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The Canadian Engineer

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The Canadian Engineer.

ISSUED MONTHLY IN THE INTERESTS OF THE

CIVIL, MECHANICAL, ELECTRICAL, LOCOMOTIVE, STATIONARY MARINE, MINING AND SANITARY ENGINEER, THE SURVEYOR, THE MANUFACTURER, THE CONTRACTOR AND THE MERCHANT IN THE METAL TRADES.

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CONTENTS OF THIS NUMBER:

FOR THE CANADIAN ENGINEER.

RAILWAY ENGINEERING.*

BY CECIL B. SMITH, MA. E., MEM. CAN. SOC. C.E., LATE ASSISTANT PROF. OF CIVIL ENGINEERING IN M'GILL UNIVERSITY.

ARTICLE 3.—TIES.

Ultimately we may expect metal ties to take the place of wooden ones. In Europe, with dear wood and heavy traffic, substantial progress has already been made. In America experimental pieces of track have proven satisfactory in cheapening maintenance, and for many reasons, to be enumerated, we may expect progress to be considerable in the near future, but for many years wooden ties will continue, on this continent, to be the rule, and metal ones the exception, although their use constitutes a heavy drain on our forests, which probably amounts to six or seven million ties per year for Canada alone.

Wooden Ties.—Wooden ties are in general use because they are cheap, and simple in use or renewal, and by the use of preservatives their life may be increased considerably. In Belgium and adjacent countries where mild steel ties are in use, wooden ties are being abandoned in favor of steel ones on the following grounds:

(1) That their price will gradually rise owing to the devastation of forests.

(2) The quality of even the best varieties of wood is variable and an unknown factor, being affected by time of felling, place of growth, seasoning, etc.

(3) Preservative methods fail to produce a uniform material for use.

(4) No timber merchant will guarantee ties of wood, while two-year guarantees can be obtained for steel ties.

(5) There is a loss of interest, due to stacking wooden ties for seasoning, whereas steel ties may be in use, legitimately, even before being paid for.

(6) The difficulty of obtaining a good fastening of the rail to wooden ties, and the constant re-spiking necessary.

(7) The selling price of old wooden ties is less than metal ones even in proportion to their first cost. All of these objections are more or less valid, even in America, but the lasting and holding qualities are most important. Ties are ordinarily 8 ft. to 8 ft. 6 inches long, 6 to 7 inches thick, and 6 to 9 inches wide on top and bottom. They may be hewn or sawed, the former method producing a more durable tie if not hacked too deep before hewing. The top and bottom faces of a tie should be true and parallel planes, all bark being removed, and in sawed ties the removal of sapwood on the sides will add to their durability. They are usually laid 2 feet centres (2,640 per mile). The two ties at an ordinary angle-bar joint being selected as the widest ones near at hand and placed about 18 inches apart, centres, centrally about the joint, giving a suspended joint, but if the long six-bolted 44 inch angle-bars are used, then three ties are placed at a joint 18 inches apart, centres, one at each end and one in the middle; otherwise it is considered best to sort ties into groups of nearly the same width. It is believed that a random mixture of ties of various widths tends to cause poor track, as the narrow ones will sink more than the wider ones.

Ties are made from lignum vitæ, oaks, chestnut, locust, cedar, pine, maple, cherry, red elm, hemlock, tamarac, beech and spruce, being named, roughly, in order of durability in track, without treatment by preservatives. The life of a wooden tie in track, untreated, varies from 4 to 6 years for the poorer kinds, up to 10 or 15 years for the more durable ones, except lignum vitæ, which lasts 30 or 40 years. The length of life will depend on locality of growth, the kind and amount of ballast used, drainage, amount and speed of traffic, whether the tie is on a curve or tangent, and finally whether the rail rests directly on the tie or on a tie-plate or metal chair of some form. The wear on curves is greater than on tangents, due to the cutting into the ties of the rail base, which accelerates the rot; also, respiking is more frequent on the former; taking the life of a tie on a tangent as 9 years; one on a 2° curve will last about 8 years, 6° curve 7 years, 15° curve 5 years. Softwood ties can scarcely be used in America, owing to the poor hold of the ordinary dog-spike, which cuts and crushes the fibers of soft woods, while with hard woods the fibers are only squeezed back and are still elastic; but in England, with large metal chairs, soft-wood ties are in general use, and attempts have been made here to use cedar alternately with oak, as they both last well, and the latter will hold the spikes; also attempts have been made to nail oak planks on top of soft-wood ties, dove-tail oak bearing pieces just under the rails, and in other ways dodge the main issue, which is the poor holding power of the spike, but none have been very successful. Metal tie plates such as the one shown on Plate XXV. are now used on heavy traffic roads, sometimes only on curves, and latterly under all the track. These spread the load over a larger surface, and are a great improvement, as they enable a cheaper tie and a deeper rail, relatively to its width of base, to be used. When railway managers in America see the wisdom of adopting wood screws or fang bolts, as in England, for holding the rails in place, a much superior track will be obtained even at a small increase of first cost.

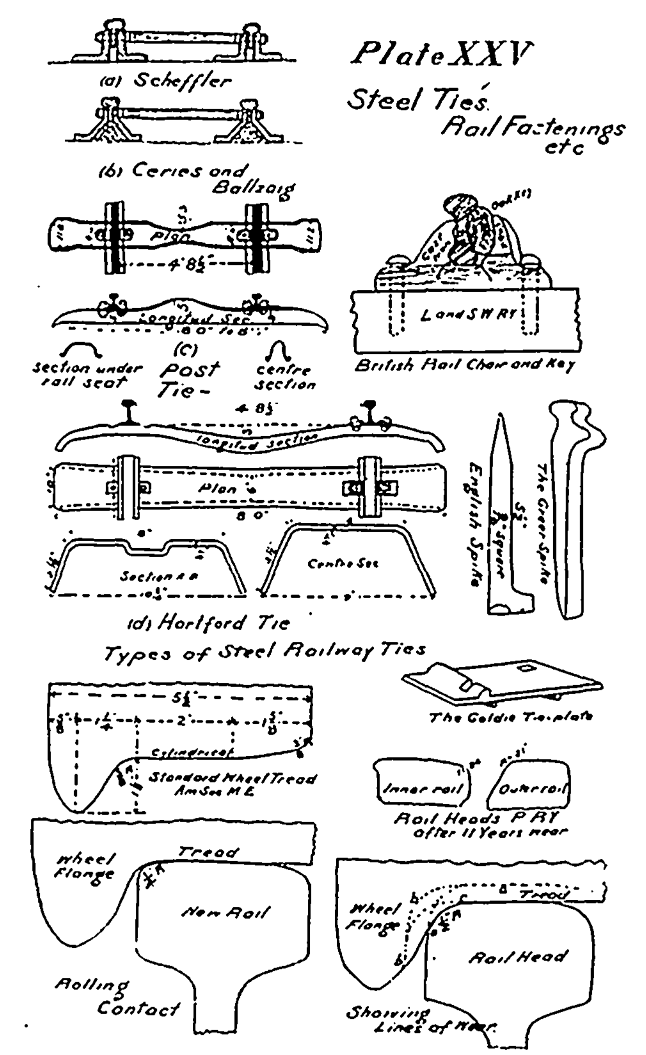


Plate XXV
Steel Ties.
Rail Fastenings
etc

There are several ways of increasing the ordinary life, in track, of a wooden tie, for a tie rots by the solidification of fermented sap, assisted by heat or dampness:

(1) By thorough drainage of the ballast.

(2) By having as little sap as possible in the tie by felling the tree in winter, and subsequent natural, steam, or other form of seasoning.

(3) By charring the surface.

(4) By impregnating the tie with an antiseptic to prevent fermentation.

Such chemicals as sublimate of mercury, sulphate of copper, chloride of zinc, and creosote or oil of tar, serve the purpose more or less successfully, especially the last two, and the last one most particularly. Creosoting is done in a closed receiver, after the tie has been air seasoned two or three months, and trimmed of its sapwood, by exhausting the air to suck out the sap from the pores of the wood. Creosote at 120° F. is then forced in at 10 atmos. pressure, and after one hour the ties are taken out ready for use; soft woods, which are the only ones usually treated, absorb 7 to 9 lbs. per cubic foot, and the cost of treatment has been reduced from 21 cents in 1879 to 10 cents per tie at the present time. The increase in the life of ties in track is greatest amongst soft woods according to the following table:

Timber.	Duration in track. Untreated.	Creosoted.
Oak	13	19
Pine	7	15
Fir (Spruce)	5	9
Beech	3	16

Creosoted ties will not resist the cutting of rails more, nor are they stronger than untreated ones, but, especially in thickly settled countries, discarded ones will be more valuable as fence posts or fuel, being worth from $\frac{1}{5}$ to $\frac{1}{10}$ of first cost.

Creosoting does not assist ties to hold spikes, and in this respect wooden ties are deficient. Spikes with hardwood ties on roads of moderate traffic are one thing, with soft-wood ties or with any tie on heavy traffic roads are another. As they are continually being pulled loose by the action of passing trains, and have to be redriven, in the future, with heavier traffic, rails and engines, something must be done to remedy this weakness of American track, the solution of which will lie along two lines, either metal ties and appropriate fastenings, or oak or other durable ties along with tie plates, and fang bolts or wood screws as fastenings—either method will allow deeper rails to be used, or ties spaced farther apart.

Metal Ties.—Three types of metal rail-supports are used:

(1) Longitudinal flanged sleepers giving a continuous support to the rail, and held to gauge transversely by rods; sections of these are shown on Plate XXV. (a) and (b); they have never come into anything like general use.

(2) A succession of cast-iron inverted pots, filled inside with ballast and connected transversely by rods, as in class (1); this method has been used in regions of brackish soils where cast iron rusts less than steel, and can be made heavier, as it is a cheaper material; this method is also only in limited use.

(3) Metal cross ties of inverted trough sections are steadily increasing in favor and are likely to obtain, in the future, general adoption.

The tendency of metal cross-ties is to decrease maintenance charges year by year, while with wooden ones, especially on curves, the reverse is the case. Of these the Post tie seems to be the favorite in Europe; on the Netherlands railway, maintenance with metal ties was about one-half of what it was with oak ones, with thirty trains per day and engines of fifty tons, and no ties reported broken. A sketch of this tie is given on Plate XXV. (c); it is of mild steel, weighing 110 to 120 lbs. each, and costing a few years ago $22 to $26 per short ton, with two year guarantee. It is closed at the ends, narrow and deep at the middle, with thickness varying, being greatest at rail seats; the bottom edges are in the form of ribs $\frac{3}{4}$ inch thick, projecting $\frac{1}{4}$ inch. The general thickness is $\frac{1}{4}$ to $\frac{1}{2}$ inch. The narrowing in and deepening at middle gives transverse strength, and prevents the track from creeping longitudinally, or forming a hog back at the centre. The rails are fastened by bolts with T heads and eccentric necks. These bolts pass through the tie from underneath, and into a crab washer which bears on the rail flange and tie; a Verona nut-lock and a nut complete the fastening, and an oblong hole through the ties allows adjustment on curves. This tie presents economy of material and maintenance and general efficiency. It has been in long, extensive use in Belgium, Holland and France, and is probably the best metal tie yet devised for flanged rails. In the United States the Hartford tie has been used with good results on the New York Central, and it appears in general to be an imitation of the Post tie, with an endeavor to simplify manufacture, see (d) Plate XXV. Other forms of less tried qualities are the Standard, an inverted channel beam, and the International, having a section like an elongated bracket ——'——, which would appear to be deficient in vertical stiffness. It is probable that persistent attempts at improvement will have a tendency to cheapen manufacture, and hasten the introduction of metal ties on many progressive railways having heavy traffic.

