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MECHANICAL HANDLING OF ASPHALT

DESCRIPTION OF A SMALL LAYOUT FOR THE HANDLING OF ASPHALT IN BULK—DETAILS OF CONSTRUCTION ARE SHOWN.

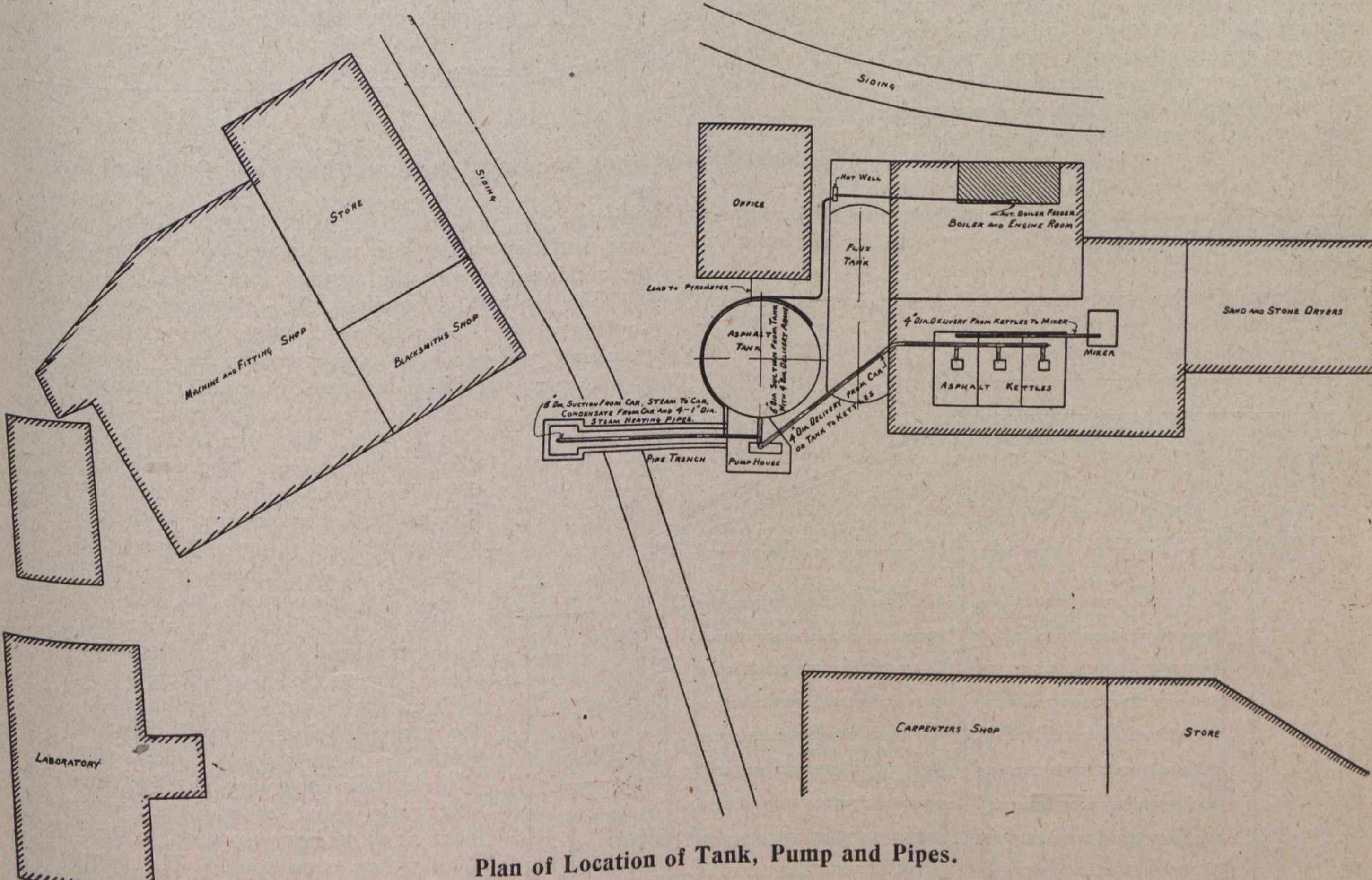
By **S. G. TALMAN, A.M.Can.Soc.C.E., A.M.I.E. (South Africa).**
Roadways Section, City of Toronto.

FOR the large consumer asphalt in the barrel has nothing to be said for its advantage, while its disadvantages are many. In initial cost it is more expensive than the article in bulk, it is costly to handle and store, quite a considerable amount adheres to the barrel without any practicable manner of recovery, the barrel itself being a complete loss, an eyesore until its removal, and an expense to get out of sight.

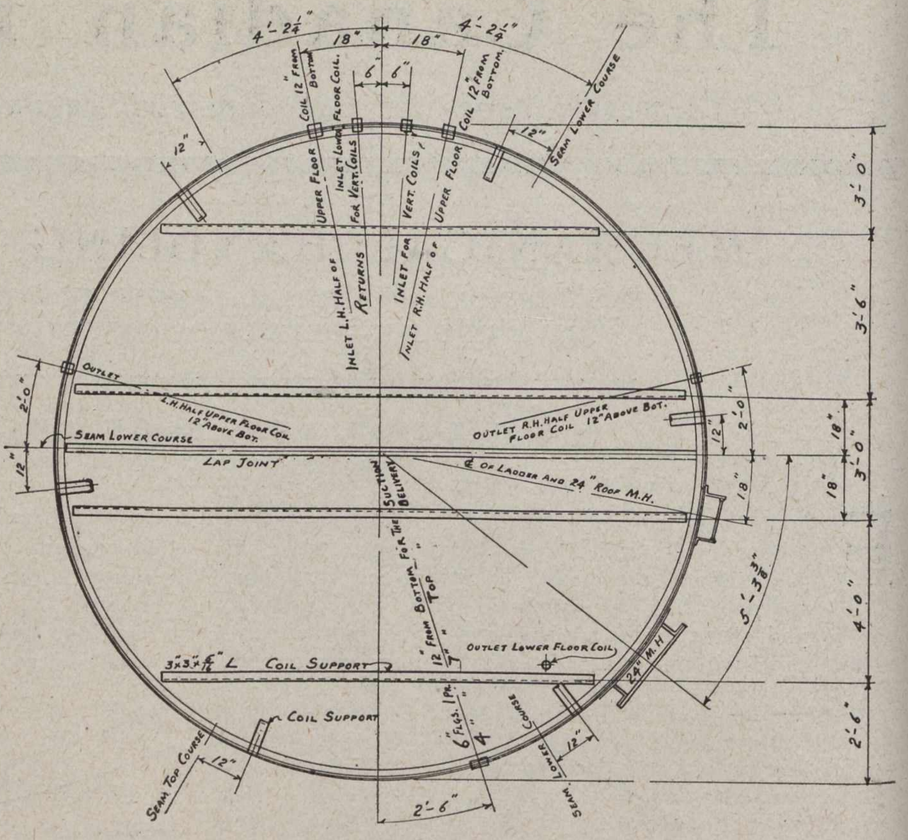
The alternative of mechanical handling seems to offer an approach to the ideal, and, as the writer knows of no data on the subject available for the immediate reference of engineers interested in the subject, he offers the following description of a small layout:—

The plant was installed at the corporation yard at Princess Street towards the end of last year, and has been running through the present year with entire satisfaction.

The tank is 16 ft. diameter and 16 ft. high, with a capacity of 20,000 imperial gallons, with a cone-shaped roof and ventilator. The plating is as follows: Bottom, 3/8 in., sides 5/16 in., and top 3/16 in.; the riveting, shell and bottom, 3/8 in. diameter at 2-in. pitch; shell and roof, 1/2 in. diameter at 2-in. pitch; roof-plates, 3/8 in. diameter at 1 5/8-in. pitch. Two 24-in. manholes are provided, one in the roof, with steel ladder accommodation to it from the ground or from the existing flux tank top, and one centred 2 ft. 6 in. from the tank bottom. The tank was shipped from the Toronto Iron Works in halves and field-riveted at the yard. Lap-joints are used in the shell, the roof is flange-jointed, and the bottom joint made with 2 1/2-in. x 2 1/2-in. x 3/8-in. angle. The foundation, which is on made ground, is a reinforced concrete slab, 18 in. thick, the tank resting on a 3-in. sand cushion, kept in place by a 6-in. curb 2 in. from



Plan of Location of Tank, Pump and Pipes.

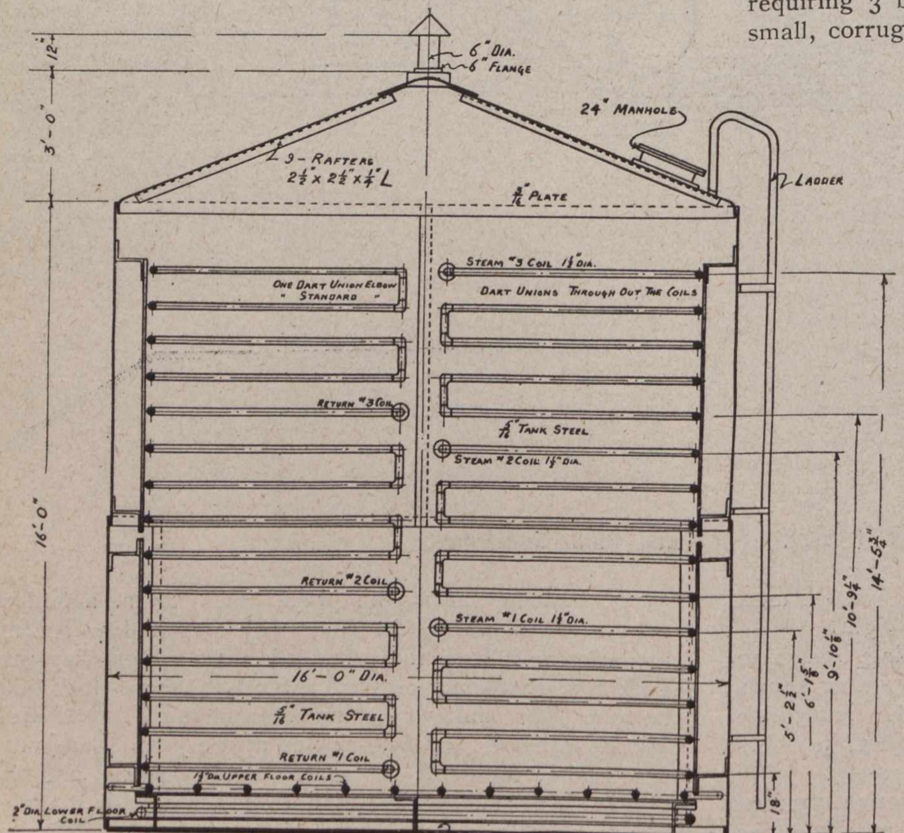


Sectional Plan of Tank Showing Location of Inlets and Outlets of Coils.

the outside of the tank, the space between being run up with asphalt, which allows for expansion and contraction and ensures a water-tight joint. The tank stands in the open.

Five sets of coils are used for heating, giving 512 sq. ft. of heating surface, two floor coils, the lower of 2-in. diameter pipe, the upper, which is in halves, with separate inlets and returns, of 1½-in. diameter pipe, and three vertical side coils, all of 1½-in. diameter. The lower floor coil is carried on small wood blocks with U-bolts 5 in. above the bottom at the inlet end and 3½ in. above the bottom at the outlet. The upper floor coil is carried on 3-in. x 3-in. x 5/16-in. angle supported by 2-in. x ½-in. flat steel 12 in. above the tank bottom. The side coils are carried by ½-in. diameter U-bolts through 2-in x 5/16-in. flat steel supported from the tank sides by 2-in. x ½-in. flat steel brackets. There are six of the vertical supports in halves, with two brackets to each half. Steam is led to the coils from the main boiler, a 100-h.p. horizontal type, each coil being fitted with halves to control the steam and condensate. The condensate from the coils is led to a common receiver and from there returned to the boiler by a No. 4 Cole automatic boiler feeder. An air-line is fitted to the steam coils to enable all the condensate to be removed by compressed air before the plant is shut down for the winter months.

Steam for heating the tank cars is taken from the main steam line through a short length of flexible steel hose and the condensate is returned to the boiler with the condensate from the storage tank coils.



Sectional Elevation Showing Arrangement of Coils.

The asphalt is handled by a Bawden pump, 8-in. diameter steam, 7-in. diameter pump and 10-in. stroke, requiring 3 boiler h.p. to operate it. It is housed in a small, corrugated iron building by itself. The pump and strainer are steam-jacketed. The suction is 5-in. diameter and the delivery 4-in. diameter pipe fitted with four 1-in. diameter steam pipes on the outside, the whole being covered with 2 in. of magnesium and 24-gauge tinned sheet, the radiation being reduced to about 1 per cent. For a considerable length of the suction there is also the 2-in. steam pipe to the tank car and the condensate return pipe. The suction is connected to the car with a short length of flexible steel hose, the asphalt being pumped direct to the kettles or to the storage tank as required.

The tank cars vary slightly in load, averaging about 76,000 lbs., and take from 24 to 36 hours to melt, according to atmospheric conditions. The pump will handle the asphalt at 250° F., but 265° F. to 270° F. gives more satisfaction. Cars are emptied in 40 to 45 minutes.

A Thwing electrical pyrometer is fitted in the office, from which the temperatures in the tank can be read at 2 ft. and 8 ft. 6 in. from the bottom.

In conclusion, the writer would suggest having a steam jacket round the side and bottom of the tank in place of the floor coils and lower side coil, dishing the bottom and taking the suction from the centre. The initial cost would be greater, but maintenance charges and risk of leaky joints would be less.

Carrying the remaining side coils in a spiral round the tank, with a good circular sweep into the tank at the inlet and outlet ends and plenty of freedom in the U-bolts. This would give ample room for expansion and a good fall in the pipes.

Fitting each coil with a steam trap, enclosing the tank in hollow tile or other suitable construction, and installing two pumps in place of the single unit.

ROAD DRAINAGE AND FOUNDATIONS.*

By Major W. W. Crosby,
Consulting Engineer, Baltimore.

IT will be assumed that the "Drainage" referred to in the title is that provision made for taking care of the water so as to improve the foundation or protect it from injury, and is not intended to cover provisions to be made for the disposal of surface or storm water to be cared for in any event. Drainage, therefore, becomes a consideration in this paper incidental to foundations and reference to it will be made along these lines instead of by attempting the really impracticable separate consideration of it.

