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The Canadian Engineer

An Engineering Weekly

THE BROOKLYN GRADE CROSSING COMMISSION.

Pipe Raising at East New York, Brooklyn, N.Y.

By WM. C. SAMPLE.

Mr. Sample was in the employ of The Brooklyn Grade Crossing Commission for upwards of five years. For four years of this period he occupied the position of designer and estimator to the Bay Ridge Improvement. Quite recently Mr. Sample was engaged to fill a position at Fort William, Ont., with the Barnett, McQueen Co., Engineers and Contractors, Minneapolis and Fort William, who have the contract for the design and construction of the three million bushel addition to the Canadian Northern Elevator at Fort William.

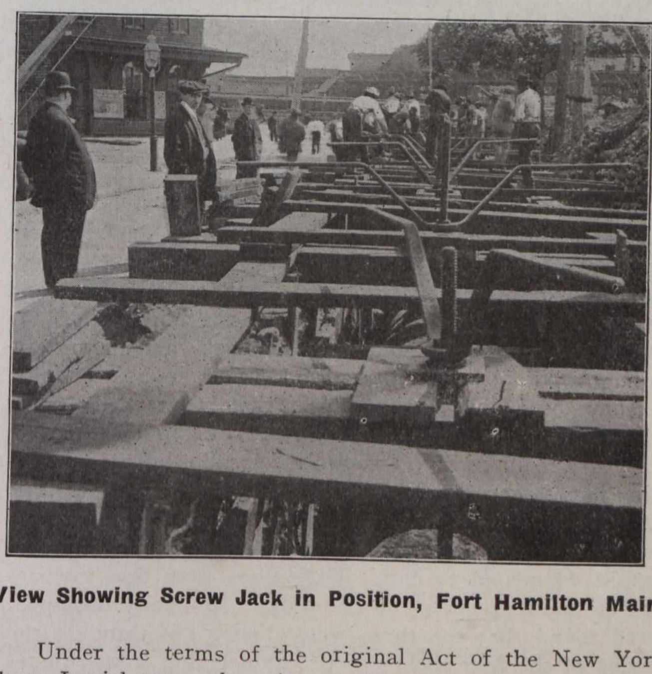
During the past eight years the Brooklyn Grade Crossing Commission has been engaged upon the largest scheme of grade crossing elimination ever carried out in the United States.

The commission was created by an Act of the New York State Legislature, which became a law on May 9th, 1903, entitled as follows: Chap. 507, an Act to abolish certain grade crossings of highways and railroads in the borough of Brooklyn in the city of New York and county of Kings, and providing for necessary changes in the grades of highways, streets and avenues, and of portions of the railroad and right-of-way of the New York, Brooklyn and Manhattan Beach Railway Company, leased to the Long Island Railroad Company, and of the Brooklyn Union Elevated Railroad Company, leased to the Brooklyn Heights Railroad Company, so as to abolish present, and avoid future crossings at grade, and providing means for the payment for such alterations or changes.

The Act authorized the mayor of the city of New York (Hon. Seth Low) to appoint a commission of five, three of whom should represent the city, one to represent the Long Island Railroad Company, and one to represent the Brooklyn Heights Railroad Company, for the purpose of carrying out the provisions of the Act above referred to.

Changes have from time to time been made in the personnel of the commission, and the membership as at present constituted, is as follows: Frank U. Brooks, president; John S. Griffith, secretary; Edwin C. Swezey, general superintendent, representing the city of New York; Ralph Peters, president of the Long Island Railroad, representing the Long Island Railroad Company; and John L. Wells, representing the Brooklyn Heights Railroad Company.

View of Fort Hamilton Main Before Raising.

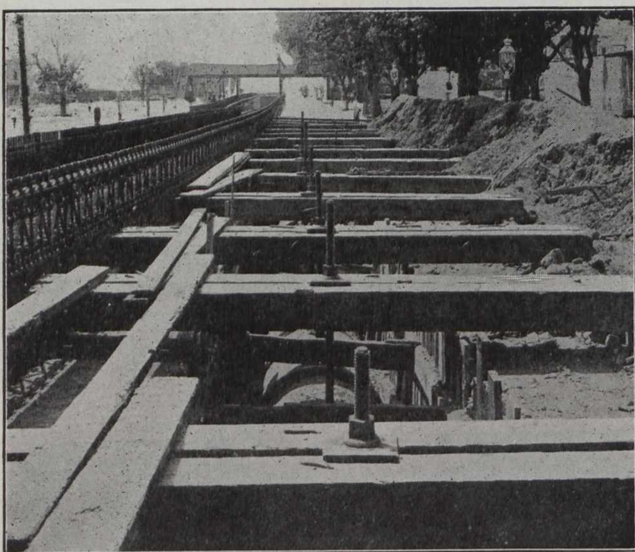


View Showing Screw Jack in Position, Fort Hamilton Main.

Under the terms of the original Act of the New York State Legislature, the city of New York was required to pay one-half the cost of the work and this was provisionally fixed at $750,000, subsequently increased by amendment to $1,000,000 for the Brighton Beach improvement (Brooklyn Heights Railroad), and $2,500,000 for the Bay Ridge improvement (Long Island Railroad), with the provision that any additional cost in excess of the joint expense of $5,000,000 should be borne by the railroad company alone, except where additional bridges were built at streets not actually opened or travelled, so as to provide for future crossings. In such cases the cost to the city was to be increased so as to cover one-half of the expense of such additional bridges.

The Brighton Beach improvement is now completed, but the Bay Ridge improvement, although in an advanced stage of construction, will take about twelve months longer to complete. The work already done on this last mentioned improvement embraces the raising and depressing of about twelve miles of double track, the construction of railroad and highway bridges with reinforced concrete floors; plain and reinforced concrete retaining walls and bridge abutments, station buildings, freight and storage yards, new streets, etc. The contract for the final section of the work was recently let for a figure approximating $1,250,000, and when complete will bring the total amount expended on the Bay Ridge improvement to about $8,000,000.

The principal item on this final section of the improvement consists of a four-tube reinforced concrete tunnel, 3,500 feet in length, the building of which, in open cut, through the busy East New York section of Brooklyn, bristles with engineering problems which the improvement engineers will be called upon to solve. The tunnel will cut through many of the busiest streets in East New York, and it was necessary to clear the way for the building of the tunnel by the carrying out of an immense amount of preliminary work. Sewers, gas and water mains, conduits, etc., have been diverted, and this article is intended to deal with a section of this work, viz., the raising of three 48-inch water mains. Fig. 1 shows the location of these water mains in reference to the centre line of the new tunnel. It will be noticed that they cross the tunnel comparatively close to the south portal, the end adjoining the improvement as completed to date. Difficulties were thus encountered at the very outset of the work. As finally designed, it was found that the three water mains cut through the intrados of the four arches of the tunnel, and it was therefore necessary that they be raised before the work of building the tunnel commenced. To have designed the tunnel to avoid interfering with the water mains was impossible. This would have entailed a big outlay in the shape of many thousand additional yards of excavation and concrete, and most important of all, would have given a grade vastly inferior to the one finally adopted. The additional cost would, furthermore, have been many times that entailed by the raising of the mains.



The Atlantic Avenue Main.

A large amount of work was necessary before the actual raising of the pipes could be undertaken. Detailed drawings showing the existing elevations and location of the water mains in relation to the proposed tunnel were prepared and submitted to the Brooklyn Department of Water Supply, who have jurisdiction over all mains laid in the borough of Brooklyn. This department in turn drew up a large scale plan, embodying a general scheme of the method to be pursued in the carrying out of the work.

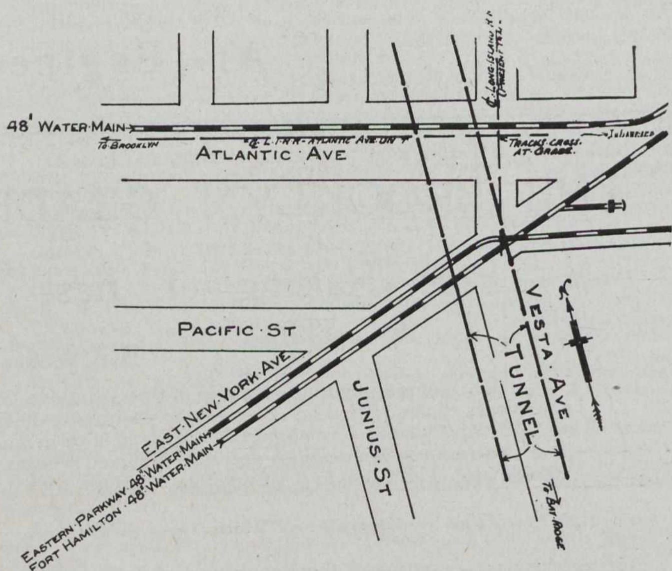


Fig. 1.—Sketch Showing Location of Water Mains.

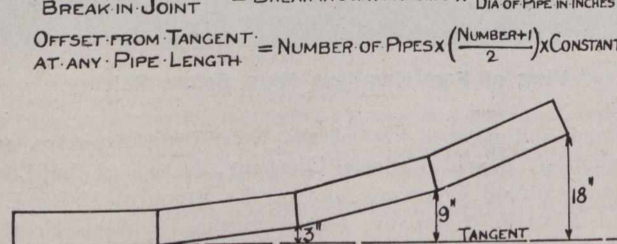
In Fort Hamilton and the Eastern Parkway water mains, or rather the portions of them which required raising, pass underneath the existing Long Island tracks and provision had to be made for the carrying on of the railroad traffic during the progress of the work. The portion of the Atlantic Avenue main raised did not interfere with the railroad, the end adjoining some stripping quite close to the tracks.

Table I.

Dia. of Pipe in Inches	Break in Inches per Joint	Offset in Inches for No. of Lengths: 1	2	3	4	5	6	7	8	9	10
12	1/4	3	9	18	30	45	63	84	108	135	165
	3/8	4½	13½	27	45	67½	94½	126	162	202½	247½
	1/2	6	18	36	60	90	126	168	216	270	330
	5/8	7½	22½	45	75	112½	157½	210	270	337½	412½
16	1/4	2¼	7½	15	25	33¾	52½	70	90	112½	137½
	3/8	3⅜	10⅛	20¼	33¾	50⅝	70⅞	94½	121½	151⅞	185⅝
	1/2	4½	13½	27	45	67½	94½	126	162	202½	247½
	5/8	5⅝	16⅞	33¾	56¼	84⅜	118⅛	157½	202⅛	253⅛	309⅜
20	1/4	1⅘	5⅖	10⅘	18	27	37⅘	50⅖	64⅘	81	99
	3/8	2 7/10	8 1/10	16⅕	27	40½	56 7/10	75⅗	97⅕	121½	148½
	1/2	3⅗	10⅘	21⅗	36	54	75⅗	100⅘	129⅗	162	198
	5/8	4½	13½	27	45	67½	94½	126	162	202½	247½
30	1/4	1⅕	3⅗	7⅕	12	18	25⅕	33⅗	43⅕	53	66
	3/8	1⅘	5⅖	10⅘	18	27	37⅘	50⅖	64⅘	81	99
	1/2	2⅖	7⅕	14⅖	24	36	50⅖	67⅕	86⅖	106	132
	5/8	3	9	18	30	45	63	84	108	135	165
48	1/4	¾	2¼	4½	7½	11¼	15¾	21	27	33¾	41¼
	3/8	1⅛	3⅜	6¾	11¼	16⅞	23⅝	31½	40½	50⅝	61⅞
	1/2	1½	4½	9	15	22½	31½	42	54	67½	82½
	5/8	1⅞	5⅝	11¼	18¾	28⅛	39⅜	52½	67½	84⅜	103⅛

$$\text{Constant for any Break in Joint} = \text{Break in Joint in Inches} \times \frac{144}{\text{Dia. of Pipe in Inches}}$$

$$\text{Offset from Tangent at any Pipe Length} = \text{Number of Pipes} \times \left(\frac{\text{Number}+1}{2}\right) \times \text{Constant}$$



Sketch showing 12" Pipes with 1/4" Breaks per Joint.

Bents were designed as shown in Fig. 2, and these were placed under the tracks to support them over the excavated pipe trenches. This work was carried out in the early hours of Sunday, when traffic was practically at a standstill.

The plan drawn up by the Brooklyn Department of Water Supply showed that it would be necessary to raise 21

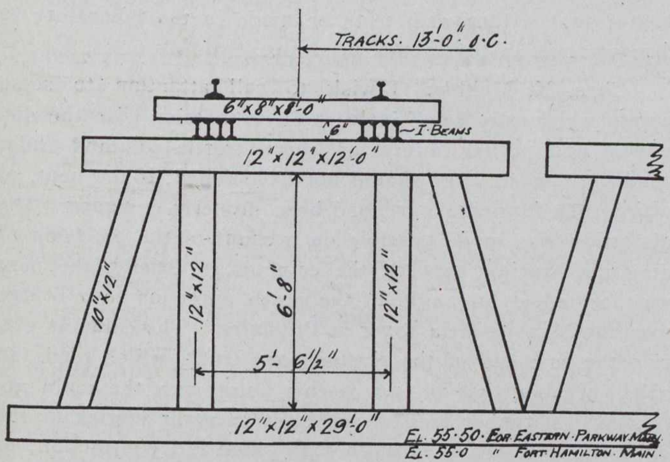


Fig. 2.—Details of Bents.

pipes in the Eastern Parkway main; 19 pipes in the Fort William main, and 17 pipes in the Atlantic Avenue main, and the heights to which the mains were to be raised above their original levels were: Eastern Parkway, 2.75 feet (2 ft. 9 in.); Fort William, 2.17 feet (2 ft. 2 in.), and Atlantic Avenue, 2.25 feet (2 ft. 3 in.). To achieve this object the Bay Ridge engineers calculated the break to be given per point from the formula given in Table I.—the formula is self-explanatory. Everything was now in readiness for the contractor, Mr. Frank J. Gallagher, of Brooklyn, to make a start and it was decided that the Eastern Parkway main would be the first to be raised, with the Fort Hamilton and Atlantic Avenue mains to follow in the order mentioned. The methods adopted by the contractor in raising the mains were similar in each case, and it will be necessary, therefore, to detail the work on one of the mains only, as typical of the others. For this purpose the Atlantic Avenue main is selected. It was much the older main of the three, having been laid about forty years ago, and it was anticipated that a great amount of trouble would be met with in raising it. Happily, however, this did not prove to be the case. The pipe joints, when bared, were found to be in excellent condition, and bear eloquent testimony to the splendid manner in which the original contractor had carried out his work. Water main laying is the one branch of contracting that the grafting contractor should avoid. He may be able to pull off some of his old tricks in practically every other

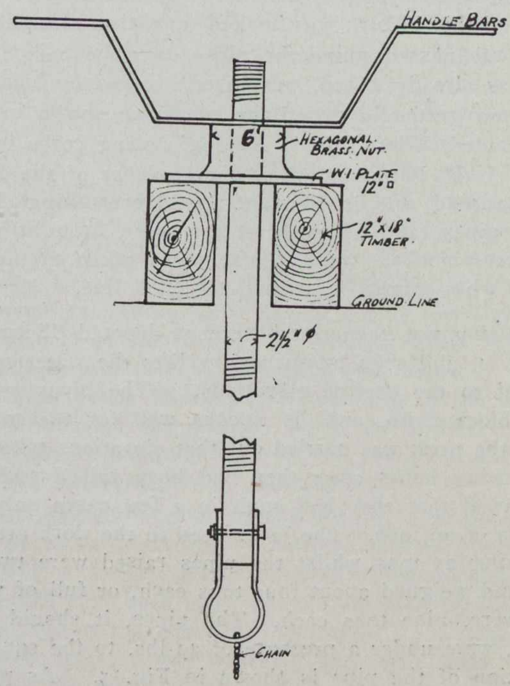


Fig. 3.

grade of contracting, but never with water pipes. Water has a little peculiarity of finding out any weaknesses at the joints.

In raising the mains twelve screw jacks were used. A sketch of this type of jack is shown in Fig. 3. This sketch, it should be stated, is from memory, as the writer has not any details of it before him, and the dimensions given are therefore only approximate. The jacks are the property of the Brooklyn Department of Water Supply, and were

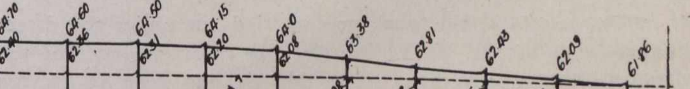


Fig. 4.

hired from the department by the contractor. It will be noticed that the jack passes through a large brass nut, this in turn rests on two balks of timber placed just sufficiently

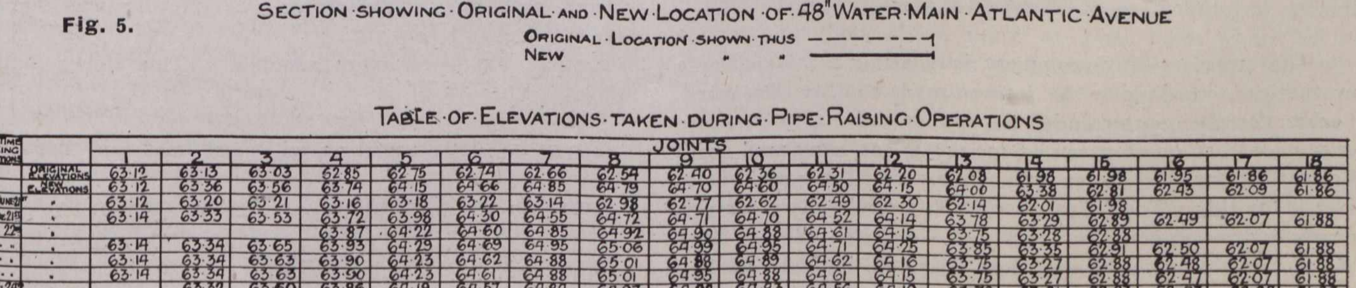


Fig. 5. SECTION SHOWING ORIGINAL AND NEW LOCATION OF 48" WATER MAIN ATLANTIC AVENUE

ORIGINAL LOCATION SHOWN THUS - - - - - - -
NEW " " ————

TABLE OF ELEVATIONS TAKEN DURING PIPE RAISING OPERATIONS

Date & Time of Taking Elevations		Joints 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	Original Elevations	63.12	63.13	63.03	62.85	62.75	62.74	62.66	62.54	62.40	62.36	62.31	62.20	62.08	61.98	61.98	61.95	61.86	61.86
	New Elevations	63.12	63.36	63.56	63.74	64.15	64.66	64.85	64.79	64.70	64.60	64.50	64.15	64.00	63.38	62.81	62.43	62.09	61.86
9.50 am June 21st	"	63.12	63.20	63.21	63.16	63.18	63.22	63.14	62.98	62.77	62.62	62.49	62.30	62.14	62.01	61.98			
4 pm June 21st	"	63.14	63.33	63.53	63.72	63.98	64.30	64.55	64.72	64.71	64.70	64.52	64.14	63.78	63.29	62.89	62.49	62.07	61.88
8 am " 22nd	"				63.87	64.22	64.60	64.85	64.92	64.90	64.88	64.61	64.15	63.75	63.28	62.88			
8.30 am " "	"	63.14	63.34	63.65	63.93	64.29	64.69	64.95	65.06	64.99	64.95	64.71	64.25	63.85	63.35	62.91	62.50	62.07	61.88
11 am " "	"	63.14	63.34	63.63	63.90	64.23	64.62	64.88	65.01	64.88	64.89	64.62	64.16	63.75	63.27	62.88	62.48	62.07	61.88
12.15 pm " "	"	63.14	63.34	63.63	63.90	64.23	64.61	64.88	65.01	64.95	64.88	64.61	64.15	63.75	63.27	62.88	62.47	62.07	61.88
8.30 am 24th	"		63.32	63.60	63.86	64.19	64.57	64.84	64.97	64.92	64.83	64.56	64.10	63.70	63.21	62.83	62.43	62.04	61.86

apart to allow the jack to pass between them. The balks of timber were given a good bearing on each side of the trench and thus distributed the pressure over a large area. Attached to the jack, as will be seen, was a large powerful hook and this in turn was hooked up with a steel link chain which was passed round the pipes near the bell. Twelve jacks, as already stated, were used, worked by hand power, and these gradually raised the pipes, as shown in Fig. 4, and denoted "First Lift." An engineering corps in charge of Mr. J. P. Patterson, assistant engineer of the Long Island Railroad, was in constant attendance taking elevations of the pipes, and as the first few were brought to grade they were blocked up and the jacks taken to the further end of what might be termed the jack line.

Raising was then commenced as denoted "Second Lift" in Fig. 4, and thus by successive lifts the water main was brought to the desired elevations. The pipes were carefully blocked up, and it speaks well for the manner in which the work was carried out that elevations taken on the pipes many hours after they had been raised and blocked up showed that they had sunk in a few cases only a mere fraction of an inch. The jacks used in the work are capable of raising 25 tons whilst the pipes raised were twelve feet long and weighed about four tons each, or full of water, as they were, nine tons each. The pipes, it should be mentioned, were under a pressure of 40 lbs. to the square inch. A section of the pipe is shown in Fig. 5. As previously stated, the pipe joints on the Atlantic Avenue main were found to be in excellent condition, but naturally the bed blocks were not found in a similar state of excellent preservation, and many of them had to be replaced when the pipes were raised. It should be stated that the contractor had a number of caulkers in constant attendance, and whenever any weakness in the joints became apparent, it was speedily attended to. Fig. 5 shows a section giving the original and new locations of the water main under review, and appended to it is a table giving the original and new elevations, together with elevations taken on the pipes during the progress of the work. A perusal of these will be found interesting and will in part explain the "Lifts" shown in Fig. 4.

The Eastern Parkway main was subject to a pressure of 40 lbs. to the square inch, and the Fort William main to a pressure of 80 lbs. to the square inch. With regard to the Fort William main it should be mentioned that part only of it was raised under full pressure. It is syphoned under the Eastern Parkway main, and owing to an extra bend having to be added to it, the water was turned off while this work was in progress.

The whole of the work was carried out under the direct supervision of Mr. L. V. Morris, the chief engineer of the Bay Ridge improvement. Mr. Morris has been in charge of this improvement, it might be mentioned, since the commencement of the work, in 1904.

The photographs illustrating the operations were taken during the progress of the pipe raising.