(*To be continued.*)

For THE CANADIAN ENGINEER.

SEWERAGE SYSTEMS OF ONTARIO.

BY WILLIS CHIPMAN, C E.

The following tabular statement gives the extent and cost of the sewerage systems of the Province, excluding those of the cities of Toronto, Ottawa, Hamilton, London and Kingston.

	Population	Miles Sewers	System	Approximate Cost	Engineers
Barrie	6,000	3½	Separate	$ 27,000	Chipman, Ardagh
Belleville	10,000	5	S. & C.	65,000	Neilson, McDougall
Berlin	9,500	10	Separate	69,000	Bowman, Chipman*
Brantford	17,000	14	Separate	134,000	Chipman Jones, T.H.
Brockville	9,000	11	Separate	121,000	Chipman
Chatham	10,000	18	Combined	95,000	McDonell, McGeorge Topp
Cornwall	7,000	7	C. & S.	55,000	Chipman, Wiggins, Brown
Goderich . ..	4,000	4½	Separate	19,000	McDougall,† Brough
Niagara Falls.	5,000	11½	Separate	105,000	Mitchell, Chipman,†
Owen Sound..	8,000	7¼	Combined	48,000	Kennedy, McDowell
Peterborough .	11,000	7½	Separate	70,000	McDougall, Belcher
Petrolea	6,000	6	Combined	45,000	Jones, J. H.
Renfrew ..	3,000	4	Separate	20,000	Chipman
St. Catharines	10,000	6	Combined	70,000	Gardiner, Reynolds, Roberts
St. Thomas ..	11,000	46	Combined	150,000	Bell, Campbell
Sarnia	8,000	7	Combined	26,000	Jones, J. H.
Sudbury	1,400	1¼	Separate	10,000	Gordon, Rorke
Stratford	10,500	8½	S. & C.	70,000	McDougall, Van-Buskirk
Tor. Junction.	5,000	11	Separate	120,000	Chipman
Walkerville ..	2,500	4½	Combined	50,000	DeGurse
Waterloo	3,000	3½	Separate	20,000	Bowman, Chipman*
Welland	2,500	1½	Combined	7,200	Ross
Windsor	12,000	21	Combined	280,000	DeGurse
Woodstock...	9,000	11½	Separate	50,000	Davis

In those places where the separate system has been adopted, the sewers are modern in design, and have been constructed during the last ten years under the supervision of competent engineers.

In some places the sewers have been built street by street and year by year without reference to any general plan or system, and occasionally without the advice or assistance of an experienced engineer. In some few places a large amount has been expended, but to the present time they have few, if any, proper sanitary sewers.

Class A.—Barrie, Berlin, Brantford, Brockville, Niagara Falls, Renfrew, Toronto Junction, Waterloo.

Class B.—Cornwall, Goderich, Peterborough, Owen Sound, Sarnia, Sudbury, Walkerville, Windsor.

Class C.—Belleville, Chatham, Petrolea, St. Catharines, St. Thomas, Stratford, Welland, Woodstock.

In Class A have been included those places in which the majority of the citizens are now served with well built, properly designed sanitary sewers; and where all plumbing work and the laying of house sewers are done according to stringent rules and regulations under the city or town engineer's inspection, and full records kept of all such work. These are undoubtedly the best sewer systems in Ontario, not excepting the five largest cities of the province. Drains of wood and stone are excluded from these systems.

In Class B some of the places have almost complete sanitary systems, but they have no regulations or rules whatever governing plumbing, and no complete records are kept of work done. The other places in this class have partial systems now built, covering the majority of the streets, but the plumbing by-laws are very imperfect. Drains of stone and wood are also excluded from class B.

In class C have been placed: (a) Those places that have constructed a very few sewers or a main sewer, but in which the great majority of the streets have at present no proper sanitary sewers. The work done has been of a modern character, but only a commencement has been made towards a first-class sewer system. (b) Those places in which a large part of the expenditure represents the cost of box drains and sewers that cannot or should not be used for sewage purposes. It must not be inferred, however, that all of the places in class C are not, on the whole, as well sewered as those in class B.

* Consulting Engineer only.
† Designing Engineer only.

ROPE TESTING.*

BY GEO. A. M'CARTHY AND ERNEST G. MATHESON.

(*Concluded from last issue.*)

EXPLANATION OF THE TABULATED RESULTS.

The ropes are arranged in the table so that those of the same order are grouped together, and the results are the more readily comparable. Under the column, "Position of fracture":

U is an abbreviation for Upper.
L " " Lower.
T " " Thimble.
S " " Strands.
P " " Pin.

Where no mention is made of the number of strands broken, one strand is to be always understood. The extensions in most cases were taken over a distance of eighteen inches. In testing some of the wet specimens, however, the stretch was so great and the travel of the machine so limited that twelve inches was all that could be allowed over which to take the extensions. In the results no distinction is made between the percentages obtained from these two different lengths. In tabulating the position of fracture as centre, it is not to be taken that this fracture occurred exactly in the centre of the specimen; but was far enough from the fixtures at either end so that no damage could possibly result to the fiber. Therefore we can at once assume that wherever in the tests, a "centre" fracture is recorded, we in that case at least develop the absolute maximum strength of the specimen. The time of the test is given from the moment the load was applied to the specimen to the time when rupture occurred. The time of immersion in water before the wet test was made varied from forty-eight hours to one week, depending on the size and quality of the rope; the idea being to have the rope at least thoroughly wetted.

In the soaked tests, the ropes were in water on an average of about six weeks. The column showing the number of twists per foot is given instead of the "percentage of hard," which is referred to in the short description of the manufacture of rope.

Sufficient comparisons are here given to show that no regularity exists between the strength of one strand of a rope and the strength of three or more strands when they are formed into one rope. The result follows that if we have a rope of two strands and also one of four, we have no good reason for assuming that the one of four strands will be twice as strong as the other. The greater strength proportionately of one strand above two and two above

*A paper read before the Applied Science Graduates' Society of McGill and published exclusively in THE CANADIAN ENGINEER.

TABULATED RESULTS.

DESCRIPTION OF ROPE.							DRY TEST.				WET TEST.				SOAKED TEST.			
MATERIAL.	No. of strands.	Yarns per strand.	Circumference.	Weight per foot.	Twists per foot.	No. of feet of yarn per lb	Load.	Per ct. of stretch	Position of fracture.	Time in Min.	Load.	Per ct. of Stretch.	Position of fracture.	Time in Min.	Load.	Per ct. of Stretch.	Position of fracture.	Time n Min.
Manilla	3	11	2"	.124	6	360	3200	12.5	At tack in centre	17	4875	19 0	At U. T.	15	4800	22 0	On L. P.	15
"	3	14	2.25	.156	6	360	3900	10.8	At U. toggle	12	6000	17.2	" "	12	5950	21 7	2. S at L. T.	10
"	3	17	2.5	.179	5 6	360	5150	12 5	At U. T.	18	7175	20.8	" "	14	7025	20.2	At Centre	15
"	3	20	2 75	.246	5	360	6400	13 1	At U. toggle	17	7950	25 4	" "	15	8050	24.3	On U. P.	13
Tarred manilla landyard, "Good Current"	4	15	2 5	.192	6	575	4400	16 9	2 S. at L. T.	20	5520	20.3	2. S. on L. P.	20	5400	21 7	2. S. on U. P.	15
" " " " "	4	23	3 0	.278	5	575	6550	14.4	On L. P.	20	7250	18.7	" " "	20	6900	18.7	2. S. on L. P.	13
Tarred hemp landyard	4	16	3 0	.332	4 5	360	4800	12 2	2. S. on U. T.	7	4900	10 2	3. S. on U.P.	12	4700	13 8	On L. P.	20
" " "	4	28	3.0	.338	5	575	5250	8 6	3. S. on U. P	20	6000	10.8	2. S. on U.P.	14	5150	11 3	2. S at U. T.	20
Manilla boltrope	3	17	2	.113	6	575	3400	8.3	At U. T.	12	5425	18.6	On L. T.	13	6175	20 3	At U. T. / At L. T.	10
" "	3	27	2 5	.184	5.3	575	7000	12 2	" "	25	9250	18.6	At U. T	17	9500	19.6	2. S. on U. P.	12
" "	3	38	3	.265	4	575	8300	10.8	At U. toggle	15	12510	25.4	On L. P.	25	13600	18.3	At L.T	15
Manilla boltyarn	3	27	2.5	.195	5 3	575	5560	13.1	2. S. on U. P.	25	7600	20.3	2. S. at L. T.	13	6535	20.8	At Centre	17
" "	3	38	3"	.290	5	575	8100	15.3	On L. P.	12	10050	23.3	At L. T.	15	8100	25.2	On L. P.	15
Manilla	3	2	0 9	.018	15 6	400	425	10.6	On L. P.	20	750	15.8	At L. T	12	880	19.7	Centre	10
"	3	3	1 0	.014	13.3	400	800	8.6	On U. P.	15	1170	19.1	At upper tack	14	1025	20	"	8
"	3	4	1.1	.035	12.3	400	1050	11.1	At centre	14	1450	16 6	At U. T.	7	1500	18	"	10
"	3	2	1.0	.021	15.6	360	700	8.0	At centre	15	825	16 6	At centre	6	900	18.8	At U. T. & Centre	8
"	3	3	1.2	.034	12.6	360	900	11.1	At U. T.	20	1525	20	"	8	1375	22.8	Centre	12
"	3	4	1 4	.037	10.3	360	1100	10	At centre	15	1800	21 9	At U. T.	8	1825	21 0	"	12
"	3	5	1 5	.048	9	360	1650	10.3	At L. T	16	2300	18.3	At lower tack	11	2550	21	"	10
"	3	6	1 65	.063	7.6	360	2175	15.0	At centre	7	2875	21.7	At L. T.	10	2750	20.4	At L. T.	12
"	3	7	1.6	.064	7.3	360	2450	9.4	"	15	3100	18.2	At U. T.	13	3175	19.6	Centre	13
"	3	8	1.8	.075	7	360	2450	10.8	At U. Toggle	15	3650	19 4	" "	10	3700	23	At L T.	10
Tarred manilla	3	2	1.0	.021	14.6	360	600	5.5	Centre	14	755	11.7	At centre	11	950	17.1	Centre	12
" "	3	2	1.25	.034	13 6	360	850	8.3	" "	12	1200	16.1	On U. P	25	1275	19.2	"	10
Tarred manilla boat hawser	3	12	2.15	.105	6.6	375	1950	17.5	At U. T.	15	2650	24.4	At U. T.	30	2820	25.8	Whole rope at U T.	27*
Sisal "oiled"	3	2	1.15	.024	13 6	360	650	14.4	At centre	25	600	24 7	At centre	20	600	28 3	Centre	11
" "	3	3	1.25	.028	12	360	750	10.7	On U. P.	15	750	18 8	At U. T.	15	800	22.2	2 S. at Centre	8
" "	3	4	1.5	.041	9.6	360	1100	9.6	At centre	12	1050	28.8	" "	12	1000	22.2	Centre	10
Tarred hemp ratline	3	2	1.0	.022	13 3	..	460	4.7	2. S. at centre	12	400	8.6	On L P.	5	590	9.4	At L. T.	9
" " "	3	3	1.23	.036	12	..	850	5.5	2. S. at L. T.	10	750	12 8	At Centre	7	800	12.5	At Centre	9
" " "	3	4	1.44	.052	10.6	..	1000	8.6	At L. P.	10	1000	13.8	2. S. at lower tack	10	1075	13.1	At L. T.	8
" " "	3	5	1.5	.063	8.6	..	1100	7.5	At L. T.	10	1300	12 5	At U. T.	15	1120	13.3	At Centre	8
" " "	3	7	1 7	.09	7.3	..	1350	6.1	At U. T.	10	1433	14 4	At L. T.	15	1450	13 9	"	10
Tarred hemp boltrope	3	2	.84	.022	12	..	525	3 1	2. S. U. T.	10	600	9 4	At U. T.	12	800	12.2	At Centre	10
" " "	3	4	1.08	.027	11.3	..	700	5 3	" "	10	740	10.0	At centre	11	700	15.3	"	8
" " "	3	5	1.16	.034	9.3	..	650	5.3	2. S. at Centre	10	800	11 1	"	12	900	11.9	"	8
" " "	3	6	1.2	.042	9.3	..	925	6.6	" "	12	1000	17.2	"	15	1050	12.5	2. S. at L. T.	7
" " "	3	11	1.7	.08	7	..	1500	8.3	2. S. at U. T.	13	2000	12.8	At U. T.	12	2025	13.1	At U. T.	12
Tarred hemp boat hawser	3	12	1.9	.108	7.3	..	1375	11.7	" "	11	1950	20.8	2. S. at centre	15	2125	21.6	2. S. at U. T.	10

* In this test had to run machine back owing to stretch.

three is no doubt due in some measure to the strands after the first breaks becoming more nearly straight, thus enabling the stress to act along the direction of the length of the fibers. The three strands were broken where rupture took place near the centre of the specimen, so that we got the absolute strength. In the ropes which contained the greatest number of twists to the foot, the irregularity between the comparative strength of three strands, two strands, and one strand was the most noted. This would appear to bear out the deduction just referred to, namely, that the proportionately less strength of three strands as compared with two, and one, is due to some extent to the less twist per foot in the two strands, and one strand, after the first and second strands break.