Let us, in approaching the subject of foundations, first divide the foundation into two classes—the natural and the artificial. The natural foundation must ultimately be that portion of the earth's crust on which the beginning of the artificial structure rests. It may be some distance below the surface of the roadway and be separated from the surfacing of the latter by various layers of construction, including an artificial foundation.

The requirements for a foundation are (a) that it shall be capable of supporting, under the most adverse conditions likely to surround it, the loads coming on it; (b) that it shall be homogeneous and uniform to an extent sufficient for the probabilities of the case; and (c) that the above qualities "a" and "b" shall be obtainable at the minimum cost in the long run.

Considering now natural foundations, *i.e.*, road beds on the soil in situ—when the proper grades shall have been reached by excavation or embankment it is evident that requirement "c" is complied with. Questions as to "a" and "b" above immediately arise. When the material is ledge, sand or sandy gravel, and perhaps some other materials, there will be slight if any need of further considering "a." There may be, however, need for considering a subordinate matter involved in "a," and that is the question of the probable permanence of the supporting power of the material under such conditions as may later arise. For instance, the incompressibility and supporting power of sand may be extremely high as long as there shall be no chance for the sand to flow. On the other hand, the tendency of the sand to flow may be tremendously increased by the assistance of water. Consequently the probabilities of the presence of other conditions which would seriously injure the supporting power of even such materials as sand and gravel must be considered, and such precautions taken by provisions for drainage perhaps as will prevent the existence to a dangerous degree of such conditions.

Drainage thus enters into the consideration of the foundation. If for no other reason, drainage must be provided in order that water shall not by its advent into the foundation injure the supporting power of the latter seriously. Again, if the amount of water normally present in the foundation is weakening its supporting powers, drainage may be provided to take away this water and thus at a moderate expense frequently to render satisfactory the natural foundation material, as well as to protect it from further weakening against the advent of more water under abnormal or exceptional conditions. With earths less desirable than sand or sandy gravel as foundations, in view of their weaker supporting powers or greater liability to weakness under adverse conditions, the necessities for proper consideration of their capabilities and of the probabilities and effects of adverse conditions are emphasized. Here, again, careful consideration of the possibilities of proper drainage, toward an economic and effective solution of the problems, enters.

So much has been said and written regarding the details of drainage that the writer will not attempt to go into these matters again here. He believes that, if he has made intelligible the reasons for drainage in connection with foundations, his readers will be perfectly well able to work out the details of construction for themselves. He would simply add one word of caution, and that is, the drainage provisions in every case should be not merely sufficient for the conditions existing at the time but should be ample to take care of any conditions that may seem possible of occurrence.

As provisions for the protection of natural foundation in its most stable form begin to be demanded, and as provisions for protection against adverse conditions are demanded and begin to accumulate, it will be seen that consideration of the substitution or interposition of an artificial foundation for the pavement enters, in order that requirement "c," as well as requirements "a" and "b," shall be met, and a permanently stable, uniform support for the pavement surface shall be provided at the minimum cost.

Perhaps a few words regarding requirement "b" should be said here before proceeding further. The desirability for uniformity in the foundation for a pavement is going to be more generally recognized. It is important because otherwise uniform wear of the surface is not likely to take place, and uniform wear of the surface, even if somewhat more rapid, is more desirable and less expensive to counteract than light or slow wear in some spots and heavy or rapid wear in adjacent areas. This latter condition means constant expense and trouble to keep the pavement surface in satisfactory shape. A uniform wear, however, requires little if any expense for keeping the surface in satisfactory condition, and if not too rapid, will not result in as much expense in the long run.

Most natural materials can be made into sufficient foundations for pavements if they are of the so-called "mineral kingdom." Vegetable matter ordinarily cannot be, and must be excluded from the foundation because of its tendency to instability. The question, however, as to whether to use the natural mineral material in place, or whether to substitute something else for it, is often mainly an economic one, and comprises, as will be seen, the question of whether or not the material is, and will be sufficient for the purpose in its natural state and the question of what it will cost to preserve it indefinitely in a satisfactory condition, or what it will cost to remove the material and substitute therefor something else more satisfactory. The decision should be on the safe side, if for no other reason, because of the probabilities of unexpectedly severe strains eventually coming on the foundation. The modern tendencies are toward the more severe use of roads and street, with greater demands on thei. foundations than heretofore, and these tendencies shou d be recognized. On the

*Paper read before the 3rd Canadian and International Road Congress.

other hand, the need for economy is equally rapidly growing greater, and if, as the old definition has it, "the engineer is a man who can do with one dollar what any fool can do with two," the demands of economy—*i.e.*, true economy in the long run, must be recognized and sought by him.

The decision in this matter at present must be made largely on the basis of judgment founded on general knowledge and experience. There is little scientific data recorded to guide one in the matter though there is some. It is admitted that the stresses from the load on the surface of the pavement passing down through the body of the pavement itself are distributed over a larger area of the foundation. The supporting powers of various kinds of earth have been approximately determined. If, now, some conclusions can be reached as to the distributing effect of the stresses through the surface of the pavement, a fairly accurate determination of the questions concerning the use of the natural material or the substitution of other material for the foundation of the pavement surfacing may often be had.

Summing up in regard to natural foundations for roadways, it may be said that the highway authorities should be sure that the supporting power of the material is and will be continuously sufficient for the purpose, and that sufficient protection against injury to its supporting power is provided, that the foundation shall be stable in place and sufficient protection against displacement of it shall be provided; that the natural foundation shall be homogeneous and uniform in character; and that these results shall be obtained at the minimum cost. Possibilities of failure in any of these respects should generally warrant the authority in prescribing reinforcement by foreign material or the substitution of other material for the natural foundation, or in prescribing the use of an artificial foundation.

Artificial Foundations.—Under the head of artificial foundations will be included for convenience all layers of foreign material not naturally found in place and specifically provided for the purpose of interposing a layer of some sort between the natural material and the pavement surfacing. Consequently, under this head will come layers of sand, gravel or similar material, macadam (old or new), paving (old or new), as well as the more common exposition of the term—*i.e.*, the concrete slab.

A layer of sand or gravel as an artificial foundation for the pavement is sometimes used to good advantage on subgrades whose supporting power is relatively weak, under such conditions as may be expected to prevail around it, and largely for the purpose of distributing, through the medium of a cheaply installed layer, the stresses coming down through this layer from the pavement, so that the strains on the foundation will be within what might be called the "elastic limits" of the latter. Sometimes, the further advantages of such a layer are that they assist in providing drainage and in increasing the stability of the sub-grade in places. For instance, such a layer may be valuable in preventing the serious effects of frost action otherwise taking place in the spring. Again, with sub-grades of clayey material, such a layer of sand or similar fine material, will prevent the working of the sub-grade material up into the somewhat porous bottom layer of the macadam to the detriment of the latter. Again, economy may dictate the use of a layer of considerable thickness, say, two feet of sand for the foundation of a pavement where traffic conditions will be relatively light and yet an insufficient natural sub-grade exists locally.

Properly graded gravel with sufficient sand in it to reduce the voids to a minimum will prove an even stronger artificial foundation than the sand layer above referred to, as there will be less tendency toward displacement under traffic. In the same way, macadam may be superior to the gravel layer and a thinner foundation of macadam may equal or be superior to a much thicker layer of the best available gravel. Well-compacted macadam is high in its supporting powers and in its stability in place. The difficulties of using it as an artificial foundation are those always found with materials containing a large percentage of coarse particles—*i.e.*, it is difficult to get its surface sufficiently even so that the surfacing shall be sufficiently smooth, and at the same time have the requisite degree of uniformity in thickness. Without going too much into the question of surfacing, the writer wishes to point out the necessity, for the sake of evenness in wear, of uniformity in thickness for the surfacing layer of a pavement, whether the latter be sheet asphalt, wood block, brick or stone block. It is true that the blocks are now generally made with a reasonable degree of uniformity in this respect, but if the bedding material on which they are placed be, as is frequently the case, sand, it must be considered as a part of the surfacing layer. The necessity for this bedding layer to be of reasonable uniformity in thickness is now generally recognized and a general demand exists rationally for a high degree of smoothness and evenness in the surface of the foundation. This demand will exist and even become more severe so long as a layer of material quite different from either the foundation or the surfacing material itself shall continue to be placed between the two.

Many brick pavements have been laid using the old macadam surfacing as a foundation. The failures of most of them have been directly connected with the unevennesses of the sand layer required for the purpose of evening up the surface of the macadam and furnishing a bed in which to set the brick. Where newly laid macadam was attempted, to provide fôr a foundation for such pavements, some of the failures have been attributed to insufficient consolidation of the macadam prior to the brick laying and to subsequent shifting of the sand layer between the macadam and the brick, which shifting was caused or intensified by the passage of the sand into the interstices of the insufficiently compacted macadam foundation, as well as to the lack of evenness for the surface of the macadam and lack of uniformity in the thickness of the sand layer.

Old pavements have frequently been used as foundations for new pavements and in some cases, an artificial foundation in the shape of a stone pavement has been provided for the new pavement. Such foundations are of considerable antiquity. The Telford pavement as a base for a macadam surfacing is a well-known instance. There are many cases in cities of this country where the streets were originally paved more or less roughly with stone blocks, or so-called cobble stones, and these old pavements used, with or without relaying, as foundations for different kinds of pavement surfacings. Various degrees of satisfaction have resulted. Properly laid, the supporting power and stability of such foundations is relatively high and in many cases under the local conditions, their use has been economical. On the other hand, in some cases, the development of traffic conditions has resulted in such severe strains on these foundations that they have failed, and have had to be replaced by the more substantial concrete slab. Probably most of the failures of these pavements as foundations have come through the lack of evenness of surface obtainable on them, and a consequent lack of uniformity in the thickness of the pavement surfacing.

Apparently the highest type of artificial foundation is the concrete slab. The power of such a foundation to

(Continued on page 101.)

POWER DEVELOPMENT IN SASKATCHEWAN.*

By E. Hanson, A.A.I.E.E., M.I.Mun.E.,
City Electrical Engineer, Saskatoon.

THE city council of Saskatoon passed a resolution some time ago urging the provincial government to take steps to investigate the Churchill River with a view to the development of electrical energy for distribution throughout Saskatchewan.

This resolution brings up again the question of water power development and distribution throughout this province on a basis similar to that on which it is carried out by the Hydro-Electric Power Commission of Ontario.

Even if it is found possible to obtain power from the Churchill River, such an investigation, to be of any permanent service to the province as a whole, must include data as to the stream flow, storage possibilities, etc., covering a period of, at least, ten years.

In the meantime this country is passing through a period in its history, when help of any description is urgently required, and will permanently affect the prosperity of the province.

The situation in Saskatchewan, as I see it, is this: The trend of colonization is westward; our railways are situated in the southern half of the province; the distance from our markets, both for buying and selling, is very great; no other means of transportation being possible but by rail, freight rates are, naturally, high; in many cases, prohibitive. Labor, owing to the relatively high cost of living, is also expensive; therefore, to encourage the development of our province and the establishment of industries, there remain only two solutions to the problem of decreasing the cost. Of these two, navigation and cheap power, I shall deal only with cheap power.

There does not seem to be a clear understanding in the minds of many people as to the limitations of water power, and the difference between, say, this province and the province of Ontario, which is a typical example.

In Ontario the manufacturing centres are situated at, or very close to, the centres of power development, thus making possible the distribution of power on a large scale for industrial and municipal purposes; whereas, the nearest possible source of water power development in Saskatchewan is situated on the Churchill River, 161 miles north of Prince Albert, which is the nearest city. These 161 miles pass through virgin territory, having almost no settlers. This, apart from any other consideration, would mean expensive development, owing to the distance of transmission away from the nearest railroad point.

The distance from the source of power to the various centres from which power would be distributed, is so great that, for economical purposes, a very high transmission voltage would be necessary. This introduces trouble, and other troubles peculiar to extra high tension voltage.

The object of water power development on a large scale in any province is to foster industries. Now, the chief industrial centres of Saskatchewan are Regina, Saskatoon, Moose Jaw, North Battleford, Prince Albert and Yorkton. The distances between these points are as follows: Moose Jaw is 42 miles west of Regina; Regina is 160 miles south of Saskatoon; Yorkton is 103 miles northeast of Regina; Prince Albert is 87 miles north of Saskatoon; Battleford is 80 miles west of Saskatoon; Prince Albert is 161 miles from the nearest point on the Churchill River. A total of 633 miles of transmission line.

*Paper read before the Utilities Engineering Society, Saskatoon, June 14th, 1916.

These distances are taken "as the crow flies," therefore the estimates which follow are only approximate.

The estimated average cost for the aforementioned extra high tension, say, 150,000 volts, and of sufficient capacity, would be about $10,000 per mile. This, I think, is a very fair estimate, and it must be remembered that 161 miles are entirely out of touch with any railway facilities, so that haulage and labor on that end would be extremely high. The mileage, at $10,000 per mile, would make a total expenditure of $6,330,000, which, at 10 per cent. for interest and sinking fund, would leave $633,000 as an annual charge against revenue, to be borne directly by the above-mentioned cities in proportion to their average maximum demand, which would be as follows:—Saskatoon, 2,500 kw.; Regina, 2,500 kw.; Moose Jaw, 1,250 kw.; Yorkton, 150 kw.; North Battleford, 450 kw.

The Department of Mines at Ottawa has issued a map showing the coal fields of Saskatchewan.

The investigation from which this map has been developed shows that we have vast fields of lignite in this province and, with very few exceptions, those have never been developed to any extent.

One of these lignite fields extends from the international boundary, passing Moose Jaw within fourteen miles, and within thirty miles of Regina. Another field of Belly River coal formation extends from the international boundary in Alberta, going north from Lethbridge and Medicine Hat, crossing our provincial boundary and extending north to within thirty-five miles of Battleford. The eastern edge of this field is within fifty miles of Saskatoon.

I might mention in passing that this field is the same as that from which we get the coal which we have been burning with very satisfactory results in our power house for the last two years. It is supplied from Lethbridge.

It is estimated that there are billions of tons of this lignite lying untouched and undeveloped.

S. M. Darling, in his report on the carbonizing and briquetting of lignite, covering an investigation carried out by him for the government of Saskatchewan during 1914, on the Souris River coal field in the vicinity of Estevan, states that power can be produced for $8 per horse-power year (at the switchboard).

I have gone into this report thoroughly, and have no doubt but that such is the case, and find that, besides making possible the generation and distribution of cheap power, it solves the problem of cheap heating for out-of-town dwellers, as it could be sold for about $2.25 per ton in any part of the province.