The street railway company is sharing in Hamilton's prosperity, according to the returns made to City Treasurer Leckie, for the quarter ended September 30th. The total receipts for that quarter were $150,144.49, as compared with $130,758.93 for the corresponding quarter of last year, an increase for this year of $19,385.56. The city's share for this year's quarter amounts to $12,011.56, as compared with $10,460.71 for the same quarter last year, an increase of $1,550.85, being at the rate of 14.82 per cent.

LIGHT COMPRESSION MEMBERS.

(Concluded from last issue).

Mr. Horton: I am disposed to suggest that the difficulty with the details was that they wrinkled, and have suggested that a thousand tests be made in the laboratory to discover how to lessen the wrinkling.

Chas. K. Mohler: I wish to call attention to some points which may be of interest, in connection with the distortion and partial failure of some trestle columns under conditions where they should not have failed, if the bent, of which they formed a part, had been properly designed. The distortion was made possible on account of the omission of diagonal bracing between the columns. Briefly, the bent was located at an angle in the north approach to a bridge over the Monongahela River at Pittsburg. The columns carried the east end of the riveted pony truss, which made an angle of about 35° or 40° at this point with the main approach. A timber trestle was built at right angles in the opposite direction. Through expansion and contraction, or the tilting of the bents of the timber trestle, or both, the spans, together with the tops of the columns, were carried at right angles to the trestle. The columns were bent fixed at both ends, and as a result both columns were bent in double flexure or reverse curves. The lacing bars in compression were badly buckled. The columns were not over 20 ft. high. There would have been no failure from any strain that comes upon the bent if it had been supplied with the necessary diagonal bracing. The omission of the diagonals was inexcusably bad design. There were many other instances of bad detail in this particular structure, but they do not relate to this discussion.

This simply shows that many times failure of a structure is caused by some of the members having to take care of loads and stresses which they were not designed to carry.

F. G. Vent: Mr. Jensen made a remark about not worrying too much over the proportion of the length to the radius of gyration. I think when you get over 200 you have to begin to look out. A short time ago a certain manufacturer submitted a design for a roof truss, which I had occasion to check. It was what is called a skimp design, and in figuring it over I found that the sections had a large ratio of $\frac{l}{r}$. One of his excuses for this was that we had a structure which was built where the $\frac{l}{r}$ was somewhere around 400; built by George S. Morison. In referring to the plans for that truss I found that by taking the section of the compression member and figuring only the outstanding metal in the section, one could reduce the $\frac{l}{r}$ to about 150 to 175, and the design was well proportioned. The design that this manufacturer was offering was somewhere around 200 $\frac{l}{r}$ in every member. This shows that if we figure in all the metal we will sometimes find that the $\frac{l}{r}$ is over 300, and if we figure just the outstanding flange we will have a structure in which the $\frac{l}{r}$ is low.

Mr. Horton: I understand, Mr. Jensen, that the $\frac{l}{r}$ is of much less significance than is frequently ascribed to it, and the tests of full-sized members certainly show this fact. Tests have been made, up to 175 $\frac{l}{r}$ on large pipe and **H** sections, and the ability to stand loads is not much lessened at that length (about 20% less than the strength at 35 $\frac{l}{r}$). No column of over 120 $\frac{l}{r}$ can be used in Chicago, whereas tests of rolled sections show a loss of only about 16% between 35 $\frac{l}{r}$ and 120 $\frac{l}{r}$. With the straight line formula 16,000—70 $\frac{l}{r}$, to limit the radii length is absurd.

Lewis McDonald: There has been considerable talk about the relation of the radius of gyration to the length, and because some experiments have seemed to show that this did not have the significance which we have usually attributed to it, it seems that some would do away with it altogether in their designs. I do not think that we should forget our early training in this respect and we should still consider the relation of the radius of gyration to the length. But there are other things which enter into the design of a column which perhaps we have overlooked in the past and which recent failures have brought more particularly to our attention, and while we should not omit to take this into consideration, we should give other things, such as wrinkling, thickness of material, etc., their proper consideration. I do not think it is the intention of any one to say that we should design our columns up to 300 or 400 $\frac{l}{r}$. Probably the original formula which was worked out was all right, and so long as we had homogeneous material, that probably would be the only consideration which we would need to give. But in built-up members it certainly is necessary that we consider the shop work and the effect of driving more or less rivets and other things which we have heard discussed.

Mr. Horton: Referring to Mr. Vanderlip's remarks, we can scarcely imagine a boom built of four angles which would not be very satisfactory as regards $\frac{l}{r}$. I am reminded of a boom 100 ft. long, 24 in. square in the centre, built of four 1½ by 1½ by ¼-in. angles, laced on four sides with 1¼ by 1¼ by 3/16-in. angles in 2-ft. panels. This boom was entirely satisfactory as regards $\frac{l}{r}$, but the other question came up as to its sufficiency as a beam. Could it be handled as a beam, that is lifted at the centre or at the ends? Calculations showed that it could. Experiments made later showed that the actual corresponded with the calculated deflections. This is interesting, as a ratio of length to depth of 50 to 1 is an unusual proportion.

J. W. Bradford: It is quite a problem to know just how light we can make many of these struts, but we are called on at times to furnish some which are not so light. I know of instances where we have been called on to make struts 2 ft. or more in width, and laced with angles, which makes a very heavy and costly member. The ordinary strut made with four angles laced makes a very good strut but it runs up in weight, and where the four angles are turned in and laced, the cost of shop work is very great. In many cases the strut made of two channels with lacing between them makes a very light strut and one with which it is very easy to get a good end connection.

Arthur N. Talbot: The compression member is a fruitful topic for discussion, and the remarks made on this topic are interesting and bring out many different views. As the column is used under such diverse conditions, it is not strange that such a variety of views exist. Our knowledge of the action of the column is incomplete, so much so that its properties offer a very promising field for investigation. In fact, one of the great needs in the line of structural engineering lies in experimentation on the action of compression members. However, it should not be lost sight of that a great deal of information on column action is available and that certain things have been established. A reader might gain wrong impressions from some of the statements in the discussion, impressions which the speakers doubtless did not intend to convey. Possibly a few general statements will serve to clear up some ambiguities.

(a) Long columns do fail by flexure, very much as indicated by Euler's analysis. Simple laboratory experiments show this. A very good collection of the results of these tests which have been made on columns may be found in the Proceedings of the American Society of Civil Engineers for December, 1911, pages 1290-98, and these tests bring out very well the effect of flexural action in long columns. If the modulus of elasticity of the column is known, and the section is such that the column will not collapse or distort laterally, the maximum load which will be carried by very long columns may be fairly definitely stated if the end condition of the column is known. For mild steel, long column action may be expected in columns having a length, say, of more than 125 $\frac{l}{r}$ for columns with round ends, and of more than 250 $\frac{l}{r}$ for columns with fixed ends. However, it is known that the stiffness of the built-up column is much less than that of a solid section, as is shown by tests in flexure, and therefore a lower value of the modulus of elasticity must be used in Euler's formula than will obtain for solid material.

(b) What constitutes a round end and what a fixed end, cannot be stated very satisfactorily. It seems evident that a pin-ended connection will offer little end restraint and may be considered to be a round-ended column in one plane. A flat-ended column may act as fixed-ended, especially if it has an enlarged base resting on a firm bearing. Between the extremes of round ends and fixed ends there is a wide range of conditions, and the method of holding the ends, the tightness of the riveting, and the fixedness of the supports are elements which give uncertainty. Tnere is a lack of information on the actual end restraint to be found in building construction.

(c) For very short mild steel columns, of other than solid section, failure is generally by a crinkling or wrinkling action. This action starts at some point where the local stress exceeds the yield point, and this critical load should be considered the strength of the compression member, even though in some forms of section the ultimate load for columns of very short lengths may be such as to give an average stress well beyond the yield point of the material. Just how far this critical load is below the load which would give an average stress equal to the yield point of the material, will depend upon such matters as the imperfection of parts, like crookedness, eccentricity of bearing, eccentricity of rivet bearing, and the movements of the structural elements upon each other. For such short members the strength depends very much upon the form of section and the method of fabrication.

(d) For compression members having a length intermediate between that of the very long column and the very short compression member, the slenderness ratio $\left(\frac{l}{r}\right)$ does affect the strength of the column. Just why this is true is not clear. It is evident that the reasoning about the effect of the length used in the derivation of Rankine's formula is not entirely tenable. It might even be thought that as the column of intermediate length does not deflect laterally to an extent which will explain failure, the strength of a column will remain nearly constant from the very short column to the vicinity of Euler's curve. However, the tests of columns show a gradual reduction in strength with increase in length, though the reduction is of a different character and generally less in amount than that given by Rankine's formula. In fact, tests show that a straight line inclined to the axis represents the results of tests of compression members of intermediate length very well—better than the Rankine formula. Failure in such columns may be by crinkling or wrinkling, the yield point being exceeded at places not necessarily at the centre of the length, and no special bowing or lateral deflection occurring in the amount which would be necessary to explain the failure, such as is seen in the failures of very long columns. In other words, failure seems to be due more to local causes than to general curvature along the whole length as is assumed in most column analyses. As has been indicated, reduction in strength in this intermediate field may be said to be directly proportional to the length of the column, though just why this is has not been determined.

(e) The extent to which length affects the strength, for columns of this intermediate length, seems to depend upon the shape of the section, the thickness of parts, and the method of making up the section, as whether the structural elements are riveted together, as in the case of built-up columns, or whether the piece is an integral rolled section. The tests of rolled **H**-sections made at Watertown arsenal (referred to in this discussion) may be expressed by the formula $\frac{P}{A} = 33{,}500 - 60\frac{l}{r}$ for ultimate strength, up to the limit of the tests, $\frac{l}{r} = 150$, and of $\frac{P}{A} = 30{,}000 - 50\frac{l}{r}$ for the elastic limit of the columns. The tests of lap welded steel tubing may be expressed by the formula $\frac{P}{A} = 36{,}000 - 65\frac{l}{r}$ for ultimate strength, for lengths up to the limit of the tests, $\frac{l}{r} = 175$, and for the elastic limit strength by $\frac{P}{A} = 32{,}000 - 50\frac{l}{r}$. These equations for elastic limit strength are applicable for lengths up to the longest length tested. The equations for ultimate strength do not apply to tests of columns having a length of $\frac{l}{r} = 25$ or less, for here there is insufficient length to complete the wrinkling action. Tests of the Gray type of column (with limits up to $\frac{l}{r} =$ 60) made at the University of Illinois are expressed by the equation $\frac{P}{A} = 36{,}500 - 155\frac{l}{r}$. It is evident that in this form of column, length has a much larger effect than in the two other forms. The general forms of column sections may be expected to have strength equations lying between this equation and the preceding two. An interesting fact brought out in the tests of the Gray columns (see Bulletin No. 56 of the Illinois Engineering Experiment Station) is that at small deformations the effect of length of column is very much less than at the higher deformations, and in this may be found a suggestion bearing upon the explanation of column action. It should also be noted here that in tests of built-up columns the load-deformation diagrams have a considerable curvature even at low loads, while in the tests of the rolled columns the low load-deformation diagram is nearly straight up to the yield point of the columns.

(f) The amount of the effect of the slenderness ratio $\left(\frac{l}{r}\right)$ through this range of intermediate lengths depends also upon the end condition of the column. The equations given in the preceding paragraph are for columns tested with flat ends which acted in the tests as fixed ends. The diagrams giving the results of tests of free-ended columns show a greater slope. Just what explanation best fits the existence of this greater slope, if general flexure is not the only cause of decrease of strength, cannot now be told. It must be understood, however, that end condition does affect the strength reduction for columns of intermediate length, and that a statement of the end condition assumed may well go with the formula.

It may be observed, too, that a single formula for all forms of sections and for different end conditions may not be expected to express the actual column strength.

Some very interesting questions have been raised in the discussion on compression members. One of these is, why not remove the limit of $\frac{l}{r}$? Why was this limit inserted in the ordinance? Possibly because it was felt that there is too much uncertainty in the action of the column beyond the length of $120\frac{l}{r}$. Possibly it was done because it was appreciated that the end condition—whether round or fixed—so largely affects the strength of very long columns, and it was not expected that the brief statement in the ordinance could provide for the variations in condition likely to be found in practice. Besides, it has been thought possible by some that in a column formula for homogeneous columns the line which represents the strengths of columns of intermediate length may intersect Euler's curve instead of being tangent to it as commonly assumed.

Enough has been said to justify the remark that more experimental knowledge of column action is needed, for the variety of condition of section, of bearing, of length, and of connections. The view expressed by Mr. Horton, that a large number of laboratory tests are essential to give us an adequate understanding of column strength, has much to support it. The effect of form of section, of thinness of parts, of local crookedness, of end condition, of length and slenderness ratio for different end conditions and different forms of section, of form of lacing and its spacing, of lateral stiffness, of the effect of local overstress, of the effect of the rivet holes and of filling the holes with rivets, of the influence of slip of rivet—it would be easy to overrun Mr. Horton's 1,000 tests. As Mr. Horton says, "No mere mental analysis will ever show us the required relations. Physical tests are required."

And why may not such tests be made? Not all that may be suggested, but a large number along specified lines selected with a view of advancing knowledge on many disputed and unsettled questions. And why should not the Bridge and Structural Section of the Western Society of Engineers take an active part in promoting a movement for such experimental work, in outlining the most profitable lines of research, and in other ways contributing toward the advancement of knowledge in this important matter? Surely a means of co-operation in so promising and fruitful a field may be found.

BRITISH INVESTIGATION OF RAIL CORRUGATION.

The Municipal Tramways Association of Great Britain has been conducting an elaborate study into the causes of rail corrugation and the possible remedies of it, and a report of its committee on this subject was presented at the convention of the association at West Ham, Sept. 25-27. The committee consisted of twenty members, of whom fourteen were railway men and six were outside engineers. The committee has been engaged upon its investigations for a number of years and has been in special activity since February, 1911.

A feature of the work of the committee was a series of extensive experiments to determine the movement of the cars on track and other facts which might have a bearing upon the general subject. Some of these tests were conducted by the committee and others by individual members of the committee. An account follows:

In one experiment a jet of white liquid was discharged from a nozzle fixed at the front end of the truck of a single-truck car, and a jet of red liquid was discharged from a nozzle fixed at the rear end of the truck. A measurement of the records left on the pavement by these jets gave information as to the movement of the truck, wheels and axles relative to the truck. The records thus obtained appeared in the report and their significance was discussed by the committee.

In another experiment a pad of felt to which a supply of white oil-paint was fed was pressed lightly against each rear wheel. In this way a film was left on the track, and it was possible in many cases to produce artificial corrugations in the paint film apparently identical in every respect with actual corrugation marks produced under working conditions. In some cases, however, there were corrugation marks in the paint where there were none in the rail.

In another experiment a single rubber stud was set into each wheel tire and, as it made contact with an ink or paint pad, each revolution of each wheel was marked on the track. On other roads a hard steel sharpened stud to mark the rail was used instead of the rubber stud. The records thus obtained with each wheel of the car were compared to determine the extent of slip and skid of wheels on straight track and curved track, with power and without power etc. Records thus obtained are shown in the report and proved in the opinion of the committee that slip and skid are taking place continually on all wheels under all conditions, even on a car in which an especial effort has been made to have all four wheels brought to the same diameter and where the car is being driven on a straight track. In one test of this kind carried out in Glasgow, where one wheel was 1/16 in. less in circumference than the other three, it was found that at no time, while the car was being driven by its own motor, did any of the wheels cover a distance equal to their circumference, although when the car was being hauled as a trailer the smallest wheel of the four covered the required distance almost exactly. The committee concludes, therefore, that there is always a certain slip going on between the wheels and the rails even under very best of conditions as regards mating of wheels.

In another test two small hard steel studs were placed in the curve of each rail at exactly right angles on straight track or exactly radial on curves. These studs were depressed by the wheel flanges and completed an electric circuit, making a record on a traveling sheet of paper. By this device the position of the axles in regard to the track would be recorded as each car passed the studs. The apparatus for this test was not completed in time for the committee to give results.

Another test was to loosen a section of rail on a curve and one on straight track to ascertain the effect of a loose rail. Another was to remove the lip of a section of rail on straight track and on a curve. Neither of these showed any apparent effect as regards corrugation, except that in Manchester the removal of the lip on the outside rail on a curve seemed to increase the corrugation.

A test made by allowing cars to coast over specified lengths of curved and straight track which was already corrugated was found to reduce the corrugation on the straight track but did not seem to have any definite result on curved track. In another test the gauge of the track in sections of corrugated track was tightened and loosened, in each case ½ in. In the case of the tight gauge the effect was marked, particularly on curves, where the outer rail became more corrugated and the corrugations changed their form, being at right angles to the gauge edge instead of sloping backward from the gauge edge. On the widened section of track the corrugations seemed at first to grow less but afterward became more pronounced.

Another interesting experiment, which was conducted on the lines of the London County Council Tramways, was that of making oblique cuts across the tread of the corrugated rail. These cuts were ⅛ in. wide, 1/16 in. deep and 3 in. pitch, and they sloped at an angle of 60 deg. in the direction of traffic. Two 45-ft. rails were treated in this way, and before they were cut one rail was ground free from all corrugations while the other was left corrugated. The rails were closely watched, but no effect was apparent. In the rail which was ground before being cut the corrugations reappeared after two months, and in the other rail the corrugations became slightly less.

In another test a car was driven along some new track by means of the rear motor alone, and the wheel brakes were applied to the front wheels. Very distinct markings, which bore a decided resemblance to corrugation, were left on the rails.

Tests were also conducted upon the character of the metal at the crests and the hollows of corrugated rails. Strips of metal cut vertically from the tread of the corrugated rail showed in the internal portions of the head an average of twenty-eight points on the scleroscope, while on the surface of the crests the average was thirty-five and at the hollows thirty-three. This indicated that the surface was harder than the body of the rail and that the crests were slightly harder than the hollows. Acid tests on the surface of the corrugated rail also showed that the surface of the crests was harder than the surface of the hollows, but this condition did not exist to a greater depth than ⅛ in.

As the result of its investigations, the committee arrived at the following interim findings:

"Corrugation occurs very widely on systems with electrically self-propelled rolling stock, the construction of which necessitates a relatively low centre of gravity, also on cable systems and to a relatively small extent on steam railways.

"The check or guard is not a necessary factor in the production of corrugation.

"On almost every system it occurs abundantly at places where the break is very seldom applied and is not any more frequent or pronounced at places where the brakes are regularly applied, as at stopping places. It may be concluded that the great bulk of corrugation is not due to any action of the brake.

"The occurrence of corrugation is not dependent on the number of cars which have passed over the rails.

"It is not necessary that the track or the rolling stock or the wheel profiles should be in a worn or defective condition in order to produce corrugation. With all these factors in excellent condition, a car traveling with power under ordinary conditions will readily produce corrugation.

"Corrugation appears on the rails independently of whether the wheels are being actively driven by the motors or not. The committee is of opinion that the explanation of this may be the slip and skid taking place owing to the different diameters of the wheels, which difference largely results from the unequal wear produced by the relative difference in speed of the two motors.

"Corrugation produced by one set of cars may be entirely removed by another set of cars running in place of the first. It may also be caused and removed by the same set of cars under apparently the same conditions.

"The pitch of corrugation is independent of the speed of the cars producing the same.

"Corrugation does not exist on tramway rails as received from the rolling mills.

"Corrugation has been produced by every known type of electric car, and the pitch and characteristics are independent of the type of such car producing the corrugation.

"It is suggested that the brightness of the crests of corrugation, as compared with the comparative dullness of the hollows, is due to a purely rolling action under increased pressure over the crests, and that other portions of the rail are not subjected to a purely rolling motion but to the action of slipping or skidding, alternating with the rolling motion; hence their dull appearance.

Suggested Measures for the Mitigation of Corrugation.— "The committee considers that its investigations have produced ample evidence that the force or forces responsible for the reaction between the wheels and rails which results in rail corrugation are external to the rail. It is realized, however, that while rails rolled to any known specification are affected to a certain degree by this reaction some are not affected to the same extent as others.

"The committee, therefore, concurrently with this inquiry, has paid close attention to the question of securing a rail steel of such physical character as to resist the tendency to corrugate and so alleviate to a certain extent the serious trouble pending the completion of the inquiry.

"From evidence collected, coupled with the actual experience of the members of the committee on their own systems, the committee is of opinion that a steel for rails can be obtained which is more durable and less liable to the development of corrugation than the ordinary varieties of steel at present in use.

"At the same time, the committee realizes the impossibility of attempting to prescribe a standard analysis, on account of the different results obtained by the different processes of manufacture and the varied compositions used by individual manufacturers with the same process. It is found that a rail steel which has merely an increased carbon content is not sufficiently durable for this purpose; it is necessary that the rail should be both hard and tough.

"The steel for this purpose should be relatively high in manganese, carbon and silicon, and should be capable of passing the following physical tests: Tensile test, not less than 50 tons per square inch; elongation, 12 per cent. on 2 in. tup test, with rails similar to B. S. section, No. 4, 1 ton falling 15-ft. deflection not more than 1½ in. Brinnel impression test, 50 tons on ball 19-mm. diameter, impression not to exceed 3.5 mm. Curving test, rails to withstand a test curve of 20-ft. radius, either inward or outward, without fracture."

Further Experiments Recommended and Information Required.—The committee suggests further experiments and additional information as follows:

Tests to be made of the amount and period of torsion on the axles of cars.

Tests to be made of the amount and period of the torsion in the wheel.

The vibration on the rail and foundations to be analyzed.

Continue Experiment No. 4, already described. In this it is proposed to place two small steel studs in the groove of each rail exactly at right angles on the straight or radially on a curve. These are depressed by the wheel flanges and each one makes a separate record electrically on a revolving sheet of paper, thus establishing the relative position of the axles with regard to the track. The speed will also be recorded on each sheet.

Tests to be made of the relative speeds of the two motors on a car and the manner in which any difference is compensated for or adjusted under service conditions.

The effect of altering the centre of gravity of the car to be investigated.

Further experiments to be made on the lines of the Leeds and Glasgow tests with retarded wheels.

Records to be kept of the profiles and diameters of successive sets of worn wheels on a car in relation to the position of the two motors on that car.

Information to be obtained as to what effect the springs of the car have on the production of corrugation.