REMARKS ON EXTENSION CURVES.

The extensions shown on the curves are (for diagrams of these curves, see CANADIAN ENGINEER for February) the amounts the ropes stretched under the different loads in a distance of eighteen inches. In the same diagram each of the three curves gives the average results of the untarred or tarred rope, as the case may be, in three different conditions, viz.: dry, wet and soaked. Diagram for untarred manilla and hemp rope: Here it will be noticed that the ratio of stretch to load is least for the dry rope, while those for the wet and soaked do not differ widely. The two curves are, however, quite different in shape. The soaked rope stretched less at first, but its curve soon crossed that of the wet rope by its stretch becoming greater. Then the stretch of the soaked specimen became less than the wet, as is shown by the two curves again crossing. At the upper limit of the load the two curves run nearly parallel. It would appear as if the great shrinkage in the soaked specimen at first resisted the load up to a certain point and then suddenly yielded somewhat more rapidly than the wet specimen and nearly finished stretching at the same time. This latter truth can be seen at once from the curve of the soaked rope by noticing how nearly vertical the curve is at its upper limit.

TABLE SHOWING COMPARATIVE STRENGTH OF ROPE BEFORE FIRST STRAND BREAKS, AND AFTER THE FIRST AND SECOND STRANDS BREAK.

Description of Rope.	1st Strand Break. Load.	2nd Strand Break. Load.	3rd Strand Break. Load.
Manilla	3,200	2,750	1,150
"	6,000	4,425	1,800
"	750	650	425
"	1,170	950	575
"	1,525	1,100	800
"	1,825	1,425	1,000
"	2,300	1,775	1,025
"	2,175	2,000	650
Tarred manilla	1,275	950	455
" hemp ratline........	750	640	475
" "	1,120	890	380
" " boltrope	740	600	600
" " "	800	650	425
" manilla "	5,425	3,400	2,000
" " boltyarn	6,535	4,475	2,600

In the diagram for tarred rope there is not such a difference between the stretches in the three conditions. What seems surprising is that the ratio of stretch to load is least not for the rope when dry, as in the untarred specimen, but for the rope when wet; while it is the curves for the soaked and the dry specimens which intersect. Moreover, it is the curve for the soaked tarred specimen which most nearly resembles the curve for the wet specimen in the untarred rope. It is also to be noted that the ratio of stretch to load decreases at an increasing rate, which decreases as we reach maximum load.

DEDUCTIONS FROM THE TABULATED RESULTS.

The most noticeable fact is that a wet rope is stronger than the same specimen dry. This was no doubt owing to the fact that the rope was more pliable so that it adjusted itself in such a way that the stress was more uniformly distributed; and none of the fibers were strained to rupture almost, before others had any considerable stress; for we found that when any of the outside fibers on a bend, which of course are strained most severely, gave way, the rope was practically at its maximum load. The above was an important factor in determining the position of fracture. A larger proportion of the failures took place at the upper pin or thimble than in any other position. This was particularly so with the larger ropes, where the outside fibers were affected not only by the direct stress, but by this stress acting at a leverage of the diameter of the rope, minus the crushed depth, in the same manner as the outside fibers of a beam in a transverse test are affected by the skin stress and the depth of the beam. We endeavored to place a sleeve on the pin, but the short distance between it and the head of the machine left barely room enough for the rope. This pin had no feather in it and turned round in its eyes, so that a greater portion of the stress developed in the specimen was transmitted down to the toggle end of the rope than would have been if the pin had had a feather to keep it from turning.

It will be noticed that a large number of breakages occurred at the upper thimble. We believe this to be due to the injury the rope may have sustained by the pin turning in its eyes, and not due to any defect in the method of fastening. The smaller number of breakages occurring at the bottom thimble, where the pin had a feather in it to keep it from turning, and where the fastening was similar to that at the top, would tend to confirm this.

Considering the bending moment referred to above it would be natural to conclude that a small rope would be less affected by it than a large one, and would be more likely to break at the centre. This was proved to be so by our tests. It may also be noted that the melting or soaking did not increase the strength of a tarred rope as much as that of an untarred. This would be expected, as tar allows motion of the fibers so that the stress is more uniformly distributed throughout the whole specimen. The increase in strength was greater in tarred manilla than in tarred hemp. Immersion always increased the strength of an untarred rope, but a continued immersion had no marked effect. It might be thought that the additional stretch of a wet or soaked specimen above that of a dry would be due entirely to the shrinkage. A comparison of results will show that this additional stretch is greater than the shrinkage.

CORROBORATION OF EXISTING FORMULÆ.

Most of the existing formulæ giving the strength of rope are very complicated and hard of application, but in "Jones and Laughlin's" hand book is the following formula: "To get strength of manilla rope, multiply the square of the circumference in inches by eight, and the result will be the number of hundred pounds required to break the rope." This agrees remarkably closely with the results of our tests; e.g., In the first rope of the tabulated results the formula giving the number of hundred pounds required to break the rope gives the following:

Load $= 2 \times 2 \times 8 = 32$; breaking load $= 3200$. Exactly what we obtained. Again, take No. 3:

Load $= 2.5 \times 2.5 \times 8 = 52$; breaking load $= 5200$, while we obtained 5150. Many others are equally near.

In submitting this thesis, we sincerely hope that the data tabulated, and the explanation given thereof, may be sufficiently lucid to all readers; and that the benefits obtainable therefrom may, in some degree, be commensurate with the labor entailed by its preparation.

For THE CANADIAN ENGINEER.

WATER WORKS EXPROPRIATIONS IN CANADA.

BY WILLIS CHIPMAN, C.E

The following is a list of the cities and towns in Canada that have from time to time acquired their waterworks systems by purchase or by arbitration from the private companies that owned and operated the works, and the price then paid by the municipality:—

Montreal, P.Q	1845		$250,000
St. John, N.B	1855		
Halifax, N.S.	1861		275,000
Toronto, Ont	1873.	By arbitration	220,000
Kingston, Ont	1887.	"	121,000
Niagara Falls, Ont	1884.	"	17,000
Valleyfield, P.Q	1887	By mutual agreement	
Brantford, Ont	1888.	" "	65,000
Owen Sound, Ont	1890	" "	55,000
*St. Cunegonde, P.Q.	1891.	" "	
*St. Henri, P.Q	1891.	" "	
Brockville, Ont	1892.	By arbitration	138,000
Vancouver, B.C	1894.	"	
Kincardine, Ont	1894.	By mutual agreement	40,000
Moncton, N B.	1894.	By arbitration	265,000
Chatham, Ont	1895.	By mutual agreement	145,000
Cornwall, Ont	1897.	By arbitration	86 500
Sherbrooke, P Q.	1897.	"	116,000
Barrie, Ont	1898.	"	78,000
Berlin, Ont	1898.	By mutual agreement	102,000

In Ontario an Act of Parliament was passed in 1882 empowering cities and towns to acquire waterworks or gas works by purchase or by arbitration. Six towns have taken proceedings under this statute since 1891, and have acquired their works, three by arbitration and three by mutual agreement.

In the Ontario Act, the word "value" is clearly defined as structural value at the time this value is being determined. Ten per cent. is, however, to be added to this valuation by the arbitrators.

The Ontario Act prescribes two methods of procedure:—

(a) The municipality may submit a blank by-law to the ratepayers before an offer has been made or a valuation prepared, which, if carried, empowers the council to proceed with the arbitration or to acquire by purchase.

(b) The municipality may proceed with the arbitration and take up the award, then submit a money by-law to the ratepayers for the purchase of the works.

In either case if the works are not taken over, the municipality shall pay all costs of the proceedings.

Berlin is the only place in Ontario that adopted the first method.

In 1898 New Brunswick passed an Act similar to the Ontario Act of 1882, but none of the other provinces have any such legislation.

In the Moncton Act, the word "compensation" was used as well as value, but in the Campbellton Act the word "compensation" did not appear, and "value" is not so clearly defined as in the Ontario Act.

In the following cities and towns the waterworks are now owned and operated by private companies:—

Belleville, Cobourg, Ingersoll, Iroquois, Lindsay, Napanee, Perth, Peterborough, Smith's Falls, Stratford, Trenton and Waterloo, in Ontario.

Aylmer, Berthier, Chicoutimi, Cote St. Antoine, Drummondville, Granby, Huntington, La Chute, Richmond, St. Lambert, and Saint Johns, in Quebec.

Lunenburg, N.S.; St. Stephens, N.B.; Winnipeg, Man.; Calgary, N.W.T.; Esquimault, B.C.; and Nanaimo, B.C.

**These works were purchased by the municipalities in 1891, but soon afterwards they made arrangements with the Montreal Water and Power Company for a supply of water, and it is now reported that they are owned by this Company.*

THE SOULANGES CANAL.*

BY THOMAS MONRO, PAST PRESIDENT CAN. SOC. C E.

At the close of 1888 the writer was transferred from the Welland Canal, and assigned the duty of determining the best location for a canal, having a navigable depth of fourteen feet, between Lakes St. Louis and St. Francis. After extensive surveys and examinations, he submitted a report, dated 15th June, 1889, addressed to the late John Page, M. Can. Soc. C.E., Chief Engineer of Canals, in which reasons were given why the new canal should be constructed on the north side of the St. Lawrence. Mr. Page died in 1890, and in June of that year a second report was addressed to the Secretary of the Department, confirming the views previously expressed. In that document the projected work was for the first time named the "Soulanges Canal." In a memorandum dated 25th January, 1891, prepared for the Right Hon. Sir John Macdonald, by Toussaint Trudeau, M. Can. Soc. C.E., Deputy-Minister and Chief Engineer of Canals, the scheme submitted by the writer was approved of in general terms. This view was subsequently confirmed by the Government, and, in August, 1891, a sum of $300,000 was voted by Parliament towards the construction of the Soulanges Canal, which was then estimated to cost $4,750,000.