Mr. Darling also points out that in the development of this power, the straw which is produced in this province from our agricultural activities, and which is at present wasted by being burned, would, with cheap power available, form the basis of a paper industry. In addition to all this, there are the by-products from the tar and ammonia compounds. The very fact of the numerous industries which the development of this lignite in Saskatchewan would make possible, seems to me an unanswerable argument in favor of the development of these fields as quickly as possible.

Now, I will endeavor to show that the development of these lignite fields, with the necessary transmission lines, making a network throughout the province, covering the greatest part of its settled portion, will be very much cheaper in the initial cost; also very much cheaper in the cost per kilowatt, at least for a great many years to come, until such time as the province has been developed to the stage where development of water power from the north can be tied in with the then existing transmission lines.

Meantime, while developing our resources, producing power, at least equal in price to Niagara power, and fostering the industries which are already in the province, the development of these fields will, in each and every one of its various steps, tend towards the ultimate grand programme of the development of this province.

This development also, owing to the fact that its transmission lines will run mostly north and south, will have a tendency to settle the country along the lines which are for the ultimate good of the province, in a way that will cheapen freight rates and shorten hauls, *viz.*, from the south, northward.

In dealing with a power development scheme, when the towns to be supplied have already their own power houses, the greatest drawback is the enormous capital charges, which, in every case, have to be met and, of course, added to the cost of power, in order to determine the cost to the consumer.

The following figures are based on 1915 reports of the various cities mentioned and, as is the case in Saskatoon, the output for 1916 will, we hope, be larger than for 1915, thereby reducing these charges. For estimating purposes, however, we can only take reports for the period immediately preceding the estimate.

The capital charges, on this basis, would be as follows:—

City	Capital charged per K.W.H.
Saskatoon	1.31c.
Regina	1.60c.
Moose Jaw	1.93c.
North Battleford	1.99c.
Yorkton	4.34c.

Assuming that we are charged on the basis of maximum demand per month, I have arrived at what I consider the average maximum demand for a year, which will give us the cost for power per annum, bought in bulk. These figures are arrived at by assuming a maximum price of $8 per horse-power per annum at the switchboard, and the total cost works out, taking the 1915 output, as follows:—

Saskatoon	$26,800	.3523c.
Regina	26,800	.3640c.
Moose Jaw	13,400	.4200c.
North Battleford	4,824	.6030c.
Yorkton	1,608	.4541c.

The total capital expenditure on the transmission line, at $10,000 per mile per annum would be, approximately, $6,300,000, and as I have allowed $8 per horse-power year, we do not require to take into consideration any capital charges on power development, as this, of course, is included in the current rate. Assuming 10 per cent. overhead charges on line, which would include capital charges and maintenance of line, this would equal 3.26c. per kw.h. on the metered output of the above-mentioned cities, and would give us total charges as follows:—

	Saskatoon c.	Regina c.	MooseJaw c.	N. Battleford c.	Yorkton c.
Capital ...	1.31	1.6	1.93	1.99	4.34
Max. demand	.3523	.364	.42	.603	.4541
Line charges	3.26	3.26	3.26	3.26	3.26
Line losses .	.0352	.0364	.042	.0603	.0454
Distribution.	.15	.15	.2	.4	.6
	5.1075	5.4004	5.852	6.3133	8.6995

Against the above, the cost, if produced by the development of the lignite fields, would be as follows:—

	Saskatoon c.	Regina c.	MooseJaw c.	N. Battleford c.	Yorkton c.
Capital ...	1.31	1.6	1.93	1.99	4.34
Max. demand	.3523	.364	.42	.603	.4541
Line charges	1.627	1.627	1.627	1.627	1.627
Line losses .	.0352	.0364	.042	.0603	.0454
Distribution.	.15	.15	.2	.4	.6
	3.4745	3.7774	4.219	4.6803	7.0065

In this case I have assumed the cost of the transmission line to be $8,000 per mile owing to the fact of the very much shorter distance, and the proximity to railway facilities, as well as the fact that a lower transmission voltage would be economically possible, thereby reducing the cost.

The total cost per kw.h. metered at these various places last year was as follows:—

Saskatoon	3.51c.
Regina	3.31c.
Moose Jaw	4.72c.
North Battleford	....
Yorkton	9.11c.

Now, even with these results, the proposition does not, on the face of it, seem to be a very profitable one for the cities. However, the transmission line will run through settled country, and a lower voltage will be possible, thereby enabling us to supply, cheaply, every municipality along the line of transmission. The railway companies, too, glad of an opportunity to cheapen the cost, especially in handling their peak load, which is during the grain rush, by electrifying their systems, would create a demand which would still further reduce the cost per kilowatt-hour.

I would advocate that in all districts adjoining the main transmission line, every municipality be approached, and an agreement made with them, whereby they would take a certain block of power to be distributed among the farmers.

Now, the question of the farmer taking power is no small one, and while in this country we are not accustomed to associating the farmer with the consumption of electricity, yet, that this is a fact is shown wherever the transmission line runs through a farming district, as, for instance, in Ontario, Colorado, Ohio, and numerous other sections of the United States, but these few will suffice as examples.

I think that in view of the many uses and labor-saving devices to which electricity can be applied, a small estimate of the amount of power which each farmer would require would be about 10 h.p. This, coming off the line at, say, every second municipality, a distance of about 15 or 20 miles, would materially lighten the overhead cost on the transmission system, and assuming that this load even lightened the capital charges to the extent of 50 per cent., would give figures as follows:—

Saskatoon	2.6610c.
Regina	2.9639c.
Moose Jaw	3.4055c.
North Battleford	3.8668c.
Yorkton	6.253c.

Besides this reduction, and the greater assurance of continuity of service made possible by the shorter transmission line, the cities which have steam plants at present in operation would be in a position to develop a system of steam heating from the central station, which would again materially lessen the capital charges per kw. hour without affecting the stand-by value. The aforementioned possible railway traction load, also, would be quite a factor in reducing the cost per unit.

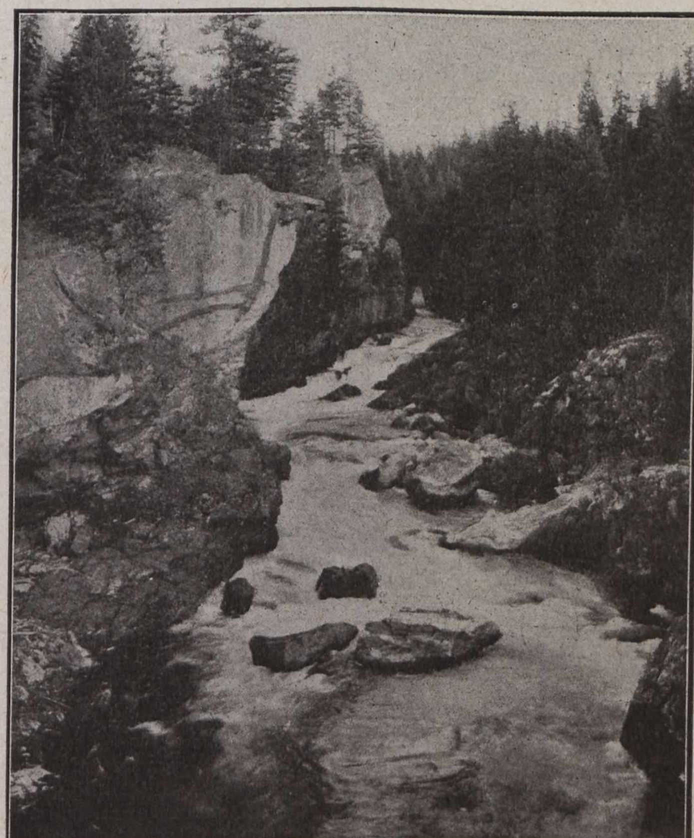
COUTEAU POWER COMPANY DEVELOPMENT.

OWING to the war, the proposed hydro-electric development in the Osoyoos Division of the Yale District, British Columbia, has been temporarily held up. The Couteau Power Co., Limited, the owners of the power rights, is a Mackenzie-Mann company. The proposed development is said to show good prospects of being a financial success, and it is most likely that work will be undertaken at an early date if finances can be arranged, or at least so soon as the war is over.

The following description of the enterprise was written by A. R. Mackenzie, Assoc.M.Inst.C.E., consulting engineer, Vancouver, for use in Mr. Conway's "Water Powers of British Columbia":—

The site of the initial and main power plant at the Shuswap Falls, on the Spallumcheen River, lies 26 miles due east of the city of Vernon, and 9 miles east of the small town of Lumby, at an elevation of 1,500 feet above the sea-level. The Spallumcheen River flows from Sugar Lake, 20 miles northeast of the site, while Sugar Lake will provide storage for the full development which, situated as it is in the "dry belt," will be essentially a storage proposition.

The drainage area above Shuswap Falls, mainly mountainous country difficult of access, amounts to between 800 and 900 square miles. Rainfall records have been taken uninterruptedly for the last ten years at a point distant 20 miles west, and at the same altitude, giving an average annual total precipitation of 12 inches. The Couteau Power Company's hydrographers, operating for the last three years at Shuswap Falls, return an average annual precipitation there of 20 inches, including an average annual total of 45 inches of snowfall at Shuswap Falls and 90 inches at Sugar Lake, with an average maximum lying depth of 3½ feet and 6½ feet respectively. At both places the ground is bare of snow from the middle of April to the middle of November.



Shuswap Falls, B.C., Site of Proposed Development of Couteau Power Company.

Sugar Lake, at an elevation 2,080 feet above sea-level, has an area of 3,786 acres, is 4¼ miles long by 2¼ miles at the widest point, and is frozen over entirely from the beginning of January to the middle of April. It is fed by the Spallumcheen, Sitkum and Outfall Creeks and supplies 75 per cent. of the river discharge at Shuswap Falls, the remainder being contributed mainly by the only two creeks of consequence between the lake and Shuswap Falls, Cherry Creek and Eight-mile Creek. Apart from a small area of flat land at each end, the shores rise quickly and are densely wooded. After a fall of 38 feet at the lake outlet, the river flows on even grade through the 20 odd miles to the gorge above Shuswap Falls where, with a series of rapids extending over half a mile, the river drops 70 feet in that distance.

The river discharge averages 350 to 400 second-feet during January, February and March, rising to a peak in the middle of June of between 6,000 and 13,000 second-feet, dropping thence uniformly to 2,000 second-feet in August, and then gradually to 400 second-feet in December.

During November and December minimum temperature hovers around 32 degrees Fahr., and during January and February fluctuates between freezing point and 10 degrees below zero. Maximum temperature rises uniformly from 40 degrees Fahr. in March to a peak of 90 degrees in July and then falls also uniformly to 40 degrees at the end of November. Ice conditions on the river are at their worst between the third week in December and the second week in February, anchor ice forming periodically accompanied by frequent flow of frazil. The river channel is usually free of ice by the middle of March.

The development, in design, is divided into four progressive phases to take shape, in turn, as increasing market calls shall require. The first, with an overflow intake dam containing 16,000 cubic yards of concrete, a net head of 130 feet, and one line of 3,750 feet of 96-inch steel pipe to the power house at Shuswap Falls, will provide 4,000 continuous h.p. with a peak capacity of 7,000 h.p. The second, with two lines of 96-inch pipe at Shuswap Falls, and storage provided by raising the surface of Sugar Lake 18 feet, will supply 8,000 continuous h.p. with a peak capacity of 13,250 h.p. The third, with three lines of 96-inch pipe at Shuswap Falls, and storage provided by raising the surface of Sugar Lake 40 feet, will supply 12,000 continuous h.p. with a peak capacity of 19,880 h.p. The fourth phase, by the installation of an additional plant at the foot of the Sugar Lake dam, operating under a head of 70 feet and using, as it passes, the water being drawn from storage to feed the Shuswap Falls plant twenty miles lower down the valley, will bring the grand total of power to be provided by the development to 18,000 continuous h.p. with a peak capacity of 28,880 h.p. The dam at Sugar Lake will be placed and designed to allow of an eventual increase of height to 80 feet to provide storage for the possible doubling of that output.

The prospective light and power market in the Okanagan Valley is attractive and that demand, coupled with the electrification of the proposed 180 miles of extensions, through the district, of the Canadian Northern Pacific Railway Company, will amply justify the prosecution of the development. On a conservative basis, assuming even no further planting, expert calculation definitely places the export of fruit alone from the valley, in the year 1920, at 7,000 carloads, allowing liberally for orchard losses by disease and misadventure, and in the year 1925 at 12,000 carloads.

The proposed Canadian Northern Pacific Railway Company's branch line in the Okanagan will deliver all construction material at the site of the proposed plant, climatic conditions are peculiarly favorable for rapid and economical construction, while a prosperous producing district of British Columbia eagerly awaits the distribution of cheap light and power.

LETTER TO THE EDITOR.

Re Rosewater's Hydraulic Table.

Sir,—Adverting to the table published in your issue of July 6th and to the direction given as to the use of same, it may be interesting to observe that the table can be used in many different ways and thus increase it value.

Let the following notation be used for convenience and abbreviation of terms:—

V_1 = velocity required in feet per second—f.p.s.
V_2 = velocity given in table for 1% grade—f.p.s.
Q_1 = quantity required in cubic feet per second—c.f.s.
Q_2 = quantity given in table for 1% grade—c.f.s.
S = slope in feet per 100.
D = diameter of pipe in inches.

(1) Given S and D required Q_1 and V_1

EXAMPLE: $S = 2.25\%$; $D = 44$ inches flowing 7/10 full; $Q_2 = 99.28$; $V_2 = 12.65$; $\sqrt{2.25} = 1.5$.

$Q_1 = 99.28 \times 1.5 = 148.92$ c.f.s. Answer.
$V_1 = 12.65 \times 1.5 = 18.97$ f.p.s. Answer.

(2) Given D and V_1 required Q_1 and S

EXAMPLE: $D = 40$ inches running full; $V_1 = 3$ f.p.s.; $Q_2 = 90.39$; $V_2 = 10.36$; $S = \left(\frac{V_1}{V_2}\right)^2$ or $\left(\frac{Q_1}{Q_2}\right)^2$.

$S = \left(\frac{3.00}{10.36}\right)^2 = 0.084\%$. Answer. $\sqrt{.084} = .290$

$Q_1 = 90.39 \times .29 = 26.21$ c.f.s. Answer.

(2a) Given D and V_1 required Q_1 and S

EXAMPLE: $D = 18$ inches flowing 2/10 full; $V_1 = 2$ f.p.s. at 2/10; $Q_2 = 0.83$; $V_2 = 3.32$.

