of property for park purposes and from Sunnyside to the Humber over a mile of fine sand bathing beach will be made and a bath-house erected at its east end. In the same district sufficient land will be reclaimed to provide for an 80-foot reservation for a radial railway entrance to the city along the location of the present Lakeshore Road with a new 66-foot commercial road to the south of the reservation. This roadway will replace the Lakeshore Road and will serve as the business entrance to a tier of lots reserved for building purposes. In front of this tier of building lots and 8 feet above the boulevard proper will be a terraced boulevard and walks 55 feet wide, faced by a parapet wall and with steps at intervals leading onto the boulevard proper. Outside the boulevard and bridle paths will be the bathing beach and protected waterway with the breakwater as its southern boundary.

The Cost.—The total cost of all the work planned by the commissioners amounts to $19,142,088. This expenditure it is intended to spread over a term of years, the expectation of the commissioners being that the work will be completed within ten years.



The city is asked to undertake the expenditure of $146,500 as its share of the general work for the purpose of constructing the highway bridge across the Don Channel into the Industrial District and the construction of a retaining wall and balustrade along the front of the Exhibition Grounds in order to separate the grounds from the boulevard. This expenditure will have to be followed later on by an expenditure of $1,656,383 by the city if the lakefront boulevard plan is approved and the city undertakes to complete it by constructing walks, roadways and park features after the commissioners have reclaimed the site. This makes a total expenditure allotted to the city of $1,802,883 as its share of completing within ten years the work shown on the plan.

The Dominion Government has been asked to undertake the expenditure of $6,123,284 in the construction of the eastern breakwater, the western breakwater, the ship-channel in the industrial district, the bridges over the eastern and western harbor entrances and the bridge over the ship channel and protection piling near the eastern channel.

The balance of the projected work will be undertaken by the commissioners at an estimated cost of $11,215,920. The money will be raised by the issue of debentures by the Harbor Commissioners and a careful estimate of the business possibilities of the plan warrant the assurance that the ultimate annual revenue from the property entrusted to the commissioners and created by them will be such as to meet the interest and sinking fund charges on the money borrowed and to leave a handsome surplus to be handed over to the city to aid in the reduction of the tax-rate.

The city is asked to undertake the portion of work allotted to it and to intimate its intention of joining in the construction of the boulevard drive.

If the city joins in the boulevard construction the commissioners will create the land necessary as a location for the drive and will ask the city to pay for the use of this

location an annual rental equal to the interest and sinking fund charges on this part of the work.

The city is asked to intimate its intention of taking over the areas reclaimed for park purposes on a similar arrangement. It has been estimated that the total annual rental to be paid by the city for these park areas and the boulevard location will amount to $153,833 and in return for this the city will receive an addition to its park area of 894 acres.

The plans of the commissioners provide for the extension of Bathurst Street southerly in a straight line from Front Street with a width of 100 feet and an arrangement has been made with the Canadian Pacific Railway Company under which they join in this extension and consent to the south ramp of the necessary bridge being carried over their property. This will provide also for an adequate eastern entrance to the Exhibition Grounds and it will be necessary for the city to undertake the expropriation of the property north of the Canadian Pacific Railway property necessary for the street extension.

Composite Steel and Concrete Piling, Dock Work and Retention Piling for Boulevard Treatment.

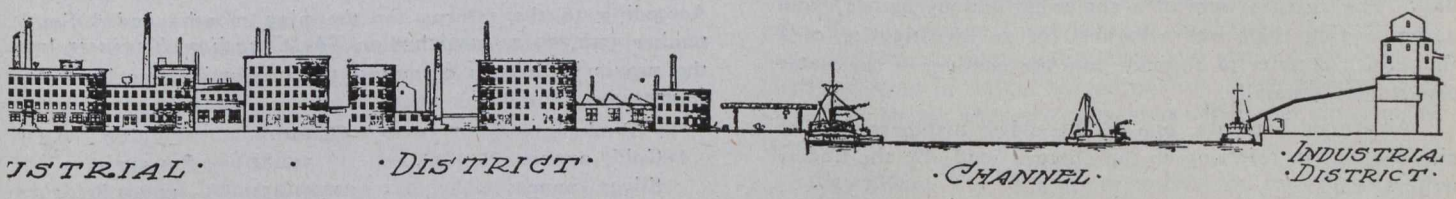
Eastern Section: Four miles of retention piling and dock work, including ship channel, turning basin, marginal way on bay face and north slip.

East Section, Park and Boulevard: Breakwater and composite pile protection work.

Eastern entrance to Woodbine Avenue....17,350 ft.
Woodbine Avenue to east city limit..... 6,600 ft.

Total .....23,950 ft.

Western Section, Bathurst Street to Humber River:
Retaining wall ..... 6,880 ft. long
Exhibition dock ..... 300 ft. long
Breakwater and composite pile protection work .....20,000 ft. long



SUMMARY OF FILLING, PILING, ETC.

Filling.—Eastern section industrial eastern entrance to Woodbine Avenue, 22,714,144 cubic yards.

To be reclaimed to 8 feet above mean water level property, 9 per cent. of which is now under water, reclaiming 900 acres.

Eastern section, park and lagoon treatment, eastern entrance to Woodbine Avenue: Filling 5,042,045 cubic yards to 8 feet above mean water level, reclaiming 352 acres.

Central or Island section, Parliament Street to Bathurst: Filling 4,267,600 cubic yards to reclaim 350 acres of park lands to elevation 6 feet above mean water.

Western Section, Bathurst to Humber River: Filling 3,942,649 cubic yards to make 190 acres of park lands.

Summary.

	Cubic yards.
Industrial	22,714,144
East Park	5,042,045
Central	4,267,600
West	3,942,649
	35,966,438
Say,	36,000,000

Available material between eastern entrance and Woodbine Avenue	27,535,486
Available in Toronto Bay	18,000,000
In vicinity of Humber Bay	4,447,476

Summary.

East	27,535,486
Centre	18,000,000
West	4,447,476
	49,982,962

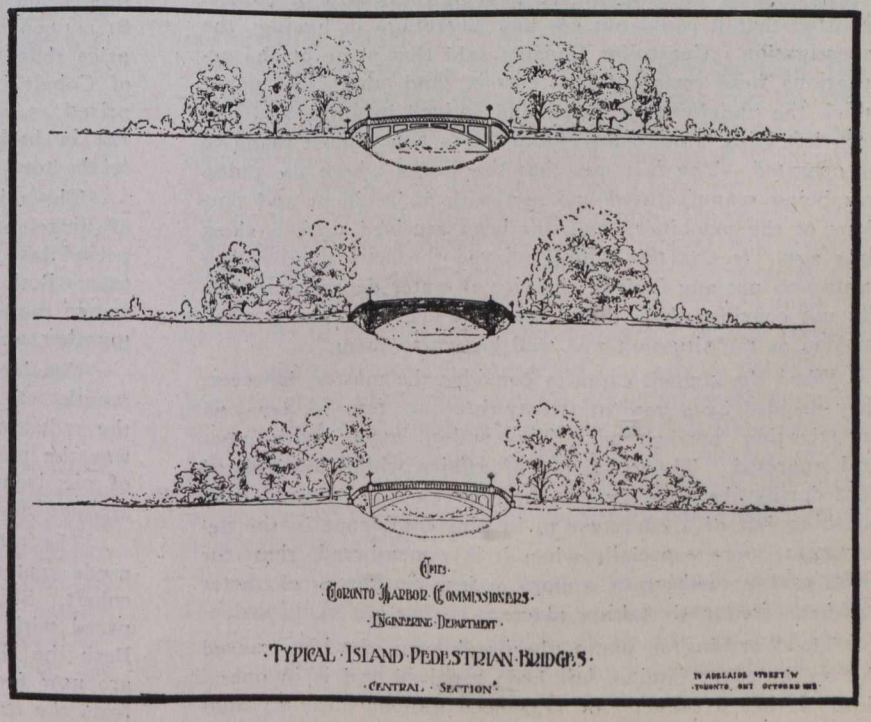
Bridges.—Suggested eastern and western entrance bridges are of the Scherzer roller lift or Strauss bascule type, 60 feet wide, providing for street railway, vehicular and pedestrian loading, a similar type of bridge is contemplated for the crossing of the ship-channel, excepting that this bridge will provide for steam railway, street railway, vehicular and pedestrian traffic, with width of 60 feet.