That the advisability of acquiring a complete set of instruments which will record all car movements simultaneously be considered. Such apparatus could be passed on from one system to another. The records could be readily compared and they could be all obtained by one operator.

In view of the considerable use now being made of micro-photography in the investigation of the minute physical structure of metals, the committee advises that the fullest advantage be taken of this science in the further investigation of the corrugation phenomena.

The report contains as an appendix a bibliography of the subject and also a large number of charts and halftone illustrations showing the results of the tests conducted.

WEIGHT OF CONCRETE.

The average weight of concrete per cubic foot when molded into beams for flexure tests and into cubes and cylinders for compression tests, is given by the U.S. Bureau of Standards as follows:

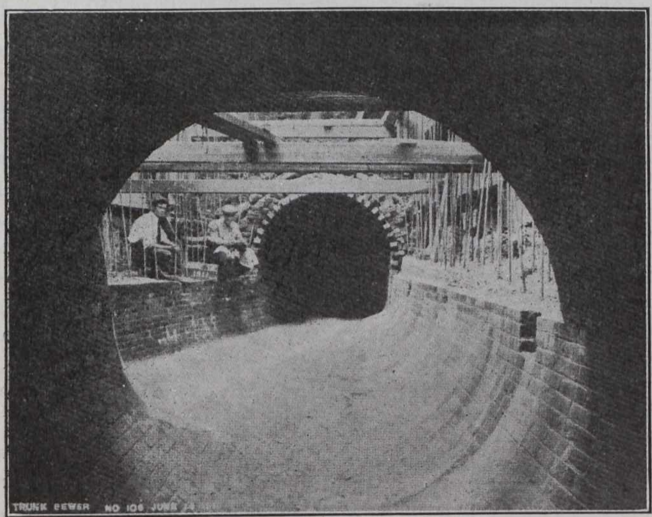
Kind of concrete.	Beams. lbs.	Cylinders. lbs.	Cubes. lbs.
Granite concrete	148	148.6	147.7
Limestone concrete	146.6	146.7	145.7
Gravel concrete	144.1	144.8	144
Cinder concrete	119	119.3	118.1

MAIN DRAINAGE SYSTEM OF THE CITY OF TORONTO.

In the issue of October 12th, 1911, of *The Canadian Engineer* we published an article dealing with the main drainage system of Toronto. The annual report of the city engineer of Toronto, for 1911, has just been published and we herewith present an abstract of the report of Mr. A. B. Garrow, assistant engineer, in charge of main drainage works.

High Level Interceptor.—That portion of the high level interceptor, for the construction of which contracts have been let, and which is now all but complete, lies between the Garrison Creek on the west and the sewage disposal works on the east, and might be termed the high level interceptor proper. The high level extension, which is at present being designed, is the continuation of the above sewer westerly to Springhurst Avenue, with a possible further extension to Roncesvalles Avenue.

The past year having, as has been noted, been one of gratifying results, has also witnessed the first, and what is hoped will be the only, misfortune in connection with the



Bellmouth.
High Level Interceptor, Section No. 6—Garrison Creek,

construction of the system, namely, the failure of that portion of Section No. 2, located on the east bank of the Don River. This is a circular section, 8 feet 9 inches in diameter, built of reinforced concrete and supported on concrete piers, the construction of which was commenced in September, 1910. For a distance of 300 feet, between the east end of the Don syphon and the old bank of the Don River, the sewage had to be constructed on a filled-in portion of the river bed. The shallow excavation—8 feet at the most—showed a fairly good clay, which, it was estimated, would sustain the weight of the piers upon which the sewer was to be built, and the construction was carried on accordingly. A considerable portion of the invert had already been constructed before it was noticed that the whole 300 feet of sewer was sinking. Observation showed that all the ground in the immediate vicinity was undergoing a similar charge in elevation, and it was realized that any attempt to prevent the sinking of the sewer would have to be postponed till the stability of the ground was restored, and in the meantime the construction was proceeded with. After a study of the conditions it was determined that this peculiar occurrence was due to a combination of circumstances, namely, the placing of the approach of the Wilton Avenue bridge simultaneously with the construction of the Don syphon across the river. The enormous pressure exerted by the former was forcing the soft underlying ground to seek an outlet into the syphon trench, with the result that the surface layer was forced to settle.

The first crack appeared in the invert of the sewer, about midway between the west end and the bank. This quickly widened, and with the appearance of others, destroyed the continuity of the work. The back filling, which was proceeded with, increased the settlement that already had occurred, which resulted finally in a maximum of three feet.

Reconstruction was commenced on August 15th, 1911, and the work put into the hands of the J. H. McKnight Construction Co., who were the original contractors for the section. It was decided to leave in place and underpin a 100-foot section upon which the maximum settlement was 16 inches, and to tear out and reconstruct the remaining 200 feet. Piles were driven close to the interceptor on both sides at 4-foot centres, the centres of the two piles of each bent being 12 feet 9 inches apart. The process of underpinning was to cut off the piles 22 inches below the bottom of the sewer and on them to construct a concrete cradle, reinforced at the bottom with 5, 1-in. diameter, round rods. This cradle was 18 inches wide, and extended up to the springing-line of the sewer. When the concrete had set, the forms were removed and the backfilling replaced, great care being exercised with the latter. The task of tearing out the remaining 200 feet of the sewer was a laborious one, due principally to the presence of the steel reinforcement, which consisted of ⅝-inch square rods. Trouble was also occasioned by the proximity of the approach to the Wilton Avenue bridge on the north side of the excavation, which the rain had made very soft, and for the protection of which a row of anchor-piles had to be driven. When the old concrete and brick invert had been removed down to grade a third pile was added at the centre of each bent, and all were cut off 13 inches below the bottom of the new work. These were capped with a concrete beam 15 inches by 18 inches, reinforced with 5 ⅞-inch diameter round rods. In this instance the invert up to the springing-line and cradle were poured together, and vertical dowels were left protruding at the haunch for bonding the arch. The single ring of brick on the invert was omitted in order to simplify the construction. The new work was set to the original grade and connection made with the under-pinned section (the grade of which was not corrected) in one 25-foot length. The concrete work was completed on December 27th, and after a sufficient interval the backfilling was proceeded with.

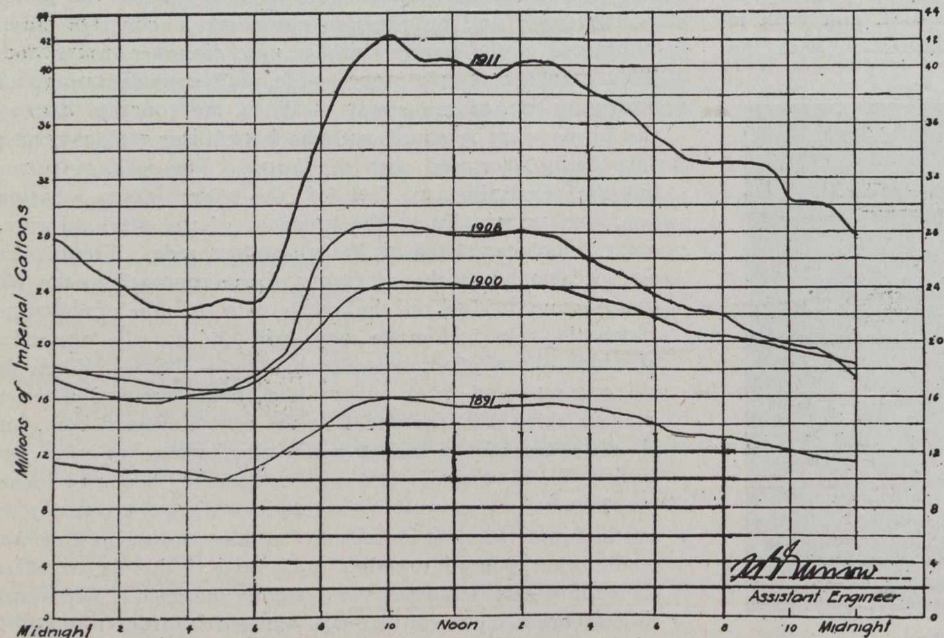
The work necessitated, approximately, the following quantities:

Excavation..............	1,220 cub.. yds.	
Piles....................	10,700 lin. feet.	
Concrete, 1, 2, 4.......	1,210 cub. yds.	(tearing out and replacing)
" "	200 "	(placing only)
Steel....................	16.75 tons.	

and the total cost, including contractors' 15 per cent., amounted to $14,712.07.

The Rosedale Creek connection, comprising Sections Nos. 14 and 15, has been designed and the contract for the construction of a portion of it awarded this year. The point of interception is located about 3,000 feet west of the Don River, on the Rosedale Ravine Drive, and the pipe required to connect it with the high level interceptor at the corner of River and Mark Streets is 6,600 feet long. It is divided into two sections for the reason that the upper length of 5,700 feet (Section No. 15) is to be in the form of an inverted syphon, for the construction of which 42-inch reinforced concrete pressure pipe are to be used, and the lower 900 feet (Section No. 14) is to be a 3-ft. x 4-ft. 6-in. eggshape brick gravity sewer. The contract for the pipe for Section No. 15 was awarded this year, and all the pipe manufactured and delivered, although a number have still to be accepted subject to test. The contract for Section No. 14 was also awarded this year, and it is expected that construction will be commenced within a month.

A departure was made in designing the pipe to be laid on curves for the syphon. Since the operation of the syphon would practically depend on the tightness of the joints between the pipes, a special bend was made to be used at the beginning and end of each curve. The standard bend for the curve is made from the straight pipe by depressing one side of the top plate of the mould a sufficient distance to compensate for the difference in distance of the two walls of the pipe from the centre of the curve. To form a true curve with tight joints it will be seen, however, that in making the pipe for the beginning and end of the curve the mould should be depressed only half the distance used on the standard bend. In this way every bend on the curve makes a tight joint with its neighbor, and, with the use of a reinforced collar in addition, a fairly watertight job is anticipated.



Intensity of the Dry Weather Flow. Imperial Gallons per Day for the Years 1891, 1900, 1908, 1911.

Low Level Interceptor.—Very satisfactory progress has been made on the construction of the low level interceptor. Apart from making the plans for Sections Nos. 1, 2 and 3, the whole sewer has been designed, contracts on all nine sections awarded, and 16,000 lineal feet, or two-thirds of the total length, constructed within the year. At the present rate of progress it is estimated that this sewer will be ready to carry sewage by the middle of next year.

The first four sections, running from Bathurst Street to Parliament Street, on Front Street, are constructed of brick, and range in size from a 2-ft. 10-in. by 4-ft. 3-in. egg-shaped to a 4-ft. 9-in. diameter circular brick sewer. From this point easterly to the disposal works, with the exception of the Don syphon, the construction adopted is reinforced concrete pipe, ranging in size from 5-ft. diameter to 5-ft. 6-in. diameter circular. The syphon across the Don River—Section No. 9—is composed of two lines of 30-in. cast iron pipe which are connected to the interceptor on both sides of the river by two concrete chambers in which the flow through the pipes is regulated.

Of the brick sections, three were awarded to the Godson Contracting Co., and the fourth, awarded first to the city engineer, was taken over by Messrs. Donnelly & Graham. The work was carried on in tunnel on account of its central location, and the material encountered was blue clay of much the same quality as that found on the line of the high level interceptor, although in some places it was encumbered with fairly large boulders. In one place, between Simcoe and Bathurst Streets, shale and rock outcropped on the invert, reaching a maximum depth of two feet and extending over a length of 500 feet. This reduced the daily progress in each heading from 8 to 4½ lineal feet, and seriously retarded the progress of the section, which had, during one week, averaged over 50 lineal feet a day.

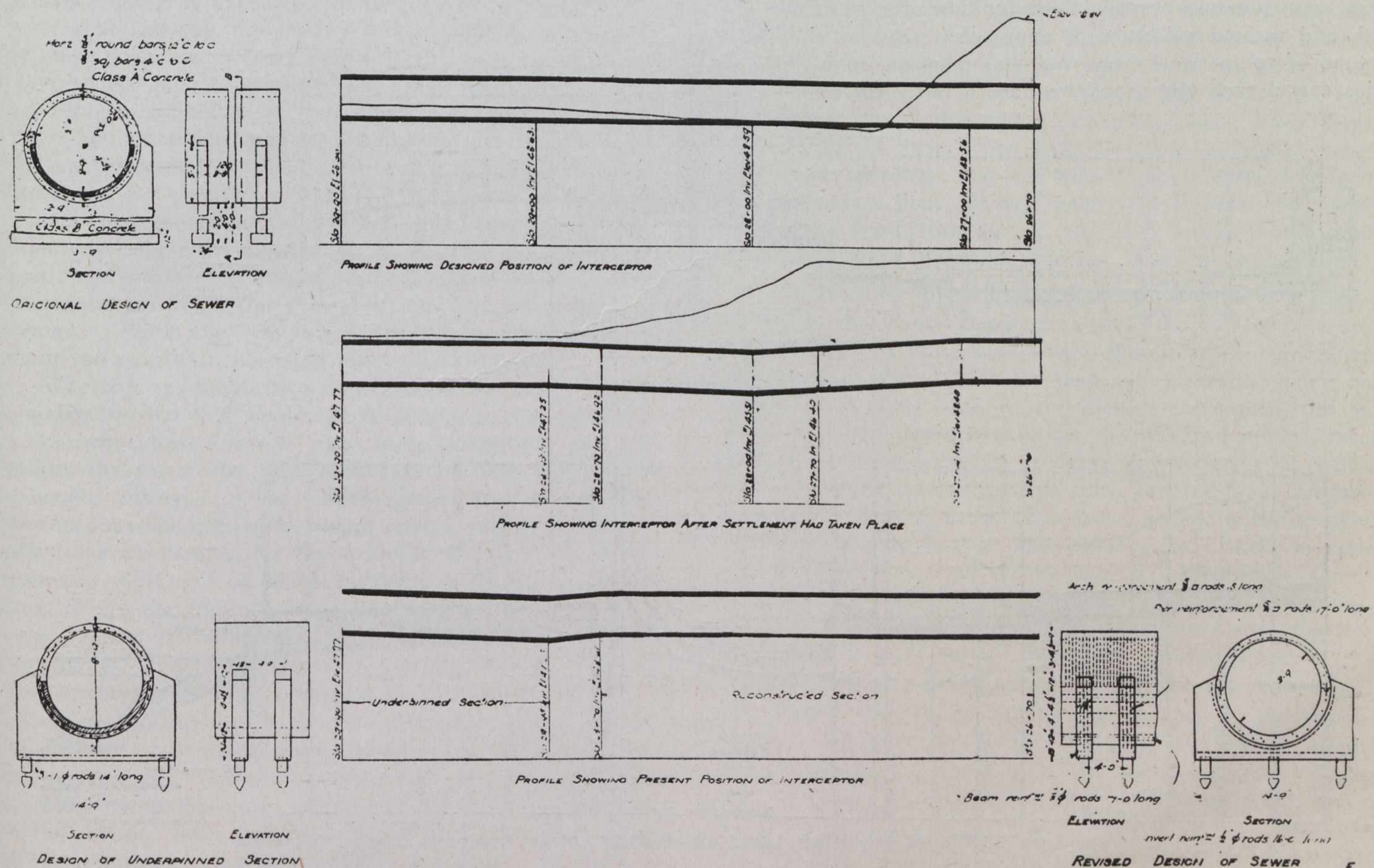
The 5-ft. diameter section and one of the three 5-ft. 6-in. diameter sections were obtained by Messrs. Lehmann, Nicholson & Jerou, and the remaining two 5-ft. 6-in. diameter sections by the J. H. McKnight Construction Co. The former contractor employed a Potter machine on each section. These did not prove very satisfactory, in that they necessitated twice handling the surplus material removed from the trench, were unwieldy on the curves and made pipe handling difficult. A progress of 150 lineal feet a week was the maximum reached by either of these machines. The two clamshell derricks used by the J. H. McKnight Construction Co., however, proved more suited to the work. One move of the machine of 36 feet representing 200 cubic yards, could be excavated in one day. The pipe-laying, which was done by the same machine, handicapped the work, however, and a progress of 188 lineal feet per week was the maximum obtained.

The contract for the construction of the Don syphon was awarded to Messrs. Miller, Cumming & Robertson. The method proposed by them is to construct the two chambers in the dry, setting the exit and entry pipes in each case, and to connect these across the bed of the river in the wet.

Some important changes have been made in the interception of certain sewers in the west end of the city, which have resulted in a considerable saving in the cost of construction, and an annual saving in the cost of pumping, by reducing the amount of sewage entering the low level interceptor.

The only sewage reaching the Garrison Creek sewer below the high level interceptor is that from King Street on the west, Niagara Street between Defoe and Wellington Streets, Walnut Street and Wellington Street between Walnut and Tecumseth Streets. The flow of sanitary sewage coming from the last three sewers is very small, and its presence in the Bay will create no nuisance until some means have been devised to handle it. By turning the smaller sewers and taking the King Street sewer into the high level extension, it is no longer necessary for the low level interceptor to intercept the Garrison Creek sewer, and it can therefore end at the corner of Bathurst and Front Streets. This plan has been adopted and has resulted in a reduction in the flow entering the low level interceptor of 500,000 gallons per day, and saving the construction of 2,450 lineal feet of sewer, the contract price of which was $13.10 per foot. A further reduction in the amount of sewage reaching the low level interceptor has been accomplished by, where possible, moving the points of interception of the existing sewers along the line of the high level interceptor as far south as the difference in elevation between the existing sewers and the interceptor will permit. In this way it has been found feasible, in the case of Bathurst Street, Spadina Avenue and Peter Street, to move the point of interception from Adelaide Street south to King Street. The total reduction in the amount of sewage reaching the low level sewer due to these two changes amounts to 1,400,000 gallons per day.

The Sewage Disposal Works.—The same expediency exhibited in the construction of the trunk sewers during the year has been evidenced in the construction of, and the ultimate completion of, the sedimentation tanks. Of the total 24 units, 16 have been completed this year, the cast iron and timber penstocks are in place, and the whole has year. They consist of concrete barrels 38 feet long, 56 inches diameter at the entry and 28 inches in diameter at the throat, substituted at the above two points by iron castings which were manufactured by the Builders' Iron Foundry. Plans were made and manufacture all but completed of the screening and elevating machinery also. It is expected that this apparatus will be in hand early in the next year, when its erection will be carried on. The contract for the supply of cranes, made in 1910, has been revised, and the cranes have been manufactured and delivered. The contract for pumps and electrical equipment suffered some delay owing to the fact that motors called for were unsuited to the current provided by the Hydro-Electric System, which is to supply the power for their operation, and tenders were accordingly cancelled. The manufacture of the pumps has, however, been proceeded with, and will be complete well on time. The revised specification for the motors is under way, and it is hoped tenders will be received early in the new year.



High Level Interceptor. Original and Revised Design of Reinforced Concrete Section.

been back-filled and graded. The storm overflow from the tanks, for which plans were made, tenders received and the contract awarded during the year, has been constructed. This consists of a line of 5-foot concrete pipe (of the same design as those laid for the outfall sewer) laid on pile bents and extending south from the southwest corner of the tanks for a distance of 318 feet to Ashbridge's Bay.

The substructure of the pumping station, with the exception of the sludge well, was commenced and completed this year. This work was carried on by the department and was completed in time to allow the contractors for the superstructure to get well under way before the cold weather set in. This latter work is being carried on under the supervision of the city architect, and the brick work is already practically complete.

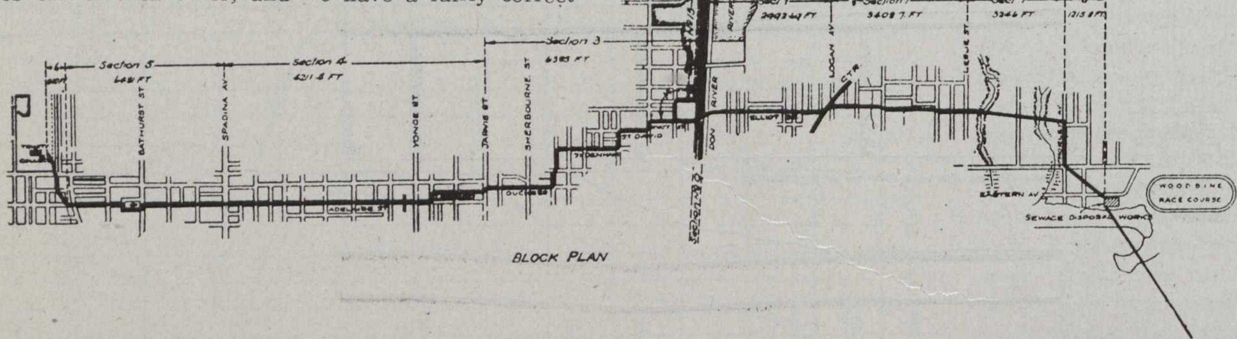
The four high level venturi meters connecting the pumping station with the tanks have been constructed this

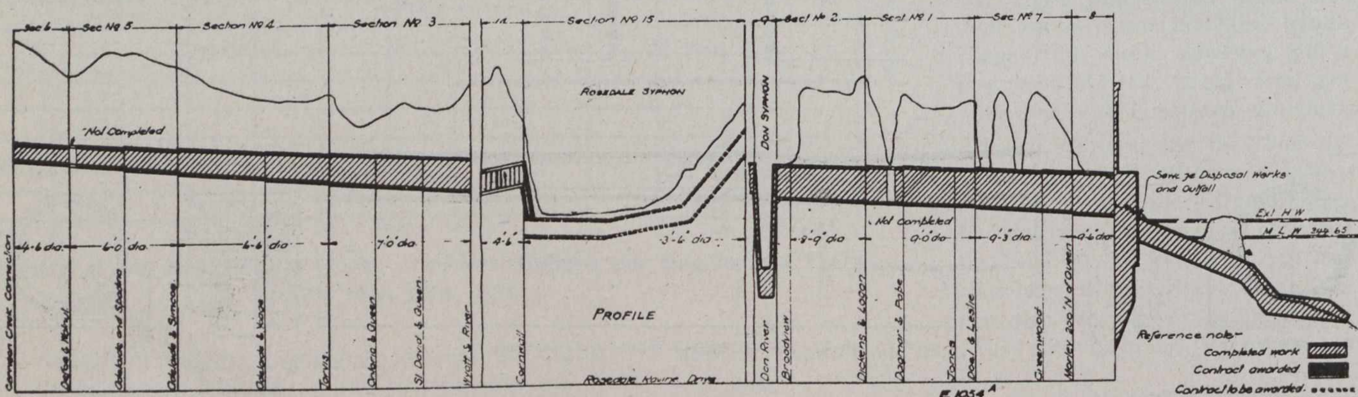
Provision for disposing of the sludge has been under consideration and the method advised in the preliminary report of employing it with the addition of refuse for filling the low-lying ground in the vicinity of the work, partially adopted. It is proposed to sheet pile the south, and portions of the east and west boundaries of the sewage disposal works site, which extend some 300 feet into Ashbridge's Bay, thus providing sufficient space for at least two years' sludge.