Plans and specifications of the work were subsequently prepared; and in May, 1893, all the thirteen sections between Cascades Point and Coteau Landing were under contract. It is not intended to discuss in this paper the fitness or otherwise of the dimensions adopted for the Welland and St. Lawrence Canals. The writer's views on this important subject are fully set forth in his address on retiring from the office of president of this society on the 15th January, 1896. The object now proposed is to briefly describe the Soulanges Canal as it is, and to draw attention to the fact that in many essential features it differs in design from the other links of the St. Lawrence system.

It may be stated, at the outset, that more extended study of the question of the fluctuations of the St. Lawrence River led to the conclusion that it would be unsafe to accept previous records as a guide in fixing the heights of the mitre sills at each end of the canal. The lowest water at Valleyfield (1849-90) was in October, 1872; when it fell for part of one day to 10 ft 8 ins. on the mitre sill of the guard lock at the head of the Beauharnois Canal. But the mean for that month was 11 ft. 13 inches. Practically, 11 feet would therefore represent extreme low water during the navigation season. Adopting this view, the sills of the guard lock at the head of the Soulanges Canal should have been placed 3½ feet lower to secure a fourteen feet draught. As a matter of fact, the sills of the Soulanges are 5 feet lower than those at Valleyfield; and it is due to this that, in November, 1895, when the lowest water occurred, of which there is any reliable record, there was a depth of 14.55 feet at the upper entrance, and 14.83 at the lower end of the Soulanges Canal. In the same month there was only 13 50 feet at the lower entrance of the Cornwall Canal, and 13.08 at the head of the Lachine Canal. Attention is drawn to these facts, because between the time when the estimate attached to the writer's report of June 18, 1890, was made, and the letting of the works, the bottom plane of the summit level (10½ miles long) and the foundations of the structures on it, were lowered about 1½ feet, largely increasing the quantities, and adding, at a fair valuation, about $500,000 to the estimated cost of con-

*A paper read before the Canadian Society of Civil Engineers.

struction, which, instead of $4,750,000, should be placed at $5,250,000.

It may also be stated that in previous canal surveys along the St. Lawrence, various datums were employed, making the results somewhat confusing, or only intelligible after a good deal of trouble. An attempt has been made to avoid this by referring the levels of the Soulanges Canal to mean tide at New York. To do this, lines were run from a bench mark established by the United States coast and Geodetic Survey at Rouse's Point, N.Y., to the head of the Beauharnois Canal. In this way the mean level of Lake St. Francis was found to be 154.80; and directly connected with the records at the Valleyfield lock since 1849. The United States Army Engineers have determined the mean height of Lake Ontario (1860-75) at 246.61 above the same datum, so that the difference between Lakes St. Francis and Ontario should be (to close the circuit) say 91.81 feet. Lines run under the writer's direction between Coteau Landing and Kingston confirmed these figures. But the previously accepted distribution of fall was found to be quite erroneous. The descent from Kingston to Prescott was supposed to be three or four feet. It is now approximated at about one-third of a foot, pending the completion of the precision levels begun some years ago under the able direction of Rene Steckel, M. Can. Soc. C.E., of the Public Works Department. This work has not yet been continued along the St. Lawrence above Lachine. It may be stated, however, that levels recently taken by the engineers of the United States Deep Waterways' Commission only differ 0.12 from the figures given above as representing the relative level at Rouse's Point and Valleyfield—about 47½ miles apart.

Attention was drawn to the lithographic profile of the St. Lawrence, prepared for the Canadian Deep Waterways' Commission of 1895, as explanatory of the foregoing remarks. This profile shows the position and length of the various canals between Kingston and Montreal. The fall in the river is about 220 feet. That overcome by locks is about 204 feet. It will be seen that Lake St. Francis is 33 miles long. It is merely an expansion of the river—a pool above the rapids between it and Lake St. Louis. The fall between these lakes is 82½ feet at mean water. In this distance of about sixteen miles there are the Coteau, Cedars, Split Rock and Cascades Rapids. At some points on the river there is a depth of not more than six feet in the channel at extreme low water. It is to surmount these rapids that the Soulanges Canal has been constructed. Its position is shown on the small sketch map which accompanies this paper.

The canal is 14 miles long, and leaves the foot of Lake St. Francis at Macdonald's Point, just below the village of Coteau Landing. Thence it runs straight 1½ miles, touching the margin of the river about a mile from the upper entrance. From the end of this tangent the line sweeps round to the north-east behind the village of Coteau du Lac for about three miles on a curve of 14,324. radius. It is then continued by a second tangent of some 8½ miles long, passing about a mile inland from the Cedar's Village. At the termination of this, the line bends slightly to the north, and is led straight into the Ottawa River, about two miles from its junction with the St. Lawrence at Cascades Point. The canal is, for all practical purposes of navigation, a straight line throughout, and is two miles shorter than the route by the river. The fall of 82½ feet is overcome by four locks. 70 feet of this is at the Cascades end, where the bluff forming the right bank of the Vaudreuil branch of the Ottawa gives an opportunity of locating three of these in the first mile; each having a rise of 23⅓ feet. The original design was for five locks. This was subsequently made four, and, after extended examination, the writer, in January, 1894, proposed a further reduction to three. In this view he was sustained by Messrs. Shanley and Keefer, who were retained by the Government to advise in the matter. The height of these lifts constitutes a peculiar feature in the Soulanges Canal. There is an interval of over two miles between the third and fourth locks. The latter is about three miles from the lower entrance. Here the lift is variable. It is about 12½ feet at mean water of Lake St. Francis—but at extreme high periods it would (if this water were permitted to enter the canal) be about 15 feet. At the upper entrance there is a guard lock by which the surface level of the summit can be regulated without interruption or danger to navigation. At periods of high water, this will be used as a lift lock, but, at ordinary stages of the lake, its surface level will be that of the canal. It is needless to point out to this audience the necessity of this arrangement. Canal engineers of experience will admit that such a safeguard is indispensable. About 1,000 feet above lock No. 4 there are a pair of guard gates placed for safety to the lower locks in case of accident.

It will be observed that the surface of the blue clay along the summit reach gradually rises towards the west and culminates at the crossing of the St. Emmanuel Road, where it is almost level with top bank, being only covered with a thin layer of sandy soil. Wherever this clay was cut into by the prism, there was danger of slides, roughly in proportion to the depth of the cutting. This danger was greater on the north side, which intercepted the natural drainage towards the river, so that in time the slope became so saturated as to break loose and slip into the canal. In other words, by the excavation of a deep trench of such dimensions, a similar condition of things was set up as that existing along the bank of the St. Lawrence between Coteau and Cascades, where, from time immemorial, *deboulements* have occurred, causing in many places a wearing away, which in some cases is measured by hundreds of feet. One of these slides took place on the 25th October, 1897; when, without any previous perceptible warning, the north bank of the canal, for over a quarter of a mile in length, slid into the prism, taking with it the abutment of the St. Emmanuel bridge, which was thrown bodily forward about fifty feet into the centre of the canal. This occurrence is considered to be of so much interest as to warrant its being made the subject of a separate paper. To discuss it in detail at present would take up too much time. Slides have also occurred more or less for a mile or so to the west of the St. Emmanuel Road, but a plan of repairs has been adopted which will enable the north slope to be satisfactorily restored in time for the opening of navigation through the canal. Towards the crossing of the river Delisle, the surface of the blue clay lowers rapidly. At the river itself rock of the "calciferous" is encountered, and this alternates with the clays and sands of the drift formation for some two miles to the west. At the upper entrance the guard lock and surrounding structures are all founded upon solid rock. There are about 6¼ million cubic yards of clay of all sorts, and 300,000 cubic yards of rock of various kinds in the excavations for the canal.

The level of the bottom of the summit reach at the foot of the guard lock is 137.00 above datum. Ordinary surface of Lake St. Francis may be taken at 155.50, at which time there will be 18½ feet of water in the canal, equal to a cross sectional area of 2,534 square feet. Propellers of the type now being built on the upper lakes to navigate these canals will have a submerged midships section of say 42 × 14 = 588 square feet, or less than one-fourth of that of the water area at mean level. This will permit of a fairly high speed through the summit reach, which it will be observed forms 75 per cent. of the whole length of the canal. The bottom of this reach has an inclination of 0.10 per mile. Top bank is level and 161.0 above datum. The cross section of the canal has, as before stated, been kept as nearly as possible uniform throughout. This will avoid the creation of cross currents, and facilitate the rapid navigation of the canal. The relation of the area of the vessel to that of the canal is a matter of much importance. Full depth under the keel is of great value, both for speed and safety. The whole question of the gain in time in relation to the cost of construction affords ample scope for further investigation. It does not appear as if a slight increase in speed where the canals are short in comparison with the length of natural navigation would warrant a largely increased outlay even where ample means are at hand. As to locks, it is believed that, as has been stated, "The single individual lock is better than the fleet lock, and can be operated more quickly—and the maximum facilities may be provided by duplicate locks. The lift of locks should be made as great as possible where conditions permit, as time is consumed by the number of locks rather than by the lift."

To return to a description of the locks. It was the writer's intention that these should be constructed wholly of concrete up to the level of the surface of the lower reach. In this particular the design was almost wholly frustrated, lock No. 4 only having been built on this plan. The nature of the foundation of all the locks having been previously indicated, it will perhaps be as well to describe the general features of lock No. 2, and thus avoid tedious repetition. It will be observed that the lock is filled and emptied through culverts in the side walls, from which cast-iron pipes 30 inches in diameter—ten on each side—lead into the bottom of the chamber. These pipes have about 40 per cent. greater discharging capacity than the culverts themselves. The lock will be filled in about five or six minutes, and this will be effected without subjecting the vessel to much surging or strain. At the head and foot of each culvert there is placed in a shaft (8 x 4 feet) operated from the coping a 6 x 6 feet sluice of the "Stoney" pattern. These are for the first time introduced into a Canadian canal. Their operation is, as will be seen by the drawings, exceedingly simple. They are in extensive use in Europe, and have given the best satisfaction in controlling large bodies of water. They are used for that purpose on the Manchester ship canal. It may here be stated that the details for these gates on the Soulanges Canal have been worked out and modified by Geo. H. Duggan, M. Can. Soc. C.E. This has been skilfully done; and it is believed that their operation throughout will prove quite satisfactory. The method of emptying and filling locks through tunnels in the side walls is considered to be entirely the best, and manifestly better than any system of filling from below the floor. The main object in adopting this plan was, however, to avoid that in vogue in the Welland Canal, where the filling and emptying is done through valves in the gates. This is objectionable from every point of view. It weakens the gates just where most strength is required, and weighs them down with cumbrous valve gear. Besides, it introduces the water for filling so as to strike the stem of the vessel heavily, creating unnecessary disturbance in the chamber and a tendency to surge it on the upper gates. All this is now well known to practical men, and need not be dilated upon here. It will be observed that each lift lock is provided with a heavy breast wall at its upper end, corresponding in height to that of the lift. These walls have been re-introduced for the purpose of removing the cause of about nine-tenths of the accidents which have occurred on the enlarged canals; namely, vessels carrying away the upper gates of the locks by striking them whilst entering from the lower reach. It is difficult to understand why all the four gates of each lock on the Welland and other canals were made the same height—but there is no doubt the plan is defective. If a vessel goes ahead too far in a Soulanges canal lift lock, she will strike against the breast wall, and damage herself instead of the gates. The filling and emptying of the lock having, it is believed, been secured in a reasonable time in the way above described, it may now be stated that an attempt has been made to simplify the manner of working the gates by the use of struts in the manner shown in the accompanying drawings. An inspection of these will render further description unnecessary. It may, however, be noted here that the writer made a series of experiments in 1894 at Lock No. 9 of the Beauharnois Canal, which convinced him that this method would prove entirely practicable. Since then machinery of a similar kind, but on a greatly larger scale, has been and is now in operation on the North Sea Canal

The distribution of lockage as above described is supplemented by a series of weirs for the passage of the necessary supply. That at the head of the canal has four openings 9 x 10 feet, furnished with gates of the "Stoney" pattern. The tops of these gates will be submerged when hoisted. This structure is connected with a raceway of large dimensions formed to the south of and parallel to the guard lock. This channel is about 650 feet long, and is pitched on both sides. It passes into the canal through a series of masonry arches, and will amply fulfil the intended purpose without creating objectionable currents. About five miles from the upper entrance, at the crossing of the à la Graisse River, a large weir has been constructed having six arched openings 6 x 6 feet. It will regulate the summit level of the canal, which can be either lowered or entirely emptied at this point. The channel from the weir connects directly with the river à la Graisse a short distance from its junction with the St. Lawrence. In connection with this weir, a power-house is being erected which will be alluded to further on. The supply is passed by the guard gates above lock No. 4 through two 20 x 22 feet Stoney sluices; and at locks 4, 3, 2 and 1, the regulating weirs consist of twin culverts through the dividing embankments between the various reaches, having submerged gates controlled from top bank level through shafts of concrete and masonry. It will be observed that the water for supply is not in any case passed over breast walls, the writer's experience being that such an arrangement is objectionable in this climate.