One bridge over the River Don diverted 80 feet wide.

Eastern Section—Boulevard Drive:

Seven vehicular bridges, 40-ft. span, 80 ft. wide.
One 100-ft. span, 80 ft. wide, vehicular.
One 100-ft. span, 56 ft. wide, vehicular.
One 40-ft. span, 56 ft. wide, vehicular.

Seven foot bridges, 50-ft. span, 10 ft. wide, for crossing lagoons.



Central Section:

Ten 50-ft. pedestrian bridges (arch).

Three 120-ft. arch pedestrian bridges.

Three bridges 180 ft. over all consisting of two 50-ft. arch spans and one 80-ft. arch span, providing for street railway, vehicular and pedestrian traffic.

One 100-ft. arch span, providing for street railway, vehicular and pedestrian traffic.

Four 40-ft. spans for boulevard drive over lagoons.

Western Section:

One 400 ft. concrete arch foot bridge connecting main land with proposed Exhibition dock; bridge to be 10 ft wide with 30-ft. arch spans.

MONTREAL'S WATER DEPARTMENT

The charges which the Canadian Fire Underwriters of Montreal recently made against the city's water department have been the subject of considerable discussion at the city hall. The charges were of a somewhat serious nature, and accompanying them was a request for an investigation of a thorough character to be made into the conduct of the water department generally.

Alderman Lapointe, one of the oldest members of the city council, in referring to the charges made by the underwriters, said:

"It is stated in this resolution that in the management of the water department there has been incompetency; faulty construction of engines; faulty workmanship; acceptance and use of inferior materials, and continued dilatory work and repeated disaster to the city water plant. Such a list of charges are serious, and there is no other course open to the city but to grant the investigation the underwriters desire. The charges are sweeping, and the allegations are direct. Whether or not they are justified we shall know when experts are appointed to look into the matter."

Alderman Lapointe admitted that there had been many accidents to the water system, but claimed that of recent years the facilities had been improved considerably, and he considered that the best way to proceed on the charges would be to ask the board of control to study the subject and to report the results.

At a later meeting of the council the board of control reported that it could not see any advantage in having the investigation. Controller Godfrey said that some of the accusations were certainly not correct, and that the pump which the underwriters stated had arrived in June, and had been left lying around for months, was now almost ready to be operated. The fact was that the works where the pump was being manufactured had met with an accident and portions of the machinery had not been received until a short time ago. It was this which delayed the setting up of the pump and not any fault of the city or water department. He did not consider that there was any necessity for a commission as the situation was well known to them.

When the council came to consider the matter, however, they decided by a vote of twenty-three or four to have an investigation carried out. This action meets with general approval. The condition of affairs which has existed here during the past three or four weeks has certainly been anything but of a character to inspire confidence in the department, more especially when it is remembered that for years past, something of a more or less dangerous character has been frequently taking place.

The Worthington pump, the breakdown of which caused the recent water famine, has been repaired and is in operation. It has a capacity of 12,000,000 gallons daily so that this will go a long way towards putting the reservoirs in a condition once more to supply not only the necessary household consumption, but to provide against any lack of pressure, in case of fire, such as was so serious recently in Montreal. The new pump, to which the underwriters referred, will shortly be ready to operate. It has also a capacity of 12,000,000 gallons per day. The situation should then be much better in Montreal, as if one pump fails, the other will be ready to take up the work. The claim is frequently heard that the trouble arises very largely through provision not being made in advance for the increased requirements of the city. These increases have been great of late years, and the investigation will now show whether foresight has been lacking or whether the department has been alive to the city's requirements.

ONTARIO'S LARGE MINERAL OUTPUT

Ontario continues to make important mining history. According to the returns for the nine months ended September 30th, 1912, furnished to *The Canadian Engineer* by the provincial bureau of mines, the production has been as follows:—

Product.	Quantity.	Value.
Gold, ounces	53,488	$ 1,117,335
Silver, ounces	22,231,451	12,707,826
Copper, tons	8,019	1,142,076
Nickel, tons	15,907	3,368,437
Iron ore, tons	37,265	101,284
Pig iron, tons	452,021	6,051,978
Cobalt in crude material, pounds	711,180	176,786
Cobalt and nickel oxides, pounds	711,180	176,786
White arsenic, pounds	2,944,104	66,316

The yield of gold for the first nine months of 1912 is more than double in value that of any preceding twelve months. The bulk was from the Hollinger and Dome mines. Other contributors were the McIntyre and Vipond at Porcupine, and the St. Anthony at Sturgeon Lake. The Cordova mines in Hastings county and the Olympia at Lake of the Woods also turned out bullion.

As compared with the corresponding period of 1911, the production of silver was 963,601 ounces less in quantity, but $1,114,090 more in value, silver being now much higher in price than last year. The productivity of the silver mines of Cobalt is being well maintained. The shipments comprised 15,408 tons ore, 7,859 tons concentrates and $2,239,124 in bullion. South Lorrain contributed 616,692 ounces to the total and Gowganda, 449,281 ounces.

The mines of the Sudbury district yielded 15,907 tons of nickel as compared with 12,711 tons during the same period last year, and 8,019 tons of copper as against 6,769 tons. Both these metals are estimated in the form of Bessemer matter produced by the blast furnaces, constituting together about 80 per cent. of the matter by weight.

Considerably less iron ore was shipped during the nine months of 1912 than during the same period of last year, the reduction amounting to 135,603 tons. The Helen mine was the principal producer. On the other hand, the output of pig iron shows a large increase, being 452,021 tons as against 296,856 tons last year.

The refining works in Ontario produces arsenic, cobalt crude materials or residues, and the oxides of nickel and cobalt. Shipments amounted in value to $300,716 as compared with $125,907 for the corresponding period of 1911. Both the European and American market for cobalt oxides are now for the most part supplied by the product made from the ores of Cobalt.

CHINA CLAY PRODUCTION IN DEVON AND CORNWALL, ENGLAND.

By W. S. Harvey, A.M.Can.Soc.C.E., A.M.Inst.C.E., A.M.I.M.E.

[Mr. Harvey, who is assistant to the City Engineer of Lethbridge, Alberta, has prepared this paper on the collecting and treating of China clay in England. As China clay has lately been discovered in British Columbia, this discussion will, no doubt, be of interest to our readers.—EDITOR.]

The Industry.—The china clay industry is carried on in Devon and Cornwall to a very great extent, in fact china clay production and lead and tin mining are Cornwall's largest industries. It is well known that grey granite has been quarried in these two counties for many years, and the felspar in this granite, when in a state of decomposition, is in reality the infant state of that valuable commercial product known as kaolin or china clay. This decomposition is caused by the granites becoming dissolved by rainwater which is charged with carbonic acid, collected as it passes through the various substances, such as decayed vegetable matter, etc., forming the surface or overburden. The following is a brief description of the various stages through which it passes before reaching the potters' hands.

Sinking Clay Pits.—In these two counties the decomposed granite lies about five or six feet below the surface, the first operation in sinking the clay pits being to remove the overburden. This is usually carried out over an area of about half an acre for each proposed pit. A pumping shaft is then sunk to the full depth of the clay beds, often approaching one hundred feet; from the bottom of the pumping shaft, adits or tunnels are driven horizontally in various directions and for varying distances. At the ends of these adits, upcast shafts are driven to the surface. The adits are driven on a slight upgrade, so that the clay liquid may drain to the sump of the main pumping shaft. Upon completion of the driving of the upcast shafts, a large wooden launder is built to the full depth of each shaft; these launders are constructed of three-inch planking, in the sides of which holes are bored from top to bottom, and stopped with moveable plugs. When the launders are in position the shafts are filled in round about. A leat or ditch is now dug surrounding the site of the proposed pits, being fed with water from adjacent streams and provided with penstocks at points around the pits.

Washing Clay.—Twenty or thirty men are employed at each pit and as the water is allowed to run over the clay beds, the clay is scraped and worked with tools, the clay liquid finding its way through the launders and adits to the main pumping shaft. As the pits get deeper the plugs are removed from the launders. The clay pits, after being worked for about ten years, will increase in area to many acres and develop into one large pit, the overburden being removed as required. The clay liquid is pumped, by means of a Rocker pump, through a rising main, thence through a vitrified pipe line it gravitates to the mica drags.