Storm Overflow Sewers.—Work on a system of storm overflow sewers was authorized, under By-law No. 5628, which was passed early in the year, providing for an expenditure of $800,000. The work was put in the hands of this department, and the preliminary estimates and surveys were commenced forthwith. Much time was spent in collecting data regarding the locality of floodings throughout the city, the intensity and duration of storms, and other information necessary for planning an efficient system of relief sewers. By September the 6th (on which date the work was handed over to the sewer department), considerable progress had been made, including the construction of 100 lineal feet of Wilton Section No. 1, from the Don to Yonge Street, the completion of the preliminary work on Wilton Section No. 2, and a portion of the preliminary work on the Sorauren, Manchester, and St. Clair relief sewers.

Gauging the Sewers.—Almost the first move in the design of the main drainage system was the gauging of the flow in the existing sewers, which was done in the fall of 1908. In order to check the increase in the flow during the past three years, and to get an idea of what might be expected when the tanks were thrown into operation, it was demed advisable to undertake a second gauging, and this was accordingly commenced in October of this year. The results are, of course, only approximate, due partly to the more or less rough construction of the apparatus employed, and also to the fact that the formula used in the calculation is an approximation between those for flow over weirs with and without velocities of approach. But as a method of comparison these common unknown quantities cancel each other, and we have a fairly correct idea of the increase in flow corresponding to the increase in population.

The population has been placed at 400,000, which is an average between the Dominion and tssessment censuses taken in the summer, and the police census taken in the winter, the latter of which, I am inclined to believe, more nearly represents the number of persons in the city at the time the gauging was made. Reference to the accompanying curve sheet shows an increase in the average flow of 1911 over that of 1908 of 8,000,000 gallons per day, for an increase in population over the same period of 85,000. Although this is at the high rate of 94 gallons per capita per day, the average flow for the year per capita per day is at the rate of 76 gallons, which approaches very nearly the results obtained in previous years. It will be interesting to note how closely these figures, which are probably correct to within 10 per cent., are borne out by the venturi meters, through which the sewage will pass at the pumping station.





Progress Profile of the High Level Interceptor, Main Drainage Works, Toronto.

GARBAGE DISPOSAL IN HALIFAX.

The sanitary disposal of the garbage of the city of Halifax is the subject of part of the annual report of City Engineer F. W. Doane, from which we have abstracted the following:

The method of disposition in vogue up to the present is to gather all garbage which would create a nuisance and be a menace to health at the individual residences and haul it to one spot where it is dumped, as a rule, the garbage is dumped at the Exhibition Grounds, but for a month during the exhibition, we are obliged to dump it wherever we can find a hollow in which we can place the material without serious objection from property owners residing in the neighborhood.

The number of places in which the garbage can be deposited is very limited. The hollow at the Exhibition Grounds is rapidly becoming smaller and within a very short time, will be filled up entirely. If the city does not take steps in the near future to provide for some other place or method of disposal, we shall be forced to deposit it on city property, where it will be most offensive and a serious menace to the health of the community.

The disposal of garbage and refuse in a manner conforming to sanitary law, is becoming a matter of vital importance and should receive the immediate attention which so important a factor in the welfare of the city deserves. It it most essential that adequate means be provided for the efficient disposal of all decomposing refuse, including dead animals and night soil. Sanitary authorities agree that the complete destruction of garbage or a complete change in its characteristics is the only solution that will satisfy sanitary requirements.

A visit to a garbage dump will show it to be a breeding place for flies and rats, and offensive and unwholesome odors are carried from it by the wind for long distances. Flies from such places cannot fail to carry disease into any residence they may enter. The danger to public health is further increased by the sorting over of the garbage by men and women who find articles which they consider of value. The fact that these articles have been in contact for hours, perhaps days, with the garbage, together with the fact that the articles are not likely to be free from filth themselves, emphasizes the risk of conveying these cullings back to the city as carriers of dirt and disease germs.

There are only three methods of disposal which give any measure of efficiency: Dumping at sea; the reduction method, and incineration.

Dumping at sea is not only fully as expensive as burning, but where practiced, is found to be very objectionable even when the garbage is carried twenty miles out to sea, and is being abandoned by all progressive cities where it has been in use.

The reduction method, which consists of passing the garbage only, through a digestive process and taking out its oils and grease, is not popular for the following reasons, namely, that it is expensive to install, it is practically impossible to carry on the process without causing a nuisance by offensive odors, it deals only with the garbage and some other means must be provided for disposing of the remaining rubbish and refuse.

In the cremation method, two systems are followed, one the low temperature furnace, and two, the high temperature furnace.

In the low temperature furnace, the heat is not sufficient to completely destroy all the organic matter in the mass, and noxious, unburnt gases are produceed. In the attempt to overcome this difficulty, coal or other fuel is burned. While the first cost is lower, the annual cost is about the same as in the high temperature furnace.

The city has authority now to borrow $12,000 to install a crematory, but that would not be sufficient even to install a low temperature furnace. The most satisfactory and up-to-date furnace is the high temperature incinerator. It is generally arranged in the modern plants so that the heat produced may be utilized for steam raising and consequently, power can be obtained for the operation of machinery. The operation is carried on without offence from odors, smoke, dust, or noxious fumes and the plant can be located in the neighborhood of residences. Such a plant is in operation in the city of Westmount, Quebec. With Alderman Martin, your engineer inspected that plant in September last.

A careful study has been made of the latest practice and the incinerator at Westmount seems to be the most up-to-date. They raise steam in water tube boilers with the heat produced by the burning of the garbage. They use no fuel in the furnace except the garbage itself and the surplus power obtained is used to assist the operation of an electric lighting plant. In Halifax, the power produced could be used for lighting, running the stone and clinker crusher and for similar purposes.

It is probable that the installation of such a plant as that Westmount with a capacity of fifty tons in twenty-four hours, would cost $40,000, but the time is near when the city must grapple with this problem, and I would respectfully recommend that early action be taken to obtain plans, specifications and tenders for the installation of a modern garbage incinerator so that the necessary legislation may be obtained and some more sanitary method of disposal provided by the time the hollow at the Exhibition Grounds is filled.

Improvements in the method of street sprinkling and street cleaning are almost solely a question of cost. It means an increase of the annual appropriation of not a few dollars only, but thousands, to enable the Works Department to do this work as the Civic Improvement League desires. The sprinkling in the suburbs of the city is done by contract, with the exception of one district which is covered by a Works Department cart. These carts are covering as many miles of street as it is possible to water in half a day, but horses could not stand the work if the length of the district were increased. The remainder of the city, including all the business and oldest residential districts, is covered by fire department carts. The Board of Fire Commissioners limit the distance which the horses are allowed to go from the fire stations and consequently the length of streets sprinkled by the fire carts cannot be increased. The appropriation for this work is limited, therefore the number of hired teams employed cannot be increased.

Street cleaning at night has been suggested as an improvement on the present system. Outside the paved streets, the work could not be as well done in the night; it would cost more and no good, practical reason has been suggested for doing it at night instead of in the day time. Under certain conditions, it is better to clean paved streets at night instead of in the day time, but such conditions do not exist in Halifax. In large cities, it is a practical impossibility to clean thoroughly, paved streets on which there is heavy traffic, during the day time. It is the practice on such streets to remove the dirt roughly during the day and give the streets a thorough cleaning at night, when there is no traffic on them. The night cleaning is adopted, however, from necessity, and not from choice. In such streets the roadway is dirty all day long. In Halifax, the paved streets are kept clean during the day, which is the time when cleanliness is needed, and not at night.

The cleaning of the unpaved streets is quite as unsatisfactory to the Works Department as to the citizens who are complaining. If there were money enough in the appropriation to clean them twice or more, the streets should be cleaned in a short time, at the first of the season, but as there is money enough to clean the unpaved streets once only, it becomes necessary to leave those streets on which there are no permanent gutters, until June or later, because if they are cleaned earlier the grass grows in the gutters after the cleaning is done and remains there until the next year, which makes these streets very unsightly. It is, therefore, the practice to do the cleaning after the grass has grown or begun to grow, so that the streets, when cleaned once, may be more sightly during the tourist season.

On those streets which are most important, and which are cleaned first, the work is begun as soon as the season opens. This year the season was very late and no allowance is made by the critics for this obstacle to early cleaning. The cleaning cannot be pushed until the frost is out of the dirt. The sun is shining brightly in some years in the month of February, but the frost is in the dirt for weeks after that date. Cleaning has been commenced as early as the 11th of March, whilst this year it did not begin until late in April.

If the money were provided, the unpaved streets would be kept as satisfactory to the public as the paved streets, but $1,000 a mile is expended annually in cleaning the paved streets, while the expenditure in cleaning the unpaved streets is only $74.00 a mile. It is impossible to organize and maintain a $1,000 service with $74.00.

RIDING ON PILOTS OF RAILWAY ENGINES.

The Board of Railway Commisisoners have issued an order following a tabulation of accidents resulting from persons riding on railway engine pilots, according to this order the practice must be discontinued in all classes except switching.

COST OF DRIVING STEEL SHEET PILING.

Very little data is available as to the cost of driving steel sheet piling. The Carnegie Steel Company has recently issued a little booklet entitled "Steel Sheet Piling." In this is listed a number of steel sheet piling jobs for which the cost of driving has been obtained by the company. The following figures are abstracted from the booklet:

The cost of driving steel sheet piling depends on a number of very variable factors, such as the kind of piling, the character and size of the structure, the character of the material to be encountered, depth of penetration, type of pile driver, kind and weight of hammer, experience of the crew, etc. The items which make up the driving expense are likewise variable, such as the pro rata cost of the pile driving equipment, including the driver, hammer, hoisting engine, tackle, etc., with proper allowance for depreciation, etc., if owned by the contractor, or its rental and maintenance cost if leased for the occasion; the daily expense in operation for labor, superintendence, etc.; cost of handling piles from the siding or boat to the driver, the cost of fuel, water, oil, waste, etc.; the cost of insurance on equipment, labor and material, etc.

The sum total expense for pile driving crew and regular equipment does not vary very greatly and may usually be put down at $50.00 a day or somewhat less, but this is complicated by the introduction of steam hammers which can be used suspended from derrick booms and for that class of work which does not need a power hammer. In view of these variable factors in driving, cost figures must, in the nature of the case, be only approximate. Such figures, however, may be of some service in estimating the probable cost of complete installations, and we, therefore, append from our records Table I., which gives a selection of the costs of driving various quantities and kinds of piling to different depths of penetration on jobs of the ordinary size and character.

The actual cost of driving 19,654 lineal feet of 12-inch 40-pound United States steel sheet piling (413 tons) in one installation per day of ten hours, was as follows:

1 foreman, per day	$ 5.00
1 engineer, per day	4.00
1 fireman, per day	3.00
6 workmen, per day	16.50
Cost of maintenance and operation	7.00
Total cost of driving crew per day	$ 35.50
Total cost of crew for 21 days	$745.50
Handling and incidental expenses	60.00
Total for job	$805.50
Total cost per foot of penetration	4.1 cents
Total cost per ton	$ 1.95

Piling driven in lengths of from 40 to 60 feet through sand and clay.

COST OF DRIVING STEEL SHEET PILING.

	Width, ins.	Weight, lbs.	Net tons	Length, ft.	Penetrat'n, ft.	No. driven per day Max.	No. driven per day Min.	Type of Hammer	Cost, cents per ft.	Material	Remarks
1 Mt. Carmel, Ill.	12	35	366	28	22	32	20	Drop	2.75	Sand, fine gravel	
2 Port Elizabeth, S.A.	12	35	96	20	15	9	4	Drop	10.60	Stiff clay silt	Slow hammer, handling included
3 Glen, Ohio	12	35	67	16	10	35	15	Drop	6.00	Riprap, sand and gravel	
4 Hartnett, Pa	12	35	38	22	22	16	11	Drop	3.00	Filled earth, clay, sand	
5 Des Moines, Ia.	12	35	85	26	16	40	35	Drop	5.00	Clay, gravel	
6 Winnipeg, Man.	12	35	154	35	30	30	13	Drop	4.50	Clay, hardpan	
7 St. Cloud, Minn.	12	35	61	18	18	35	20	Drop	12.00	....	Labor, fuel, oil, etc.
8 Decatur River, Ill.	12	35	72	14	11	...	...	Drop	11.90	Sand, gravel	Labor and equipment
9 Louisville, Ky.	12	35	113	30	21	100	80	Drop	5.00	Silt, sand	
10 Williamsport, Ind.	12	35	28	12	12	...	...	Drop	6.64	Sand, course gravel	Labor and equipment
11 Butler, Pa.	12	35	312	20	20	30	3	Steam	12.50	Sand, blue clay	Price paid contractor
12 Bloomer, Wis.	12	35	18	10	10	...	...	Maul	29.00	Quicksand	Labor and equipment
13 Albion, Neb.	12	35	35	26	10	14	6	Drop	10.00	Clean sand	
14 Rothschilds, Wis.	12	35	505	30	28	40	35	Steam	3.50	Course sand, gravel	
15 Newark, N.J.	12	35	140	25	23	20	...	Steam	11.50	Gravel, sand, hardpan	
16 Neligh, Neb.	12	35	35	20	12	26	2	Drop	8.00	Sand	
17 Hatfield, Wis.	12	35	150	35	31	15	...	Drop	21.00	Sand, clay, gravel	
18 Otisco Lake, N.Y.	12	35	46	20	18	15	3	Drop	17.00	....	Much time lost, labor and equipment
19 Minneapolis, Minn.	12	35	15	14	14	16	13	Steam	7.00	Sand, gravel, boulders	
20 Milwaukee, Wis.	12	35	21	30	30	30	12	Drop	7.90	Clay, quicksand, gravel	
21 Minnehaha, Minn.	12	35	182	35	29	34	13	Steam	7.40	Sand, gravel	Labor and equipment
22 Evansville, Ind.	12	35	105	20	19	86	10	Drop	0.63	Clay, loam, sand	
23 St. Louis, Mo.	12	35	15	10	10	...	...	Drop	4.00	Clay, quicksand	
24 Barrow in Furness, Eng.	12	35	92	25	24	6	4	Drop	63.00	Marl	Driven under water—divers
25 Pittsburgh, Pa.	12	35	134	24	5	105	20	Drop	5.00	River mud, silt	
26 Monterrey, Mex.	12	40	130	24	20	28	5	Drop	9.00	....	
27 Evansville, Ind.	12	40	81	20	20	31	26	Drop	5.00	Close packed sand	
28 Evansville, Ind.	12	40	81	20	17	31	26	Drop	10.00	Close packed sand	
29 Kilbourne, Wis.	12	40	176	34	30	20	3	Drop	10.00	Sand	Driving, handling
30 Fargo, N.D.	12	40	58	20	20	20	8	Drop	10.00	Sand, gravel	Inexperienced crew
31 Pittsburgh, Pa.	12	40	400	Sp	50	33	12	Drop	14.80	Heavy clay	Price paid contractor
32 Brownsville, Pa.	12	40	335	25	20	60	8	Drop	3.90	Sand, clay, hardpan	
33 Brownsville, Pa.	12	40	77	45	44	20	15	Drop	15.00	Sand, clay, hardpan	Labor, equipment, etc.
34 Waukegan, Ill.	12	40	17	14	10	10	6	Drop	11.40	Sand, gravel, hard clay	Handling cost, 13.6 cts.
35 Chicago, Ill.	15	54	810	65	9	...	...	Steam	10.00	Silt clay	
36 Omaha, Neb.	15	44	85	30	14	30	10	Drop	6.50	Slag, quicksand	
37 Inglis, Fla.	12	29	70	20	16	26	2	Drop	16.00	6 ft. into sandstone	Price paid contractor
38 West Point, Ky.	12	33	120	37	15	25	1	Drop	30.00	Mud, clay, gravel	Difficult job
39 Berrien Springs, Mich.	15	41	900	30	30	35	14	Steam	11.00	Mud, sand, clay	Labor handling
40 Rock Island, Ill.	15	41	21	17	16	15	12	Drop	14.50	Gravel, hardpan	
41 New York, N.Y.	15	38	75	15	15	...	...	Drop	20.00	Earth, sand, gravel	Price paid contractor
42 Preston Park, Pa.	15	39	142	40	34	22	8	Drop	5.33	Decayed vegetation, clay	
43 Evansville, Ind.	10	28	26	14	12	35	25	Drop	7.50	Clay, shale, cobbles	
44 Tomahawk, Wis.	15	45	148	22	16	16	2	Drop	20.00	Very hard driving	

Note—Nos. 1 to 34 U.S. steel sheet piling. Nos. 35 to 41 Friestedt interlocking channel bar piling. Nos. 42 to 44 symmetrical interlock channel bar piling.

The Canadian Engineer

ESTABLISHED 1893.

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CONTENTS OF THIS ISSUE.

THE USE OF FUEL OIL ON THE BRITISH COLUMBIA COAST.

The use of fuel oil on the British Columbia Coast has many advantages over the use of coal. The quantity required to perform the same service is less both in weight and the space occupied, with a proportionate decrease in fuel bills. On the larger boats, the reduction in firemen and trimmers by its use has been as 67 per cent., with the consequent lowering in pay-roll and the cost of subsistence. Such expenses as renewing of grate-bars, stoke-hold floor plates, slice-bars, rakes, etc., are done away with.

Owing to the uniform temperature of the fires, boiler repairs have disappeared. With the use of fuel oil there is no constant opening of furnace doors for firing up, no cleaning of fires, with the consequent inrush of cold air, and the resulting lowering of temperature, which has a serious effect on joints and rivets because of contraction. The experience on one of the large boats running out of Vancouver in this respect is that one boiler in a battery of six was constantly under repair when coal was in use. Since oil has been in use there have been no repairs necessary.

Because of the absence of smoke, cinders and coal dust, oil-burning ships are not only cleaner, but the supplies required for scrubbing and painting are much less. There are no dirty bilges and no corrosion to the bottom boiler plates as a result of absence of ashes.

In point of efficiency the advantages are quite as marked. The calorific values of oil far exceeds that of coal, after deducting the percentage of moisture and ash from coal, the latter from experience being found to run as high as 20 to 25 per cent. The average run of coal will be found to represent 7,000 to 9,500 B.T.U., whereas oil will give as high as 18,500 B.T.U. Owing to incomplete combustion when firing with coal the stack temperatures are very high; with oil, combustion is practically complete, and stack temperatures of 400 degrees to 450 degrees are obtainable. In the case of one large coast steamer the reduction in stack temperature was 950 degrees; the temperature with coal being 1,400 degrees, with oil 450 degrees.

With fuel oil there is perfect control of the fire. When the engines are stopped fires may be completely extinguished, if desired, in the course of a minute. There is no lost time in filling the coal bunkers. The oil tanks can be filled in several hours, fuel enough being taken on to last in some cases twice as long as when using coal.

The efficiency of the plant, and, to a large extent the economy to be obtained, depends on the system of burners adopted. As is well known, there are three methods of atomizing fuel oil employed, viz., by air, by steam, or by mechanical process. The first entails considerable initial expense for compressors, etc., and the cost of operation. The second, while not so costly to install, uses a large amount of live steam, which is unreclaimed, and a consequent drain on the fresh water supply. In addition, the roaring of the burners is disagreeable and a nuisance. The third, or mechanical system, consists of heating the oil to a high temperature and putting it under pressure, from which, when escaping at the burner, it bursts into a vapor and readily ignites.

A large number of vessels, also a number of stationary plants, have been equipped with the mechanical system. Its adoption as being the cheapest to operate and most efficient, was only after careful consideration of the various systems. It is practically noiseless, and consists of a pump, heater and burner. In practice, two pumps and two heaters are fitted, so that in case of a breakdown or overflow there will always be one pump and one heater in reserve. The burners are very simple as to design, and are arranged for changing or cleaning. A burner can be taken out and changed in five seconds, and has various sized tips, which can be used as required, for increasing or diminishing the consumption.

With regard to the supply of fuel oil on the British Columbia coast, there are no present indications of failure. It was reported about the beginning of the year that there was in storage in California alone a quantity sufficient to take care of the world's consumption for seven months. The California and Texas oil fields are by no means exhausted; new wells are constantly being sunk and from indications in Alaska, Alberta and South America other fields will be developed. Notwithstanding, therefore, the immense increase in consumption, the supply promises to be adequate. Two large companies now have storage tanks in Vancouver, and one of these companies will shortly have a storage tank in Victoria. These companies are each prepared to make term contracts for the supply of oil fuel in large quantities.

SUPERVISION OF SEWAGE WORKS.

The proper disposal of sewage is daily becoming a more important factor in the preservation of the health of populous communities. The customary methods of disposal by discharge into flowing streams and large bodies of water as the population increases must often be changed and some method of sewage treatment be used. A few plants for the treatment of sewage have already been installed in different parts of Canada, and it is to the operation of these plants already installed and the increasing number which will be built in the near future that these remarks are directed.

The mistake is made of deciding after the works have been installed that there is no further need for the sanitary specialist or engineer. The pursuance of this policy has been disastrous in many well-designed and well-constructed plants in the United States. Thousands of dollars have been spent for the construction of sewage work only to entrust their operation to unskilled and incompetent persons. Capable men to take charge of sewage treatment plants need a slightly different training from the constructing and designing engineer; but they should nevertheless be technically trained men. One of the leading experts in sanitary engineering recently stated that the ideal course for the operating engineer in charge of sewage treatment plants should give less attention to civil engineering features and more attention to mechanical engineering and laboratory work; also, more attention should be given to the subject of accounting and scientific management.