$S = \left(\frac{2.00}{3.32}\right)^2 = 0.36\%$. Answer. $\sqrt{0.36} = 0.6$

$Q_1 = 0.83 \times 0.6 = 0.498$ c.f.s. Answer.

(3) Given V_1 and Q_1 required D and S

$\frac{Q_1 \times V_2}{V_1 \times Q_2} = 0$; $\frac{Q_1 \times V_2}{V_1} = Q_2$; $\frac{V_1 \times Q_2}{Q_1} = V_2$; all approximate.

EXAMPLE: $V_1 = 4$; $Q_1 = 10$; $\frac{Q_1}{V_1} = \frac{10}{4} = 2.5$; $Q_2 = 2.5\,V_2$

Look down the full flow 1% table for the discharge figure, which is approximately 2.5 times the velocity figure, and it will be found at 22 inches, which is the answer.

$Q^2 = 17.94$; $V_2 = 6.80$

$S = \left(\frac{10.00}{17.94}\right)^2 = .310\%$. Answer. $\sqrt{0.310} = .557$

Check: $17.94 \times .557 = 10$ c.f.s.
$6.80 \times .557 = 3.79$ f.p.s.

(4) Given S and V_1 required Q_1 and D.

$\frac{V_1}{\sqrt{s}} = V_2$. (See table for the figure or one larger at 1% grade.)

EXAMPLE: $S = 0.50\%$; $V_1 = 3$ f.p.s.; $\sqrt{0.50} = .707$; $V_2 = \frac{3.00}{.707} = 4.24 =$ 12-inch pipe. Answer.

Q_2 for 12-inch pipe at 1% = 3.40 c.f.s.
V_2 for 12-inch pipe at 1% = 4.34 f.p.s.

$Q_1 = 3.40 \times .707 = 2.40$ c.f.s. Answer.
$V_1 = 4.34 \times .707 = 3.07$ f.p.s.

(5) Given Q_1 and S required D and V_1

EXAMPLE: $Q_1 = 15$ c.f.s.; $S = 0.40\%$; $\sqrt{0.40} = .632$.

$Q_2 = \frac{Q_1}{\sqrt{s}} = \frac{15.00}{.632} = 23.73$. Nearest figure in table = 26-inch pipe. Answer.

$Q_2 = 28.27$ $V_2 = 7.67$
$Q_1 = 28.27 \times .632 = 17.87$ c.f.s.; $V_1 = 7.67 \times .632 = 4.85$ f.p.s. Answer.

(6) Given Q_1 and D required S and V_1

EXAMPLE: $Q_1 = 15$ c.f.s. at 5/10 full; $D = 30$ inches; $Q_2 = 41.64$ for full, $V_2 = 8.48$; 20.82 for 5/10 full, $V_2 = 8.48$.

$S = \left(\frac{15.00}{20.82}\right)^2 = 0.52\%$. Answer. $\sqrt{0.52} = 0.72$

$V_1 = 8.48 \times 0.72 = 6.1$ f.p.s. Answer.

The calculations were made by slide-rule. With the above explanations and examples the table is made very handy for everyday use.

R. O. WYNNE-ROBERTS.

310 Temple Building, Toronto.

Wallace & Tiernan Co., Inc., manufacturers of chlorine control apparatus for water and sewage purification, have moved from 136 Liberty St., New York, to a larger and new factory at 137 Centre St., corner White St., New York City.

The Provincial Government of Manitoba maintains a road department under a provincial highway commissioner, while municipal organization is active. The province is divided into 100 rural municipalities with population varying from 600 to 5,000 in each. The municipal council (controlling local expenditure) consists of a reeve and four or six councillors, half of whom are elected for one year, and the remainder for two years. Municipal organization is very similar to that of Ontario. The expenditure under the good roads act is made under the direction of engineers of the provincial department and in conformity with well-defined systems within the municipalities operating under the act. Towards the expenditure of $374,790 for the season of 1915, the Provincial Government contributed $141,700. The general features of the Manitoba good roads act are as follows: 1. The council must initiate the scheme of improvement. 2. Council must then submit the system to the good roads board of the province, by resolution of the council. 3. The scheme is then examined and reported on to the board by one of the engineers of the department. 4. If the board approves, the scheme is recommended to the Lieutenant-Governor by the Minister of Public Works. 5. If it is finally approved there, the secretary-treasurer of the municipality is notified. 6. The council submit to the ratepayers a by-law to which their assent must be obtained. The vote of the people is required in each and every case. They vote that these roads will be the main roads of the province. 7. After assent of ratepayers is received, the scheme may go ahead and receive the prescribed assistance under the act. For an earth road this is one-third of the cost; for a gravel road or any more permanent form of road than earth, one-half of the cost. The road mileage of the province is 31,000.

AN APPARATUS FOR DETERMINING SOIL PRESSURES.*

By A. T. Goldbeck and E. B. Smith.

FOR many hundreds of years, engineering structures have been built whose safety to a large extent has been dependent on the physical behavior of the adjoining or the underlying soil, and although these centuries have elapsed with their records of disastrous failures, our ideas of the laws governing the action of soils and the pressures which they exert are still indefinite, and are based mainly on mathematical theory rather than on adequate experimental data. Certainly the present vagueness of our knowledge is not due to any lack of effort, for many attempts at an experimental solution are recorded in engineering literature. The very fact that there are now no satisfactory laws concerning earth pressures evidences the inadequacy of the existing data for the formulation of such laws, and is suggestive of the difficulty and elusiveness of the problem.

Measurements of the pressure of earth against or under a wall or other structure are rendered difficult, because the location at which the measurement should be made is almost impossible of access without disturbing the soil, and such measurements have not been accomplished because no apparatus seems to have been designed for this use, whose action does not have some influence on the very pressure it was constructed to measure.

Then, too, the many variations in the condition and character of fills make the problem very complicated. It has been the aim of the authors to develop an apparatus that will be applicable to the measurement of earth pressures against structures, as well as for use in the laboratory for the study of the laws of pressure distribution through particular kinds of materials, under different conditions of compaction, moisture content, load application, etc.

Soils are made up of granular particles of various sizes, together with very finely divided material, generally containing moisture. The action of pressures is to cause motion of some of these particles with respect to others, and the manner of transmission of pressures is influenced by the mobility of the mass or the ease with which the particles move with respect to one another. It is evident that several factors must control this movement, such as cohesion and friction, and these factors are in turn governed by the physical characteristics of the soil, such as the grading, moisture content, kind of fine material, degree of compaction, etc. It is probable that all of these characteristics should be known so as to make any experimental data obtained applicable to similar cases in the future. In view of the fact that friction and cohesion between the particles exist, it is evident that an apparatus employed for the measurement of soil pressures should be so constructed that no movement of its parts will take place against or away from the soil during the measuring process. If the measurement requires a movement against the soil, a higher pressure than actually exists will be indicated. On the other hand, should a movement away from the soil be necessary, an indication lower than the true pressure will be obtained. The authors have, therefore attempted to develop an apparatus which will measure the pressure of an earth fill with practically no disturbance of its natural condition, and in considering such an apparatus it was deemed advisable to develop the idea of a portable cell of small size, capable of indicating at some remote station the value of any pressure coming upon it.

Description of Apparatus.—After a great deal of experimenting, a diaphragm cell has been developed as shown in Fig. 1. A cast-iron base *g* is fitted with a brass diaphragm *j*, held in place by the annular ring *c*. On each side of this diaphragm are disks, *a* and *b*, securely and rigidly held together by means of Bakelite cement and machine screws, as shown. These plates have an annular clearance from the ring *c* of 0.03 in., thus allowing only a small annular portion of the diaphragm *j* to be the flexible element. The diaphragm *h* serves the double purpose of protection and of stiffening the plates *a* and *b* against side motion and eccentric loads. In the base *g* is placed a slightly crowned contact support *f*, held in place

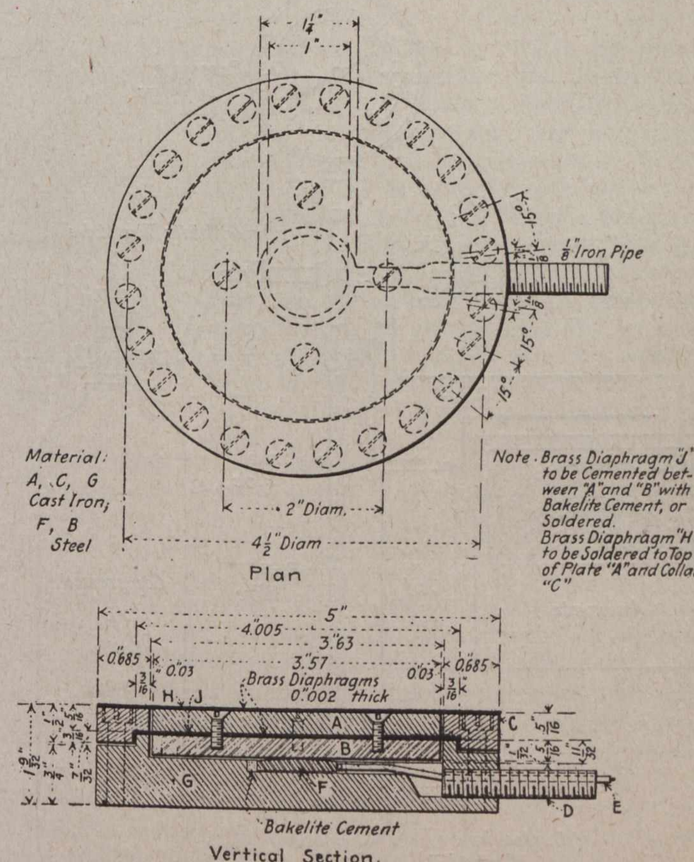


Fig. 1.—Diaphragm Cell for Determining Soil Pressure.

and electrically insulated from the base by Bakelite cement. An insulated bell wire *e* is soldered to the support *f*, and passes to the outside connections through the 1/8-in. pipe *d*.

In the use of this apparatus the cell is buried in the soil to the required depth, and, by means of the 1/8-in. pipe and the bell wire, is connected to the remote control and indicating instruments as shown diagrammatically in Fig. 2. Air pressure is slowly admitted from a compressed-air supply until the air pressure within the cell equilibrates the external pressure on the disk *a* (Fig. 1), and causes the contact between disk *b* and support *f* to be broken, as indicated by an ammeter or a telephone receiver.

In the development of this cell an attempt was made to reduce the movement of the disks and diaphragm to the very smallest possible value, for as previously mentioned, any movement of the disks against the soil fill introduces stress conditions which will no doubt vitiate the results. It was found that a movement of 0.001 in. or

*Paper presented to the American Society for Testing Materials.

more against the soil fill required a very large increase in load.

Pressures of very small values on the diaphragm disks were found to deform them appreciably, and a correspondingly greater movement was necessary to secure a pressure reading. This elastic deformation existed in the disks, the contact support, and in the insulating material. In the construction of the first experimental cells, brass was used throughout in combination with such insulating materials as paper, shellac, mica, celluloid, and hard fiber. The joints on the diaphragm between the disks *a* and *b* were made tight by pulling the disks together with twelve No. 10 machine screws, the surfaces having been coated with a special compound of rubber, beeswax, and vaseline. But none of these combinations was found satisfactory as the elastic deformations varied from 0.005 in. to over 0.01 in.

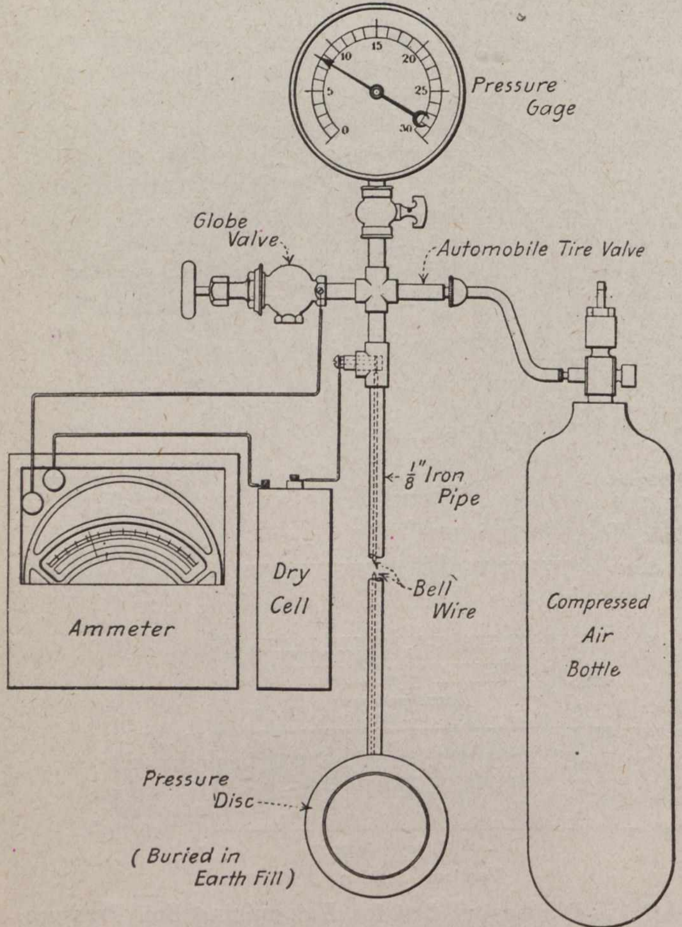


Fig. 2.—Control and Indicating Apparatus for Determining Soil Pressure.

By the adoption of cast-iron and steel in the construction of these cells, with the use of Bakelite as a cement and insulator under the contact support, and also for cementing the disks to the diaphragm, and by reducing the deforming length of the loaded parts, the elastic deformation has been reduced to about 0.0003 in. The movement necessary to break the electrical contact is not over 0.00001 in. With the present construction and type of cell it has been found easy to obtain check readings on wet and dry sand and on damp clay, without appreciably changing the load on the material.

Calibration of Pressure Disk.—In order to test the accuracy of the cell and its ability to measure earth pressures, three forms of loads were used in its calibration, namely, hydrostatic load, dead load and earth pressures.

Hydrostatic Load.—The calibration under hydrostatic load served to demonstrate the accuracy of the cell under this type of load, and showed that the pressure required in bending the diaphragm while breaking contact is inappreciable. The cell was placed in a vessel having a top tightly clamped down and having hose connections to a water column. Measurement of the height of this column accurately determined the pressure on the disk. A mercury gauge was connected with the air line and measured the intensity of air pressure within the cell. A typical set of calibration results obtained in this way is as follows:—

Hydrostatic pressure, lbs. per sq. in.	Air pressure, lbs. per sq. in.
2.23	2.3
4.43	4.5
6.64	6.7
8.85	8.9
10.38	10.4

Readings were taken with the cell on its side as well as in a horizontal position, and no difference was observed.