Mica Drags.—These consist of a series of shallow tanks, their duty being to arrest the mica, sand and other foreign matter from the clay liquid, which enters the drags at a sand bay provided with screens and baffles; here the greater part of the sand is removed. The sand bay is divided into two compartments so that cleaning may be carried on without stoppage of the flow. The liquid next enters the mica drags proper; these are usually about one hundred feet long and fifty feet wide, being divided longitudinally into narrow channels, each eighteen inches wide; the division walls being of brick on edge and faced with two-inch lumber. The channels are separated from the sand bay by hand sluices. The mica drags are not baffled in any way as the velocity of the liquid is so reduced that any particles of mica and remaining sand will deposit themselves on the floor of the drags. The drags are cleaned out about once every week, the sand and mica being sold for plastering and other building purposes.

Concentrators.—Upon leaving the mica drags the liquid continues on its journey through the pipe line to the concentrators. These are circular tanks about forty feet in diameter with granite masonry walls and a conical bottom of granite pitching. The concentrators are, as a rule, built in a battery of 8 or 10, and are so arranged that the liquid can be drawn off from any one or all of these as required; there is also a by-pass and valve on the pipe line to shut off all the tanks, the liquid then flowing to other concentrators further down the line. The duty of the concentrators is to take off the surplus water, this being accomplished by means of a floating valve. When pumped from the clay pits, the liquid contains on an average 5 per cent. of clay and 2 per cent. of mica and sand in first quality clay, and about 4 per cent. of mica and sand in clay of second quality. Concentrators are, therefore, placed wherever convenient along the pipe line to take off all the surplus water possible.

Clay Silos.—The silos are of rectangular form, built with granite masonry walls and a granite pitched bottom sloping down from back to front. At the bottom of each front wall is a large aperture provided with a penstock operated from a platform above. The silos are built in a battery of 15 or 20 arranged in tiers, the number being of course governed by the required output of dried clay. The clay liquid now having passed through the concentrators, on arriving at the silos, is greatly reduced in its percentage of water. It now enters the silos and as a silo becomes filled it is allowed to settle for two or three weeks, when as much as possible of the remaining water is drawn off, this being done by means of peg launders, the pegs being removed as the clay settles and the top water drawn off.

Kilns.—The kilns are situated in immediate proximity to the lowest tier of silos, the kiln floors being on a level with the apertures in the silo walls. These are from one hundred to one hundred and fifty feet long with the furnaces at one end, and the flues running to a stack at the other end of the building.

As soon as the clay in a silo is ready to be dried, the penstock is opened and the clay allowed to run over the kiln floors, the clay at this stage containing about 30 to 35 per cent. of water. It is now heated and when dried sufficiently is cut by wooden tools into convenient blocks for handling, the heating process still continuing until thoroughly dry, when the clay is removed by a belt conveyer and stacked under cover, or loaded direct into cars for shipment to the potteries. The kilns are provided with an ample supply of ventilators to take off the steam during the drying process.

It will be noticed that from the clay pits to the kilns it is a process of gravitation with the exception of the pumping and in some clay works, where sufficient fall from the pits can be obtained, even this is disposed of. Several of the Devon clay pits are situated five or six miles from the kilns, in fact one of the latest works opened up has a pipe line of nine miles in length.

All hand sluices, weirs, baffles and other details are constructed of galvanized metal or wood to prevent any possibility of the clay being discolored by rust, as it is absolutely essential that china clay of first quality should contain no traces of discoloration.

DESIGN OF TURNTABLES FOR HEAVY LOCOMOTIVES.

Recent developments in the design of locomotives, accompanied by great increase in weights and changes in the distribution of weight on long wheel-bases, have introduced elements into the design and operation of turntables materially different from the problems of a few years ago. In view of these changes an exhaustive study has been made of present practice by a committee of the American Railway Bridge and Building Association, of which Mr. C. E. Smith, bridge engineer of the Missouri Pacific Railway, is chairman, and the results have recently been presented in a report to the association. A large amount of descriptive data regarding turntable design, construction and operation on fifty-seven railroads, aggregating 175,000 miles of line, is included in the report, and from this information the committee has formulated a number of general principles underlying present practice.

Length and Type of Table.—The committee found that in the past it has often been the practice to build turntables only long enough for engines actually in use, with the result that frequent enlargements have been necessary. Turntables now actually in use were studied in connection with the loading diagrams of the heaviest locomotives of the principal builders. It was found that for standard-gauge roads no future turntable should be built shorter than 75 ft., and that roads expecting to use the heaviest engines should adopt 90 ft. as standard. For engines having wheel bases longer than 90 ft. wye tracks should be provided unless special local conditions compel the use and justify the expense of a longer table.

The committee feels that the deck type of table is preferable to any other on account of low first cost, ease of operation and economy of maintenance, but sees no serious objections to through tables where conditions demand their use. Where through girders are used the best practice seems to favor providing supports for the ties by means of steel stringers and floor beams instead of using deep ties resting on shelf angles. The deep ties are expensive in first cost and maintenance and promote corrosion of the girder webs and shelf angles. The steel cross girders at the centre of the turntable require a depth at least as great as a standard floor system, so the depth of pit need not be increased for the floor system.

The depth of pit for the shorter tables will probably never be sufficient to compel the use of short through tables, say, less than 75 ft. The advantage of using through tables for the greatest lengths is indicated by the pit for the Pennsylvania 100-ft. deck turntable, in which the depth from base of rail to top of catch basin is 11 ft. 2 in., while for the Norfolk and Western 100-ft. through turntable the depth is only 7 ft. 6 in. Where through girders are used they should not be placed less than 15 ft. between centres, as with a closer spacing the danger arises of men getting caught between an engine and the girder flanges.

Loading and Stresses for Design.—Loadings and unit stresses used in the design of turntables are found to be greatly diversified. Cooper's loadings are believed to be unsuitable for this purpose on account of their short wheel-bases.

Turntables should be so designed that the deflection of the ends will not cause both ends to drag while turning heavy engines, and it should not be necessary to place the rails on the table too high above the approach rails to accomplish this, as that will result in too great a drop of the ends when an engine reaches the end of a table. In general, the rails on the table should not be more than ¾ in. above the approach rails and should come down level while engines are passing on or off. A deflection of ½ in. at each end, then, will leave ¼ in. clearance over the circle rail while turning. The unit stresses should be so chosen that the deflection of each end will be not greatly in excess of that amount.

Although a bridge designed for Cooper's loading will support, without any increase in stress over that used in the design, modern engines considerably heavier than the Cooper's loading, on account of the longer wheel-base distributing the load over a greater length of bridge, the same engine on a turntable will cause the stresses that affect the deflection of the ends to exceed very materially those used in design, for the reason that the longer wheel-base increases the negative bending moment on a turntable.

The tables should be designed for the heaviest actual engine that could use them. The unit stresses should be chosen low enough to keep the deflection down to a minimum, 10,000 lbs. per square inch for tension and compression and 6,000 lbs. per square inch for shear being reasonable values. With those stresses, it is not necessary to add for impact except at the ends, where live-load stresses in parts subject to pounding should be increased 100 per cent.

Construction of Pits.—Drainage of pits is always important, and becomes a larger problem with long tables and deep pits. The most satisfactory drainage is provided by catch basins and gravity drains, where the highest water in the outlet is lower than the bottom of the pit. Where this condition does not obtain, the problem of drainage can be simplified by use of through type of table, decreasing the depth of pit; use of shallow, non-tipping tables; waterproof pits, with sumps and pumping.

Little has been done to handle the situation by waterproof pits, sumps and pumping, and it appears that the extra expense and the neglect that may be expected, combined with the very deep pits for modern deck turntables, is so great as to indicate the desirability of through girders, provided direct gravity drainage can be secured for the through pits. A careful comparison of expense should be made before the through table is adopted.

The old practice of flooring over the entire pit has almost disappeared. Standard bridge ties are now used on the stringers of through tables or on top of deck tables, with occasional ties long enough to support footwalks outside of the locomotives. The width of the floor is 14 to 16 ft., and sometimes foot railings are provided. In a few cases pipe handrails are used on each side.

Great care is necessary in constructing the centre foundation. Most roads use bases 12 ft. square on 16 piles, rock or pile foundations usually being required. The top or bottom of the concrete centre is reinforced in many cases, and sometimes both. Settlement of centres is often stopped by excavating a trench around the footing, extending down 2 or 3 ft. deeper than the footing to permit underpinning, and increasing the base by filling the trench with concrete, sometimes on piles.