There are seven road bridges and one railway bridge across the canal. The latter traverses the lower wings of the guard lock, and carries the Canada Atlantic Railway. It swings over the lock and raceway, and is about 180 feet long. The superstructure of this bridge was manufactured and erected by the Dominion Bridge Company, of Lachine, Que. At the head of this lock there is another swing to pass the main road between Coteau Landing and Cascades Point. A similar structure will be erected at lock 3 in connection with the Quinze Chiens Road. The superstructure of these two small bridges is from the shops of the Weddell Company, at Trenton, Ont. The remaining five road bridges cross the full prism of the canal, and have been designed to permit a full and free flow for the water, and so as not to impede rapid navigation. This is effected by building the pivot pier in a line with the toe of the south slope, between which and the foot of the north slope there is an opening of 100 feet. The bridges are 242 feet long, and the south half swings partly over the land and partly over a channel formed in rear of the pivot pier to give additional water section. It is believed that this is a considerable improvement on the old method of placing the pivot in the middle of the canal with a narrow channel on each side of it where vessels have to slow up, and often find it difficult to get safely past. The piers, abutments, etc., of these bridges are of concrete coped with cut stone. The superstructure was manufactured and erected by the Dominion Bridge Company in a quite satisfactory manner.

To pass the drainage of the country lying to the north, across the line of the canal, has necessitated a very large outlay. The first stream met with in descending is the river Delisle. This has its sources some sixty miles inland. Its catchment basin has an area of about 180 square miles, and during spring floods the flow is sometimes over 200,000 cubic feet per minute. The river is passed under the canal through four lines of cast-iron tubes 10 feet in diameter, laid in a trench fifty feet wide, excavated in the rock to the depth required. The tops of these tubes are two feet below canal bottom. At each end there are masonry wells, and at the north end the macadam road is carried over by arches of masonry and concrete. This structure has been found to answer the required purposes satisfactorily. At no time has there been, so far, a greater head than from 18 inches to two feet on it, whilst the position is such that no just claims for backwater can arise. In connection with this culvert there has been excavated a channel of diversion of considerable length and dimensions, which secured a good foundation for the structure and diminished the interruption from water which would have been inevitable had it been placed in the old bed of the river. It is believed that this plan should be followed where at al practicable. The next stream is called the Rouge River. Its flow during floods is about half that of the Delisle, and it is carried under the canal by two lines of tubes of the same diameter as those previously mentioned. The excavation for the foundation of this structure was carried down to boulder clay through a stratum of soft blue material, which gave a good deal of trouble through sliding during the progress of the work. A diversion channel has been formed here also, the sides of which are pitched with masonry laid in cement. At the à la Graisse River the water is carried by a single line of tubes 10 feet in diameter. The foundations of this structure are on piles driven some 25 to 30 feet to hard material. There are also two pipe culverts of small dimensions towards the lower end of the canal which do not merit particular description.

Now as to the dimensions of the canal itself. Ordinary prism is throughout about 100 feet wide at bottom with side slopes of 2 to 1. The banks or cuts are first formed to these and then a notch is cut to receive the stone protection lining. This reaches from four feet below to four feet above mean level in the summit. It is about 3 feet wide at the base, tapering up to about one foot on top, where it is finished by a rough coping. Between this coping (158.0) and the top of the bank (161.0) the surface of the slope is sodded, the sodding being returned about five feet on the level. On the north side of the canal a macadam road, 16 feet in width, will be formed throughout its entire length, the centre of which is 33 feet from the edge of the cut or bank on that side. This road was designed, not only for the sevice of the canal, but also to provide a means of intercommunication between the various farms cut across by the canal and the sideroads where bridges are built; and so, if possible, reduce damages—a result which has not, however, been realized, as the sums paid for right of way are very much greater than was anticipated. The total quantity of land taken is about 950 acres, ample width having been secured throughout. Wherever practicable, material arising from the excavation has been used to widen out the embankments to give additional safety to the north side of the canal, where in-filling is fifty feet wide on top. On the south side it is generally thirty feet at least. The large amount of surplus material was spoiled either on land adjacent to the canal taken for that purpose, or wasted into the St. Lawrence river at several points. At the Cascades' end the excavation is of rock of the Potsdam formation, which affords a solid foundation for locks Nos. 1, 2 and 3. The upper extension walls of the latter lock are, however, of piles and concrete. The reach between locks Nos. 3 and 4 is in clay, upon which the piers and abutments of the St. Antoine Road bridge are founded.

At lock No. 4 solid material is from 30 to 35 feet below the floor line. The lock walls are therefore placed upon a foundation of piles and concrete. They are 36½ feet high, and, from careful levels taken before and after building, have not perceptibly subsided. The structures immediately to the west of lock No. 4, viz., guard gates, sluice abutments, retaining walls, etc., are all founded on the clay, which affords a sufficiently solid bearing. The road bridges at St. Fereol and St. Dominique are also built on similar material. The gates are constructed on what is called the "solid" plan, which consists of a number of superimposed timbers shaped to the required horizontal pattern and fastened together. The method is simple and in this case the strength is superabundant. One leaf of the lower gates of the high lift locks at the Cascades' end of the canal weighs over 90 tons in the air. The drawings were made by J. B. Spence, M. Can. Soc. C.E., and the gates have been constructed in a thoroughly workmanlike manner by the firm of J. & R. Miller, of Ingersoll, Ont., who have had very extensive experience in connection with the Welland and St. Lawrence canals. The timber used is principally Douglas fir, which was hauled across the continent for that purpose. A number of spare gates are on hand in case of accident.

It is proposed to work a lock from one point on the south side, and about 20 feet back from the coping, where a switch cabin will be placed. This will be connected with the motors actuating the sluices and operating bars previously described. Suppose a vessel to enter the lock from the lower level. When her stem is up to the breast wall she signals, and the lower gates are closed. The machinery will effect this in a perfect manner. The gates will shut precisely and synchronously, and avoid any trouble from over-lapping, which often occurs now. This should be done in one minute. The lower sluices are then dropped and the upper ones hoisted, the lock being filled as indicated. When the water has risen to the full height, the upper gates are opened and the vessel passes out. The lockages should be easily made in from 12 to 15 minutes. But the saving of time at a lock, although of much importance, has been unduly magnified. The capacity of the canal at four lockages per hour on the basis of one-third westbound freight would be about 20 millions of tons in an ordinary season. Of course, this estimate is merely theoretical. But even if one-half of it is realized, it will require a good many ports like Montrea to handle such tonnage economically.

In the construction of the Welland canal locks, nearly every mitre sill on the line was forced up, causing great delay to navigation, annoyance, and much expense. The plan of mitre sill and bottom designed for the Soulanges canal will, it is believed, fully obviate these difficulties. It will not be possible under any imaginable circumstances to disarrange sills held down as shown on plan of lock No. 2; and which is a type of all the rest. It will also be seen that the mitre sills themselves are the only pieces of timber in or connected with the lock bottom, and these can easily be renewed when this becomes necessary. The extension walls above and below the locks and in immediate connection with their masonry should not be built on a twisting batter. Where these walls cease to be self-sustaining and become slope walls, they are sure to crack—and besides the bases of those of the lower ends of the locks are liable to be washed out by the strong currents created when they are emptied, and have a tendency to slide into the canal All the walls connected with the upper and lower entrances to the locks of the Soulanges Canal stand upon their own bottoms, and are therefore not liable to failure in the way alluded to. The macadam road which runs along the north side of the canal is carried past the locks by a series of ramps, the inclination of which does not exceed 1 in 8. To enable foot passengers to surmount the rise between the different levels, a flight of steps is provided on each side of the lower ends of all the locks.

Concrete has been introduced into the construction of these locks to an extent greater than heretofore in Canada. Since the plans for them were made, the use of this material has rapidly spread. But a few years ago experienced hydraulic engineers looked upon construction with suspicion, at least in this climate. This is not to be wondered at, because the cement (which is the life of concrete) supplied was of very inferior quality and manufacture. Now, however, excellent Portland is obtained at moderate rates. On the Soulanges canal the writer specified that cement of a certain quality should be supplied by the Government to the several contractors—and should not be purchased by them at all. The benefits of such a course are obvious. There is no inducement to supply an inferior article or to stint its use; both of which may happen with the ordinary type of canal contractor. It is better to remove the temptation than to depend upon the virtue of the individual. The specifications for the preparation of concrete do not offer any feature out of the common. Some 70,000 briquettes have been made for testing purposes in a quantity of about 200,000 barrels. Good clean sand and properly broken stone have been insisted upon; and so it is believed that this work is excellent throughout. Mixing has been done both by hand and machine, but in either case the product when carefully laid and rammed makes an unexceptionable hydraulic wall, whilst its cost per cubic yard is less than half that of masonry. Of course this varies with circumstances, but on the Soulanges canal its use is clearly suggested by the fact that in the excavation for the prism about 300,000 cubic yards of rock had to be taken out, which is excellent for concrete, but unfit for masonry. This supplied the 150,000 cubic yards required for concrete—also about 120,000 cubic yards for stone protection, lining together with over 50,000 cubic yards for macadam, repairs, etc., leaving a large surplus to be thrown to spoil. It will be seen on reference to the plan of road bridges that these structures are almost entirely of concrete, the copings only being of cut stone. This remark will also apply to the retaining walls, regulating weirs, etc. A large amount of concrete was also used in connection with the culverts under the canal, and in other positions too numerous to mention.

Time will not permit of more than a passing reference to the style of supply weir or regulating culverts designed for the canal. The plans will show details of construction. They can be made to control the levels automatically if so required. It will be seen that the weir at Lock No. 4 is connected with its south wall, and differs in construction from those at the lower locks. It is believed that the drawings and photographs will show with sufficient clearness the main features of the culverts under the canal to pass the Rivers Delisle, Rouge and à la Graisse. The casting of the ten foot tubes was done by H. Ives & Co., Montreal.