Dead Load.—The dead-load calibration was accomplished by placing the cell on a platform scale and allowing one end of an I-beam to rest upon it, the other end being supported from the floor. Variation in the weight on the cell was produced by loading the I-beam with weights at various positions throughout the span. All air-pressure readings were taken on a mercury gauge.

The following readings simply show the degree of accuracy which may be expected with this type of apparatus, and serve to check the area of the weighing disk which was designed to be 10 sq. ins. It was found that concentrated eccentric dead loads influence the accuracy of the results and probably account for the small inconsistencies in the readings.

Dead load, lbs.	Reading of mercury gauge, lbs. per sq. in.
23	2.6
49	5.4
61	6.2
87	8.5
113	11.4
148	14.7
180.5	18.4

Earth Pressure.—The fact that the cell gave substantially correct readings under hydrostatic and dead loads was no indication that it would give true values of earth pressures, as its action depends on the breaking of electrical contact, requiring, as has been pointed out, a motion of about 0.0003 in. under high loads (50 lbs. per sq. in.). Experiments made on dry quartz sand showed that a very small movement of a plunger of the same area as that of the soil-pressure disk required quite a large increase in load. In the experiments, the sand was placed in a 6-in. cylinder, 6 ins. deep, and the plunger was set on the level surface of the sand. The cylinder was then placed under load in a testing machine and the movement of the plunger for an increase in the load was measured with an Ames dial reading to 0.0001. The readings are given in Table I.

It will be noted that in general, when under high loads, a larger increase in load is required to produce a definite deformation than when under low loads. Thus, under an initial load of only 3.4 lbs. per sq. in., an increase of 0.4 lbs. per sq. in. was required to deform compacted quartz sand 0.0001 in., while under a load of 44.0

lbs. per sq. in., an increase of 1.4 lbs. per sq. in. was required to produce a corresponding deformation. Owing to the small size of the container, compared with the plunger, and the resulting great lateral restraint and effect of friction along the sides, it is probable that a much greater increase in load was required in this test to produce a deformation of 0.0001 in. than would ever be required in actual fills. These tests were made to gain some idea of the maximum amount of error to be expected in the cell due to its expansion against the fill. It is apparent that the error of the instrument, due to the very small motion required to break contact, should be quite small. This error was further ascertained by the following method (see Fig. 3):—

A box 22 ins. square and 10 ins. deep was placed on a large platform scales, and sand or clay was tamped in the box and leveled off. A disk 3.57 ins. in diameter (10 sq. ins. in area) was then placed on top of the fill and the cell was mounted thereon. Load was applied by means of weights placed on an I-beam resting on bearing blocks in contact with the cell. The amount of load imposed on

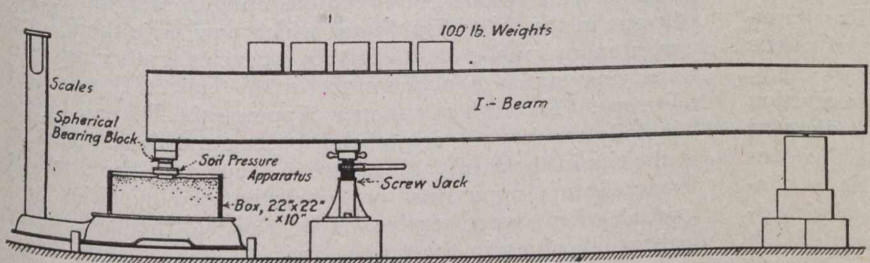


Fig. 3.—Method of Calibration of Soil Pressure Apparatus.

the cell was regulated by means of a screw-jack, and the load was weighed on the platform scale. After the desired

Table I.—Deformation of Moist Silica Sand Produced by Increase in Load.

Cylinder Loosely Filled. Unit load, lbs. per sq. in.	Deformation, in.	Sand-Tamped in Cylinder. Unit load, lbs. per sq. in.	Deformation, in.
5.0	....	3.4	....
5.2	0.00007	3.8	0.00010
5.4	0.00015	4.0	0.00016
5.6	0.00019	4.4	0.00023
5.8	0.00024		
9.4	....	14.2	....
9.6	0.00009	14.6	0.00004
9.8	0.00017	15.0	0.00007
10.0	0.00030	15.4	0.00022
20.0	....	26.7	....
20.2	0.00010	27.2	0.00002
20.4	0.00028	27.6	0.00007
		28.4	0.00015
28.0	....	44.0	....
28.2	0.00010	44.6	0.00005
28.4	0.00020	45.4	0.00010
47.0	....	45.8	0.00022
48.0	0.00010	46.6	0.00035

load had been adjusted on the disk, air pressure was admitted slowly and the scale beam carefully watched. In no case was there a perceptible rise in the beam during the increase of air pressure within the cell, and not until after electrical contact had been broken did the beam rise, thus showing that the small elastic expansion of the cell does not appreciably vitiate the readings. The air pressure was read on a mercury gauge. Table II. gives typical sets of readings obtained in the above manner.

Table II.—Results of Tests for Error of Instrument.

Initial Load on Disk, lb. per sq. in.	Load on Disk at Breaking of Contact, lb. per sq. in.	Load Indicated by Mercury Gage, lb. per sq. in.	Error, lb. per sq. in.	Material.
10.0	10.0	10.2	0.2	Damp sand, clay.
15.0	15.0	15.6	0.6	Damp sand, clay.
20.0	20.0	21.0	1.0	Damp sand, clay.
5.3	5.3	4.7	0.5	Dry sand.
8.3	8.3	7.8	0.5	Dry sand.
11.0	11.0	11.2	0.2	Dry sand.
13.8	13.8	14.0	0.2	Dry sand.

The experience gained by the authors in the actual use of this cell leads them to the opinion that the methods of trial and calibration as indicated above, are far more severe than any conditions that can possibly be met with in its designed use. It is nevertheless realized that the apparatus is capable of being improved so that it will give more precise readings, and the authors are still working toward that end. However, when the enormous variations in the condition of fills are considered, it is probable that the present error of the instrument is negligible.

It is intended to bury a number of these cells in a horizontal or vertical position within earth fills, the piping from each cell being brought to some convenient position where readings may be taken at any time. One set of indicating and controlling instruments mounted in a convenient carrying case is all that is necessary for reading any number of pressure cells. The cost of each cell when made in lots of ten should be about $15, and the cost of one complete indicating and control apparatus without a case should not exceed $40.

There are a number of uses to which the apparatus may be adapted besides that of measuring earth pressures. Thus, the pressure of concrete in forms may be determined very readily, that of ensilage in silos, the pressure of various finely divided solids in bins, and that of any material which may be slightly compressed without an appreciable increase in the pressure exerted against the instrument.

According to the Good Roads Year Book for 1916, there are about 250,000 miles of graded roads in Canada.

Crude oil production for the first half of 1916 in the United States totalled 148,000,000 barrels, a loss of 2,500,000 barrels compared with 1915. Pennsylvania, Ohio and Indiana production was 12,000,000 barrels, a decline of 250,000. During the half-year stocks of oil in Central States were reduced 675,001 barrels and those of Illinois 1,100,000 barrels, while in Oklahoma and Mid-West fields increased 3,500,000 barrels.

The cost of making gasoline from fuel oil by the Rittman process is made public in a bulletin just issued by the Bureau of Mines. The first cost of a plant with a capacity for producing 850 barrels of gasoline per month, or 35,700 gallons, is estimated at $20,000. Where fuel oil can be purchased at 50c. a barrel, the estimated cost of the gasoline produced, including interest and depreciation, is 7.8c. per gallon. With fuel oil at $1 per barrel, the estimated cost of the gasoline produced is 9.74c. per gallon. With fuel oil at $2.10 per barrel, the estimated cost of the gasoline produced is 13.9c. per gallon.

THE SUCCESS OF AN UNIQUE EXPERIMENT BY NEW YORK STATE CITIES.*

By William P. Capes,
Director, City Bureau of Municipal Information of New York.

THE cities of New York State have just completed an experiment that is unique in the history of American municipalities. They have conclusively demonstrated that a central clearing house of municipal information is a necessity and that such an institution can be successfully operated on a co-operative basis.

The institution, known as the New York State Bureau of Municipal Information, is unique. It is the first agency of its kind in the world. Many cities and some States have reference libraries and bureaus and research agencies, but none of these is doing the same kind of work as the New York State Bureau, nor is any operated the same. Some are operated for the benefit of a single city; others are under a private organization or an organization of citizens and officials. A few are connected with the State university. The research bureaus investigate the work of public officials and make recommendations. The municipal reference libraries keep on file for the use of public officials the information gathered and collated by others. The New York State Bureau is exclusively an institution of and for the cities of the Empire State. Being directed by a council of five mayors elected annually at the conference of official representatives of the cities, it is controlled absolutely by the municipalities. It is also supported only by the cities, and with the sanction of the State. No vested or special interests, no political party and no individual city or class of citizens can control it. It is a non-partisan, non-factional servant of every official in all cities in the State.

Its policy and purpose are expressed in its slogan, "Not to Reform, but to Inform." By this the Bureau does not mean that it objects to reform. It believes, however, that what reformation is needed in the administration of municipal affairs will come more quickly through knowledge, and that when it does come in this way it will last. The Bureau does not advocate anything, nor does it recommend any person, thing or firm. It is not a propagandic agency. It gives as much information on both sides of a controversial subject as is available and can be obtained. Facts are its merchandise. It believes that policies and plans should be made by the city officials and that the Bureau should confine its efforts to supplying the facts which cities may use in formulating correct plans according to their local conditions.

A lack of knowledge about the multitude of city problems, insufficient time to gather and collate the information they need to solve these problems and inadequate facilities to ascertain where the needed data can be obtained—these are the rocks upon which the careers of many conscientious public officials go to pieces. Each official has to grope through a maze of perplexities and uncertainties in his effort to solve the many intricate problems involving the expenditure of large public funds. Guesses constitute the foundation of many important decisions. Much needless and costly experimentation is being done, simply because a particular city department does not know and has no effective means of learning that some or several other cities have already solved that particular problem.

A comprehensive study of New York State cities, made by the Conference of Mayors, showed there existed everywhere duplication of time, labor and expense to obtain information about systems, costs and results in other cities. At least five cities were writing eighteen months ago to learn what others had done to regulate the jitney bus which at that time was giving city officials considerable trouble. None knew that the information had already been collected by a national organization and was available. One city started to collect data about the number of policemen employed per thousand of population and per square mile of area without any knowledge that the comptroller's office in New York City had spent time and money gathering the same information from the one hundred largest American cities.

At the annual meeting of the New York State city officials last June it was decided to bring order out of chaos. The experiment of operating on a co-operative basis a central clearing house of municipal information was, therefore, launched.

A cordial and valuable relationship has been established with the State Library, so that this immense plant of information and the services of its staff of researchers are at the Bureau's disposal at all times. It has also established a co-operation relationship with each municipal league in the thirty-five States which now have them, and with many public and private agencies gathering and studying statistics about cities in the United States and Europe. Through newspaper clippings the Bureau keeps in daily touch with each official, bureau and department in all cities in the State. It is also in touch with firms which manufacture apparatus or products used by cities and which offer expert service. It has on file the basic data about all cities in the State, such as the charters, ordinances, budgets, annual and special reports and various codes and regulations. These are kept up to date. While the legislature is in session the Bureau receives daily reports of all bills introduced and copies of all measures affecting cities. Its staff is in close touch with all State departments.

The Bureau renders service to the fifty-seven cities in the State. Its chief function is to supply information about any municipal problem to any New York State city official requesting it. During the winter this service was also extended to State officials. The number and variety of inquiries received have been astonishing. When a request comes from a city all departments of the State Library are asked to send to the Bureau the information they have on the subject. If additional information is required, letters, and sometimes questionnaires, are sent not only to New York State cities but also to municipalities in other States. If the information desired is not too detailed or technical and does not call for opinions the State leagues and other co-operating agencies are called upon, *e.g.*, if the State Bureau wants information of this character about Pennsylvania cities it does not write to each city but sends one query to the Division of Municipal Statistics and Information of the Pennsylvania State Department of Labor. The Bureau has an agreement with this and other public and private agencies to supply information about New York State cities and in return to receive any information it may desire about cities in the State or section covered by the particular agency. In this way all of the agencies interested are able to get information more accurately and quickly and at less expense and effort than they could if such a plan were not in existence. At the same time the officials of the cities are saved trouble and expense. After the data have been collected and collated a report is prepared. If the report is of general interest it is sent to the mayor of each city in the State with a request that after examination he refer it for permanent filing to the particular official interested. If the report is of interest to one or a limited number of cities

*From "Pacific Municipalities."

one copy is sent to the city making the inquiry and the others are filed until called for by any city official.

The staff is constantly on the lookout for information which it believes will interest city officials. When the director of public works of Philadelphia last year issued an unique report, copies were obtained by the Bureau and one was sent to each mayor in the State. In this way various reports and much literature have been sent to officials.

To keep city officials in touch with one another by distributing new ideas and plans is another important function of the Bureau. The city of Syracuse had been successful in operating a municipal asphalt repair plant. When the report was ready for distribution a copy was sent to each city in the State. When the Health Department of New York City decided to abolish terminal fumigation a copy of the order and a report of the experiment that had been made were sent to each municipal health officer in the State. These are only two of the many new ideas which have been distributed by the Bureau.

Another duty the Bureau has to perform is that of keeping cities informed about all legislation affecting them. As soon as a bill has been introduced the Bureau receives a copy. If it is general in character, it is referred to the Legislative Committee of the Conference and later the Bureau receives instruction from the committee what to do. If the bill affects only one or two cities notification is sent to the mayors of these with a request for instructions if any action by the Bureau is desired. The progress of the legislation is watched and the cities affected are kept informed. Whenever the Bureau is required to appear before a legislative committee care is taken to impress upon the legislators that it is acting only as an agent of the city or cities.

The director of the Bureau, upon request and instruction, appears before any State department for any city. One city had had difficulty with the State Civil Service Commission. The Bureau received detailed information about the controversy and after a few conferences with the State body it was able to submit facts which resulted in a satisfactory adjustment.

Another city appointed a special committee to investigate the subject of water sterilization. The Bureau was notified through its clipping service and immediately sent its report giving the experience of cities in the United States with liquid chlorine, hypo-chloride of lime and the ultra-violet ray method.