Operating Details.—The committee finds no necessity for locks where tractors are used, the power brakes being considered sufficient. In all cases where tables are turned by hand, locks should be provided. The simple I-shaped forging, sliding between the webs, answers the purpose well. Although it is convenient to have such a lock connected so that it will slide by the manipulation of a hand lever, it can be satisfactorily operated by hand, rings being attached for ease of handling. At outlying points it might be advisable to provide a locking attachment to keep boys from playing with the table and getting injured.

Electric power has the preference on practically all roads, and turning by air motors next for outlying points where tables are not much used and where current cannot

be obtained, and where trouble, necessitating turning the table by hand, will not be serious. Gasoline engines are recommended where electric current cannot be obtained and where liability of freezing renders the use of air motors objectionable.

Turntables of the non-tipping type, having supports at other points in addition to the centre, were considered by the committee, but it was found that they have given much difficulty to the principal users.

Approach and Circle-Rail Supports.—The committee recommends providing a support for the ends of the approach rails on creosoted coping timbers, not less than 12 in. wide at the narrowest point, and preferably 8 in. thick, with two heavy standard tie plates under the end of each rail, where the space permits this, or a special plate not less than 1 in. thick, 12 in. wide and long enough to pass under the two near rails of adjacent tracks, the plates to be drilled for track spikes or screw spikes and for lag screws for attaching them to the coping timber. The coping timber should be attached to the concrete by anchor bolts. Supports should also be provided for the circle rail by short creosoted ties about 15 in. centre to centre under main tracks and 24 in. elsewhere, with tie plates and screw spikes where available. To hold these ties in position and to prevent the accumulation of dirt and cinders, the space between them and between their outer ends and the parapet wall should be filled with concrete sloped to drain under the circle rail to the pit.

It is customary at present to build the circle walls of concrete, except at such points as timber walls are used to effect economy or for temporary installations. Where timber walls are used over hardpan or rock, blocking can be used, but care must be taken to break joints and in drifting the timber together to keep the wall from crowding forward. Where the foundation is not firm enough, piles should be driven as long as possible to refusal, spaced about 3 to 4 ft. centre to centre. Timber walls have been built, and can be built, in such a manner that they will be entirely satisfactory.

Where a concrete circle wall is used, great care must be taken to secure a sound foundation for the wall and for the circle rail in order to avoid settlement. The footing should be extended to hardpan or rock or supported on piles driven to refusal. The piles should be placed directly under the parapet and circle rail. Great care must be taken in placing the bearings of the approach rails and in placing the circle rail to get a perfect level. Some roads make the cross-section of the circle wall equal to that of a gravity abutment, but this is not necessary if a complete circle be constructed, as the arch effect permits the use of a considerably lighter wall.

It is of great convenience to have a recess in the parapet wall at some point and a concrete pit constructed around the recess through which access may be gained to the end of the table.

Practically all railroads report the use of concrete or brick paving for pits in standard installations at the most important points, concrete having the preference, but the majority also report many pits with no paving, the floor of the pit being finished with earth, cinders or gravel. Concrete or brick paving gives a much better appearing pit, but there is a question whether the expense is justified. The cost will be close to $1,000. A layer of cinders or gravel 6 to 12 in. thick will absorb all water and oil and will prevent the occurrence of mud. The growth of vegetation should be very easy to stop.

Conical Roller and Disc Centres.—The difference in cost between a poor centre and the best centre is so slight compared to the importance of avoiding trouble that the best centres available should be used. The conical roller centres appear to be satisfactory if properly designed, constructed and maintained. Improper attention to these features has caused much trouble and much criticism of this type. One of the principal faults with the design of former conial roller centres was the small length of the rollers, which created unit pressures greater than they should have been. This resulted in the wearing and flattening of the rollers and in the wearing of the rollers into the surfaces of top and bottom castings, requiring renewal of the entire centre. Rollers have now been lengthened and track plates provided on the castings, so that only the plates require renewal. The rollers and plates should be of hardened steel and the castings of steel.

In the earlier designs no means was provided for keeping the rollers a constant distance from the centre. Their working in resulted in rubbing on one another with consequent increase in difficulty of turning. Their crowding out resulted in the castings coming together and in the outer ends of the rollers working against the rough inner surface of the castings with damage to rollers and castings and increase in difficulty of turning. In later designs means are provided for holding the rollers in line. The most approved practice consists in placing a steel ring around the rollers, set screws or lugs projecting from the end of each roller or bolts passing entirely through the length of the rollers and through the live ring. Phosphor bronze frictionless washers or ball bearings are provided in many designs between the ends of the rollers and the live ring.

A large majority of the roads favor conical centres for turntables, though several report very successful results with disc centres. The committee recommends that properly designed disc centres be given serious consideration.

In the preparation of standard layouts the committee recommends the avoidance of frogs in approach tracks as far as practicable.

Relative to maintenance of turntables, it is believed that proper design and construction, together with frequent inspection, will simplify the work. They should be frequently cleaned and painted, with patch painting when necessary. At least once each year and as much oftener as centres are submerged by floods or turn hard for any reason, the table should be jacked up and the centre thoroughly cleaned and refilled with oil. To facilitate jacking, many roads provide steel brackets riveted to the table and concrete foundations for the support of the jacks on one diameter of the pit.

SOUTH AFRICAN WATER POWER

The Cape Times weekly edition of September 18th states that Mr. Charles Weidner, of Oudtshoorn, Cape Colony, has formed a strong syndicate which has acquired 100,000 acres of land with a frontage of some thirty miles on the Orange River, upon which it is proposed to erect power stations to generate electric energy from the volume of water falling over many cataracts.

This hydro-electric power is to be utilized in various ways:—

(1) To drive powerful pumps by which water may be raised to higher levels, in order that wide areas may be irrigated.

(2) To operate flour mills and other manufacturing plants which are to be established by the syndicate.

It is hoped that Canadian manufacturers may be interested in the above; and the subject is also interesting to persons engaged in irrigation work, as showing what is being done in South Africa.

ELECTRICAL SUPPLY OF MONTREAL.

Considerable interest has been aroused here in power and financial circles, and among the citizens generally, in the report which has come from Quebec to the effect that the National Hydro-Electric Company, with head offices at Montreal, is making application at the present session of the Quebec Legislature for the necessary powers to enable it to make use of the streets and roads of Montreal and, in fact, of the streets and highways generally in about a score of counties of this province.

The National Hydro-Electric is the company which owns the Carillon Falls power, of which considerable has been heard from time to time during the past few years. The Falls are situated some thirty-five miles up the Ottawa River from the city of Montreal, and they mark the head of navigation so far as the larger steamers are concerned. From Montreal to Carillon and return is the round trip of the line of steamers of which Mr. R. W. Shepherd, who died last week, was the manager.

The statement was made that the falls are capable of producing 160,000 horse-power, and that it would cost $10,000 to develop them. Manifestly, one or two cyphers must have been dropped off the sum mentioned, inasmuch as $10,000 would not commence to develop a power of any consequence, and the company would not be applying for powers to issue $12,000,000 bonds, as it is doing, if it could get along with just $10,000.

So far as concerns the report that 160,000 horse-power can be developed at the Falls, this would seem to be confirmed by the report of the Conservation Commission, it being therein stated that the Falls have a total possible capacity of 200,000 horse-power, when the Georgian Bay Canal has been completed. By this is no doubt meant that the storage reservoirs planned for the watershed near French River must be also brought into play before the total of 200,000 horse-power will be available. The head of water for the complete development would be about 40 feet.

Under present conditions, the conservation report gives Carillon Falls a possible development of 26,000 horse-power, at a head of 13.5 feet. Whether, by the expenditure of considerable money, any more than this can be developed previous to the actual completion of the canal or not, is not stated.

Mr. Henry Miles, the president of the company, is a well-known man in Montreal, having a few years ago been president of the Montreal Board of Trade. He says:—

"We believe that Montreal wants more power, and we want the privilege of bringing it in. The small plant we already have will shortly be in operation, and it will supply the neighboring municipalities with their requirements, as well as the company with what it requires while carrying out the work on the larger installation. Montreal wants more electric power, and if they give us the opportunity we will supply it."