The work to be undertaken in the supervision of these works is not necessarily unpleasant, and it presents mechanical, chemical and biological problems which are well worthy of the time and energy of the technically trained man. The problems involved are not simple, but many of them are exceedingly complex because of the presence of biological factors. The treatment of sewage is a very rich field for study and investigation which has scarcely been opened up.

In a recent issue of the monthly bulletin of the Ohio State board of health, it is stated that the larger American cities are able to employ technically trained men for this work, but many of the small cities are unable to do so; it was added that good and efficient supervision and operation of small sewage work could be secured by placing a technically qualified man over all the plants in a given district, which, in some instances, might be a single county, and in others two or more counties, the size of the district being determined by the number of plants.

This suggestion is a very good one, but would hardly do yet for the conditions existing in Canada. The plants are too few in number and too widely scattered for this method of supervision. It would appear that for some time to come the best method would be to place the supervision of the plants under the control of the Provincial Boards of Health.

THE SHIPMENT OF CEMENT.

The question of how cement should be shipped is receiving considerable discussion just now. It has been argued for some time past that there would be a great advantage in shipping and handling cement on large jobs in bulk rather than in bags. One of the largest Portland cement companies in the United States has recently begun the shipment of cement in bulk. The results were so satisfactory that they are now sending out a circular urging the advantages of this method.

The wooden barrel method seems to have practically disappeared, the methods now remaining being shipment in cloth sack, paper sack and in bulk. The use of paper sacks has been strongly urged by some engineers on the ground that the return freight charges, the time and labor of collecting, counting, storing, keeping tally, packing, cartage, etc., of the cloth bags, the lost time in emptying them, the risk of loss through dampness, the risk of a dispute with the cement company supplying the cement and the risk of not getting the brand of cement specified leaves the balance in favor of the paper bag. There is a good deal of force in the above arguments, but it is unlikely that the use of the paper sack will increase much over the use of the cloth sack. The paper sack costs more to handle, and there is a greater probability of loss of cement in their use.

Shipment in bulk presents certain advantages over the cost of packing and handling cement in bags. There is a saving in cost all the way along the line. At the same time, it is extremely unlikely that shipment in bulk will ever come into general use. On large contracts, where a great deal of cement is being used, this method will give better results with a great saving in cost. The jobs, however, must be very large to warrant this method.

EDITORIAL COMMENT.

An important feature that has marked a step forward for sanitary protection is the abolishment of the public drinking cup. It only remains for the Government to arrange for saloons to install the now familiar drinking mouthpiece, which will necessitate the use of a slot machine and eliminate treating the bartender.

* * * *

Attention is drawn to the article in this issue on "Canadian Draughtsmen and Engineers." The writer's suggestions deserve careful thought. The extension of the night classes in the technical schools is being done, and an impetus will be given this work, no doubt, when the long-deferred report of Royal Commission on Technical Education appears.

CANADIAN DRAUGHTSMEN AND ENGINEERS.

By F. Tissington.

It is with a certain amount of diffidence that I approach this subject, as, perhaps, I am not so well qualified to write about it as some others.

At the same time, I believe that, perhaps, my views may draw other people's attention to a serious handicap against Canadian engineering enterprise. What I refer to is the apparent lack of draughtsmen of almost every class, but more particularly the trained man, and further, those possessing any practical knowledge.

I have bracketed draughtsmen and engineers together in my title, because, to a large extent, the latter are recruited from the ranks of the former, and, failing an adequate supply of the first, how shall we keep pace with the demands for either class of men if our population keeps on increasing as at present, and incidentally their requirements from an engineering point of view?

To get down to the root of the matter, I would suggest that we are not training sufficient men, or training them quite the right way.

In the first place, it must be borne in mind that Canada is only in its infancy as regards engineering work, and that first and foremost it is essentially an agricultural country.

Now, from a common sense point of view it is not an easy matter to train a man for an engineer if his ancestors for generations back have been nothing but farmers, as he has a distinct bias for the land, which is a part of his heritage

Bearing these facts in mind, it is not surprising to find that we are to a large extent indebted to the States and the Old Country for a large proportion of our trained men, and who have had as ancestors workers in iron or steel instead of farmers or the like.

I would like to say right here that occasionally one sees instances of men who have come right off the land and climbed to the top of the engineering tree, but these are exceptions only, and I believe, as a general rule, environment plays a large part in what we are cut out for.

What is being done at the present time to raise up a body of men capable of carrying on the great traditions of the engineering service in Canada, or are we to be dependent upon other countries for people to fill this profession?

We have our colleges in the large towns, and presumably we are training some men in our offices and works, but, so far as I can see, no adequate scheme is in operation to satisfactorily train the men necessary to fill the positions of the future.

My experience so far has been that very few draughtsmen get a practical training; that is, they do not plough their way through the shops, and so get the fundamental knowledge of how to handle the material they are working into articles of commerce on their drawing paper, and the consequence is often seen in the inaccessibility of parts, poor details of construction, and lack of appreciation of the respective importance of things in general.

It is by no means uncommon to see the purely office draughtsman split hairs on dimensions, using 64ths, and so on, where it is totally unnecessary, and then miss the most essential points to make a workmanlike job.

There are also quite a number of men to whom technical knowledge is quite a stranger, although they claim to be draughtsmen, and it is, therefore, wholly impossible for them to do anything else but flounder.

Having thus severely criticized my own class, I would like to suggest a few ideas which would probably mitigate to some extent these faults.

First, I would suggest an extension of the evening technical schools as rapidly as could be found convenient, with grants from the Government on attendance at same.

In those districts where no such classes are available it would be a good scheme for the employers to interest themselves and get up classes in their own works suited to their own particular needs, and these could easily be run by one of the leading men if he would devote a little of his time to them. Probably the firm would be glad to make a small grant to act as an encouragement.

Then, for the practical side I would suggest that all the new men as far as possible are drafted from the works to the office, and this should act as a spur to the young men in the works to do their best and put in all the time at study they could, it being understood that those showing themselves most proficient, irrespective of age or length of service, should have first chance.

I am not at all in love with the premium apprentice system, such as is run in the Old Country. Generally speaking, the boy who stands on his own legs comes out at the finish the best man.

It will be seen that the scheme as outlined takes care of both the practical and theoretical features of the profession, and the reward of being transferred to the office, I believe, would influence quite a large percentage of young men in the works.

Some managers or owners may say that it would not appeal to them, because probably as soon as they had trained a young fellow up and improved his earning capacity he would be running away to some other shop and give them the benefit. This, however, appeals to me as a question of dollars and cents, and if the employer is not willing to pay a man according to his earning capacity, even though the firm may have been instrumental in giving it to him, then there is no doubt they should lose him.

The issue either way is entirely a business proposition, and cannot, therefore, be treated by either party as a philanthropic institution.

GENERAL NOTES.

The precipitation was above the average in Eastern Ontario, over the whole of Quebec, the larger portion of New Brunswick, and in Southern British Columbia; elsewhere in the Dominion the average was not maintained. In Eastern Quebec and in New Brunswick the rainfall was heavy, varying from five to seven inches; whereas in our Western Provinces it was quite light, only a few localities reporting a total fall for the month exceeding much over half an inch.

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

	Depth in inches.	Departure from the average of twenty years
Calgary, Alta.	....	......
Edmonton, Alta.	0.70	—0.06
Swift, Current, Sask.	0.70	—0.01
Winnipeg, Man.	1.10	—0.41
Port Stanley, Ont.	2.6	—0.18
Toronto, Ont.	2.35	—0.35
Parry Sound, Ont.	3.0	—0.74
Ottawa, Ont.	4.4	+2.15
Kingston, Ont.	2.9	+0.20
Montreal, Que.	3.4	+0.39
Quebec, Que.	3.5	+0.41
Chatham, N.B.	5.3	+1.61
Halifax, N.S.	3.8	—1.77
Victoria, B.C.	2.3	+0.04
Kamloops, B.C.	0.6	+0.07

REPORT OF COMMITTEE ON SEWERAGE AND SANITATION.*

In reviewing the progress of events in the field of sewerage and sanitation during the past year it is very evident that representative governing bodies in both the United States and Canada are taking a greater interest. This is particularly noticeable in regard to the districts surrounding the Great Lakes, where an organization known as "The Great Lakes International Pure Water Association" has just held its second session at Cleveland.

Pollution of Surface Water.—There appears to be a general consensus of opinion among those representing state health authorities that the time has come when some definite action must be taken by the Federal Government. This is necessary, for while one State may have most drastic laws with reference to "river pollution," the adjoining State may have none. As an illustration, the Chicago drainage canal may be cited, where, by the simple but barbaric method of turning the sewage from its own water front to a river flowing through a neighboring State, there was caused much litigation and hard feeling. This central control also applies to Canada where this question has reached the same stage and where the central authority at Ottawa is being asked to supervise surface water pollution. Representatives from the United States and Canada have already had three meetings to work out a line of action in order to obtain the necessary data on which to pass an international policy taking all the States and provinces and centralizing under one association. The following bill was introduced in the Canadian Senate last year and, after being discussed, was referred to the committee of public health, and there is little doubt but that this or a similar bill will become the law in the near future. The bill briefly provides as follows:

"Every person is guilty of an offence against this act and liable on summary conviction to the penalties hereinafter provided, who puts, or causes or permits to be put, or to fall, flow, or to be carried into any navigable water, or into any other water any part of which is navigable or flows into any navigable waters:

"(a) Any solid or liquid sewage matter; or

"(b) Any other solid matter which, not being sewage, is poisonous, noxious, putrid, decomposing, refuse or waste; or

"(c) Any liquid matter which, not being sewage, is poisonous, noxious, putrid, decomposing, refuse, or waste; unless such matter, whether solid or liquid, is disposed of in accordance with regulations or orders made or permits granted under the authority of this Act."

While such a bill is drastic, there is no doubt but that it is necessary. Throughout the United States and Canada practically all the waterways and watercourses in the populated districts are so hopelessly contaminated that they are unfit as sources of water supply unless artificially treated, and these are the principal sources of supply through this country. While it is possible to filter a polluted water it is better to filter a slightly contaminated water than an altogether contaminated water provided, of course, you cannot get an unpolluted supply. In this country at present sanitarians rely more upon filtration and treatment of water supplies than upon the treatment of sewage. The Lake Michigan Water Commission adopted a resolution in which they stated that on that lake sources of supply even twenty to thirty miles from the point of entrance of large quantities of sewage, are not safe places from whence to derive water for domestic use. The Water Commission appointed at Toronto to investigate the source of that city's supply as to Lake Ontario, found that polluted water could be obtained sometimes as far out as fourteen miles in Lake Ontario. Tests were made of water every half mile out, both at the surface and seventy-five feet below and islands of polluted water would be found at different points out for the distance mentioned. In one instance a sample was taken about one mile out and was found free of bacteria coli, with a bacterial count of 70 per c.c. Twenty feet away another sample showed bacteria coli and a bacterial count of 13,000 per c.c. This is interesting, as showing that under certain conditions of the lake and wind that the sewage polluted water does not form a combination with the colder and cleaner water. In nearly every case the samples near the surface were purer than those taken 75 feet below.

A study of the chemical analysis of the Lower Great Lakes shows that the average amount of chlorine in the water is, at Detroit 4.7, Cleveland 10, Buffalo 10 and 6.5 in the middle of Lake Erie; the west end of Lake Ontario shows that the amount of chlorine has increased two and one-half times in thirty years, while the easterly end shows that the amount of chlorine has doubled in twenty years. The increase in the chlorine indicates sewage pollution, which, if not stopped or minimized, will in time render Lake Ontario unsafe for use as a public water supply. On account of the agitation now being carried on and mentioned before, it is probable that most large cities of the Great Lakes, anyway, will be treating their sewage with the resultant decrease.

The Treatment of Sewage.—The object of all present-day treatments of sewage disposal has been to knowingly or unknowingly take advantage of the oxidation process through the intermediary of living organisms. Those that have failed are those which have not supplied these micro-organisms with a sufficient supply of oxygen to carry out their functions. In connection with sewage treatment there are two distinct factors:

(a) The removal of all causes which may effect a nuisance.

(b) The removal of all causes which may effect disease Most of the standard methods of sewage disposal using screens and sedimentation tanks perform only the functions of clarification to a greater or less extent. Filtered through slag or stone, the nuisance is altogether removed and at present only in exceptional cases is the sewage treated to effect the total removal of disease germs. On account of the great cost and the cheaper means of treating the water supply by means of the addition of very small quantities of hypochlorite of lime, as low as two parts in one million, it is very seldom that the sewage is treated beyond the filter stage. This, then, seems to be the theory of the sanitarians of the present day, namely, to only remove the chemically organic attributes which create a nuisance by decomposition, from the sewage. No longer do we find the septic tank being built, for, being wrong in principle, it is doomed as an integral essential to any method of sewage disposal. Instead, we have the sedimentation tank in some cases, and a great vogue for two-story tanks, of which the Imhoff is at present the most popular.

Water Purification.—For years we have known that sunlight is a wonderful bacteriological agent, and that the active rays were the ultra-violet rays of the sunlight. Acting on this theory, special lamps have been devised to create the greatest possible quantity of these ultra-violet rays and experiments in sterilizing water have been going on for some time. As a result, Marseilles, in France, has installed a one-hundred-and-thirty-thousand-gallon plant for sterilizing water by this means. The cost of sterilization could not be

* Report presented to the annual meeting of the American Society for Municipal Improvements, held at Dallas, Texas, Nov. 12-15, 1912. Mr. A. F. Macallum, C.E., city engineer, Hamilton, Ont., chairman of committee.

ascertained, but ninety-nine one-hundredths per cent. of the bacteria was destroyed.

Papers.—This committee has been fortunate in securing several papers on the Imhoff tanks, the purification of sewage, and the sanitary condition of Dallas. The committee wishes to extend its thanks for these papers to Mr. Y. Chalkley Hatton, of Wilmington; Prof. N. H. Ogden, of Cornell University; Mr. G. H. Daumgartner, city engineer of Dubuque, Iowa, and Mr. E. J. Dalton, of Dallas, Texas.

LATERAL PRESSURE IN CLAY FROM SUPERIMPOSED LOADS.

Much has been written on the subject of earth pressure in general, and many have been the theories evolved relating to the stability of retaining walls, and the intensity and point of application of the pressure exerted by a mass of earth against the back of such a wall. In certain forms of construction the lateral pressure against a retaining wall or any vertical surface, induced by a vertical load applied at a given distance from that surface, becomes a matter of special interest. Mr. Walter L. Cowles, in a paper read before the Western Society of Engineers, gives an analysis of the lateral pressure of clay.

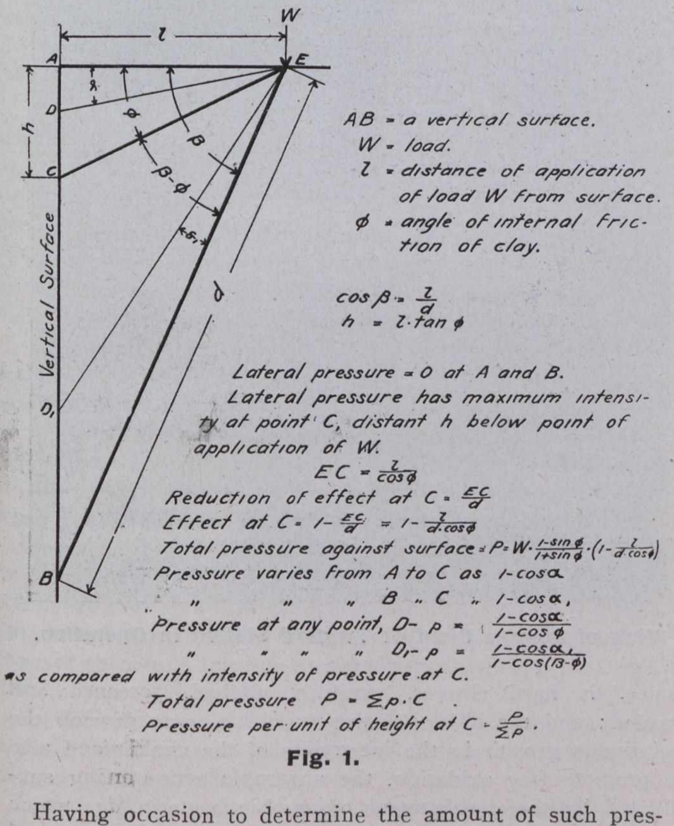


Fig. 1.

Having occasion to determine the amount of such pressure, he made a careful examination of the literature on this subject, with the result that he discovered a wide divergence of opinion as to the location of the maximum pressure as well as to its amount, varying from a maximum at the bottom of a cut to a maximum near the top, while the arguments advanced from a theoretical point of view, as well as the results of experiments and of observations of actual conditions under varying circumstances, might favor either conclusion.

Moreover, in the experiments described, the materials used were granular in character, the theories advanced were for the most part based on the action of granular substances, and the conclusions were not applicable to masses of clay such as constitute the sub-soil of Chicago.

In a few instances (notably in a paper by Wm. Cain, M. Am. Soc. C.E., published in the Transactions American Society C.E., Vol. LXXII., pp. 403-448) pressures from clay have been discussed, including the effect of cohesion. This was in line with the general direction of the investigation which Mr. Cowles was conducting, but still did not touch the particular point with which he was concerned, namely, the horizontal effect of a vertical superimposed load.

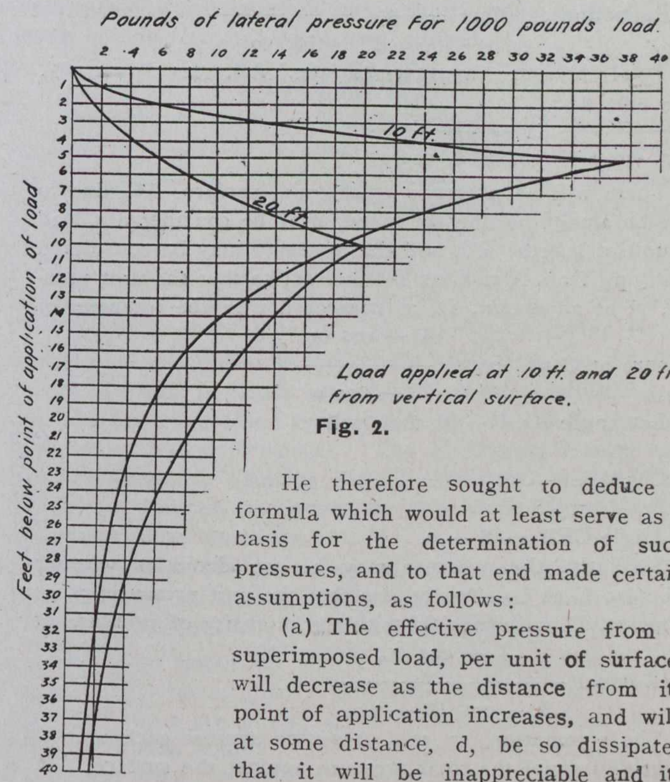


Fig. 2.

He therefore sought to deduce a formula which would at least serve as a basis for the determination of such pressures, and to that end made certain assumptions, as follows:

(a) The effective pressure from a superimposed load, per unit of surface, will decrease as the distance from its point of application increases, and will, at some distance, d, be so dissipated that it will be inappreciable and its amount may be considered equal to zero.

(b) The pressure in a horizontal direction will equal zero.

(c) The load may be considered as being supported at the apex of a cone, whose elements make an angle with the horizontal equal to the angle of internal friction of the material considered.

Clay, being a plastic instead of a granular material, has no "angle of repose," since, in excavating, it may be left with a vertical surface of considerable height; therefore this angle, commonly used in discussions of lateral pressure, is inapplicable to this material. Clay, however, has cohesion, and offers a certain resistance to shear due to its tenacity, and exerts also a resistance, due to its friction, against the movement of one portion of a mass over the underlying portion. The coefficient of this friction may be determined, and the angle of internal friction is that angle whose tangent is this coefficient.

Let us, then, consider an open cut with a vertical face, and a vertical load, W, applied at a distance, l, from the surface. Pass a plane through the point of application, and perpendicular to the face of the cut, cutting the latter in the line AB, Fig. 1. Draw the line, EC, making the angle ϕ equal to the angle of internal friction; also the line EB, making its length equal to d. By assumptions (a) and (b) the pressure will be zero at points A and B, and it is assumed as a maximum at point C.

Also, by assumption (a), at any distance, d_1, from the point of application, the reduction of effect will be equal to $\frac{d_1}{d}$, and the effective pressure will equal $1 - \frac{d_1}{d}$.

Let the total pressure against the surface, AB, be found by Rankine's formula $= W. \dfrac{1 - \sin\phi}{1 + \sin\phi}$, reduced by the effect of the distance of C from E.

$$EC = \frac{1}{\cos\phi}.$$

$$\text{Reduction of effect} = \frac{EC}{d} = \frac{1}{d.\cos\phi}.$$

Total pressure against surface, AB, $= P = W. \dfrac{1 - \sin\phi}{1 + \sin\phi} . \left(1 - \dfrac{1}{d.\cos\phi}\right).$

There will be pressure against the surface, AC, due to cohesion along the line (or plane, if W be considered a load per unit of length) EC, and this pressure may be considered as varying from A to C as $1 - \cos\alpha$, so that the unit pressure, p, at any point, D, as compared with the intensity of pressure at C will equal $\dfrac{1 - \cos\alpha}{1 - \cos\phi}$.

Let angle AEB $= \beta$, then will

$$\cos\beta = \frac{1}{d}.$$

Angle CEB $= \beta - \phi$.

Similarly, the pressure may be considered as varying from B to C as $1 - \cos\alpha_1$, so that the unit pressure, p, at any point, D, as compared with the intensity of pressure at C will equal $\dfrac{1 - \cos\alpha_1}{1 - \cos(\beta - \phi)}$.

The summation of the pressures against each unit of height will equal the total pressure against the surface, AB, or, if p be given in terms of the intensity at C,

$$P = C\Sigma p,$$

whence, the pressure against a unit of height at C is

$$C = \frac{P}{\Sigma p},$$

from which the distribution of pressure over the surface, AB, may be found.

This result is not offered as a final or adequate solution of the problem, but as an effort to arrive at some rational method of determining the probable lateral pressure exerted against a vertical surface by a vertical load at a greater or less distance, and the distribution of this load over that surface.

The values of both d and Φ will vary with the consistency of the soil, and d, especially, will be determined largely according to the judgment of the individual.