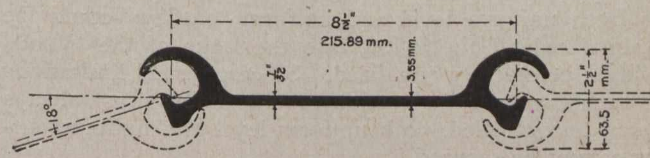
The Bureau has kept pace with the increasing demand for information by all cities in the State. From September 1 to May 1 it sent to the cities 1,239 reports—an average of 135 a month. During the last four months it has handled a total of 6,520 pieces of mail. It has prepared and issued reports on 146 general municipal subjects in addition to the special work done for individual cities.

As a result of this co-operative plan each city in the State is receiving a needed service which it could not possibly duplicate by individual effort and for the same money it pays. Mayor James T. Lennon, of Yonkers, chairman of the Bureau Council, said at the Syracuse meeting: "The experience of the first eight months has convinced us that the Bureau is able to get more quickly, accurately, easily and economically information about cities and city problems, both in and outside the State, than any individual municipality could. This has been demonstrated many times. One city tried to secure a copy of a valuable publication issued by an Ohio city, but was informed that none was available. The mayor then appealed to the Bureau which within a week sent the book to him. To secure the data for the report on the cost and method of collecting and disposing of garbage, the Bureau sent a three-page questionnaire to all New York State cities and the fifty largest cities in the United States. Every city responded, giving the Bureau a 100 per cent. return for its effort. The director attributes the success of the Bureau in this respect to the fact that when it makes a request for information, each city realizes that the information it sends is for the benefit of all municipalities in the State. One answer to an inquiry from the Bureau serves at least fifty-seven cities, and will serve every city in any State which has a State League co-operating with the New York agency."

A NEW SHEET PILING.

The Lackawanna Steel Company has recently placed on the market a new 8½-inch section steel sheet piling, which is illustrated herewith. This new section is of the standard Lackawanna Straight-Web type with interlock consisting of similar hooks and guards on both edges, and is for use where a comparatively light section is required with high transverse strength and minimum weight, in medium trench and cofferdam work.

The interlocked joint formed between adjacent piles is flexible through an arc of 18° on each side of the centre plane of the piling section. The hooks of adjacent sec-



tions engage to offer the greatest resistance to longitudinal displacement while the guards overlap and engage the outer surface of the hooks on the adjacent sections, thus preventing lateral displacement and co-operating to prevent longitudinal displacement. The joint can be disengaged only by withdrawing one pile. There are three lines of contact between the interlocked members of each joint, so that there is a positive, double, firm and close interlock, yet a minimum of friction in driving or withdrawing and ample opportunity for displaced material to work into the joint and assist in rendering it watertight, while at the same time the interlock holds the piling in proper alignment to form the wall.

In the development of this new section, special attention was given to secure for this joint high tensional and transverse strength, and at the same time to produce a pile which would have comparatively low weight per square foot; be simple, interlock perfectly, and have the material so distributed as to give a high section modulus per lineal unit of wall.

This piling is made by the Lackawanna Steel Co., Lackawanna, N.Y.

The Hackney Tile and Supply Co., Limited, Winnipeg, has been succeeded by the Hackney Tile Construction Co., under the same management as in the past, with Mr. Wm. Q. Watkins as construction manager.

During the first half of the present year the British Board of Trade has only considered it necessary to inquire into four railway accidents—one goods train collision and three passenger train derailments. During the first half of 1915 there were ten inquiries, and during the first half of 1914 there were 13. No passengers were killed in train accidents in the first half of the present year, but four servants have been killed. The corresponding figures for 1915 were 239 passengers and six servants killed—224 passengers and three servants at Quintinshill—and for 1914 six passengers and six servants.

DESIRABILITY AND PRACTICABILITY OF REGULATING LEVELS AND OUTFLOW OF THE LAKE OF THE WOODS.*

By Arthur V. White and Adolph F. Meyer.

INTRODUCTORY COMMENTS.

THE first question of the official reference to the International Joint Commission deals with the desirability and practicability of regulating the level of the Lake of the Woods in order to secure the most advantageous use of the waters of the lake itself, of the waters flowing into and from the lake, and of the shores and harbors of the lake.

Numerous and diverse interests, both large and small, are, in varying degrees, dependent upon these waters. Navigation, agriculture, logging and lumbering, fishing, summer outing, water supply and sewage disposal, water power development and manufacturing may here be mentioned as the chief interests which must receive consideration.

Regulation of the level of the Lake of the Woods may, broadly speaking, have in view two objects,—either regulation to secure as nearly uniform lake levels as possible throughout a period of years, or regulation to secure as nearly uniform outflow from the lake as possible.

Both uniform level and uniform outflow could be obtained only if the inflow into the Lake of the Woods could be completely equalized. Since physical limitations are such that a large portion of this inflow must always remain uncontrolled, both uniform level and uniform outflow cannot be secured.

Any method of regulation which aims to secure either uniform level or uniform outflow, or any combination of the two, will affect the various interests involved in different ways. No single method or combination of methods of regulation will be most advantageous to all of the several interests, consequently "the most advantageous use" of the waters, shores, and harbors of the lake and of the waters flowing into and from the lake, must be considered to be that representing the maximum aggregate advantage to all interests involved.

The effect of various methods of regulation on the water power interests at the outlets of the lake will first be discussed.

Water Powers at Outlets.—The fall at the outlet of the Lake of the Woods varies both with lake level and with outflow. An increase in lake stage produces a corresponding increase in fall. The available head, however, varies inversely as the outflow—that is, the greater the outflow the less the head, because of the rise in tail water level which accompanies increased outflow. The most desirable condition for the water powers at the outlets of the lake would be to have both a high uniform level and a uniform outflow. It being impossible, as stated before, to obtain both of these results at the same time, the most advantageous conditions, therefore, can only be determined by weighing the advantages and the disadvantages resulting from each given method of regulation.

To equalize the outflow it is necessary to fluctuate the level of the lake, and the result of any variation in lake level, below the highest level permitted, is to reduce the available power, because it reduces the head water level, and, consequently, the available head.

*Fourth of a series of articles giving summary of the report of the consulting engineers to the International Joint Commission.

A study has been made of the power which would have been available at the outlets of the lake during the period of years from 1892 to 1914:—

First, under natural conditions.

Second, with 100 billion cubic feet of available storage capacity on the Upper Rainy reservoirs, and regulation of both the Upper Rainy reservoirs and Lake of the Woods according to Method A. (See *The Canadian Engineer*, July 13th and 20th issues.)

Third, with 100 billion cubic feet of storage capacity on the Upper Rainy reservoirs and regulation of both the Upper Rainy reservoirs and Lake of the Woods according to Method B.

From the results of this study, it appears that,—

First, that under method of regulation A, the lake would, on an average, have been full about 30 per cent. of the time, and that under method of regulation B it would have been full about 10 per cent. of the time, with a consequent greater damage to riparian property under method of regulation A than under Method B.

Second, for every ordinary maximum level which may be established, the available head would, on an average, be about 1.2 feet greater under Method A than under Method B.

Third, if an ordinary maximum level of 1,061 had been established, for example, method of regulation B would, on account of the increased utilizable flow and notwithstanding the fact that the average head would have been 1.2 feet less than under Method A, have resulted in an average of 4,654 more available horse-power than Method A, and 4,190 more horse-power than in a state of nature.

Fourth, if an ordinary maximum level of 1,060 had been established, method of regulation B would have resulted in an average of 4,359 more available horse-power than Method A, and an average of 2,934 more horse-power than in a state of nature.

Fifth, if an ordinary maximum level of 1,059 had been established, method of regulation B would have resulted in an average of 4,064 more available horse-power than Method A, and an average of 1,678 more horse-power than in a state of nature.

It would appear from the computations on which the curves of Fig. 1 are based, that if the outflow from the lake had been regulated according to Method B, and the ordinary high level maintained had been 1,057.7, practically the same amount of power would, on an average, have been available at the outlets of the lake under this method of control as would have been available under natural conditions.

If, now, method of regulation B were modified slightly so that extraordinary rates of inflow into the lake could be partly absorbed by additional storage capacity on the lake, then the existing high rates of discharge prevailing for a very small percent. of the time would be considerably reduced and the flood-water head would be increased. Method B thus modified, then, will permit of the more advantageous use of the water flowing from the lake under regulation, even with an ordinary high level of 1,057.7, than under natural conditions. If any higher level than 1,057.7 is established as the ordinary maximum level, regulation according to modified Method B will be more advantageous for power developments at the outlets of the lake—using up to 16,000 c.f.s.—than the natural, unregulated level and outflow, but it would not be as advantageous as the conditions which these interests have enjoyed during the past twenty years, unless the ordinary maximum level is fixed at 1,061.5 or above.

Under method of regulation B, every foot increase in the ordinary maximum level,—that is, the high-water level which is not to be exceeded except perhaps once in twenty or thirty years—represents an increase of 1,256 horse-power in the average power available at the outlets. On the other hand, however, every foot increase in lake level results in an almost equal reduction in the available fall at the Long Sault Rapids, and at all other developed or undeveloped water power sites at which the level of the Lake of the Woods determines the elevation of the tail water; that is, the increase in power at the outlets, resulting from an increase in lake stage, would be offset by nearly as great a reduction in the power which could be developed at other sites. So far, then, as the utilization of the waters of the Lake of the Woods for *power development only*, both at the outlets and at the Long Sault Rapids, in particular, is concerned, there would appear to be no advantage in maintaining the Lake of the Woods at a higher level than ordinary natural high water. In case only the present water consumption of existing power developments is taken into consideration, however, each foot increase in lake stage would result in an increase of about 225 continuous horse-power, or about 375 horse-power at the time of maximum demand.

Apart from international considerations, but viewed from the standpoint of the interests holding water power rights or privileges at the outlets of the Lake of the Woods, and on the Winnipeg River, it may be urged by such interests that they have undertaken developments during periods while the Lake of the Woods has been under control, and that, consequently, they are entitled to at least as advantageous conditions as they have enjoyed under such control as has been exercised in the past in the interests of navigation.

Navigation and Lumbering Interests.—Navigation on the Lake of the Woods consists, principally, of the towing of logs and the transportation of freight and passengers by steam and gasoline boats. Most of the gasoline boats are of relatively light draft, requiring from two and one-half to four feet of water. Most of the steamboats vary in draft from about four to six feet, a few of the larger boats being reported as drawing from eight to ten feet of water.

The effect of various levels on the navigation and the summer resort interests, in the vicinity of Kenora, is, in large measure, determined by the depths in the various navigation channels and harbors of the lake, by the available depths of water leading into the boat houses, and by the elevations of the boat house floors and the tops of docks.

The total value of docks in the vicinity of Kenora and Keewatin in 1914, before the construction of the large Kenora Municipal Dock, amounted to substantially $35,000. The total value of boat houses amounted to $185,000. The tops of all docks in the vicinity of Kenora and Keewatin are at, or above, an elevation of 1,061 sea-level datum, and the boat house floors are all above an elevation of 1,059.5,—over 90 per cent. of them being above 1,061. Only about 50 per cent. of both docks and boat house floors, however, are above elevation 1,062.0.

The lumbering interests are affected by the levels of the lake of the Woods, mainly, insofar as the stage of the lake has a bearing on the facility with which logs can be gotten out of the various bays and inlets, and then towed across the lake, and hoisted into the mills by means of jack ladders. In low water the towing channels become narrower and more difficult of navigation with log booms, through the protrudence of reefs above the water surface. Low stages, that is, stages below about 1,058, would also require additional dredging in harbors and navigation channels in various portions of the lake. At the January, 1914, hearings of the International Joint Commission, in Washington, Col. Charles L. Potter, U.S.A., in charge of the district which includes the United States portion of the Lake of the Woods, testified that the cost of dredging the harbors of Zippel and Warroad was $9,600 per foot increase in depth.

Evidently the most desirable level for the navigation interests, the lumbering interests, and the summer resort interests on the lake, would appear to be a fairly high, uniform level, irrespective of what the outflow may be.

Navigation interests on the Winnipeg River between Kenora and Minaki are affected by fluctuations in the outflow from the lake. In view of the fact that at low water there is less fall and hence less current at The Dalles than at high water, moderately low rates of outflow from the Lake of the Woods are more favorable for navigation on that portion of the Winnipeg River than high rates. Very low rates of discharge, however, are unfavorable to navigation of the river immediately below the outlets of the lake. It follows, then, that any regulation of levels and outflow which results in either very low or very high rates of outflow from the lake is detrimental to the navigation interests on the Winnipeg River below the outlets of the lake.

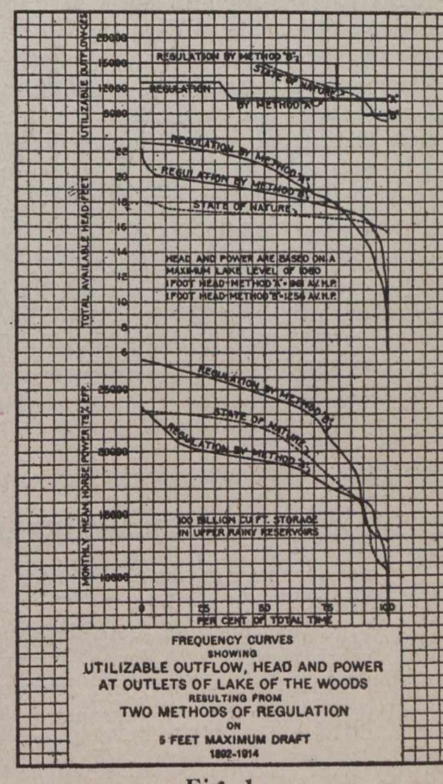


Fig. 1.

Riparian Lands.—If the utilization of the maximum amount of low land adjoining the lake, and which may be brought under cultivation, be considered, then the most desirable condition for agricultural interests is a low level. These interests are not directly concerned either in the outflow or in the fluctuation in lake level, so long as the highest level to which the lake is permitted to rise is a low one.

According to results obtained from the instrumental surveys of the southerly shore of the Lake of the Woods, and portions of Shoal Lake and Big and Bigsby Islands, it appears that all of the cultivated land below the 1,064 contour (of which there are only about 275.1 acres in the United States and 66.8 acres in Canada) lies above the 1,060 contour, and all but 84.6 acres lies above the 1,062 contour. Practically all of the land, in the United States above the 1,060 contour has little or no covering of peat vegetation. Below the 1,060 contour the peat cover gradually increases, but hardly anywhere, even at the lake shore, does it reach a thickness exceeding 1.0 or 1.5 feet. This is apparent even from a comparison of the contours giving the elevation of the bed of the lake at the shore-line, with the contours on the adjacent land.