Montreal should certainly be well supplied with electrical power very shortly. Already several companies are sending in current from different hydraulic developments, great and small, within one hundred miles of the city. The Montreal Light, Heat and Power Company is supplying from its developments at Chambly, Lachine Rapids and Soulanges Canal somewhere around 30,000 to 35,000 horse-power, and in addition to this it has auxiliary steam plants within the city. The principal interests in the company, as well as in its side-partner, the Shawinigan Water and Power Company, have lately acquired the Cedar Rapids power. This is situated near the Soulanges development just referred to, and is quite possibly the largest power obtainable anywhere near Montreal. It is claimed that in a very few years the Cedar Rapids Manufacturing and Power Company will be sending in 150,000 horse-power to the city of Montreal, or to the surrounding district. It seems likely, however, that a very considerable portion of this will be taken by certain large special industries which it is claimed will be established here by the time the power is ready. The Montreal Light, Heat and Power Company is also bringing in a large amount of power from Shawinigan Falls, it having contracted to deliver all the power for the Shawinigan Company required on the Island of Montreal. The present contract is for about 63,000 horse-power, though it is said that not all this is being asked for as yet. The Shawinigan Company is able to develop about 175,000 horse-power. Of this, 45,000 is sold at the Falls as hydraulic power, while the installation is prepared to deliver 85,000 horse-power, and the development is completed for 45,000 more, although the electrical machinery has not been installed for it. All the power previously mentioned, including 63,000 of the Shawinigan Company, is virtually in the hands of the Montreal Light, Heat and Power Company, and it is generally the ambition of each new power concern to compel the "monopoly" to buy it out.

The Canadian Light and Power Company is the one concern which is in opposition, and is likely to remain in opposition. Just what its development is, is difficult to say. It has been variously estimated from 7,000 horse-power to 25,000 horse-power. The statement is made on excellent authority that the company is actually disposing of and receiving pay for over 13,000 horse-power, so that ought to dispose of the 7,000 estimate. On the same authority it is stated that the company has a connected load of upwards of 20,000 horse-power. This does not include what is being generated in the city and district of Montreal, by the company's own plants or by those of its subsidiary companies. The Saraguay Electric and Water Company, which is a subsidiary of the Canadian Light and Power Company, is applying at the present session of the Quebec Legislature for authority to change its name to the Montreal Public Service Corporation, and to increase its capital to $5,000,000, and to extend its borrowing powers. All these companies, together with the Montreal Tramways Company, are subsidiaries of or component parts of the Montreal Tramways and Power Company which operates the street railway system of the city and island.

From the above it would seem that the power companies of Montreal are in a position to supply at all times from 100,000 to 125,000 horse-power. Should there be occasion, the Shawinigan Water and Power Company can provide 45,000 more, and it is understood that the Canadian Light and Power Company is making an effort to increase its capacity. The capacity of the Cedar Rapids Manufacturing and Power Company, within thirty miles of the city, may be counted on, and if the National Hydro-Electric, with its Carillon Power be added, it would seem that the requirements of the city of Montreal may double without pressing unduly upon the producing capacities of the companies mentioned.

The C.P.R. bridge across the Saskatchewan River at Outlook has been completed. The last girder was put into place recently and immediately the work of laying the rails was commenced. This bridge is one of the biggest in Western Canada, being over three thousand feet in length, and 156 feet in height. The construction work was commenced in 1909, and is conceded to be one of the biggest undertakings ever attempted to cross the Saskatchewan River. There are nine piers of solid concrete and the piers are 110 feet above the water level with a steel superstructure 46 feet high.

IMPROVEMENT IN FIRE HYDRANTS.

Every city engineer and fire chief is well acquainted with the cost of fire hydrants, and would welcome any efficient method that would allow of economy and certainty in this matter, but the question does not lend itself to an easy solution, owing to the increased pressure that is constantly being demanded from these hydrants by firemen in their improved methods of fire-fighting.

It has long been the ideal of fire fighters to secure some appliance that would automatically regulate the pressure of the stream, and several valves for this purpose have been devised, but their cost was prohibitive to their application to every hydrant. The problem has been solved by the portable hydrant head illustrated by Fig. 1.

This portable hydrant head may be quickly attached to any existing hydrant opening and contains a number of hose taps, each furnished with an automatic valve. In a city

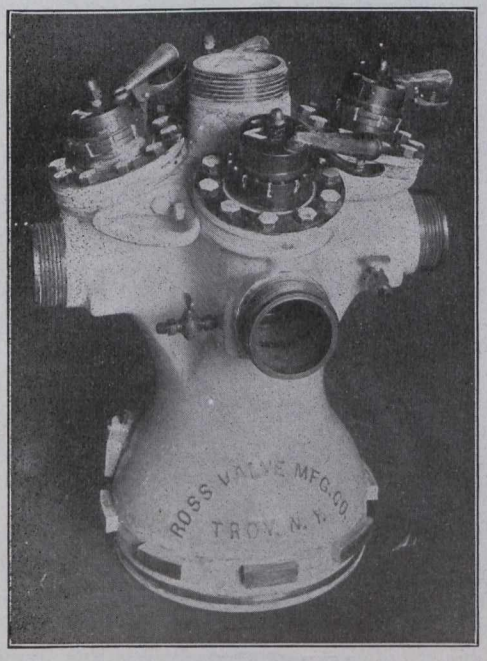


Fig. 1.—View of Portable Fire Hydrant Head.

where the system is operative each hose wagon carries one hydrant head, and the connection with the main is made immediately upon arrival.

This system was recently introduced in the high-pressure area of Baltimore, the hydrants being constructed for that municipality by the Ross Valve Manufacturing Company, of Troy, N.Y.

When attached to the main each hydrant sets flush with the pavement, and in order that many points of contact will be at the option of the firemen the means of connection with the water supply is greatly simplified; consisting of a cutting in the main with a section of 8-inch pipe welded in. The hydrant itself is of semi-cast steel resting on a concrete base in a concrete chamber with the upper end constructed to receive the portable head which is secured by a slight turn and may be placed firmly in position in a few seconds. When the special head is removed a grating covers the hydrant top and tap, giving a neat and unobstructive finish. The portable head has five hose taps and weighs about 110 pounds; four of the taps are fitted to take 2½-inch hose couplings and the fifth is fitted for a 3-inch hose. The tap handles are so placed and weighted that they balance the entire structure.

RAILROAD NOTES.

Work has been suspended on the Providence extension of the Central Vermont. The work has been stopped, it is said, owing to the unsettled condition of the money market in England. It was the first intention of the company to have the road from Palmer, on the Central Vermont, to Providence, a distance of 57 miles, completed by the end of the year. It is stated that thirty per cent. of the grading has been accomplished.

The Canadian Northern Railway will probably seek legislation this season providing for its maritime outlet for through traffic from the West. The final eastern link of the Canadian Northern system from Sudbury to Quebec now under construction, will be completed within a year or so. There is no provision for further outlet to the seaboard, and the road wants to be in a position to secure the through haul, instead of having to turn its traffic over to the rival roads at Montreal or Quebec when the St. Lawrence navigation season closes. The alternative schemes are running rights over the Intercolonial, or connections with the Boston and Maine.

The company is applying for legislation authorizing the construction of a line from Montreal to Levis, with a branch running down from St. Hyacinthe to Sherbrooke. At this latter point the road will make connections with the Boston and Maine line, giving a through outlet for export grain and other commodities via Boston. Thus the Canadian Northern Railway would be in a good position to compete with the Canadian Pacific Railway and the Grand Trunk Railway from coast to coast, and would be independent of these roads or their allies for the Atlantic outlet.

Important changes are to take place in the agreement between the Grand Trunk Railway system and the Wabash Railway, in connection with the Air Line branch, over which the Wabash has running rights. President Chamberlin, of the Grand Trunk, and General Manager Deland, of the Wabash, recently made an inspection of the Air Line division, so that there is indication that the Wabash Railway will increase its interests in Canada.

The Wabash Railway has completed arrangements for the purchase of three of the old Michigan Central car ferries for use on the Detroit River. Heretofore, the Wabash has used the Grand Trunk car ferries to handle its trains across the river.

Twenty miles of steel of the Temiskaming and Northern Ontario Railway on the new Elk Lake branch have been laid, leaving about ten miles to be completed. While a service may be inaugurated by Christmas, the Montreal River has yet to be crossed. The piers and coffer-dams are all ready, and the steel work is now being assembled at the factory. With fair conditions the work ought to be completed late in December.

The Chatham, Wallaceburg and Lake Erie Railway has been bonded by the Canadian Northern interests. The sum of $25,000 has been paid to secure the option. The action of the Mackenzie and Mann interests in securing this line is regarded as further evidence that the Canadian Northern Railway means to push through with the work in Western Ontario to Windsor.