As an illustration of the results of this method, and without implying that the values are worthy of adoption, Mr. Cowles assumed in the figure an angle of 26 deg. 30 ft., equal to a slope of 2 to 1, for the angle of internal friction, and if a distance of 100 ft. be assumed for d, the curves of pressure for load applied at distances of 10 and 20 ft. from the vertical surface will be as shown in Fig. 2. The area included between the curves and the vertical line representing the surface will equal the total pressure against the surface.

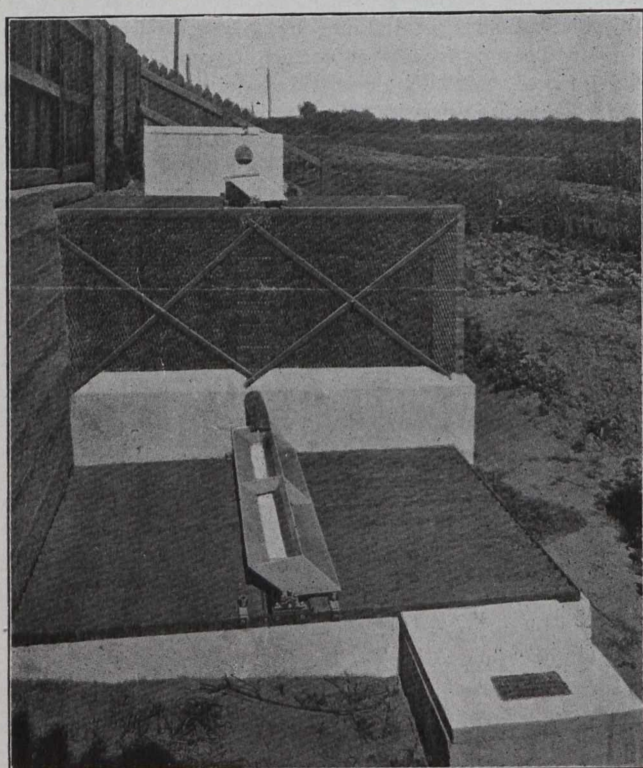
The Imperial Limited Canadian Pacific Express, westbound, was derailed Sunday night by a broken rail, four cars leaving the track near Wayland Station, 280 miles west of North Bay. Traffic was delayed about six hours by the accident.

A SMALL SEWAGE PLANT.

By H. G. Clark.

For some time past difficulties have arisen in disposing of the sewage from Twyford Station, England, on the Great Western Railway Company lines, there being no local sewerage system. Various expedients temporarily tided over the requirements, but the necessity for more thorough steps became evident and plant was provided which represents the latest methods of scientific treatment about a year and a half ago. This plant follows the process by which Nature clears away effete organic substances, i.e., by fermentation and oxidation, in the order specified.

The second process occurs in filter beds about 4 ft. 6 in. deep, served by iron distributing trays, a tipper automatically deflecting to each filter bed alternately. The medium in these filters, between which an air space intervenes, is hard clinker, carefully washed, screened and graded; and the object of this provision is to develop the gelatinous growth in the interstices of the clinker and also to promote free oxidation, the anaerobic action being supplanted by the development of aerobic bacteria, for which a medium containing air is necessary, while the converted product, termed "humus," is retained in a small pit. The final purification is effected by a clinker drain. Special provision in the form of baffles and drain-off valves arrest and extract a quantity of paraffin oil used for cleaning the sanitary fittings.



View of Sewage Plant at Twyford Station in Operation.

The plant was designed to the approval of the divisional engineer, Mr. J. N. Taylor, and provided by Messrs. Tuke & Bell, Limited, sewage specialists, 69 Leadenhall Street, London.

The plant has now been in operation for a year and a half successfully, without a complaint from the Rivers Board, although the sewage from the station is an exceptionally strong one, and difficult to treat.

THE BUILDING AND ORNAMENTAL STONES OF THE MARITIME PROVINCES.*

By Professor W. A. Parks.

The economic production of stone for structural purposes in the Maritime Provinces is practically confined to granite and sandstone. A brief account of the condition of the industry is given below for each province separately.

NEW BRUNSWICK.

Granite.—The red, pink, and grey granites of St. George and the black granites of Bocabec, in Charlotte county, are being quarried by several firms; the product is nearly all manufactured into monuments in the extensive mills at St. George. In this country also, there is a small and intermittent production of grey granite from the vicinity of St. Stephen.

Near Hampstead, on the St. John River, the so-called Spoon Island stone is worked in two extensive quarries by D. Mooney & Company, of St. John. Both pinkish and grey, rather coarse-grained stone is obtained which is employed for monuments, for building, and for the making of paving blocks.

The rough grey granite boulders which are so plentifully scattered over the area north of McAdam Junction, in York county, are cut into building blocks by different operators and employed for structural purposes in Woodstock and other towns.

Near Bathurst in Gloucester county, a coarse-grained granite is from time to time quarried for local use.

Sandstone.—Roughly speaking, the sandstones of New Brunswick may be classified into red, grey, olive-green, and brown types. An excellent red freestone is quarried near Sackville, in Westmorland county, by the Sackville Freestone Company. The formation at this point is very favorable for the profitable extraction of stone. Large quantities are quarried and dressed by a modern plant, the product, in many cases, being shipped to a distance.

True grey sandstones occur along the Gloucester coast of Chaleur Bay; they are quarried by two companies for the making of grindstones. The cost of quarrying is, however, too great to allow this material being put on the market as a building stone.

Olive-green sandstone is quarried in Northumberland, Kent, and Westmorland counties.

The quarry region in Northumberland is situated on the Miramichi River, near Newcastle. Two firms are now actively engaged—the Miramichi Quarry Company, Quarryville, and Adam Hill, Cassilis. C. E. Fish, of Newcastle, proposes to reopen the old French Fort quarries at an early date.

In Kent county olive-green sandstone is quarried near Notre Dame, on the Moncton and Buctouche railway, by Hall and Irving, of Moncton.

Westmorland county was for many years the chief seat of the freestone industry in New Brunswick. At the present time a great many of the old quarries near Shepody Bay and Cumberland Basin are idle. H. Read and Company are operating a quarry at Northport, and the Dorchester Stone Works have a small quarry on the point between the Petitcodiac and Memramcook Rivers. Near Shediac, Dr. E. G. Smith is producing a stone which may be included in this class.

Brown sandstone is quarried by the Read Company, at Wood Point, in Westmorland, for grindstones, and the Cape Bald Freestone Company, of Port Elgin, is getting out building blocks at Cape Bald, on the eastern coast of Westmorland.

Crystalline limestone is largely quarried for the manufacture of lime at St. John, with the incidental production of a small amount of rough building stone.

The pure white gypsum at Hillsborough, in Albert county, has, in the past, been employed as a decorative stone, but there is no production for that purpose at present. The porphyritic felsites of Passamaquoddy Bay, the Tobique Valley, and elsewhere may have a future value as decorative stone but they are not at present utilized.

NOVA SCOTIA.

Granite.—A greyish, coarse-grained, and porphyritic granite is quarried by several firms along the Northwest Arm, near Halifax. At Terrence Bay, a coarser and lighter colored type was quarried for the construction of the Bank of Commerce in Halifax.

On the west side of Shelbourne harbor, in Shelbourne county, a very fine grey granite was formerly obtained. The character of the stone and the excellent shipping facilities should encourage the further exploration of this deposit.

At Nictaux, in Kings county, are extensive exposures of an excellent fine-grained grey granite resembling the famous stone from Barre, Vermont. The Middleton Granite and Marble Company, Thelbert Rice, S. Williamston, and John Kline, of Halifax, are quarrying this stone for structural and monumental purposes.

Sandstone.—The sandstones of this province are, for the most part, of an olive-green or reddish color, and are obtained more particularly in Cumberland and Pictou counties.

The most important quarry of red stone is that of the Amherst Red Stone Quarry Company, near Amherst. Two small operators are producing a reddish stone near River John, in Pictou county. At Toney River and other places along this coast, as well as at Whycocomagh and Judique, Inverness county, Cape Breton, there was a former production of red sandstones.

Olive-colored sandstones were at one time extensively quarried along the coasts of Chignecto Bay and Northumberland Strait, in Cumberland, Pictou, and Antigonish. In Cape Breton they were obtained, more particularly, on Boularderie Island and at points near Sydney. At the present time there are only two quarries worthy of mention here, although small amounts of stone are raised by other operators. The quarries of the Wallace Stone Company, at Wallace, in Cumberland county, have furnished stone for many of the chief buildings in Eastern Canada, and are still in active operation. The Pictou Quarry Company, of Pictou, produces a fine grade of stone which rivals the Wallace product in popularity.

Metamorphosed Slate.—A hard stone of this character is quarried on the Northwest Arm below Halifax. The product is largely employed for purposes of rough construction and, in some few cases, has been used in buildings of a higher type.

Crystalline Limestone.—The demand for flux in the steel plants has led to the opening of very large quarries at Marble Mountain and George River, in Cape Breton. Good exposures have in consequence been made which reveal the shattered nature of the formation. Although fair-sized pieces of considerable beauty could be obtained from time to time, there does not seem to be much promise of success in the operation of these quarries for marble. Variegated crystalline limestones of marble quality are known to occur at other points in Cape Breton: among these may be particularly mentioned Whycocomagh and Eskasoni. No positive evidence was obtained that these deposits are cap-

* Abstracted from summary report of the Mines Branch, Department of Mines, for 1911.

able of economic working, as they are much covered by soil and present only isolated exposures.

Felsite-breccia.—Along the coast of Richmond and Cape Breton counties, and more particularly on the north shore of Scatari Island, handsome, varicolored felsite-breccias occur. Although this material could not be secured in very large blocks, pieces of sufficient size for many decorative purposes could be readily obtained. Somewhat less brilliant but still handsome felsites may be obtained at many points in Pictou, Antigonish, and Guysborough counties.

PRINCE EDWARD ISLAND.

The only stone suitable for building produced in this province is a red and not very durable sandstone of the Permo-Carboniferous age. Small and unimportant quarries have been opened at many places, but the only production at present is from Swan's quarry, near Charlottetown.

In the Maritime Provinces, as in other parts of the country, the stone industry has suffered severely from the general introduction of cement for purposes of construction. Those quarries which formerly produced heavy stone of a coarse type for bridge building and other works of a like nature are practically all closed. The long haul by rail to the chief centres of consumption is a deterrent factor in the profitable working of the finer grades of sandstone. The failure of the numerous quarries about the head of the Bay of Fundy has been ascribed to the almost prohibitive duty imposed by the United States government. This same factor has had much to do with the closing of the granite quarries at Shelbourne. It is encouraging to observe that Wallace, Pictou, Sackville, Amherst, and Miramichi stone can be profitably quarried and shipped to points as far distant as Toronto. It should be remembered also that many of the old quarries at Mary Point, Demoiselle Creek, Boudreau, etc., were operated almost entirely without machinery. Strong companies with modern equipment might well be able to revive the industry in this district.

The granite quarries of Charlotte county are handicapped by the long haul by team into St. George, by the small scale on which operations are conducted, and by the fact that no outlet is found for the large amount of debris. The stone has been quarried for monumental or large structural work only: in consequence, immense piles of material have accumulated from which paving blocks and even building stone of fair size could easily be cut. It is stated that an effort is being made to form a company embracing the various interests. It is to be hoped that such an attempt may meet with success, for such a company could concentrate the quarrying, provide better means of transportation, and devise ways for the utilization of the smaller stone.

WATER STORAGE IN BRITISH COLUMBIA

A good example of what can be done in developing and, at the same time, conserving water-power resources is given by the Jordan River plant of the British Columbia Electric Railway Company, on Vancouver Island. Although the average precipitation over its watershed reaches the excessive figure of 80 inches, the Jordan River, like the majority of our streams, has a wide variation between summer and winter flow. The company has had the flow of this river systematically gauged since 1907 and the results obtained justified the building of large storage reservoirs for the purpose of impounding waters which would otherwise go to waste. The total capacity of these reservoirs, of which there are five, is 1,500,000,000 cubic feet, and they provide ample storage, within reasonable cost, for an ultimate maximum plant output of 24,000 h.p. to 36,000 h.p.

REPAIRING OF UNARMORED CABLES IN WET SHAFTS.

In a paper read before the East of Scotland Branch of the Association of Mining Electrical Engineers, Mr. J. Gillespie gave an interesting account of his experience with the above.

While there may be some room for divergence of opinion as to the respective merits of armored versus unarmored cables for shaft work, there can be very little room for any difference of opinion with regard to the great difficulty experienced in the execution of repairs on cables which come under the latter category, particularly when they have to withstand the stress of high-tension currents in wet or damp situations.

On a recent occasion the writer had some connection with a colliery at which the shaft cables were a source of continual trouble, they having on successive occasions broken down to earth on one or more phases. The cables in question consisted of three conductors of 37/14 copper insulated with vulcanized bitumen, taped and double-braided, installed in a pitch-pine casing 9 in. broad, which was screwed to the end tubbing of the pit, each conductor being in a groove by itself and the whole capped with 1-in. pitch-pine boards.

Prior to the writer's connection with the colliery several attempts had been made to eliminate the trouble, the method adopted being to build a substantial wooden box round the part affected, which box was then filled in solid with bitumen or some insulating compound. This improved matters for a time, but had no lasting effect, as another defect made itself apparent soon after each repair, at a point immediately above the range of the compound.

When the trouble first attracted the attention of the writer, he made a complete investigation, and became convinced that the root of the matter lay in a quantity of water finding its way into the casing at the junction where one length butted against the other. Water was found in appreciable quantities in each groove, the braiding of all three conductors being saturated while a continual stream flowed in the part of the groove between the cable and the capping. On consideration it was decided that it was impracticable to exclude the moisture from the casing, and that it was impossible to effectually insulate the cable in presence of the water. The alternative which presented itself to the writer's mind was that by some means the cables and casing should be removed from proximity to the water. The volume of water passing the affected part was found to be about two gallons per minute.

Fig. 1 shows the discarded method of repairing the cables. The wood box is shown fastened to the tubbing and surrounding the casing on three sides. One great defect of this is that it leaves the back of the repaired part exposed to any water which may find its way through the interstices of the barring. In addition to the presence of water in the casing, there had also to be considered the presence of a large amount of water in the open shaft, which at times was increased by the overflow from a small lodgment situated above and almost directly in the line of the cable run.

The cables having been placed behind the buntons it was necessary to arrange suitable water scaffolds between the buntons and the tubbing under which to carry on the work. These scaffolds were fixed in such a way as to divert the falling water, and were given such a run as would carry the collected water away from the casing in the direction of the tubbing, thus obviating the chance of the jointer's clothing becoming wetted by the drip water; in which case there would be present the risk of his carrying moisture to the joint.

The first step was to cut out the part of the cables which had been under the influence of the recurring earths. This was a length of 6 ft., and the casing was also taken out in such a way as to lay bare about 2 ft. of sound cable at both top and bottom. At the part from which the casing was removed a stout pitch-pine batten was fixed 3 in. from the barring by means of iron brackets, the space between the tubbing and the batten being left in order that any water which percolated through and was flowing inside the casing, might drip down clear of the joints. To this batten was screwed a length of casing in which were placed three pieces of new cable which had already been tested and proved to be impervious to water. The three protruding tails of the old cable at the part nearest the surface were then bent swan-neck fashion, the ends of each being turned down to meet the corresponding end of the new cable, and each conductor was jointed by means of a copper sleeve fastened to the cores by pinching screws and sweated solid. Pains were taken to arrange the bends in the cables in such a way that the water which found its path in the grooves of the casing was bound to drip from the rearmost convolution of the bend and fall clear of the joint. The major portion of the water being thus disposed of, the cables were heated gently over a protracted period in order to drive out the moisture saturating the braiding. This was carried out before making the joints, and continued until the cables were perfectly dry.

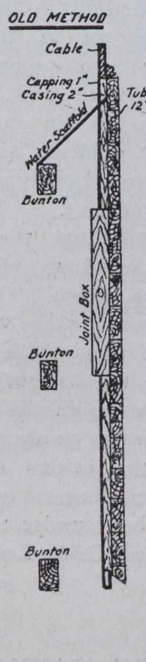


Fig. 1.

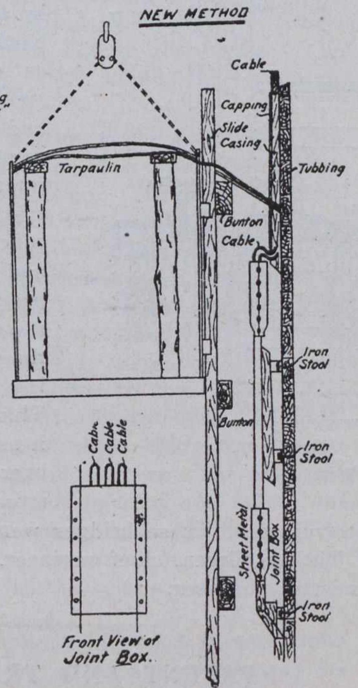


Fig. 2.

The drying process had to be repeated immediately before the box was filled in solid with compound, as it was noticed that some moisture showed a tendency to creep along the braiding even where it had to travel over the almost vertical portion of the bend in an upward direction. This the writer attributes to capillary attraction.

A joint box made up of 3/32-in. sheet iron (bent into the requisite shape at the Colliery) was then placed over the joints and was firmly glanded to the casing. Rubber insertion was used between the two portions of the box and between the box and the casing as jointing material, on account of its non-hygroscopic properties. Fig. 2 includes an enlarged sketch view showing the front elevation of the joint box with the cables entering same from above. Diatrine compound was used to fill up the box, and during the progress of the filling and for some time after the box had been filled a blow-lamp flame was kept playing on the front and sides of it so as to ensure that all traces of moisture were eliminated. At the lower end of the repair a similar joint box was used, but at this point there was no need to put close bends on the cables, as on account of the water-shedding arrangements prepared for the upper joint, that part of the casing immediately above the lower was found to be comparatively free from moisture. The work having been carried out at a holiday time, it was possible to make use of the cage for lengthy periods without unduly interfering with the output. The length of time occupied with the work was bounded by the period during which it was possible to keep the dock pumps idle without danger.

In order to arrange an almost completely water-tight structure from which to carry on operations, the ironwork forming one side of the cage was removed, and a tarpaulin fixed up in pitman fashion, by means of trees. This arrangement was carried out immediately under the cover of the cage, and one part of the tarpaulin was draped to form a flap, which, when the cage was in position for carrying on the work, was laid on the upper side of the water-scaffold to form with it a fairly water-tight roof some 8 ft. in length by 7 ft. in width. This permitted of tools and other gear being laid down in a dry position, besides providing more comfort than is usual in shaft work. Fig. 2 illustrates how the work was carried to completion. It shows the upper and lower joint boxes with the cage in position for making the upper joints. The work has been completed for a considerable period, and as yet shows no sign of recrudescence of the trouble. The cure is apparently of a permanent nature.

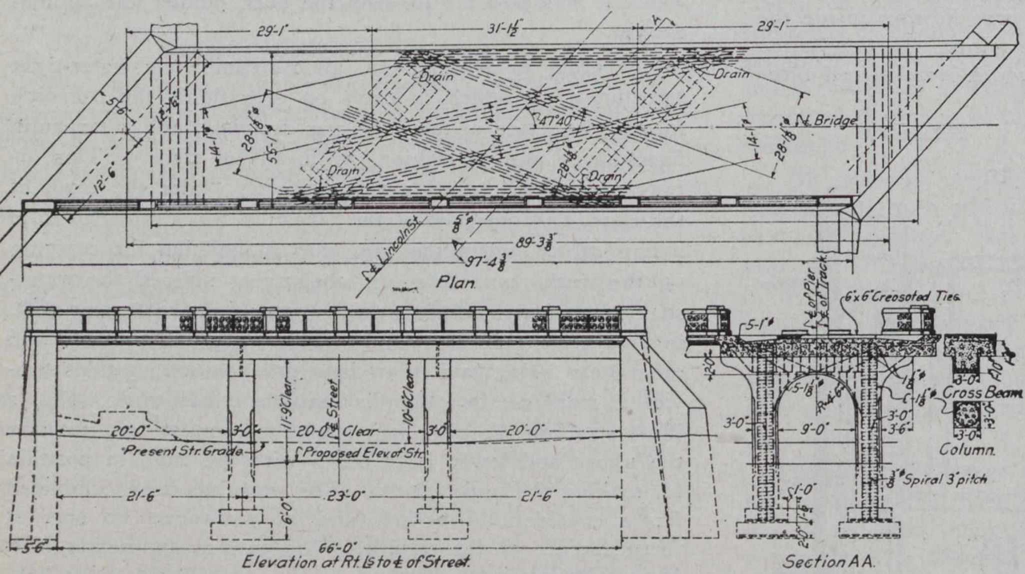
The writer does not intend that these few remarks should be construed into an argument in favor (or the reverse) of any particular type of cable, but hopes that they may be of service to any member who may encounter similar difficulties. He further hopes that during discussion, modification or improvement may be suggested of which he may take advantage should the repair as outlined turn out to be other than permanent.

CALGARY WANTS NATURAL GAS AS PUBLIC UTILITY.

The possibility of acquiring natural gas as a public utility is exercising the minds of many prominent citizens of Calgary. Since the introduction of the gas on a large scale by the Canadian Western Company, the convenience of its use in residences has been brought closer to more people. There is no complaint that at 35 cents per thousand feet it is too expensive when properly used, but having in mind the many wells scattered throughout Alberta where only a small portion is being used, or none at all, the question is freely asked why the city should not have its own supply? True, there is a well within the city limits piped into many houses and used extensively for lighting the streets east of the Elbow River, but its depth, 3,300 feet, and the difficulties met with when it was drilled, rather discouraged any further attempts just then. There is a pressure of 230 lbs. to the square inch at this well. At Bow Island the pressure is 800 lbs. But large manufacturers, though they may, with this gas at present prices, produce power at a cost of under $10 per horse-power per annum, would be more readily induced to locate in this city if that rate was reduced, a concession that the present company is not prepared to make. Hence it is advocated that the city ask the ratepayers to sanction an expenditure of $100,000 on the chance that a sufficient quantity can be tapped at a reasonable depth.

REINFORCED CONCRETE SLAB BRIDGE.