The site chosen for a power house to generate electricity for the operating of the locks, bridges, etc., and the lighting of the canal throughout, has many advantages, and will perhaps merit a brief description, which must close this paper. At this place the River à la Graisse crosses under the canal and joins the St. Lawrence about 400 feet to the south of it. The surface of the canal is as before stated at ordinary stage about 155.50 above datum. At such time the à la Graisse is about 135.00 or 20.5 feet lower. It is obvious that by drawing a sufficient volume from the summit reach and passing it through wheels, power can be readily obtained here; and from this site a free discharge can be had into a wide tail race connecting directly with the St. Lawrence on Government property where no claims for damages can arise. Of course the above height of 20.5 feet represents the fall on the River St. Lawrence between Lake St. Francis and the mouth of the à la Graisse. The amount of electrical power required to operate the locks, bridges and other structures, and to light the canal satisfactorily throughout its entire length of fourteen miles was carefully determined by the officers of the Royal Electric Company, who also worked out the details of the distribution and application of this power. They also provided designs and drawings for the power house proper, and the switch cabins at the various locks, together with the necessary specifications. The hydraulic development was entrusted to A. M. Rice, of Dayton, O., a gentleman of acknowledged skill and experience in such matters. He prepared plans showing the number and position of the wheels, tail races, etc. These have been partly carried out; and work will be resumed in the spring. The power house is connected with a regulating weir previously referred to, and which is intended to control the summit level of the canal without discharging a great volume of water through the Cascades locks. The works for electrical power plant have been recently let, and the whole system will be in operation next season. The canal will be efficiently lighted throughout, and, considering its position in the St. Lawrence system, this will be of great importance in securing safe navigation through it by night. The entrances at each end of the canal are wide, of full depth, and sufficiently commodious. It will be observed that there are concrete walls heavily coped with cut stone on the top of the cribs forming a permanent face work instead of the timber generally used in such positions.

There are a number of other matters of interest to canal engineers which cannot even be touched upon in this sketch. It will, however, be seen that an attempt has been made to provide an unobstructed channel of full dimensions for a fourteen foot navigation at lowest water, with a much less number of locks than has hitherto been deemed advisable to overcome a similar fall on the other canals of the St. Lawrence system. In construction materials of a practically imperishable kind have been almost wholly used, and this fact, taken in conjunction with the improved methods of operating the locks and bridges, will, it is believed, largely decrease the annual expenditure for maintenance and operation.

The writer sincerely hopes that the beneficial results which must follow from the completion of the St. Lawrence Canals to dimensions capable of passing vessels of 2,000 tons will be realized to the fullest extent; and that the immense expenditure so pluckily incurred by Canada with her comparatively small population and limited resources may at last draw to our national route the current of European trade for which we have waited so long. The writer may be permitted to state, in conclusion, that, in his humble opinion, if such a large volume of traffic as may be reasonably expected on the completion of the St. Lawrence canals, has to be economically and quickly handled at Montreal—a very different condition of things to that existing there must be at once established and maintained. If not, the expected benefits to Canada will be largely neutralized, or the point of trans-shipment for grain in bulk, and whole cargoes, will be transferred to Quebec.

The thanks of the writer are due to John L. Allison, M. Can. Soc. C. E., by whom he was materially aided in the preparation of the general designs for the canal and its structures. He also desires to acknowledge the zeal and intelligence of C. R. Coutlée and A. J. Grant, MM. Can. Soc. C. E, to whom, together with a staff of juniors, inspectors, etc., the superintendence of the principal works was entrusted.

At the conclusion of the paper the magic lantern was brought into requisition, under the direction of Mr. Redpath, and Mr. Monro made an interesting running commentary on the pictures as they were thrown on the screen. His explanations were listened to with the closest attention, and a hearty vote of thanks was passed, on motion of Stuart Howard, of Montreal, seconded by Geo. A. Mountain, of Ottawa.

The chairman congratulated both the society and Mr. Monro on this valuable paper. This was the first annual meeting for which papers had been specially prepared, and the maintenance of this feature would add greatly to the interest of the meetings, and would increase the attendance.

Mr. Keating would be glad to know if Mr. Monro had noted any effect on the concrete from the action of the sun or frost. He had noticed that in Halifax, where there were sudden and extreme changes in temperature from rain and its accompanying temperature to below zero, the east side of the graving dock on which the sun had most power was badly scaled from the alternate action of the heat and frost —was the effect the same at the Soulanges Canal?

Mr. Monro said that after three or four years' exposure there was no degradation, either from change of temperature or other cause. In reply to several questions he said that nearly all the cement used in the canal was foreign Portland of the best brands. There were five or six of these all about equally good, namely "Condor," "Jorson," "Alsen," "Dyckerhoff," "Hemmoor," &c. There had also been used some Canadian Portland of the "Star" brand, which was found to be an excellent article. The proportions used were 1 of cement, 3 of sand and 6 of stone, broken into cubes of about 2 inches. It was true that in the landslide of October, '97, the wall of concrete was thrown down, but it fell as a monolith, and in its whole extent of 80 ft. long by 26 ft. high, there was not a crack caused by the fall, and one could not put a penknife between the coping stone and the concrete. The question remains to be decided how far we can use concrete to advantage in canal work. He was convinced by an examination of the Manchester Ship Canal in 1891, and of the breakwater at Buffalo in 1892, of the efficiency of concrete work for canals. When he saw the Buffalo breakwater it had been built for four or five years, and had been covered with enormous piles of ice and exposed to violent gales without any signs of weakness. He did not think the concrete at the Soulanges Canal cost on the average more than $5 or $6 per yard. While the proportions were as already mentioned, they sometimes used one of cement, five of sand and ten of broken stone, according to the nature of the work. The facing mortar was incorporated with the body of the concrete and mingled with it, the two being made at the same time. The concrete was made in thick layers, but was often dumped down in large lumps, and he did not believe in putting it down in thin regular layers.

Mr. Marceau commended the plan here adopted of returning to the breast-wall as a guard against accidents to vessels. The lack of a breast-wall such as this was the cause of nine-tenths of the accidents in recent years on our canals. As the breast-walls were placed in this canal, a boat could not touch the gates to break them.

Mr Monro said the mitre sills were laid in masonry checks so that the timbers could be removed without disturbing anything. It often happened with the old locks that stones would get in between the gates, causing trouble. To avoid this he had iron plates six inches wide by ⅞ inch thick put on the upper face of the sill and under the gate, so that when a stone got between the gate and the mitre, it was crushed without doing any damage to the gate. In reply to further questions Mr. Monro said the concrete was deposited both in the water and out of it. In the former case it was boxed in, and was frequently deposited a foot or more under water, but it set as well in one case as the other. The "slope protection" to prevent the wash caused by passing vessels, was here laid with smaller stones than in former works, as the small stones were less disturbed by the waves. These stones were laid down to a thickness of 3 feet at the bottom, shallowing to a foot thick at the top, the top being about 4 feet above the water level, and the bottom about 4 feet below the water level.

Prof. Bovey, on the conclusion of the paper, asked Mr. Rogers as to the crack that had developed in one of the locks of the Trent Canal. What was the length of this body of concrete, and was one section of it allowed to set before the next was added?

Mr. Rogers said it was laid at regular intervals in horizontal layers, and the length of the wall was 40 ft.

Prof. Bovey did not see why a piece of work 400 ft. long should crack any more than one 40 ft. long. He did not think that contraction or expansion would account for it. He was glad to know that in this work and the Soulanges Canal, the Canadian brands of cement had given such a good account of themselves. There was now every prospect that Canadian makers would produce a quality of cement that could not be beaten by the product of any country in the world. Of special interest was the hydraulic lift lock referred to in Mr. Rogers' paper, and the whole work would not only prove a credit to the country but to the engineers in charge of it. He hoped that it would also prove to be fully as great a commercial benefit to Canada as Mr. Rogers hoped.

In reply to Mr. Leprohon, Mr. Rogers said the cement was tested to 250 lbs., but they had not called for any specific mixture of sand. In reply to Mr. Rust he said the cost was about $5.25 per cub. yd. Replying to Mr. Skaife he said the Canadian brands of cement used were the "Star" brand and the "Samson" brand, and they had given the best satisfaction. To a question by Mr. Kennedy he said the width of the crack referred to was $\frac{1}{32}$ to $\frac{1}{16}$ of an inch, this part being built on rock foundation. In cold weather it opened very slightly.

Mr. Butler (Napanee), observed with regard to the last point, that the co-efficient of expansion of concrete was about the same as that of cast iron Now, when a large mass of concrete was built up it adheres to the bottom and becomes attached to the back, which causes friction through expansion and contraction. These forces of expansion and contraction have to be restricted by the inherent strength of the mass of concrete. It will expand in the least restrained direction, and if the wall was weaker in one spot than another it would there give way. It was not practicable to get that perfect homogeneity that would insure a long wall from cracking. If you walk along the concrete sea walls you will see these cracks occurring wherever they are not provided for. It was therefore better to build in blocks of reasonably limited size.

Prof. Bovey observed as to testing, that it was easy to lay too much stress on a test. The difficulty is that there is no uniformity of procedure among the testers themselves; so that no two testers will give the same results from the same materials. In all tests the neat test and the sand test should be carried out. Above all, tests should be made with a standard quality of sand, and under a definite pressure which should be the same in all cases. Even University tests were disputed; and to show how small a circumstance may affect the result, he cited a case where a test was returned from McGill quite different to what the applicant had looked for, when it was compared with another test. But he pointed out that in carrying out one of these tests a little of the cement had settled on the meshes of the sieve and had become hardened, thus materially altering the result when the same sieve was used again. This showed how important it was that all the conditions should be precisely the same in all tests. If we can eliminate these differences we shall be able to show results with Canadian cements quite as good as any that can be shown across the water. He was pleased to move a vote of thanks to Mr. Rogers for his interesting paper. This was seconded by Robt Surtees, of Ottawa, and carried.

METAL IMPORTS FROM GREAT BRITAIN.

Following are the sterling values of the imports from Great Britain of interest to the metal trades during January, 1898 and 1899.

	January, 1898.	January, 1899.
Hardware	1,609	1,538
Cutlery	3,329	4,765
Pig iron	504	361
Bar, etc	200	445
Railroad	50	..
Hoops, sheets, etc	814	125
Galvanized sheets	1,976	488
Tin plates	11,617	5,685
Cast, wrought, etc, iron	1,573	997
Old (for remanufacture)	..	..
Steel	4,521	3,770
Lead	924	889
Tin, unwrought	301	2,515
Alkali	1,501	1,545
Cement	485	213

SILICA PORTLAND CEMENT.*

BY M. J. BUTLER, M. CAN. SOC. C. E., ETC.
Consulting Engineer to the Rathbun Co., Ltd., Deseronto, Ont.

Silica Portland cement, as manufactured in Canada, is a mixture in equal parts by weight of a high-grade Portland cement and clean, dry Silica sand, ground together to an extreme degree of fineness, in mills specially designed for the purpose.

The Portland Cement used has the chemical composition and properties shown below:

PORTLAND CEMENT.

Chemical Analysis	Lime	62.0
	Silica	22.0
	Alumina and iron	12.0
	Magnesia, sulphuric acid, etc	4.0
Fineness.	Residue on No. 100 Sieve—10,000 holes to the square inch	8%
	Residue on No. 200 Sieve—40,000 holes to the square inch	35%
Tensile Strength, lbs. Per sq.-in.	Neat cement mortar, lbs. per square inch:	
	One day in air, six in water	500
	One day in air, twenty-seven in water	600
	Three part standard sand	
	One day in air, twenty-seven in water	200
Soundness—Absence of Free lime Unhydrated.	Very great care is taken to ensure a Portland cement that is absolutely sound, i.e., free from unhydrated calcium oxide.	

The resulting Silica Portland Cement has the chemical composition and properties shown below:

SILICA PORTLAND CEMENT.

Lime	31.0
Silica	61.0
Alumina and iron	6.0
Magnesia, sulphuric acid, etc	2.0
Residue on No. 100 Sieve—10,000 holes to the square inch	Nil
Residue on No. 200 Sieve—40,000 holes to the square inch	7%
Neat cement mortar, lbs. per square inch:	
One day in air, six in water	350
One day in air, twenty-seven in water	450
To one part cement.	
One day in air, twenty-seven in water	200
As silica in itself is wholly inert, the resulting mixture of sound Portland and pure silica must likewise yield a sound cement; the small percentage of lime is a further assurance against the possibility of a blowey cement.	