The Peace River and Great Western Railway Company has opened offices in Edmonton and construction will be pushed next season. In the meantime preliminary work will be done. It is stated that surveys will be completed, ties cut along the right-of-way, and supplies sent forward during the winter for construction camps to be established in the spring.

LOSS OF HEAT FROM STEAM PIPES.

A paper was read by Prof. Petavel and Dr. C. N. Lander before the Engineering Section of the British Association (Dundee, September, 1912), in which they gave results of an experimental investigation to determine the relative importance of convection, conduction and radiation in promoting the loss of heat from hot wires and from hot pipes. They found that a bare 1-in. steam pipe in free air lost heat at the rate of 3 B.T.U. per sq. ft. per hour per deg. F. of temperature difference. Of this total, 15 per cent. was due to radiation, 4 per cent. to conduction, and the remaining 81 per cent. wholly to convection. In insulating a pipe it is necessary to determine the best density of the packing material. The best of such materials have thirty times the conductivity of air, so that, were it not for convection, clothing a pipe would increase the loss of heat. What actually happens is, that covering a pipe greatly diminishes the convection, but by an amount which depends on the closeness of the packing. If too tightly packed, the efficiency will be low, owing to an increase in the conductivity; while if too loosely packed, a large proportion of the convection still continues. Hence there is in each case a certain best density for the packing. In the case of slag wool, this is one-fourteenth of the actual density of the individual fibres. In this case the loss by conduction will rise from 0.1 to 0.4 B.T.U. per sq. ft. per deg. F. per hour, but the loss by convection will fall from 3.2 B.T.U. to 0.1 B.T.U. per sq. ft. per hour, the net loss being one-seventh of what it will be with a bare pipe.

With bare metal pipes the character of the surface has a distinct influence, but it affects only the loss by radiation. With a good machined surface this loss is reduced from 15 per cent. of the total to about 7 per cent.; polishing the pipe to a mirror-like surface will reduce this loss still further to between 3 and 4 per cent. of the total. Little, however, is to be gained by polishing in the case of ordinary steam-pipe temperatures, as the main loss—by convection—is not affected in any way by the condition of the surface. When the pipe radius is small, the conduction loss becomes the more important, so that the total loss varies with the pipe diameter. For pipes larger than ½ in. in diameter, however, this increased loss by conduction is unimportant. For bare pipes of about 1 in. in diameter the total loss, as stated above, is about 3 B.T.U. per sq. ft. per deg. F. per hour; for pipes above 4 in. in diameter the loss becomes nearly constant at 2 B.T.U. per sq. ft. per deg. F. per hour, irrespective of diameter.

RELATION OF RAILWAYS TO DEVELOPMENT

President Finley, of the Southern Railway, in an address before the Transportation Club, of Indianapolis, spoke on "The railway and the shipper." He said in part: "The railway and the shipper are each dependent upon the other. It is recognition of this dependence upon the shipper that has led the railways of the United States to adopt policies having for their purpose the enlargement of the business of shippers on their lines and the multiplication of the number of shippers. These helpful policies are based on sound business principles, for if we look beyond the immediate present, it is apparent that the ultimate prosperity of the railway is dependent upon the lasting prosperity of those upon whom it must rely for its traffic.

"In my opinion it is equally true that the shipper is dependent for his ultimate prosperity upon the lasting prosperity of the railway."

Mr. Finley pointed out that not only wages, but materials and supplies used by railways have advanced in price, and that their taxes, levied by government, have increased $80,000,000, or 167 per cent., since 1900, and amount for the fiscal year 1912 to about $130,000,000.

These facts were presented in order that some conception of the railway situation of to-day and of the problems with which railway managers must contend in their efforts to provide facilities for serving the shipper might be formed. Looking to the future development of the country and the growth of agriculture and manufacturing, it is clear that an increase in carrying capacity will be needed. Leaving out of account the new construction that should be undertaken in some localities, generally speaking, the policy of the railways should be that of keeping their existing plants abreast of requirements.

The practical question confronting those responsible for making these improvements is that of providing the necessary capital. The ability of the companies to attract the investment of new capital on reasonable terms will be measured by their net earnings capacity. Railway credit is dependent upon net income, and it is essential to the continued development of the American railway system that units of revenue shall bear a proper economic relation to units of cost.

The shipper who takes this broad view of the railway situation in all of its far-reaching economic bearings will be led to the conclusion that some rate reductions that are asked for are unreasonable and hurtful to the best interests of all concerned, and that some rate advances proposed by the railways would be helpful in their ultimate effects to the railways and the shippers alike.

When the time shall arrive that the shipper shall take the same lively interest in the railway by which he is served —when he shall study its reports and understand its needs and its resources, and when he shall look upon its progress as an indispensable factor in his own prosperity, the solution of the railway problem of the United States will be arrived at and the interests of the railway and the shipper have been promoted.

This is an opportune time for the railways and the shipper to draw closer together in mutually helpful cooperation. We have entered upon a period of general prosperity which is reaching all classes of our people, and it has come to stay.

ELECTRIC SMELTING IN CANADA

That a report demonstrating that electric smelting of Canadian ores is now a commercial possibility will be issued early in the year by the Mines Branch of the Department of Mines is announced in conservation. It will cover the results obtained from the use of the 100-ton electric furnace that was installed at Sault Ste. Marie, in 1906, for experimental purposes. In addition, the perfecting of the process as carried out in Sweden will be dealt with.

Such an announcement is of great importance to Canada, and especially to Ontario. Hitherto, the extensive iron deposits in Ontario have been scarcely touched, for two reasons: First, Ontario has to import all its coal; second, Ontario iron ores contain a relatively high percentage of sulphur, which could not be removed by the blast furnace. The new process will eliminate both these objections. Electricity will not only smelt the ore, but, by means of the greater heat that it will provide, it will volatilize and drive off practically every particle of the sulphur. The country surrounding the important iron deposits possesses valuable water-power resources, which, for the most part, have not yet been developed. It is thus easily seen that the introduction of an economical electric smelter will make possible an industry of vast importance to Canada.

COAST TO COAST.

St. Lawrence River.—The Minister of Marine and Fisheries, has ordered a strict enquiry into the recent shipwrecks that have occurred in this river.

Saskatoon, Sask.—The announced opening of the street railway for December 1st will likely be delayed owing to the non-arrival of the power house generators.

Ottawa, Ont.—The Board of Railway Commissioners for Canada will hold a sitting on Saturday, December 3rd, to discuss the protection of car repairers.

Ottawa, Ont.—Plans for the new Welland Canal are nearing completion, and from the estimates now available, it is expected that this work will cost $50,000,000 and take five years in building.

Calgary, Alta.—A recommendation made to the city council in a report submitted by the joint committee of council, park board, school board, and city planning commission, calls for a $600,000 system of parks, boulevards and playgrounds.

Province of Alberta.—At a meeting of municipal representatives recently held in Regina, the system of bonusing industries was condemned and a resolution introduced to have the governments of the other western provinces pass a law in conjunction with the authorities of this province, to have this evil reduced.

London, Ont.—Ald. Ashplant has made an estimate of expenditures upon the West London Embankment since the year 1898. During this space of time the sum of $31,000 has been spent on this work to keep the breakwater in proper condition. He will introduce a motion before the council to spend $45,000 and make the affair permanent.

Stratford, Ont.—Some items extracted from the Board of Trade report are of interest. The capital invested in local factories is reported as $3,597,913, with an annual output of $5,807,148. A wage bill of $1,323,199, and an army of 2,337 male and 553 female employees, with a total assessment of $9,708,780. The city has 12.81 miles of paved and macadam roadways, and 38.74 miles of concrete sidewalk.

Hamilton, Ont.—In January the ratepayers will vote on the new hydro-electric commissioners, and also vote on by-laws which, if carried, will authorize an expenditure of $910,000 for various civic works. The principal by-law will be to provide for the building of a storm sewer at a cost of half a million. Another is to raise $130,000 for the purpose of purchasing mountain face properties for park purposes.

Province of Saskatchewan.—The amount of construction of telephone lines in this province accomplished since March 1, 1912, is approximately 800 pole miles, and 1,572 wire miles. This gives a total for the province of 2,964.07 pole miles, and 9,744.3 wire miles. The number of toll offices opened and purchased to date is 228, and the total number of exchanges built and purchased to date is 80, with 12,802 subscribers.