The Minneapolis, St. Paul & Sault Ste. Marie has adopted concrete slab bridges, reinforced by the "mushroom" system, for a number of highway crossing locations. This system of reinforcement, patented by C. A. P. Turner, consulting engineer, Minneapolis, has been in use for some time in building construction, but has not been widely adopted for railway bridge construction. Two bridges built in the town of Amherst, Wis., are typical of these structures. The details of the Lincoln Street bridge are described in a recent issue of the Railway Age Gazette and are shown in the accompanying illustration.



Plan and Elevation of Subway Built at Amherst, Wis.

The street is crossed on a skew of 47 deg. and 40 min., the abutments and piers being parallel at an angle with the centre line of the street. The piers consist of two reinforced concrete columns 3 ft. square spaced 12 ft. centre to centre, connected at the top by a concrete beam. The footings are spread to 7 ft. square and are reinforced in four directions, as shown in the drawing. The columns are reinforced by six 1⅜-in. round rods set vertically and banded spirally by ⅜-in. round rods on 3-in. pitch. The columns are 14 ft. 3 in. high from top of footings to bottom of slab, and the corners are chamfered to a depth of 3 in. The transverse beams, which have a minimum depth of 2 ft. below the slab, are arched between columns and are carried out beyond the columns on the curved lines shown in the accompanying cross section. The beams are reinforced in the upper plane by five 1-in. round rods, and in the lower plane by eight 1⅜-in. round rods bent up for shear reinforcement, and five 1⅜-in. rods bent down for surface reinforcement over the arch. In addition to this, there are ⅜-in. stirrups spaced 12 in. centre to centre between column reinforcements.

The floor slab is reinforced in four directions, in accordance with the usual "mushroom" design, the rods being crossed over each column in the piers. The reinforcement parallel to the centre line of track consists of 1-in. round rods spaced 4 in. centre to centre, and that perpendicular to the centre line of tracks of ⅝-in. rods spaced 12 in. centre to centre. The diagonal reinforcement connecting alternate pier columns consists of 1⅜-in. round rods for the shorter lengths and 1-in. rods spaced 6 in. centre to centre for the longer lengths. The central span is 31 ft. 1½ in., and the two sidewalk spans are 29 ft. 1 in. Drainage is carried in troughs built in the upper surface of the slab on either side of the ties to outlets over each pier. The clearance over the street level is 11 ft. 9 in., and between railings 16 ft.

A similar bridge over Wilson Street was built first. In this case turnouts were installed and a temporary pile trestle was driven alongside the old structure, over which trains were operated during the construction of the new bridge. In building the Lincoln Street bridge, however, traffic was maintained over the structure during the construction work. To accomplish this, the jack stringers, guard rails and long ties were removed and the deck of the original pile bridge was jacked up about 2½ ft., run-offs being provided at both ends by cinder fills. The track was blocked up in this position on cast iron spools. These spools were 2 ft. 3 in. long and 10 in. in maximum diameter, placed so as to not interfere seriously with the slab reinforcement. They were concreted into the floor slab and allowed to remain in the position shown. The forms for the concrete slabs were built on the old trestle, effecting a saving in the cost of false work. This hump in the track made it necessary to operate carefully over the bridge during construction, but traffic was never interrupted. These bridges were built under the direction of Thomas Green, chief engineer, and C. N. Kolk, principal assistant engineer.

PATENT AND TRADE MARKS.

We have been forwarded the following news item which appeared in the Manchester Guardian, by Mr. Egerton R. Case, foreign member of the Chartered Institute of Patent Agents, London, registered patent attorney, Temple Building, Toronto:

"I learn that one of the last questions discussed between the Canadian Ministers and the Government relates to a scheme that is being prepared by the Board of Trade for the assimilation of the laws of patents and trade marks in the United Kingdom with those of Canada and of the other dominions. This question was first raised at the conference of colonial premiers in 1902, and again at the imperial conferences of 1907 and 1911. The majority of the patents issued in the self-governing dominions are granted in Canada, and the number granted in any one year in the whole of the dominions amounts to considerably more than half of those granted in the United Kingdom. It has been generally agreed that uniform legislation on these subjects should be established. In the United Kingdom a patent may be granted to one or more applicants. In Canada a patent may be obtained by the inventor or his assignee. In Australia the applicant for a patent may be the actual inventor or his nominee. In New Zealand one of the applicants for a patent must be the first inventor. In Newfoundland before any person can obtain a patent he must make an oath in writing that he is the inventor or discoverer. In the Transvaal and the Orange Free State one or more of the applicants must be the first inventor or his legal representative. The object aimed at by the Board of Trade is that a patent granted, say, in London should have validity right through the Empire.

THE DEVELOPMENT AND STATUS OF THE WOOD PRESERVING INDUSTRY IN AMERICA.*

By E. A. Sterling.†

The literature on the subject of wood preservation in America is voluminous, but so fragmentary that a summarized review of the developments and present status of the industry is, perhaps, justified because of the importance of the question to scientific and commercial interests.

The first recorded use of treated ties is that of kyanized chestnut, laid in the tracks of the Northern Central in Maryland in 1838, which were still sound when examined eleven years later. Kyanized oak trees, laid in the tracks of the Chesapeake and Ohio in 1840, were sound when examined fourteen years later.

The first treating plant, worthy of the name, was probably that built at Lowell, Mass., in 1848, by the proprietors of the locks and canals at that point. The plant consisted of two wooden tanks, each 50 feet long, eight feet wide and four feet deep, in which the lumber was immersed in accordance with the kyanizing process, using bichloride of mercury. Prior to 1895, several temporary plants were constructed by railway companies, among those being one established by the Central Vermont in 1856; another by the Erie in 1861, at Owego, N.Y.; another by the Union Pacific in 1867, at Omaha, and one by the Philadelphia, Wilmington and Baltimore in 1863, all of these being for the use of zinc chloride by the burnettizing process. The first permanent railway plants were built in 1875 and 1876, one being constructed by the Louisville and Nashville at West Pascagoula, Miss., which is still in operation, and the other by the Houston and Texas Central. Both were creosoting plants.

In spite of the many attempts at wood preservations during the past forty years, the rapid and permanent developments have mostly occurred during the past ten years. In 1900, there were eleven plants in operation, while at the beginning of 1912 there were about one hundred, with several more under construction or authorized. Prior to the year 1900 the most definite developments were in the West, where scarcity of timber forced the railways to adopt measures by which longer life could be given their cross ties. We thus find that the Southern Pacific has a burnettizing plant which has been in operation since 1867, while a plant using the same process was put into service by the Santa Fe in 1885. The latter road has since adopted the Reuping creosoting process. Several commercial plants were also built in the western part of the United States prior to 1900, but the general adoption of preservative treatment throughout the United States, particularly by the eastern roads, has all been during the last ten years.

In Canada the developments have been even slower than in the United States, and it is only within the past two or three years that treating plants of any size have been put into operation. At present the Canadian Pacific and the Canadian Northern either use treated ties from plants already in operation, or have arranged for the construction of plants. In Mexico and South America little or nothing has been done, although some of the Mexican roads have experimented extensively with crude oil and several plants have been built. In South American countries there are no plants, as far as the writer's knowledge goes, but large quantities of creosoted material have been shipped from plants in the United States for use, particularly in marine work.

At the beginning of the year 1912, 101 plants were listed by the American Wood Preservers' Association. Of this number, twenty-five are owned and operated by railway companies, and twelve in addition are maintained solely for railway work. The remainder do a general commercial business. The industry in the United States, up to the present time, has been built up largely on railway cross ties, yet out of the 148,000,000 ties used in 1910, according to census figures, only 26,000,000, or about 18 per cent., received preservative treatment. This, however, is an increase of 275 per cent. over the number treated in 1905. During the year 1910, there were also treated approximately 133,000,000 board feet of lumber, which represents only 0.33 per cent. of the total consumption. The total output of all treated material in 1910 amounted to slightly over 100,000,0000 cu. ft., which was 500 per cent. more than was treated in 1904. To treat this amount of material in 1910 there were consumed approximately 17,000,000 pounds of zinc chloride and 63,000,000 gallons of creosote, 71 per cent. of which was imported.

In 1911, according to statistics compiled by the American Wood Preservers' Association, a total of 110,372,660 cu. ft. of material was treated in the United States, this being an increase of 10 per cent. over the previous year and a 62 per cent. increase over 1907. Of this amount, 84,672,370 cu. ft. consisted of cross ties, 3,910,740 cu. ft. of piling, 1,085,971 ft. of poles, 10,140,474 cu. ft. of paving blocks, 6,831,416 cu. ft. of construction timber and 2,568,857 cu. ft. of lumber and miscellaneous material. By kinds of treatment 73,558,621 cu. ft. were treated with creosote, 29,501,665 cu. ft. with zinc chloride and 7,312,374 ft. with zinc chloride and creosote.

The kind and character of the timber treated varies greatly in different sections of the country. In the northeastern States the bulk of the material is hardwood, including red oak, beech, birch, maple and pine, which is shipped in by water from south Atlantic States. In the Lake States and the upper Mississippi valley the cross ties treated are almost exclusively hardwood of the species above named. In the south Atlantic and Gulf States, and to some extent in the Southwest, pine is used almost exclusively; while in the lower Mississippi valley and adjacent territory both black and red gum are being treated with apparent success. In the West and Northwest the wood most largely used for treatment is red fir. Considerable difference of opinion exists as to whether the so-called sap pine is suitable for cross ties. It is used extensively by some of the railways in the South and Southwest, where traffic is comparatively light, but the experience of the railways in the northeastern States, where traffic is heavier, indicates that the soft sap pine does not hold the spikes well and is not sufficiently resistane to rail-cutting.

At the present time only two standard preservatives are in general use in the United States, namely, creosote and zinc chloride. Of these, creosote seems to be gaining ground steadily, while zinc chloride is used mainly in the semi-arid regions of the Middle West or in combination with creosote. It should be mentioned that the Santa Fe is making very extensive experiments with a crude oil which carries a high percentage of asphaltum. While possessing no toxic properties this oil seems to effectively close the pores of the wood and act as an inert filler against the entrance of air, moisture and fungus spores. In later experiments a mixture of natural asphaltic oil and creosote has been used. In addition to the accepted preservatives named, many manufactured preservative compounds are on the market. Most of these are intended only for superficial application with a brush or in open tanks. Although the number of accepted preservatives has been reduced to

* Presented at the Eighth International Congress of Applied Chemistry, September, 1912.

† Forest and Timber Engineer; president of the American Wood Preservers' Association.

two or three, several different and distinct processes for introducing the solutions into the wood are in general use. Each of these has its ardent advocates, and each has points of merit which can hardly be disputed. The following table summarizes the processes now used in America. The high-pressure processes are most generally used, and, while the so-called open tank or atmospheric pressure and the low-pressure treatments have been used quite extensively by small concerns which could not afford expensive plants, it may be expected that the pressure treatment will prevail almost universally within a short time:—

High artifical pressure processes............	Full cell	Bethell—creosote.
		Burnett—zinc chloride.
		Wellhouse—zinc chloride, glue and tannin.
		Card—zinc chloride and creosote.
		*Crude oil—natural asphaltic oil.
		*B. & M.—zinc chloride and aluminum salts.
	Empty cell...	Reuping—creosote.
		Lowry—creosote.
Atmospheric pressure processes	Full cell	Soaking in cold preservatives.
		Soaking in hot preservatives.
		Alternate hot and cold treatments.
	Empty cell...	Hot, cold and hot treatments.
		Hot and graded cooling treatment.
Low artifical pressure processes	Full cell	
	Empty cell...	

* May be considered as still in the experimental stage.

In addition to the above, kyanizing and vulcanizing plants are still operating in New England, the latter being a rapid drying or baking process without the use of a solution.

The question of specifications and standards and many important technical points requiring consideration do not come within the province of this paper. Zinc chloride, being a mineral salt, can be manufactured to meet definite specifications. Since crude oil is a natural product, it is necessary to procure the supply from oil wells which produce the quality desired, namely, that with a very high percentage of asphaltum. The oil which has been found most suitable for preservative treatment is that known as Bakersfield oil from southern California, also from certain districts in Mexico.

In the matter of creosote specifications much more difficulty is encountered. Coal tar and creosote being a by-product of a by-product, and not manufactured exclusively for preservative purposes, varies greatly in its chemical composition, and except by re-distillation cannot be made up to meet too strict specifications. The consumers have rather definite ideas as to the quality of creosote desired, but unfortunately it has been necessary to base the specifications on the kind of oil available, both abroad and in this country, rather than to make arbitrary standards and expect the manufacturer to meet them.

Several additional problems relating to the use of creosote as a preservative are pressing for solution. These include the advisability of using various mixtures of creosote and other products, such as filtered tar, water gas oil, or the combining of creosotes of different grades; the use of water gas creosote either alone or in combination with pure coal tar creosote; the value and possible use of oil from coke over tar; and the combined use of creosote and crude oil.

The mechanical equipment of the modern American plant leaves little to be desired. High pressure cylinders six or seven ft. in diameter and up to 150 ft. long are practically the standard. Labor-saving devices are in much more general use than in Europe, and hand work is reduced to a minimum. One of the important recent improvements is an arrangement whereby the measuring and working tanks are mounted on scales, so that the amount of creosote or other solution absorbed is measured closely by actual weight rather than by volumetric sale readings. Automatic devices for unloading full tram carloads and machines which adze, bore, saw to even length and stamp with the date ties before treatment, are included among the mechanical developments.

The present tendencies are towards lighter impregnation with creosote, except in construction timber, or the use of mixture, which reduces the initial cost. No less than sixteen of the plants listed by the American Wood Preservers' Association use a light impregnation creosote process, and probably as many more use it on at least one part of their material, while several more plants use zinc chloride and creosote in mixture. This means that a large percentage of the treated cross ties used by the railways have less than six pounds of oil per cubic foot. Actually, they have more than six pounds in the treatable or sap portion of the tires, because the absorption is figured on the gross cubic contents. It may be argued that these light treatments are poor economy in the long run, and it is indisputable that they have not had the test of time. It must be remembered, however, that wear under the rail is responsible for a large percentage of tie failures after five years, and that full impregnation would certainly not be justified without large and expensive tie plates and screw spikes. Recent developments in the adzing and boring of ties before treatment promises a solution of the question of mechanical wear in relation to impregnation and decay.

Apart from the many details which are in a fair way of being worked out, there are two very broad problems which confront the wood preservers of America, and to which they should give their attention if the industry is to remain permanent and profitable. One of these is the source of supply for creosote oil, the present indications being that a shortage is imminent and that high prices will prevail. While the consumers can, perhaps, do little of themselves to stimulate production, they can at least co-operate with the manufacturers and encourage the construction of by-product ovens in America, and maintain trade relations, which will guarantee to the European distillers a definite market for their available creosote. Enough creosote is burned in the beehive coke ovens of the United States every year to supply all reasonable demands for years to come.

The other problem is that of timber supply, and it is one to which the wood preservers have paid too little attention. This applies to the owners of commercial plants, and particularly to the large railway companies which either operate their own treating plants or have their work done by contract. At the present rate of increase, the cost of treatable cross ties and other material will, in a very short time, be equal to that of white oak and other more durable woods. There are still enormous supplies of cheap woods available, and it is for this very reason that steps should be taken to perpetuate the supply. In some regions, however, the supply of treatable timber is already becoming depleted, and many plants will have to seek new locations or have their material shipped long distances within the next ten or twenty years.

Most of the hardwood timber, suitable for treatment, is of such slow growth that under present conditions it would not be profitable to reproduce it under any system of forest arrangement. In the South, on the other hand, are several fast-growing trees which would respond very readily to a system of conservative management. In the loblolly pine belts, for example, the output of timber from a definite area could easily be made permanent. It is estimated that about 100,000 acres of well-stocked loblolly pine land would produce 1,000,000 ties per annum for all time. It would have been very easy at the time some of the first railway plants were built to have acquired timber lands at comparatively low cost, and by proper management made them a permanent source of cross tie supply. This has not been done.

GAS AS A MEANS OF HOUSE HEATING.

By Lyman B. Jackes.

The adaption of gas, both natural and artificial, to house and building heating is a problem that has been worked upon by several inventors. The factors which were in favor of the commercialization of the scheme are many.

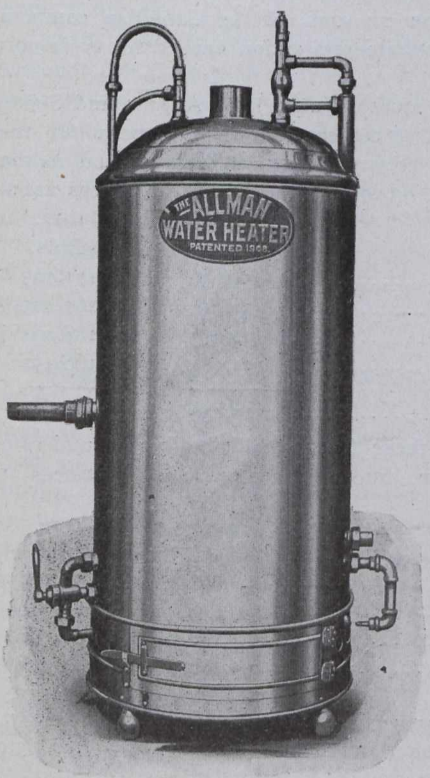


Fig. 1.

First there is the point that would appeal to many householders, viz., the elimination of ashes. A second might be considered to be the handling of coal, and this at once suggests the storage of that fuel and the use that could be drawn from the space, providing the coal could be dispensed with. The varying qualities of the coal, to say nothing of the tendency of prices upward, and the bother of relighting a furnace after the fire has been extinguished, are all among the dreams that have led inventors on from step to step in the hopes that a success could be made from their designs.

In the first attempts that were made much attention was paid to the burners; the idea apparently being to reduce the consumption of gas to a minimum, at the same time securing a maximum output of heat. Then the inventors became bolder, but their attempts did not fill the ideal that was hoped for and the old-fashioned cylindrical gas heater became an installation in many rooms not heated from the furnace; but the results attained were crude. The specifications of a capable gas heater were few, and yet it was many years before even the less complicated features were properly worked out. It was the invention of the automatic water heaters now on the market that contained the original germ of success. In these heaters a circular tube of copper is arranged above a burner supplied with a pilot light. A valve that is controlled by the running water gives entrance to the gas at the burner when a faucet is turned and the escaping gas is ignited by the pilot, with the result that scalding hot water is supplied through the tap. After the water has been turned off the valve closes, the gas is cut from the burner, and all light extinguished excepting the pilot.

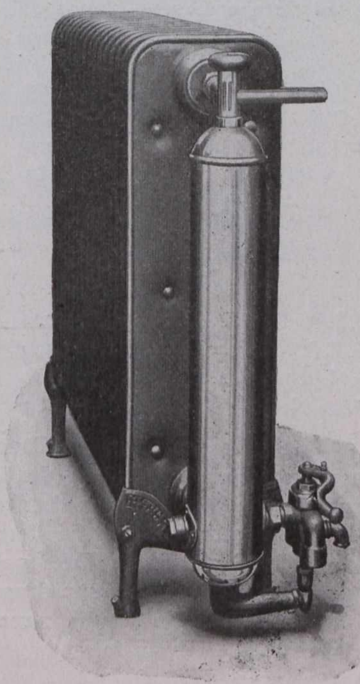


Fig. 2.

There was on exhibit in one of the industrial buildings at the recent Canadian National Exhibition a system of water heating, for house warming, that was the outcome of many years' experimenting, and would appear to have a brilliant future. The system contains a central heater and individual heaters for the radiators. The main heater is shown in Figure 1, and the radiator in Figure 2.

The main heater has many points in common with that described above. One advantage, however, not to be found in the older system is the fact that there are facilities for the storage of thirty gallons of water at a temperature of 150 degrees Fahr. with a consumption of only three cubic feet of gas per hour. This may be used for kitchen, bath or laundry.

The operation of the scheme, put briefly, is as follows: The heater is lighted and water drawn through the radiator until the same becomes warm; then the burner attached to the radiator is lighted and the warm water kept warm. This gives the privilege of using any number of the radiators installed and should it be found convenient to close certain ones the gas consumption is reduced accordingly and the remaining heat confined to the rooms in which the active radiators are operating. The pipes connecting the radiators with the central heater are half-inch in size and the radiators consume four feet of gas per hour each.

The central heater is entirely automatic in all its workings and should either the water or gas be turned off, between the heater and the street, the gas supply is automatically locked and the heater cannot be lighted till the gas has been turned on at the safety valve.

HIGHWAY BRIDGES.

The Illinois State Highway Commission has issued as bulletin No. 9, a 56-page pamphlet entitled, "Modern Bridges for Illinois Highways." The purpose of the bulletin is to encourage the construction of better highway bridges. Better bridges are needed for the traffic of to-day, it is stated, and good bridges are an essential factor towards future road improvement. The bulletin, it is further stated, shows by illustrations the difference between poorly and well constructed bridges, the text having been purposely reduced to a minimum and a relatively large number of illustrations used. These, it is believed, will show clearly the difference between old and modern types of bridges.

The illustrations occupy 41 pages of the bulletin and are accompanied, in most cases, by titles and sub-titles containing much explanatory matter. They show existing bridges of poor design and of correct design and include structures of long and short spans, concrete bridges, steel bridges with both wood and concrete floors, and wooden bridges. Many of the structures shown were built from plans drawn by the State Highway Department. Several of the illustrations show old bridges and the structures which have replaced them. Some of the views show a test bridge built by the Department, and illustrate the tests to which it was subjected.

This test bridge is a reinforced concrete arch having a clear span of 40 ft.; and was built at the Southern Illinois Penitentiary by convict labor and subjected to a number of very severe tests. Heavy loads were placed upon it, each heavier than would be likely to be brought on a bridge or a public highway. In one of these a layer of crushed stone, 12 ins. deep, was spread over the bridge and on top of this cut stone was piled to a depth of 3 ft., making a total unit load of about 300 lbs. per sq. ft., or a total load of 106 tons. Under this the total sag due to the bend in the floor, as well as that in the girders, was ⅛ in. This load was allowed to remain on the bridge for about three weeks, during which there was no increase in the deflection. The original deflection disappeared when the load was removed.