Portland cement and clean, dry sand are weighed into the tube mill in equal quantities by a continuous uniform feed adjusting device, and in order to make clear the process of grinding it will be necessary to give a brief description of the tube mill. It consists of a horizontal steel cylinder, 18 feet in length by four feet in diameter, lined with specially hard cast-iron plates, which slowly wear away. The mill revolves at the rate of 27 revolutions per minute, and is filled half full with flint pebbles. The sand assists the pebbles in the grinding action, being itself, at the same time, reduced to a very fine state. The cement is reduced to an impalpable powder and is thoroughly intermixed with the ground sand, in fact, each minute particle of silica is enveloped with a flour of cement. Silica Portland has all the good qualities usually found in the best Portland cement, and the question naturally arises: Why is it? How is it possible to add 50% of inert material to a barrel of cement, and by the mere act of grinding them together to secure practically the same cementitious value as before the addition? An effort will be made to explain the seeming anomaly, as compared with the fineness of the molecule, the finest ground particle is coarse, yet the more nearly we approach the ultimate molecule, the more nearly we render it possible for the elements present in the cement to unite together and crystallize into the silicates which form cement.

A barrel of Portland cement when ground to the finest degree commercially, practically has quite 50% of the material too coarse to admit of crystallization, the underground particles are for all practical purposes inert matter, sand if you please, the active cementing material is the impalpable flour. Now, in the case of Silica Portland, the whole of the cement is ground to this impalpable flour-like condition, and therefore in a position to do work; the silica is reduced to a minute degree of fineness also, but not to the same extent as the cement, each speck or particle of silica is enveloped, wrapped up, in a layer of flour-like cement and offers a clean, sharp surface for the cement to adhere to. All very finely ground cements show strong adhesive properties, hence we see the useful function the silica performs; it takes the place of primarily, the unground clinker, and secondarily, is an excellent filling material, wholly inert under the usual conditions to which cement mortar is exposed, and in itself is stronger than the unground particle of clinker it has displaced. Owing to the exceeding fine conditions of the material, when tested neat it does not give as high a tensile strength as the more coarsely ground Portland cement, yet when made up into mortar, with three parts of sand, it actually equals in strength a like proportioned mixture of the Portland.

It is a peculiar fact that mortars made from very finely ground cement do not show quite as strong a resistance to abrasion, although they excel in adhesive properties. Hence the concrete for pavements and such like work preferably should be made of Silica Portland, and the top wearing surface of the coarser Portland cement. There are certain uses which silica cements are peculiarly well adapted to. Speaking generally, all cases where the low percentage of lime is an important factor: Notably in lining digesters for the manufacture of sulphite wood pulp it has been found of the very highest value, in sewers where free ammonia or acids are likely to attack the mortar and in all such cases. In pointing fine stone work, the color and permanent properties are peculiarly valuable.

Silica Portland Cement has already largely entered the market and proven itself a valuable cement. The following partial list will show to what extent and the nature of the work where it has stood the test of experience: The Laurentide Pulp Co., Grand Mere, Quebec, 21,000 barrels in concrete masonry, floors, brick work, etc; Montreal Street Railway Com-

*Paper read before the Engineering Society of the School of Practical Science, Toronto pany, in concrete and floors, etc., 2,500 barrels; Canada Paper Company, Windsor Mills, N.S., 1,000 barrels; W. W. Ogilvie, Montreal, 1,000 barrels; Holland Emery Lumber Co., Byng Inlet, Ont., for saw foundations, 750 barrels; Riordan Paper Mills, 1,000 barrels; Dalhousie street station, C.P.R., Montreal, masonry, floors, etc., 2,200 barrels; Longue Pointe Asylum, Montreal, 880 barrels; Ottawa, Ont., pavements, 3,500 barrels; Cornwall, Ont., pavements, 600 barrels; Waterloo, Ont., pavements, 900 barrels. It has also been used in sidewalks and pavements in Ontario towns to the extent of some 10,000 barrels. Among other users are the Grand Trunk and Canadian Pacific, Central Ontario and Bay of Quinte railways, Public Works Department, Ottawa; in all over 75,000 bbls. of Silica Portland Cement have been used in Canada, although the manufacture was not undertaken until the season of 1897. Arrangements are being made to double the output for the ensuing season. It has been said by rivals that this cement gives facilities for adulteration not equalled by other cements, and objections have been made by "smart Alecs" that they had plenty of sand without buying it in the form of cement. Of course all such objections are met at the outset with every new material. When Portland cement was first produced it had to undergo an equally hostile criticism, and this naturally brings us to consider the testing of cement, a subject on which there has been a great deal written. The following scheme conforms to the best thought and experience in the engineering world:

TESTING.

Hot Bath Test.--Faja's apparatus is so simple and well-known that it is unnecessary to describe it, but let me draw attention to a point sometimes overlooked. The sample when trowelled on the glass, should be well worked up, the air and excess of moisture worked out, and the sample be covered with a wet cloth, otherwise drying cracks may show up across the thickest part of the slab. This drying crack is sometimes mistaken for an expansion crack and the cement condemned. Too much importance is sometimes attached to the fact that the sample leaves the glass. If, as is usual, smooth glass is used, the slightest jar will loosen the slab. If it preserves its shape and does not curl up or show fine hair cracks at the edges, there is no danger to be apprehended from free lime, in fact from the low percentage of lime present a blowey Silica Portland Cement is almost an impossibility.

Specific Gravity, Weight per Bushel, or other Density Test.—Silica Portland Cement weighs a little less than Portland cement. It is so very finely ground that for equal measures, owing to the greater bulkiness, it must weigh less. In any case, the old test of weight per bushel should be abandoned as being unscientific and misleading; offering as it does, a premium on coarse grinding. The specific gravity test is a delicate laboratory test and is one requiring a high degree of care and skill, as usually conducted by volumetric displacement, confined air, minute error in reading, a slight change in the temperature of the liquid used, or irregularity in measuring apparatus or weighing, may give widely varying results. The object of the test is to determine the density of the cement, i.e., the sufficiency of the burning; in other words the soundness, hence the hot bath test practically suffices and is much more easily made.

Tensile Strength.—Neat tests, as usually made, show Silica Portland to be slightly weaker than Portland cement, this is probably due to the fine grinding. Mortar tests, however, are the best of all, and show the real working qualities of any cement, and it is as a mortar maker that Silica Portland proves its good qualities.

Having satisfactorily determined the safe qualities of the cement, having shown it to be sound, strong, both in neat and mortar tests, all of which should be a condition precedent to beginning the work, it sometimes happens that still the concrete or masonry shows poor work. Well, what are we to do then? Condemn the cement? No; suspect the sand, examine the gravel or broken stone, the water, the temperature of the air, the methods of mixing and measuring the aggregates, depositing in place, ramming, etc. After all, the cement is only one of the factors in the problem; for a complete solution we should investigate the whole of them. Do not try the experiment of building works out of cheap, lean concrete, consider the relatively small saving a few barrels more or less of cement amounts to in comparison with the value and importance of the work at stake. Your reputation as engineers will depend upon your capacity to do good sound work.

ECONOMY TEST OF A UNIQUE FORM OF FEED PUMP.*

BY F. MERIAM WHEELER.

During the past few years considerable attention has been given to the subject of steam economy of the auxiliary machinery on steam vessels, particularly those on warships, where a saving of coal has much to do with the steaming radius of the vessel. Under favorable conditions, as, for instance, in the full power trials of the United States warships, it has been found that in the case of the main feed pumps the average indicated horse-power developed by such pumps is about one-half of one per cent. of the I.H.P. of the main engines. I mention this fact to show that feed pumps use more power than any other pumps of a vessel. It will therefore be seen that the feed pump is quite an important auxiliary, and everything should be done to improve its economy in the use of steam. For this reason I have given considerable attention to the subject, and take pleasure in now bringing to the notice of the society the "Economy test of a unique form of feed pump" recently conducted in England, in which the economy was quite remarkable compared with that of the ordinary type of steam pumps usually employed for feeding boilers.

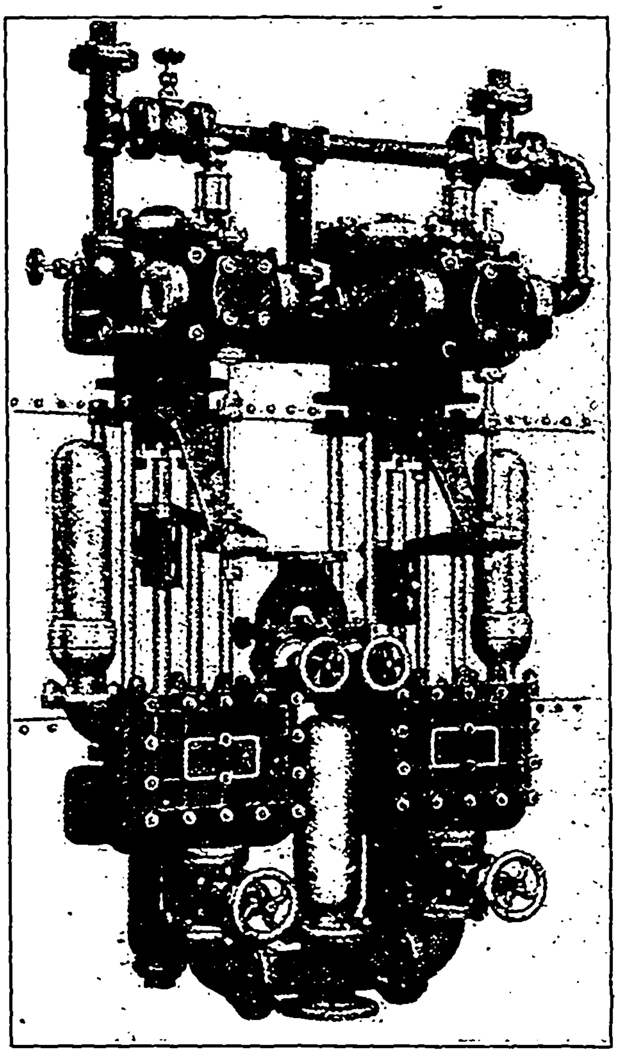
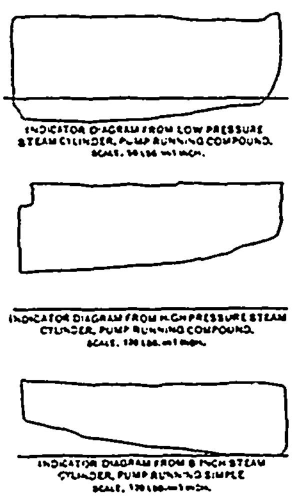


FIG. 1.