Ottawa, Ont.—A report demonstrating that the electric smelting of Canadian ores is now a commercial possibility will be issued shortly by the mines branch of the Department of Mines. It will cover the results obtained from the use of the 100-ton electric furnace which was installed at Sault Ste. Marie in 1906 for experimental purposes and will also deal with the perfecting of the process as carried out in Sweden.

British Columbia.—The annual report of the Minister of Mines of British Columbia shows that taking the province as a whole there were 546 tons of ore mined per year for each man employed about the mines. In this respect, however, the districts vary materially as follows: Slocan District, 113 tons; Nelson District, 130 tons; Trail District, 372 tons; and in the Boundary District 1,201 tons were mined per man employed.

Victoria, B.C.—Creditors of the defunct Midway & Vernon Railway, a considerable part of which undertaking was taken over at the chartering of the Kettle River Valley Railway by that company, are to receive in the near future full settlement of their legitimate claims for labor, material, teaming, etc. Upon the incorporation of the Kettle River Valley line with government assistance in its financing, such aid was made conditional upon the payment of outstanding claims as against that portion of the line which they will utilize.

Dauphin, Man.—At the Board of Trade meeting held last week it was decided to approach the city council to further investigate the water power scheme at Meadow Portage with a view to approaching the government to connect the two lakes by a canal and secure the right to install and operate hydro-electric power plant. There being a fall of 18 feet between Lake Winnipegosis and Lake Manitoba, it is anticipated 40,000 h.p. can be generated there at little cost. This would give Dauphin a fine power supply at comparatively small cost.

Galt, Ont.—Ald. Dakin, chairman of the local Hydro-Electric Commission, will apply for power to inaugurate underground wiring, thus compelling the Bell Telephone Co. and C.P.R. and G.N.W. telegraph companies to transfer transmission lines to conduits. The policy to be followed is that conduits shall all be laid by the corporation, primarily for hydro-electric wires, but the extra cost to accommodate the lines of private companies shall be paid by them, according to the space used. This places the construction of the conduits entirely in the hands of the municipality.

Hamilton, Ont.—The matter of placing all wires in the down-town section of this city, as mentioned in *The Canadian Engineer* of last week, has been settled by the Hydro-Electric Power Commission issuing an order for the placing of all wires in the down-town district underground. This order involves the Cataract Power Company, the Hamilton Hydro-Electric service, and states that provision shall also be made for the telephone and telegraph wires. This is the first order of the kind to be issued under the legislation of last session under which the Hydro-Electric Commission could hold joint sittings with the Dominion Railway Board.

Province of British Columbia.—As the lines of the Grand Trunk Pacific Railway are pushed farther and farther westward several croppings of coal are found in unexplored portions of the province. Among the best so far found is the property on Kitseukla Creek, 12 miles from the railway and nearly south of Hazelton on the Bulkley River. Advices from British Columbia state that there are 31 seams of coal outcropping on this land and that of these two have been partially developed, one of them being 7 feet in thickness and the other 4 feet. The coal, according to recent assays, yields 68.5 per cent. of coke in addition to being a high-grade steaming and domestic fuel.

Collingwood, Ont.—The energy consumed by ratepayers from the civic power plant shows a steady increase. The monthly totals for last year and this are shown:

	1912.	1911.
January	$2.069	$1,911
February	1,848	1,759
March	1,391	1,392
April	1,270	1,518
May	1,118	1,126
June	1,011	910
July	974	991
August	839	663
September	1,060	905
October	1,561	1,259

London, Ont.—Adam Beck, chairman of the Ontario Hydro-Electric Commission, has submitted a report to the council of London, Ont., recommending the electrification of the municipally owned London and Port Stanley Railway at an approximate cost of $890,000. The report recommends the adoption of the overhead system and the double-tracking of the entire line between London and Lake Erie. The intention is to maintain a high-speed half-hourly service between London and St. Thomas. A fifteen-minute shuttle service between St. Thomas and Port Stanley would also be maintained for especially heavy traffic. The estimated gross revenue for the first year under electric operation is $261,500. Of this $140,000 would come from freight and $121,500 from passenger traffic. The estimated disbursements are $220,545, consisting of $130,000 for operating expenses and $90,545 on capital expenditure, leaving net earnings of about $41,000.

Edmonton, Alta.—Further extension of municipal ownership at Edmonton, Alta., was indicated when the commissioners directed City Engineer Latornell to report upon the cost of installing a paving plant of not less than 100,000 square yards capacity during the building season, also to engage a construction engineer qualified to take charge of of the city's paving work. The plant is to be in operation early next spring. The cost is estimated at between $40,000 and $50,000. The office of construction engineer is a new one in the city's service. His duty will be to take charge of the plant and supervise the paving work. The city will compete with private firms in all municipal work, taking contracts to keep the plant running at full capacity throughout the season. Five hundred thousand square yards of new pavement will be laid by the city next year, as against about 250,000 square yards put down during the season of 1912. It is expected that the specifications will be announced in January or February, giving ample time for contractors to assemble men and materials.

Niagara Falls, Ont.—The Ontario Power Company has filed an application with the Queen Victoria Park Commissioners for permission to install another turbine and generating unit, to be known as wheel No. 13. The necessity of installing this additional unit is the natural result of the greatly increasing load of the hydro-electric, which has assumed such large proportions that it has been found next to impossible to supply the demand for electric energy with the present machinery. The last two units installed, Nos. 11 and 12, have not yet been completed, but probably will be put in operation on or about January 15, but unit No. 13 will probably be placed in commission by July 1. With ten units already in operation, approximately 125,000 electrical horsepower is being generated, and this will be greatly increased with the completion of the three additional units. All of the exterior excavation work on the new wheel and Nos. 11 and 12 will be entirely completed by April 15, in compliance with an agreement between the power company and the park commission.

Province of Saskatchewan.—The large amount of work which has devolved upon the Department of Public Works in connection with the laying out of the grounds of the numerous government buildings in the province has necessitated the employment of an expert in this line, and Mr. Malcolm N. Ross has been appointed to take charge of this very important work. The grounds of the parliament buildings, of the university, the normal schools, the provincial asylum and the court houses will all be under his care. In some of the larger works such as the university and parliament buildings grounds where the architectural features of the buildings will have to be considered, Professor Mawson has been retained to assist Mr. Ross. Mr. Ross, who was until recently Parks Superintendent of the City of Regina, is a man with high qualifications for his new position. He is a Bachelor in Scientific Agriculture, a graduate of Guelph Agricultural College, with a post graduate experience in the several parts of the United States, and was in the employ of Mr. George Vanderbilt on the Viltmore estate in North Carolina.

Edmonton, Alta.—One hundred thousand dollars is the estimated cost of a three-story market building to be erected by the municipality of Edmonton, Alta., early in 1913. The plans, prepared by City Architect Jeffers, show a structure of horseshoe shape, built of reinforced concrete and brick with stone trimmings. The site chosen for the building is the present hay market in First Street, which is served by the municipal street railway and is within easy distance of the Grand Trunk Pacific, the Canadian Northern and the Edmonton, Dunvegan & British Columbia Railroads. The last named line is under construction and will serve the north country. Provisions have been made for stores and offices in the wings of the building, which will face First Street and Queens Avenue. An arcade entrance will lead to the market proper, consisting of long rows of stalls, where market gardeners and growers will be able to display their products and deal directly with the consumer. It is probable that a refrigerating system will be installed in the butter and egg and fowl and meat departments. The building to be erected next spring will form part of the general market. It is expected that a by-law to provide funds will be submitted to the ratepayers in a short time. Commissioner Chalmers, who has charge of the plan, states that the market is to be the central point for the street railway system, as well as for all the suburban lines on the north side of the Saskatchewan River. The suburban roads will become express lines within the city limits, running direct to the central station. This will facilitate the handling of products from the suburban communities and will be the means of settling the close-in districts.

EXPERIMENTS ON REDUCTION OF STRESS.