Another test described in the bulletin was made about a year later, when a railroad track was laid on the bridge and a very heavily loaded freight car was run upon it. As the car was somewhat longer than the bridge it was evident that when one truck was placed the centre of the span would produce the maximum bend or sag in the structure. The weight on one truck was found to be 44 tons, and the rails were so cut that they would give no support to the load beyond the length of track occupied by the truck, which was about 8 ft. Thus the total load of 44 tons was applied over an area approximately 5 ft. by 8 ft. Under this load the total deflection, including the sag in the floor as well as that in the girder, was found by careful measurement to be 0.09 in. This deflection disappeared when the load was removed, and six or eight applications of the same load produced the same effect.

During the summer of 1911 another series of tests, more complete than the preceding ones was undertaken, according to the bulletin. Nine brick piers were built beneath the bridge for the purpose of measuring the deflections and the steel reinforcements in the girders and floor was exposed in 15 places to permit determinations of the deformations by means of gauge marks placed on the steel, and bolts were set in the upper part of the concrete girders to determine the deformation in the concrete. A load consisting of 420 tons of crushed stone was placed in eight large bins, and, in addition, 100 tons of pig iron were placed on the west girder and about 60 tons on the east girder. This load produced a total deflection of 1 in. in the west girder and ¾ in. in the east girder without causing failure of the structure. The pig iron was removed within a few days, but the load of 420 tons of stone remained on the bridge for a year, until the present summer. It was then taken off, the deflections being noted as it was removed. When the structure had been completely unloaded it was found to have recovered its original position.

The remainder of the text of the bulletin consists of a general discussion of the economy of well designed bridges of modern types; a detailed presentation of the subject of creosoted timber for bridge floors, and an explanation of the Highway Commission's part in the construction of bridges.

MONTREAL FIRE AND WATER.

The frequent breakdowns in Montreal's water department were discussed by the fire underwriters this week, an increase of rates being considered. Mr. A. W. Hadrill, secretary of the Canadian Fire Underwriters' Association, stated after the meeting that the discussion was the result of the heavy loss at the fire in St. Patrick Street on Sunday night, as no one denied the lack of water had run up the loss. "When we consider that both buildings were fully equipped with fire sprinklers, we feel the fire should have been confined to the rope-walk and that probably would have been the case had there been enough water. The neglect of the water department to have their 15,000,000 gallon pump ready, which was ordered last year, is an instance of the way things are done. We are inclined to believe that the cause for so many accidents is either bad material or bad engineering, or insufficient supervision."

CEMENT DUTY BACK AGAIN.

The five months period in which the duty on cement was reduced by half expired on November 1st. The Government will not extend it. The remission was granted because of the alleged lack of supply in the West and inability, for transportation or other reasons, of the Canadian companies to meet it. The Government's action caused heavy importations from abroad.

During the four months June, July, August and September the importations of cement increased greatly. In these four months of 1911 they were 327,000 barrels, and in those of 1912, they rose to 793,000. The figures by months are:—

Month.	1911. Bbls.	1912. Bbls.
June	55,646	171,395
July	27,314	267,405
August	72,695	188,404
September	171,784	166,452
Totals	327,439	793,656

Significance of these figures will be better understood when the importations into the three prairie provinces are given:—

Month.	1911. Bbls.	1912. Bbls.
June	263	50,434
July	514	140,084
August	187	62,166
September	2,227	49,766
Totals	3,191	302,450

Thus the remission brought the imports up from 3,000 to 300,000 barrels.

RAILROAD EARNINGS.

The following are the railroad earnings for the week ended October 21st:—

	1911.	1912.	Increase or decrease.
C.P.R.	$2,532,000	$2,943,000	+ $411,000
G.T.R.	1,023,892	1,132,152	+ 108,260
C.N.R.	459,000	561,100	+ 102,100
T. & N.O.R.	44,182	27,959	— 16,222

The following are the railroad earnings for the week ended October 31st:—

	1911.	1912.	Increase or decrease.
C.P.R.	$3,675,000	$4,295,000	+ $600,000
G.T.R.	1,463,496	1,648,054	+ 184,558
C.N.R.	794,700	628,500	+ 166,200
T. & N.O.R.	61,285	40,234	— 21,051

The gross earnings of Canadian Pacific Railway last month reached $12,962,000, the largest in the history of the road. The increase over October of last year was $1,847,-000. The earnings for the first four months of the company's fiscal year were $48,845,000, which is an increase of $7,498,000 over the corresponding four months of last year.

The statement of the revenue and expenditure of the Intercolonial Railway for the year ended with March 31st, last, shows:—

Passenger traffic, $2,842,810; freight traffic, $6,891,937; mails and express, $428,985; miscellaneous, $430,052; total revenue, $10,593,785. Maintenance of way and structures, $1,812,419; maintenance of equipment, $2,681,543; traffic expenses, $217,943; transportation expenses, $5,630,139; general expenses, $248,990; total working expenses, $10,591,-035.

COAST TO COAST.

Toronto, Ont.—It is reported that work will be commenced on the new Union Station for this city early in the coming spring.

Galt, Ont.—Building permits issued in this town during October last have a total value of $80,000. This is 100 per cent. above the same period last year.

Haileybury, Ont.—The Haileybury Board of Trade is opposed to the re-building of the Energite Explosive Foundry here. This is the factory which was destroyed by the explosion in which six persons lost their lives.

Calgary, Alta.—City Commissioner John Chalmers and A. W. Ormsby, of Edmonton, made an examination of the lighting facilities of the city in order that a report might be prepared for the consideration of the Edmonton authorities.

Calgary, Alta.—Figures recently made public by the chief clerk of the electric light department show that the number of users of power for domestic and other purposes from the civic electrical department increased by about 500 during the month of October last.

St. John, N.B.—Mr. W. T. Thorne, president of the Imperial Dry Dock Company, as a director of the proposed steel works for this city has requested the provincial government for aid in the finances of the project. If this work is commenced it is expected that the plant will cost about $3,000,000.

Montreal, Que.—The plants of the Canada Cement Company at the present time are operating on an output of 8,000,000 barrels a year, but with the extensions to present plants and new ones being erected, the company expect by the first of August of next year that there will have been an increase of 50 per cent. in output, bringing the total output for the year to over 12,000,000 barrels.

Province of New Brunswick.—The Transcontinental Railway commissioner has decided in the public interest to operate the completed line of the National Transcontinental Railway in New Brunswick temporarily, or until such time as the G.T.P. has applied for and been granted a lease of this section of the line, under the terms of the National Transcontinental Railway.

Ottawa, Ont.—The Marconi Wireless Telegraph Company, of London, England, have signed a contract with the Canadian Government for the operation and maintenance of nine additional stations on the Great Lakes in Canada. When the stations are completed the company will receive an additional subsidy from the government of $31,500 per annum. The agreement is for nineteen years.

Petrolea, Ont.—At a largely-attended meeting of delegates from various portions of Lambton County of an organization to be known as the Lambton County Good Roads Association, the following were elected officers:—President, Dr. C. O. Fairbank; vice-president, A. D. Arvillee; secretary, A. B. Rocu, and the executive committee will consist of the Reeves of all the municipalities in the county. A grant will be immediately asked for from the county to cover organization expenses. The meeting was addressed by Mr. W. A. McLean, of Toronto, the Provincial Good Roads Engineer.

Oriole, Ont.—The joint campaign committee of the Good Roads Association and Ontario Motor League, at a recent meeting discussed the appointment of a man who would give his whole time to the work of rousing the Ontario public to a realization of the necessity of improving the highways of the province. The board decided to seek for this important position the services of an energetic young man, preferably with newspaper training. In order that as large a number of applications as possible might be received by Mr. George Henry, of Oriole, Ont., the secretary of the Good Roads Association, it was decided to leave the appointment until a subsequent meeting to be held on Friday, November 22nd.

Peterborough, Ont.—That the city may in the near future be defendants in an action for damages instituted by the townships of Otonabee, North Monaghan, and South Monaghan for alleged pollution of the Otonabee River with sewage, was brought out at the meeting of the city council last week. Notice of the issuance of a writ by the legal firm of Peck, Kerr and McEderry on behalf of the said townships, for an injunction restraining the city from polluting the Otonabee River with sewage, and for damages, was submitted for the consideration of the council. On motion of Ald. Johnston and Ald. Anderson, the city solicitor was authorized to appear on this writ within ten days, as after that time plaintiffs would be allowed judgment by default.

Toronto, Ont.—Commissioner R. C. Harris has presented a report, on a proposed Garbage Disposal Plant, to the municipal council. According to the figures submitted the plant will cost $942,000, and the yearly cost of operation will be $298,000 less $224,000, the value of the by-products. Under the plan the commissioner proposes the establishment of four loading stations within the city limits, with incinerators adjacent thereto, at which the garbage is stored in railway cars during the day and removed at night to reduction works, located outside the city limits. The rubbish gathered would be burned at the incinerators near the loading stations, together with a quantity of ashes containing sufficient combustible matter to aid in the destruction of the rubbish, the balance of the ashes to be used for purposes of filling.

Canadian Pacific Railway.—The Canadian Brotherhood of Railroad Employees, claiming to represent 5,000 men on the Canadian Pacific, has for some time been threatening a strike on that road. Last week reports from Winnipeg said that 1,500 of these men, mostly clerks in the freight department, had left their work. They had demanded a large increase of pay. Officers of the road said that the places of the strikers would be filled without much delay. The Minister of Labor, Mr. Crowthers, refused to appoint a board of conciliation, and the railway company not only refused to deal with the representatives of the brotherhood, but announced that it would not nominate a member of the proposed conciliation board. Giving its reasons for its position, the railway company said: "We cannot permit any employees engaged in confidential positions or who have access to the company's correspondence to be a member of any organization, as such would be contrary to the interests of the company. If the employees were permitted to join an organization such as this the records of the company would be confidential no longer. The company from time to time has granted and quite recently granted substantial increases to the above-mentioned class of employees."

Hamilton, Ont.—The municipal council have requested the Dominion Railway Commission to act as arbitrators in the matter of a civic law calling for all electrical companies in Hamilton to bury their wires underground. At a meeting of the board Manager Coleman, of the Hamilton Street Railway Company, testified that it would occasion the Cataract Company a loss of $123,000, and maintained that compensation should be allowed. He was willing that the board's engineer should estimate the extra cost to the company. Chairman Drayton, of the Dominion Railway Board, said it seemed to be felt that the Cataract Company, in estimating the cost, was not merely charging for the work which would be made necessary by the change, but for the improvement of the system. Hon. Adam Beck added that in the estimates the board could take cognizance of the actual expense of going underground only, and not of resultant betterments. Mr. John Markey, for the G.N.W. Telegraph Company, declared that in a municipality of only 80,000 population the revenue derived by the company was insufficient to warrant the change. The gross revenue from outgoing telegraph business in Hamilton was $18,486, and the expenses within the city were $15,147. In addition, the office had to bear its share of charges for everhead wires. The Hamilton office actually stood the company a net loss, and other cities had to assist in paying its deficit. Mr. Edward Beatty, for the C.P.R. Telegraph Company, said his company was not making great objection except on the question of principle. He estimated his company's cost at $12,000.

AN OLD GEORGE WASHINGTON LANDMARK.

The house shown in the accompanying illustration was built by George Washington in 1790—122 years ago. It is located in Glasgow, Barren County, Ky., although when it was built that section was located in Fairfax County, Va. Mr. A. L. Harris now owns and occupies the house.

George Washington, at the time the house was built, owned all that land which now comprises Virginia, Tennessee and Kentucky, it having been granted to him by a greatful American government in consideration for the services rendered during the Revolutionary war.

George Washington built this house as a residence for his cousin, General Spotteswoode, who was governor of Virginia at that time. General Spotteswoode was, by nature, of a very retiring disposition and later became a recluse. He occupied this house until his death, the exact date of which we were unable to learn, and is now buried at Knob Lick, a small hamlet about five miles from Glasgow, Ky.

House Built by George Washington in 1790.

The architecture of the house is a wonderful combination of the frontier's man precaution and the city type of dwelling. The walls are solid brick, 36 inches thick. The floors are of hardwood, two inches thick, made of chestnut and laid with dowel pins. The original roof was hand-drawn chestnut shingles, one-half inch thick and fastened with wooden pegs. There is not a single nail in the entire building, for nails were not manufactured at the time when this house was built.

The windows are of glass that was brought over from France, for glass was not made in America at that time. The wear and tear to which a building is subjected in the course of the years is here given full proof, for this glass is worn so thin that many of the panes are no thicker than an ordinary piece of tissue paper. In late years, light rain storms have at times been sufficient to break out some of the panes.

The portion of the roof shown in the accompanying illustration, is still covered with the original hand-drawn chestnut shingles. A small part of the roof was replaced with a tin roof by Mr. Harris a few years ago. Lately, Mr. Harris has covered the kitchen with J-M asbestos roofing, manufactured by the H. W. Johns-Manville Co., New York.

With the exception of this roofing on the kitchen and the tin roof, the house has not been remodeled during its 122 years existence, and only such minor repairs have been undertaken as were absolutely necessary for its preservation.

CANADA'S PACIFIC COAST ACTIVITIES

With the calling of tenders for the erection of its smelter at Granby Bay, Observatory Inlet, the Granby company is making a start in the practical initiation of a large mining industry in the northern part of the province. Much preliminary work has been done, and much money spent, and it is now proposed to have the smelter in operation inside of another year. It will be able to handle 2,000 tons of ore daily, and will have three copper furnaces, the expenditure to be over $1,500,000. After the copper furnaces are in commission a lead stack will be installed so that custom ores from the Hazelton district can be treated. Already 400 men are employed by the company, which means quite a little town.

Industries are steadily being established on the coast, the operation of which mean much to business and supply men. Close to Vancouver there is the Britannia mine; at Texada Island two or three good mining propositions are being exploited; at Powell River a pulp and paper mill is in operation; at Swanson Bay is another pulp mill; at Ocean Falls, another, along with a large sawmill; mining prospects at Hazelton are bright, while on the Portland Canal the Granby Company will have a mining town of its own.

Although conditions have been reported quiet in Vancouver, figures of different public departments do not show much diminution. Building returns had new records this week; the new Canadian Pacific Railway depot created a record for the largest permit. Just what the Canadian Pacific Railway has in view on the Pacific coast is indicated by what it proposes to do in the way of hotel accommodation in this city. Some time ago plans were submitted to the city building department for a new Vancouver hotel to be eleven stories in height and to cost $800,000. These plans have been cancelled, for it is proposed to make the structure sixteen stories high at a cost of at least a million dollars. Besides these two items just mentioned, there is the Canadian Pacific Railway tunnel under the city to its yards on False Creek. The Canadian Northern Railway has agreed with the city to expend several millions in connection with the improvement of the head of False Creek, the expenditure to be made within a specified time. The Great Northern will spend another million or two. Several other schemes involving large expenditures have been suggested.

Surveys have been begun by the British Columbia Electric Railway Company for a line to be constructed between New Westminster and Port Moody. When this line is built it is hardly probable the construction will stop there, for it would be an easy matter to complete the belt line via Vancouver. The utilization of these routes would give the British Columbia Electric complete control on the lower mainland.

United States capital is seizing opportunities in the northern interior in the way of colonization possibilities, and the latest deal is an immense one. Mr. Lauchlin Maclean, of Spokane, and associates have bought 550,000 acres for $2,730,000. The question might be raised, though, if the acquisition of these large areas by syndicates might not be a cause in discouraging the bona fide settler who wants land as cheap as he can get it, as otherwise he cannot afford to pay two or three profits.

HIGHWAY ENGINEERING COURSE IN COLUMBIA UNIVERSITY.

The following non-resident lecturers in highway engineering at Columbia University have been appointed for the 1912-1913 session: John A. Bensel, New York State engineer; William H. Connell, chief, Bureau of Highways and Street Cleaning, Philadelphia; Morris L. Cook, director, Department of Public Works, Philadelphia; C. A. Crane, secretary, the General Contractors' Association; W. W. Crosby, chief engineer to the Maryland Geological Survey and consulting engineer, Baltimore; Charles Henry Davis, president, National Highways Association; A. W. Dow, chemical and consulting paving engineer, New York City; Walter H. Fulweiler, engineer, research department, United Gas Improvement Company; John M. Goodell, editor-in-chief, Engineering Record; D. L. Hough, president, The United Engineering and Contracting Company; Arthur N. Johnson, state highway engineer of Illinois; Nelson P. Lewis, chief engineer, Board of Estimate and Apportionment, New York City; J. C. Nagle, professor of civil engineering and dean of the School of Engineering, Agricultural and Mechanical College of Texas; Harold Parker, first vice-president, Hassam Paving Company; H. B. Pullar, assistant manager and chief chemist, American Asphaltum and Rubber Company; J. M. F. de Pulligny, ingenieur en chef des ponts et chaussees, et Directur, Mission Francaise d'Ingenieurs aux Etats-Unis; John R. Rablin, chief engineer, Massachusetts Metropolitan Park Commission; Clifford Richardson, consulting engineer, New York City; Philip P. Sharples, chief chemist, Barrett Manufacturing Company; Francis P. Smith, chemical and consulting paving engineer, New York City; Albert Sommer, consulting chemist, Philadelphia; George W. Tillson, consulting engineer to the president of the borough of Brooklyn.

REGINA ENGINEERING SOCIETY.

About sixty members of the Regina Engineering Society and their friends sat down to the second annual dinner in the cafe of the Parliament Buildings on the evening of November 7th.

The event was a complete success and it is probable, as was suggested by the president, A. J. McPherson, that the dinners will be given oftener than once a year in future.

The president's response to the toast "The Engineering Society," was filled with suggestions of future policy. He touched on the need of a home for the society, and advanced his suggestion of a club with the members of the Engineering Society in the majority.

Some months ago there appeared an article in *The Canadian Engineer* dealing with a sun power plant, the invention of Mr. Frank Shuman, of Philadelphia. Word has been received from Zeitoun, Egypt, which states that one of these plants is installed at Meadi, a suburb of Cairo, and is pumping water with complete satisfaction.

PERSONAL.

MR. M. B. HASTINGS, until recently with the Toronto Hydro-Electric system, has accepted a position with A. H. Winter Joyner, Limited, Toronto, as sales engineer.

COLONEL CLOUGH, formerly assistant superintendent of Halifax and St. John district of the Intercolonial Railway, has been appointed assistant to General Superintendent F. P. Brady.

MR. T. KENNARD THOMSON, C.E., consulting engineer, of New York, addressed the Canadian Club of Niagara Falls, Ont., on Thursday, November 7th, on "Bridges of the Past and Future."

MR. W. A. STEWART, of Cornwall, late superintendent of operation, St. Lawrence Canals, has been appointed superintendent of works for Mr. D. R. McDonald, on his harbor contract at St. John, N.B.

MR. M. R. SHAW, a graduate of the Faculty of Applied Science, Toronto University, of the class of '09, has been appointed to a research fellowship, the funds for which have been raised by the Engineering Alumni Association of the University.

MR. PAUL SEUROT, M.Can.Soc.C.E., M.Am.Soc.C.E., of Montreal, Que., has been awarded a Telford premium of the Institution of Civil Engineers of Great Britain for a paper published in the "Proceedings" of the society during the 1911-1912 session.

PROF. C. A. ZAVITZ, of the reforestation station in Norfolk county and lecturer at the Ontario Agricultural College at Guelph, has been appointed provincial forester by the Ontario Government. This appointment, in all likelihood, means the establishment of a forestry branch in connection with the Department of Lands, Forests and Mines with Prof. Zavitz as its head.

MR. A. CHAUSSE, chief building inspector of Montreal, is attending the convention of the American Society of Municipal Improvements as a delegate from Montreal. He will call on the return journey at Detroit, Chicago, St. Louis and Kansas City to study matters in connection with the administration of building departments and with building operations in those cities.

MR. CHARLES H. BIGELOW has accepted the position of chief mechanical engineer of the Millville Manufacturing Company, Millville, N.J. Mr. Bigelow recently returned from St. Catharines, Ont., where he had charge of the construction of a factory which will handle the Canadian business of the Yale and Towne Manufacturing Company, Stamford, Conn.

MR. DONALD MALCOLM McINTYRE, K.C., of Kingston, has been appointed chairman of the Ontario Railway and Municipal Board to succeed the Hon. James Leitch, who was recently appointed to the high court bench. The announcement of this appointment was made by Sir James Whitney recently. Mr. McIntyre will assume the chairmanship in the near future.

MR. J. A. MacMURCHY, of the Class '96 Faculty of Applied Science, University of Toronto, chief draughtsman to the Westinghouse Machine Company, of Pittsburg, will address the Engineering Society of the University of Toronto on Friday afternoon, November 15th, at 4.30 p.m., on "The Development of a Reaction Steam Turbine." His address will include explanatory notes on practical methods employed in this manufacturing plant. The meeting will be held in the Chemistry and Mining Building.

NATIONAL ASSOCIATION OF CEMENT USERS.

The ninth annual convention of the National Association of Cement Users will be held in Pittsburgh, Pa., December 10-14, inclusive. The convention proper will open on Tuesday evening, December 10, and will close on Friday evening, December 13. The sessions and headquarters of the convention will be at the Fort Pitt Hotel. In view of the numerous suggestions received to that effect, the convention period has been reduced over those of former years by two days, and in order that an equal amount of work may be accomplished, afternoon sessions will be held. No session will be held on the evening of the opening of the Cement Show in order that members may be afforded the opportunity to attend the same. The annual banquet will be held on Thursday evening.

COMING MEETINGS.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.—Annual Convention to be held at Dallas, Texas, November 12th to 15th, 1912. Secretary, A. P. Folwell, 50 Union Square, New York.

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

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

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

AMERICAN RAILWAY ASSOCIATION.—Nov. 20th. Annual Meeting at Chicago, Ill. Secretary, W. F. Allen, 75 Church St., New York.

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

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

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

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

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

ENGINEERING SOCIETIES.

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

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

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

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

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

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

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

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

MUNICIPAL ASSOCIATIONS

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

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

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

THE UNION OF CANADIAN MUNICIPALTIES.—President, Chase. Hopewell, Mayor of Ottawa; Hon. Secretary-Treasurer, W. D. Lighthall, K.C. Ex-Mayor of Westmount.

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

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

UNION OF SASKATCHEWAN MUNICIPALITIES.—President, Mayor Bee, Lemberg; Secy-Treasurer, W. F. Heal, Moose Jaw.

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

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

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

CANADIAN TECHNICAL SOCIETIES

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

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

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

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

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