Practically no timber is found, at the present time, below the 1,060 contour. Ninety-five per cent. of all the land below the 1,059 contour consists of open marsh or bog, and the remainder is covered with willows and brush.

Between the 1,058 and the 1,060 contours there are approximately 16,000 acres of land, or 8,000 acres per foot increase in elevation. Above the 1,060 contour the area is substantially 12,000 acres per foot, the slopes becoming very slightly steeper again above the 1,062 contour.

While the riparian owners on the Lake of the Woods are affected by the levels resulting from various methods of regulation, riparian owners on the Winnipeg River are affected by rates of outflow from the lake resulting from such regulation.

Fishing Interests.—The most desirable level for the fishing interests would appear to be a fairly uniform level, and below the higher stages, particularly insofar as fishing in the Big Traverse is concerned. Some fishing interests have specified levels desirable for the northerly portion of the lake higher than the levels mentioned as desirable for the southerly portion of the lake. Uniformity in levels protects spawning grounds and aids in the setting of pond nets. A rather low level results in clearer and purer water, particularly in the Big Traverse, because at high stages the muskegs are broken up by the waves and the vegetable matter is scattered far out into the lake, making the water dark in color and disagreeable in taste. At the preliminary hearings of the Commission at Warroad, in September, 1912, Paul Marschalk testified that during the high water of 1905 many fish died, and those which were caught in the Big Traverse became unfit for food within twenty-four hours after being taken from the nets.

(To be concluded in next week's issue.)

THE MOTOR TRUCK AS A FREIGHT FEEDER.

Considerable attention has been given to the use of the automobile as a feeder to the passenger traffic of electric railways but little consideration to its possibilities as a freight feeder. A large interurban system in the United States which has gone in extensively for freight handling recently made an arrangement with the owner of a motor truck line to deliver to it all freight for shipment, largely fruit, from a small town in the midst of a rich agricultural country but located several miles from the railway.

In this way the railway extends its service to a new territory without incurring the expense of an extension of its own tracks, an expenditure which undoubtedly would not be warranted at the present time. The railway includes in its tariffs the charges for the motor truck haul so that this town has the same shipping facilities virtually that it would have were it located directly on the railway. Not only will the railway secure considerable business that it would not get otherwise but it will build up the territory, so that it will benefit doubly by the arrangement.

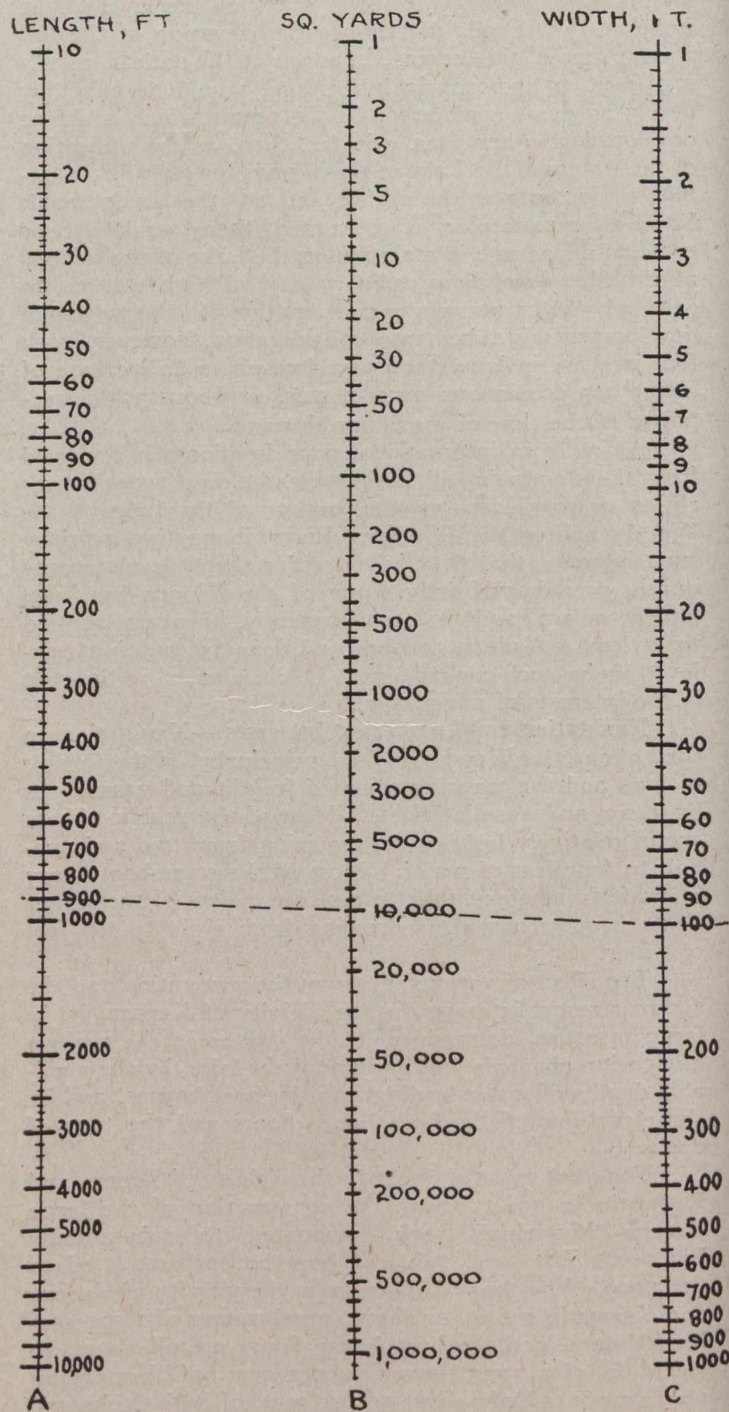
A similar arrangement has also been made with a steamer line plying on a river which the railway crosses. This line taps a good fruit growing district, and will turn over to the railway a large amount of freight.—[Electric Traction.]

According to unconfirmed reports, Japan has acquired from Russia for the sum of $7,000,000, 75 miles of the main line through Southern Manchuria. The concession was paid for, the reports said, in war munitions, including aeroplane motors, valued at $1,000,000, manufactured in Berkely, Cal.

A HANDY ROAD CHART.*

By N. G. Near, New York City.

The accompanying chart will be of service to road builders for determining the number of square yards in any road up to nearly two miles in length and in any width up to 1,000 ft. Just lay a straightedge across as



indicated by the dotted line and the area is immediately found in the middle column (column B).

For example: A certain contractor laid 900 ft. of road in one day, the width of the road being 100 ft. Connect the 900 (column A) with the 100 (column C) and column B gives the area as 10,000 sq. yds.

The chart is especially valuable for estimating work, for the foreman in making his daily report, or for anybody who has to do figuring of this kind.

*"Engineering and Contracting."

Editorial

MUNICIPAL ENTERPRISES.

One difficulty inherent to our democratic form of municipal government is the weakness in the preparation, development and execution of new enterprises. This is where a city managership should result in a great improvement. The aldermen who are elected to represent the ratepayers are often new to the office, have had no previous municipal experience and their preconception of what constitutes municipal administration often proves to be a stumbling block. But apart from this, it is well to consider how municipal enterprises are undertaken. How often have we read of candidates advocating some pet scheme which is going to do much to provide the ratepayers with an improvement which will result in great satisfaction? Street railways, water mains, sewers and pavements have been extended beyond the limits of prudence, but the anticipated results have not always been secured by the ratepayers. The benefits, if any, have been enjoyed by others.

It is true that developments on these lines have for the time been discontinued, but when more prosperous times return, it will only be necessary to sway the popular votes by elequent speeches and golden visions to have the former unsatisfactory methods of promoting municipal enterprises repeated again despite the lessons learnt meanwhile.

It was hoped that the Canadian Civic Improvement League was launched for the purpose of promoting a better system, but after the great things which were said at its inauguration there does not appear to be very much progress made on the lines of its constitution. It may be said that the war absorbs the public attention and that our business is to concentrate on victory. If such is the argument, then the League was launched a little too soon. On the other hand, the argument may apply more forcibly after the declaration of peace, for then, after two or more years of violent political, commercial and social disturbance, the people will set to put their affairs into order once more and there will be no time to spare to think over "abstract and dry-as-dust" problems of municipal government. It will then be almost impossible to get the average ratepayer to think municipally and indeed few, outside a circle of municipal enthusiasts, will do so.

The present is Canada's opportunity to arrange her municipal house in order, whilst ordinary business is quiet and people have some leisure to ponder over problems.

WATER WASTE.

The recent continuous dry weather which has been quite general, at least through a great portion of the country, has caused those who have to do with the distribution of water in our various municipalities a great deal of concern.

The disposition to use water freely during such a season without due regard to waste is a common one. One can hardly walk along our streets without seeing evidences of undue waste of water which goes on, and doubtless if one could but see it, there is also a corresponding waste going on indoors, due to leaky faucets and other causes.

It is as true to-day as of old that the most eagerly sought commodities are those which cost the recipient nothing—waste is practiced upon other people's goods and properties in preference to our own. We seem to be built that way.

A constant dribble from a leaky faucet may easily become in the course of twenty-four hours more than the legitimate use of an entire family.

Metering would seem to be the only really equitable and economical method of dealing with this matter. Systems of inspection and prevention are used, but it is questionable if the results are lasting.

As to the detrimental effect of water meters on public health, much has been written, but it is doubtful if the slightest foundation for making such statements really exists, if the water itself is wholesome. Municipal water waste is no more justifiable than any other form of waste, and where it is persisted in something should be done to prevent it. Somehow or other people must have brought home to them the fact that they can reduce their expenses by giving more attention to water waste. A leak in the pipe is a leak in the pocket-book either directly or indirectly.

Is there any intelligent person who believes that a limit can be placed on the cost of absolutely unrestricted use of water? Double the supply, enlarge the mains and the situation will remain the same. Water famines will always be in evidence whether the per capita is a hundred or a thousand gallons.

THE TECHNICALLY TRAINED MAN IN BUSINESS.

During the past few years an ever-increasing number of technically trained engineers have been taken from purely professional work and placed in actual charge of railroads and industrial enterprises.

A few years ago the active business man looked with some suspicion upon the idea of a technically trained man as manager or holder of any kind of administrative position. Not so to-day. Modern business methods depend more than they ever did upon technical training. In the matter of mental equipment the technically trained man has, other things being equal, a distinct advantage over those who, for various reasons, have not had the privilege of a college training. He has, in a managerial capacity, opportunities to utilize his practical knowledge to better effect than the man without a scientific training. Heads of industrial enterprises are ever on the look-out for men who are not only endowed by a mental alertness which is often the direct result of a college training, but at the same time possess balance—a sense of proportion and who are safe, if not brilliant.

In the past, materials were bought on the guessing principle; the standard of the product was variable; the manufacturer felt sure he was selling at a profit. That has all passed and to-day the manufacturer, in order to be sure that he is making a profit, is following scientific methods. All this makes it necessary that he turn more than ever to the technical schools for his men if he is to meet competition successfully.

While the combination is not unknown, it is nevertheless rare to find a technically trained engineer who, in addition to his professional knowledge, possesses a working acquaintance with business methods, business law and who also understands men.

The demand for this type of engineer has been so insistent of late years that heads of schools of engineering recognize it, and many of them have already adopted courses which provide not only for specialization along mechanical or civil engineering lines, but also studies in such subjects as will more adequately enable engineers to fill positions where executive ability and business sense are called for.

PERSONAL.

ARTHUR W. ODLUM, city electrician of Port Alberni, B.C., has resigned his position.

EDWARD J. O'NEIL, reeve of Sandwich South, has been appointed superintendent of road construction for Essex County.

W. L. BIRD, local manager for the Kaministiquia Power Company, Fort William, Ont., has been elected a director of the company.

J. H. DUBUC, civic engineer of bridges and subways, Montreal, has been elected a member of the American Society of Municipal Improvements.

C. A. MULLIN, of New York, who was at one time commissioner of public works in Milwaukee, has been engaged by the city of Montreal as pavement inspector.

WILLIAM S. COOK, engineer, Canadian Porcelain Co., of Hamilton, Ont., has been elected an associate member of the American Institute of Electrical Engineers.

ELLIS THOMPSON and H. B. ELLSWORTH have been engaged by the Ontario Bureau of Mines to map the Rognon and adjoining properties near Dryden, Ontario.

SMITH CURTIS, former British Columbia minister of mines, has been in Montreal, Que., endeavoring to arrange for the opening of a zinc smelter in British Columbia.

Lieut.-Colonel C. J. Burritt, engineer of Barrifield Camp, near Kingston, Ont., has been transferred to Ottawa and will be succeeded by Captain PALMER, R.C.E., Halifax.

A. VAN ZWALUWENBURG, formerly associated with Walter Harvey Weed in the preparation of the Copper Handbook, has taken a position as chemist for the Nipissing Mines, Limited, Cobalt, Ont.

LEONARD FOULDS, senior partner of the firm of Foulds & Bowes, architects and engineers, Toronto, and son of Sir Samuel Foulds, one of the leading surgeons in England, has "signed up" with the 220th York Rangers as a sergeant.

GEORGE W. FULLER, consulting engineer of New York City, has been awarded the Edward Longstrath medal of merit by the Franklin Institute, Philadelphia, for a paper on "Biochemical and Engineering Aspects of Sanitary Water Supply."

EDWARD FITZGERALD, late of the Canadian Pacific Railway Company's Purchasing Department, and since February last purchasing agent for the Imperial Munitions Board, has been appointed assistant to the chairman of the board, Mr. J. W. Flavelle.

Capt. JAS. G. ROSS, who went to France with the 13th Canadian Battalion Royal Highlanders of Canada, and was wounded at Festubert, has returned to Canada and resumed his practice as consulting mining engineer with the Milton Hersey Co., Limited, Montreal.

Lieut. WILLIAM DUNBAR, Black Watch, who is unofficially reported wounded, was a civil engineer and surveyor in British Columbia. When the war broke out he went to England and joined the Sportsmen's Battalion, afterwards transferring to his present regiment.

M. E. BRIAN, city engineer of Windsor, Ont., has been appointed chairman of the Board of Engineers which will prepare plans for a joint water and sewage system for Windsor, Walkerville, Ford City, Sandwich, Ojibway and Sandwich West. LEONARD RICE, assistant engineer of Ojibway, was elected secretary.

T. J. VAUGHAN-RHYS, for several years associated with various mining enterprises in Portland Canal division and other parts of the northern coast district of British Columbia, recently took charge of development work at a mine in Cedar Canyon district, on the State of Washington side of the international boundary line.