A description of and data from experiments made at the testing laboratory of the Darmstadt Technical High School on the reduction of stresses in metal members by rounding off sharp angles are given in a recent issue of the Journal of the American Society of Mechanical Engineers. The author states that although the fact that the stresses are particularly large at sharp angles was known for a long time, there are practically no experiments available showing numerically the precise influence of the radius of curvature

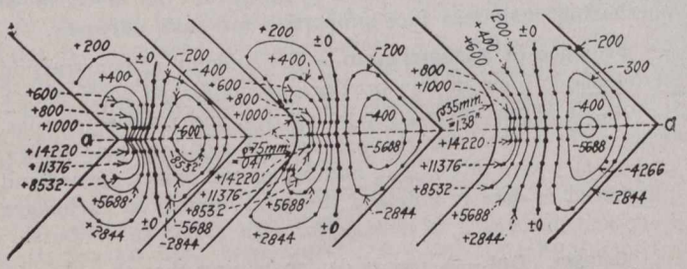


Fig. 1.—Distribution of Lines of Equal Stresses for Various Radii of Curvature.

+ Tensile stress; — Compression; o Points constructed from Measurements: above Line aa in kg/qcm, below in Lb. per Sq. In

on the stress at and near the point of flexure. Fig. 1 shows graphically how the change in the radius of curvature affects the distribution of lines of equal stresses. Among other things, these experiments have established the fact that the neutral point of stresses as found from actual measurements does not coincide with that determined theoretically.

PERSONAL.

W. COLIN EWING has been appointed junior assistant to Mr. F. G. Goodspeed, district engineer of St. John, N.B.

R. H. FLAHERTY, of Port Arthur, Ont., has returned from an exploration of Ungava district, in the interest of Mackenzie and Mann.

A. E. ROSEVEAR, assistant general freight agent of the Grand Trunk at Montreal, has been appointed assistant to vice-president, with office at Montreal.

HON. LOUIS CODERRE, M.P. for Hochelaga, Que., has become Secretary of State and head of the Department of Mines, which has been transferred from the Minister of the Interior to the Secretary of State.

R. S. LEA, the well-known consulitng engineer, of Montreal, is on a five-week Western trip. He will visit Medicine Hat, Edmonton, Kamloops and Vancouver, in all of which cities he has been retained in connection with large engineering undertakings.

EDWARD L. COUSINS, B.A.Sc., engineer to the Toronto Harbor Commission, is a graduate in civil engineering of the University of Toronto. The Harbor Commission, who were appointed last fall, chose him as their engineer in January of this year. Mr. Cousins was appointed divisional engineer for the Grand Trunk Railway, with headquarters in Toronto, on graduation. In July, 1910, he became Assistant City Engineer in charge of railways, bridges and docks. He was born in Toronto, and received his early education at St. Andrew's College. The plans of the Toronto harbor improvement, which appear in this issue, were prepared under his direction.

Mr. E. L. Cousins, B.A.Sc.

DR. FRANK D. ADAMS, dean of the Faculty of Engineering, McGill University, was recently the guest of honor at a dinner given at Albany, N.Y., by Dr. John M. Clarke, the state geologist, to celebrate the dedication of the new State Survey and Museum Building.

DAVID WHITE has been appointed by the secretary of the interior as chief geologist of the United States geological survey to succeed Waldemar Lindgren, who leaves Washington to become Rogers' professor of geology and head of the geological department of the Massachusetts Institute of Technology.

FRED. A. ROBERTSON ('08 Science, University of Toronto) who has been in charge at the Toronto office of the cement and reinforced concrete departments of the Canadian Inspection and Testing Laboratories Company, Limited, has severed his connections with the above concern to join the selling forces of the Canada Cement Company, Limited, out of Toronto.

ROC MAC CONSTRUCTION.

During 1911 a 1,200-ft. section of Yonge Street, at Toronto, Ont., was reconstructed for 30 ft. of its width with broken stone and the preparation "Roc Mac." The method of construction, as described in the last annual report of the city engineer, was as follows: The surface of the old macadam was first swept thoroughly in order to remove as much of the mud as possible. Upon this prepared base a paste consisting of a mixture of limestone dust and Roc Mac solution was then spread to a depth of about 1½ or 2 ins. The proportions of this mixture were ⅓ cu. yd. of dust to 5 gals. of the solution. Granite crushed to about a 2-in. size was then evenly spread to a depth of from 3 to 4 ins. The pavement was then rolled until the paste worked through the stone from the bottom and formed a slurry on top. All surplus slurry was always swept forward to the head of the work. This character of work depends for its existence largely on the care with which the rolling is done, it being necessary to carry on the rolling constantly until all voids are absolutely filled. Yonge Street carries perhaps a larger volume of traffic entering and leaving the city than any of the other main entrances, and during the progress of the work described above, this traffic was not interrupted for a moment, all vehicles being allowed to drive over the work no matter what stage it was in. It was found that the roadway when completed, although roughly used, had a very hard, compact surface, and for the few months subsequent to its completion it has carried all traffic without receiving any apparent impression other than that shown in the thin film of mud covering it in wet weather. The cost of the work was about 78 cents per square yard.

THE NOBEL PRIZE.

The Nobel Prize for physics has been awarded Gustaf Dalen, a Swiss engineer, who is head of the Stockholm Gas Company.

The Nobel Prize for chemistry has been divided between Prof. Grignard, of Nancy University, and Prof. Paul Sabatier, of Toulouse University.

The value of these prizes is $38,600 each

ELECTRICAL MEETING IN MONTREAL.

Mr. Fred Thompson gave an interesting paper before the Electrical Association recently on "Some Early Electrical Installations in Montreal." In 1883, he said, it was considered necessary to give an exhibition, and it fell to his duty to show some of the wonders of electricity in heating, cooking and lighting. The cooking demonstrations on electric stoves were, however, faked, and the tasty beefsteaks, fried eggs, tea and toast that were so praised were spirited from a back room, where they had been cooked on a gas stove, while those tried on an electric stove were badly frizzled.

The lighting of McGill University in 1884, when the British Association, headed by Lord Kelvin, visited the city, and how they had to run wires over citizen's front doors, trees and shutters, and how citizens were unable to open their doors, and threatened legal proceedings, was told in a most interesting manner by the speaker, who said that the ladies had taken a fancy to learn electricity, but their ardor cooled when they were put to covering wires, which was a very dirty job.

The establishment of connection between Montmorency Falls and Quebec, the running of wire across Victoria Bridge, and the railway experiments in 1892 were also referred to by the lecturer.

OBITUARY.

MR. PETER LYALL, well known in Canadian contracting circles, died at his home in Montreal recently. He was president of the Peter Lyall Construction Company, and connected with many other interests. Mr. Lyall was born in Caithness, Scotland, seventy-one years ago. He was early apprenticed as a stone mason and after thoroughly mastering his trade he came to Canada in 1870, beginning business under the auspices of his cousin, Peter Nicholson. Six years later he founded the contracting business which bears his name, and with which his three sons, William, Traill and Peter, Jr., are associated. This firm has developed until to-day it is unquestionably the largest construction company in the Dominion.

MR. GEORGE CRADDOCK, a well-known architect of London, Ont., died at his home in that city on November 16th last. He designed many of London's buildings.

COMING MEETINGS.

THE CANADIAN SOCIETY OF CIVIL ENGINEERS.—Meeting of the Electrical Section will be held in the rooms of the Society, 413 Dorchester St., West, Montreal, Nov. 21st at 8.15 p.m. Paper on "Transmission Line Design," by Mr. Julian C. Smith, M.C.S.E.E., will be read by the author. Chairman, L. A. Herdt

THE CANADIAN INSTITUTE.—198 College Street, Toronto. Saturday Evening Lecture, Nov. 23rd, at 8 o'clock. "The Prevention of Sewage Pollution relative to Water Supply," by T. Aird Murray, C. E., Toronto. Secretary, J. Patterson.

NATIONAL ASSOCIATION OF CEMENT USERS.—December 12th to 18th. Annual Convention, Pittsburgh. Pa. President R. L. Humphrey, Harrison Building, Philadelphia, Pa.

AMERICAN CIVIC ASSOCIATION.—Annual Convention will be held at Baltimore, Md., November 19th to 22nd. Secretary, Richard B. Watrour, Union Trust Building, Washington, D.C.

UNION OF MANITOBA MUNICIPALITIES.— Programme for Ninth Annual Convention to be held in Convention Hall of the Industrial Bureau, Winnipeg, Nov. 26, 27, 28, 1912. Secretary, Reeve Cardale, Oak River, Man.

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.

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.

AMERICAN ROAD BUILDERS' ASSOCIATION.—Ninth Annual Convention will be held in Cincinnati, December 3, 4, 5 and 6, 1912. Secretary, E. L. Power, 150 Nassau St., New York.

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. E. 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.

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.