Lieut. PETER D. D. LYALL, of the Peter Lyall & Sons Construction Co., Limited, Montreal, has received an appointment with the 190th battalion. Lieut. Lyall was born in Montreal in 1877, and since the death of his father, the late Peter Lyall, has had charge of the firm, which has done extensive contracting work all over Canada.

A. M. MORRISON, of the Canadian Engineers of the British Army, has been awarded the Distinguished Conduct Medal for conspicuous gallantry. He also has received a commission as lieutenant in the Canadian Engineers. At the outbreak of war Mr. Morrison was an engineer engaged in the construction of the Pacific Great Eastern Railway in British Columbia.

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Lieut. L. B. REYNOLDS, of Nelson, B.C., one of a number of Kootenay mining engineers who a few weeks after the outbreak of war volunteered for active service and were soon engaged in engineering work on the Continent, was one of several wounded men who returned to Canada last month. Several years ago Lieutenant Reynolds was manager of the Eureka copper mine, at the head of Eagle Creek, a few miles west of Nelson, B.C.

A. F. MACALLUM, B.A.Sc., C.E., commissioner of works, Ottawa, Ont., has announced the organization of his department as follows: Assistant engineer, FRANK C. ASKWITH; pavement engineer, L. McLEAN HUNTER; sewers, incinerator and garbage, WILLIAM F. BRICE; sidewalks and surveys, NORMAN B. McROSTIE, P.L.S.; mechanical engineer of waterworks, L. L. GISBORNE; bridge engineer, ROBERT HENHAM; street cleaning, watering and oiling and oversight of the district foremen, GEORGE LITTLE.

JOHN EDWARD HANLON, B.A.Sc., has been given a commission in the Canadian Engineers in the tunneling corps, and will go to Valcartier for two weeks' preliminary to going overseas. Lieut. Hanlon was born in Guelph, Ont., got his early schooling there and graduated with honors in his science course at Toronto University. He was in Chile when the war broke out, and returned and enlisted as a private with the 170th Battalion. He has had experience about Cobalt, and was for four years at the Hollinger mines. Being anxious to get to the front he went over to the engineers, and his training won him a commission.

OBITUARY.

WILLIAM NORTHGRAVE, a municipal employee of St. Marys, Ont., for the past fifteen years and latterly road commissioner, died recently after a lingering illness, at the age of 53 years.

LORNE MARSHALL died recently at Gravenhurst, Ont., after a long illness, at the age of 33 years. He was born near Bracebridge, Ont., and was engaged in the contracting business with his brother in Toronto.

JOHN H. ALLEN, who for the last fifteen years was president of the John F. Allen Co., of 370-372 Gerard Avenue, New York City, widely known as the makers of the original "Allen" riveting machines, died at his summer home, Kattskill Bay, Lake George, N.Y., on July 22nd at the age of 58. Mr. Allen succeeded his father, who founded the business some forty-five years ago.

ROAD DRAINAGE AND FOUNDATIONS.

(Continued from page 86.)

distribute widely stresses coming through it is very high, so high in fact that it will often carry stresses like a beam. Little has actually been determined as to its distributing power and as to its abilities in pavement foundation to carry indefinitely these beam-like strains. There is great need for investigation on these points. The cement concrete slab, however, has proven its ability to aid weak sub-grades to carry satisfactorily continuous heavy traffic; to aid good sub-grades to support the heaviest traffic; and, within limits, to insure permanency for these effects or results. "Within limits" is used in this statement because of the rather recently developed agreement among at least engineers advanced in the study of the matter, to the effect that cement concrete slabs used as pavement foundations are not the rigid masses they were commonly supposed to be, nor is their elastic limit in any case coincident by any means with their ultimate strength. On the contrary, they have a limited amount of resiliency or elasticity, and they have what is perhaps fully as important, the ability to become permanently deformed. That is, the cement concrete under continuously repeated stresses flows and the slab takes a different position from that which it formerly occupied. This theory explains the deformation of the surface of some pavements which has occurred in numerous cases, and which cannot be explained by any shifting of the pavement surfacing or of any intermediate sand layer. In such cases, the surface of the concrete foundation is found to be deformed and yet no deterioration of the concrete itself is evident. Admitting this to be true shows again the necessity of proper consideration of the sub-grade even when it is to be reinforced or supplemented by a concrete layer above it. Too often the practice has been to consider no care necessary in the selection or preparation of the sub-grade where a concrete slab was to be interposed between it and the pavement surface. The contrary should be the real practice, and not only should the decision as to the use of the concrete slab be based on careful consideration of the possibilities with the natural material of the sub-grade, or of other materials brought in for its improvement, but also when the concrete slab shall be decided upon for use, careful consideration of the possibilities of the natural material for the sub-grade, and even of other materials brought in for its reinforcement, should be had, so that the utmost use of the concrete slab may be developed, as well as economy had in its introduction.

The standard concrete pavement foundation in America is 6 ins. in thickness. A greater thickness has been advocated as desirable and even necessary under certain extreme traffic conditions. It is a fact that the pavement on a 6-inch slab seems to have given way under such traffic conditions in certain cases, but it is equally the fact that even in these cases, the fracture of the slab or the actual failure of the slab itself as such has seldom been found to take place. What did occur was the subsidence or deformation of the slab without fracture and without destruction and this deformation appears to have been permitted by a failure of the supporting foundation. It would seem to the writer that a remedy such as preparing and providing better sub-grades should be considered in these cases along with the provision of a thicker slab, and that the decision might be for one or the other according to the demands of economy in the case.

On the other hand, the necessity for a minimum of 6 ins. to the concrete slab in all cases may be questioned, and why even 3 ins. of good concrete would not answer the purpose under many local conditions and where proper regard is to be shown the preparation of the sub-grade and the provision of a permanent and fairly substantial natural foundation, is not apparent.

It is impossible in the limited time assigned the writer to discuss exhaustively, or even perhaps to mention all the points of interest in connection with foundations, but if he has indicated to you a majority of the important ones and done so intelligibly and in a manner which will permanently impress them on your minds as well as inspire discussion at this meeting, he is repaid for his effort.

An artesian well to float dredges for digging a drainage canal near Crawfordsville, Ark., is to be put down by the Canal Construction Co., of Memphis. Instead of waiting for the fall rain to fill the ditches, a centrifugal pump will be used to lift the water. Seven dredges will be used in digging the canal. The latter will drain 90,000 acres. The contract price for the canal is $47,000.

The use of national funds for road improvements was urged early in the history of this continent by Alexander Hamilton. A little later Albert Gallatin succeeded in securing the passage by the United States Congress of an act setting aside one-twentieth of the proceeds of the sale of public land in Ohio for building a highway from tidewater to the Ohio River. In 1806, President Jefferson appointed three commissioners to locate this route, which ran through Maryland, Pennsylvania and Virginia. The first contract for construction was placed in 1810 and in 1818 part of the road was opened to travel. It was called the National Road and was built with national funds exclusively, says a bulletin issued by the American Highway Association. The United States Government did not have the same views then that it has now of the importance of maintaining highways. The National Road was the main thoroughfare for the heavy travel between the seaboard and the Ohio Valley, and lack of maintenance resulted in the road becoming very poor. In 1831 Pennsylvania asked Congress to turn over to her care the portion of the road within her boundaries, and Maryland and Virginia also made a similar request somewhat later. Unfortunately, State control did not result in any marked improvement. The counties which had charge of the portions within their boundaries did not pay much attention to highway improvements, and it was not until the comparatively recent organization of state highway departments that the old National Road was given any real care. In the last ten years, however, reconstruction has been going on steadily. In about two years the entire length in Pennsylvania will be in good condition and the portion in Maryland is also very nearly reconstructed. Farther west the old highway is not in such good condition, although sections of it have been rebuilt there. So this early venture in national roadbuilding, successful until the railroad took its place, is again in a prominent place among the highways of the United States.

COAST TO COAST

British Columbia Province.—It is reported that preliminary work in connection with the establishment of shipbuilding yards on Poplar Island in the Fraser River, B.C., has been commenced by the Westminster Marine Railway Company, New Westminster, B.C., which has started to clear the site. The company proposes to build a plant on the island to cost $70,000 and to install $15,000 worth of machinery.

Calgary, Alta.—Work is proceeding rapidly on the Center St. bridge, and the programme that was mapped out at the beginning of the year is being kept up with.

Cambie, B.C.—It is expected that the Selkirk tunnel will be open for general traffic in four months.

Cobalt, Ont.—The construction of the power transmission line from the plant of the Northern Ontario Light and Power Co.'s station at Cobalt to Kirkland Lake is now under way and will, it is expected, be completed within three or four months.

Cobourg, Ont.—The lock gates at Campbellford and Healey Falls on the Trent Canal system will be installed in a short time, and when completed navigation will be open from Lake Ontario as far west as Orillia through the Kawartha Lakes system.

Fredericton, N.B.—The City Council shelved a proposition to purchase current from the Fredericton Gas and Light Co., at 3½ cents per kw.h. and will continue to light the city streets with current supplied from the city's plant on Carleton St.

London, Ont.—Two of the greatest natural gas gushers yet struck in this district were found on July 21 in Raleigh Township, near Merlin by the Southern Ontario Gas Co. They yield thirteen million feet, and will be used to supply Hamilton and district.

Merritt, B.C.—Mining men are showing considerable interest in a molybdenite property located on Texas Creek, in the Lillooet district. The property is owned by J. B. Perkins and A. Hautier, of Lytton, B.C., who have recently given a bond on it to American capitalists for $300,000.

Montreal, Que.—A big break in the waste-weir walls of the Lachine Canal occurred recently, the wall of heavy blocks of limestone stretching across from the canal embankment to the corner of Royal Flour Mills being washed away. The Montreal Light, Heat and Power Co.'s power cables, carrying 25,000 volts from the plant at Chambly ran across the top of the wall which was demolished. The wires were carried away. Quinlan and Robertson are in charge of the work of repairing the wall.

Montreal, Que.—It is reported that the C.P.R. intends to lay down rock ballast between Montreal and Toronto, which will be a large undertaking, but not this season—at least, a beginning may be made this season, but the work, which is necessarily slow, would not be completed for many months.

Montreal, Que.—The completion of the Mount Royal tunnel terminal scheme is to be pressed on the Canadian Northern Railway by the Government in connection with the financial assistance recently granted to the company.

Nelson, B.C.—The West Kootenay Power and Light Co. is busy installing another 8,000 h.p. unit in their No. 2 plant, thus bringing the total horse power of the company up to 32,000. Increased demand for power in the development of mines and smelters in Kootenay and Boundary has made this installation necessary.

Niagara Falls, Ont.—According to a statement made by P. P. Barton, general manager of the Canadian Niagara Power Co., three additional 12,500 h.p. units will be in operation in the power house of the company before next year. The first of the three new generators will be in operation early in September. The company now has five 10,000 and two 12,500 h.p. units in use.

Niagara Falls, Ont.—The new plant of the Canada Nickel Smelting and Refining Co. at Chippawa is practically finished, and will likely be in operation within a few weeks. It will be the first nickel refining plant to use Niagara power.

Ottawa, Ont.—On July 24th, the powers and duties of the civic waterworks committee passed into the hands of the Board of Control.

Renfrew, Ont.—The Pembroke Electric Light Co., Limited, is interested in the Renfrew, Ont., power supply, which is insufficient to meet the demand. The Pembroke company proposes to generate the current at their plant on Black River. This will entail the expenditure of some $40,000 on this plant but the Renfrew council would construct the transmission line, which is about 35 miles in length.

Salmon Arm, B.C.—It has been announced that work on the Canadian Northern Railway extension from Kamloops to Vernon and Kelowna will start at once.

Sarnia, Ont.—Work on the new gas line from Tilbury to Sarnia, a distance of 70 miles, is now progressing rapidly. From Wallaceburg to Sarnia, a distance of 30 miles, the pipe will be placed in at the rate of a mile per day, and it is expected that the work will be finished in one month.

Saskatoon, Sask.—Owing to the fact that the entire faculty has enlisted for active service, the School of Engineering of the University of Saskatchewan here will not re-open this year. Most of the engineering students also have enlisted.

Smooth Rock Falls, Ont.—Some six hundred men are now at work constructing the coffer dam for the Matagami Pulp and Paper Co., at Smooth Rock Falls, Ont., and also excavating for the foundation of power house and the sulphite mill. Good progress is being made considering the scarcity of labor. The contractors report that they could use several hundred more men, but are unable to secure them.

Stratford, Ont.—The new water tower being erected just south of the Public Utilities Commission pumping station, is nearing completion. Work began on the structural part of the tank the first week in April of this year, but owing to the unfavorable weather, operations were delayed somewhat, and it will be nearly three weeks before the contract is complete. The erecting is in the hands of the Chicago Bridge and Iron Works. The supervisor for this contract is Mr. S. W. Clements. The tank is 55 feet in diameter and 35 feet high and has a capacity of 500,000 imperial gallons. It is supported by eight pillars or columns, 130 feet high, thus making the whole structure 165 feet in height. Up the centre from the ground to the tank runs a 6-foot cylinder or drum, which is connected with the tank by a 16-inch pipe.

Toronto, Ont.—Twenty cars of steel were unloaded at the new Union Station last week. The contractors claim they will have the building completed within the contract time and work will be now rushed until the finish.

Vancouver, B.C.—The hauling of the 18-inch submerged waterworks main across the First Narrows has been successfully completed. This big main, when its connections are completed, will give the city three 18-inch and two 12-inch submerged mains connecting with the Capilano service.

Victoria, B.C.—Work will be resumed immediately by the Pacific Great Eastern Railway Co. on the construction of the line to Fort George.

Windsor, N.S.—Work has been started on the Bay of Fundy tide power project at Cape Split, N.B., by the Cape Split Development Co., Limited.

Winnipeg, Man.—It has been announced by Frank Simon, Government architect, that tenders for the completion of the new Parliament buildings, which close August 21st, will be confined to Canadian contractors who have been in business in Canada for five years.

Winnipeg, Man.—The doors of the mammoth new service building and assembly plant of the Ford Motor Co., at the corner of Wall St. and Portage Ave., were thrown open to the general public July 20, 21 and 22. George Malcolmson is manager of the Winnipeg branch.

York County, Ont.—The York County Highway Commission is meeting with a great deal of difficulty in securing laborers to carry on the construction work outlined by the engineer during the summer. While the programme laid out was not an extensive one, unless the labor market improves, it is doubtful if the 15 or 16 miles decided upon will be all built.