Now, it has been shown by tests that the steam consumption of a feed pump of the duplex type will average about 120 pounds weight of steam per I.H.P. per hour. In one test made the very best economy shown in the case of the main feed pumps was a little over 93 pounds, while the poorest showing (i.e., when one of the main feed pumps was supplying the donkey boiler, and consequently running at an abnormally low rate of speed), was over 200 pounds per I.H.P. per hour. The particular pump my paper refers to did its work with an expenditure

*Extracted from a paper read at the sixth general meeting of the Society of Naval Architects and Marine Engineers, New York, Nov. 1898.

of only 52 pounds of steam per I.H.P. per hour, which, considering the fact that it was quite a small unit, is a most excellent showing. In other words, this special form of pump uses considerably less than one-half the steam required ordinarily by a duplex pump of the simple type. The test referred to was conducted by experts connected with the engineering department of the well-known engine builders, Willans & Robinson, at their works at Rugby, England, and was for the benefit of the British Admiralty, who were represented by Mr. Antsey, the first assistant of the chief constructor of the Admiralty. There were also present Mr. Keighly, representing Thornycroft & Co.: Mr. Krohn, representing Yarrow & Co., and Mr. Hobbs, representing the Chester Engineering Co.; also Mr. Powel, representing the Blake & Knowles Steam Pump Works, of London. The feed pump tested consisted of a pair of Blake "Simplex" vertical double-acting steam pumps arranged on the cross-compound plan (see engraving of perspective view, figure 1), the high-pressure side having 6 in. diameter steam cylinder, 3½ in. diameter water cylinder, 8 in. stroke; and the low-pressure side having 9 in. diameter steam cylinder, 3½ in. diameter water cylinder, 8 in. stroke. The steam after being used in the



Figs. 2, 3 & 4.

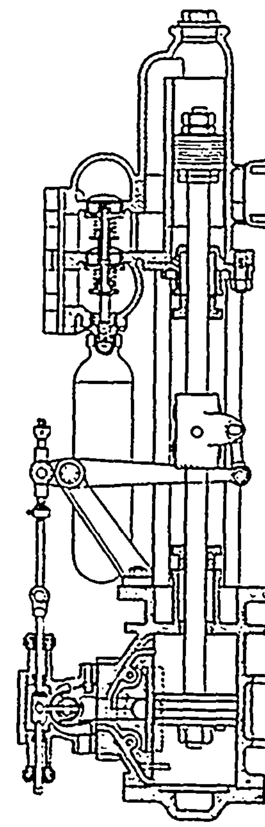


Fig. 5.

6 in. cylinder was expanded into the 9 in. cylinder; from the latter the exhaust steam was condensed and pumped to the weighing apparatus. Both water cylinders were connected to the one suction pipe having a length of 70 feet with five bends. The height of suction from level of the water in the supply well to the level of the discharge valves in the pump cylinders was 19 feet, to which should be added about 2 feet to represent the friction in the suction connections. The discharge of each pump led into a Y connection as shown, and the discharge pipe was provided with a gate valve sufficiently throttled to put on the pump cylinders a pressure of about 200 pounds per square inch—which, by the way, will be about the pressure these pumps are to feed against when installed in the torpedo-boat for which they were built.

I desire to call attention to an important feature of this arrangement of pumps in that it has all the advantages of the duplex system, so far as the continuous flow of the water is concerned, and yet either side can be run as a separate pump in case of accident to the other side. Then, again, the economy of compounding is secured with but two steam cylinders instead of four, as would be the case of a compound duplex pump. Therefore, there is less loss of steam from cylinder condensation; clearance is also reduced to a minimum, as the valve gear of one pump is not operated by the opposite pump, as in the duplex system; consequently, one side can make a full stroke without interference from the other side. The arrangement for testing (excepting the naked pipe that supplied the steam) was as complete and perfect as could be desired. For condensing the steam a surface condenser was employed with tubes having only screwed joints (Wheeler double-tube system), the same being tested to 200 pounds per square inch, so there was no suspicion of leakage. The condensed steam was carefully weighed in a perfectly balanced collecting tank. A small air pump was used simply for drawing off the water of condensation and discharging same to the weighing tanks, forming little or no vacuum. It was the intention of forming no vacuum in order to have this compound pump run under the usual conditions when exhausting into an auxiliary feed water heater—the latest and most economical method in use! The length of stroke could be accurately measured, as metal pointers were

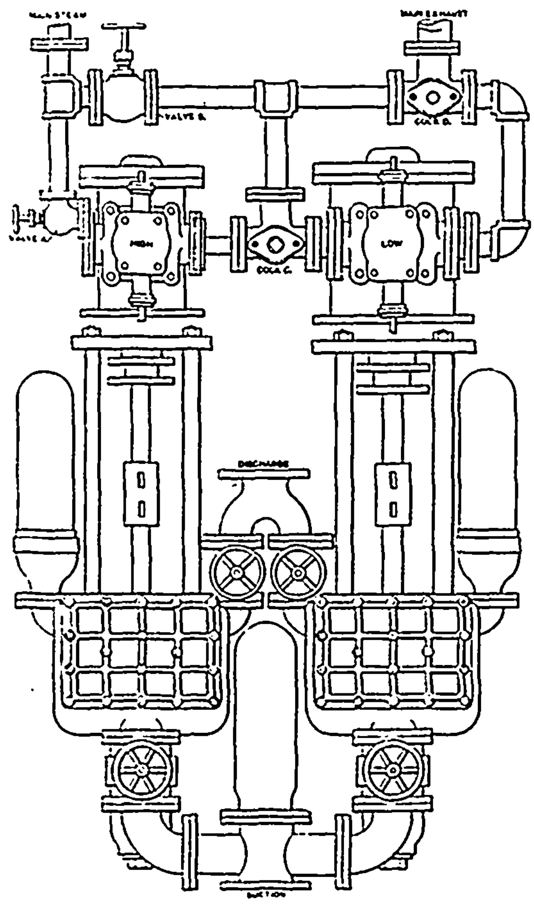


Fig. 6.

attached to the piston-rod crossheads. The length of stroke was easily regulated, as one of the special features of the "simplex" valve gear is the arrangement of the adjustable collars on the valve rods so that proper length of stroke can be obtained for all speeds, even when the pumps are in operation. The testing apparatus of Willans & Robinson's works is one of the most complete and perfectly arranged in Great Britain. The weighing of the water during the test was done automatically by electrically connected attachments, so that great accuracy was obtained and the time observations were taken to a fraction of a second.

Two tests were made—First, by running the pump compound; and, second, by shutting off entirely the low-pressure side and running the high-pressure side as a single pump. As mentioned above, the economy of the pumps when running compound was at the rate of 52 pounds weight of steam per I.H.P. per hour, while the economy of the pump running as a single pump was at the rate of 93.41 pounds per I.H.P. per hour. The former test is designated as "A" and the latter as "B," of which the following are the particulars:

Test "A."—Compound.

Duration of test	20.55 minutes.
Speed per minute, average for each side	40 double strokes.
Average length of strokes	8.06 inches.
Initial steam pressure per square inch	112.5 pounds.
Mean steam pressure per sq. in. high-press. cylinder	58.06 pounds.

Mean steam pressure per sq. in. low-press. cylinder	30.28 pounds.
Power developed by high-pressure cylinder..	2.54 I.H.P.
Power developed by low pressure cylinder..	3.07 I.H.P.
Total power developed by both steam cylind's	5.61 I.H.P.
Total weight of water collected	100 pounds.
Weight of water collected per hour	292 pounds.
Weight of water collected per I.H.P.per hour	52.04 pounds.

TEST "B."—SIMPLE.

Duration of test	28.35 minutes.
Speed per minute	54 double strokes.
Average length of stroke	8.05 inches.
Initial steam pressure per square inch	67.5 pounds.
Mean steam pressure per square inch	62.23 pounds.
Power developed	3.961 I.H.P.
Total weight of water collected	175 pounds.
Weight of water collected per hour	370 pounds.
Weight of water collected per I.H.P.per hour	93.41 pounds.

It will be noticed that these tests were of short duration, but they were amply long to demonstrate the economy of the pumps under the conditions given. The so-called system of "Flying test," in the opinion of the writer, is one of the best when the testing apparatus is electrically operated. Indicator diagrams, taken from the steam cylinders when running compound and simple, are herewith shown.

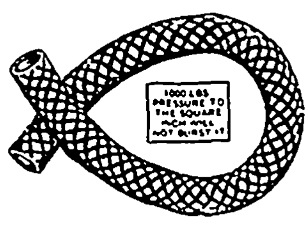
Figure 2 is the diagram from the high-pressure cylinder, and figure 3 the diagram from the low-pressure cylinder when the pumps were running compound; figure 4 shows the diagram from the pump running "Simple" (single pump). The steam-valve mechanism is very simple, and is shown by the sectional view of the pump; (see figure 5). It will be seen that the valve rod (so-called) has no valve directly attached to it as is usual; it merely rotates the auxiliary piston, which latter combines within itself the auxiliary valves. This rotating motion is claimed by the makers to be a great advantage, as it frees the auxiliary piston from possibility of sticking for any reason, causing the pump not only to be positive in its action, but securing uniformity of wear. The rolling movement given this auxiliary piston by means of the "valve rod" and the intermediate swinging pin or tongue, opens and closes the auxiliary ports, which, in turn, control the steam to operate the auxiliary piston, moving said piston back and forth across the main steam cylinder. A plain D slide valve is attached to this auxiliary piston, which valve supplies steam to the main cylinder through the two sets of ports, i.e., the main steam ports and the starting ports. By this cross arrangement of steam chest and valves, a "Simplex" pump can work, it is said, just as well vertically as horizontally.

As regards the amount of steam that can be saved by this system the makers claim that there is no doubt but what the pump will save its own weight in coal in 24 hours' steaming. As an illustration, they state this particular pair of pumps with the attachments weigh about half a ton, and handled during the test at the rate of 17,570 pounds of feed water per hour. Now, this amount of water would supply the boilers necessary to operate a marine engine of the triple expansion type of about 1,100 h.p. The power of the pump as noted in the compound test was 5.61 I.H.P., or about one-half of one per cent. of the power of the engine above given. On the basis of a saving of, say, 70 pounds weight of steam per I.H.P. per hour over and above what would be ordinarily used by a duplex pump of the simple type, it shows a total saving of steam (feed water) of about 393 pounds per hour, or, say, 50 pounds of coal per hour, on a basis of about 8 pounds of water per pound of coal, for the rate of boiler evaporation. This gives a total saving of 1,200 pounds of coal per 24 hours, which, it will be observed, is somewhat more than the weight of the pump, so that I am rather understating than overstating the case. Or, as compared with the single system of feed pump, the cross-compound "Simplex" would save its weight in coal in forty (40) hours. With larger size pumps, and with steam pipes covered, the economy of the "Simplex" compound would be even better than that shown in these tests.

The Mispec, N.B., pulp mill will, it is expected, be in operation by April 1st.

METALLIC FLEXIBLE TUBING.

This illustration shows an article new in the Canadian market and one of great merit. Metallic flexible tubing is devised for the armoring or re-enforcing of rubber hose where great resistant power coupled with flexibility is required. The old method of attaining that end was the using of the best grades of rubber hose of heavy weight, and having it strongly wired. By the use of this new armor, which can be put on the hose by any ordinary mechanic, a three-ply hose is made to withstand the highest steam, hydraulic or compressed air pressure used. It is then claimed to have the durability of steel with the flexibility of rubber hose, and can be made to withstand 5,000 pounds pressure to the square inch. It prevents bursting, kinking and mashing of the hose, and being smooth on the surface is easily drawn over rough ground. Besides being used for hose protection it is adapted for armoring electric cables, protecting the outer insulation and materially increasing the tensile strength where cables are suspended. This tubing can be applied to the inside as well as to the outside, when desired for suction hose. The value does not only consist in the safety feature, but is claimed to be an economizer on rubber hose expense to the extent of 80 per cent., besides preventing loss of time, and guarding against accidents so often caused by bursting hose. It is made of fine, tempered, flat steel wire, galvanized, and as it is made in long lengths, can be cut as desired. Samples for testing purposes, price list and discounts may be obtained from the Canadian agents, Darling Bros., Reliance Works, Montreal.



THE MONTREAL, OTTAWA AND GEORGIAN BAY CANAL.

The subject of the Ottawa Valley route for western traffic to Montreal was discussed at the recent meeting of the Canadian Society of Civil Engineers in a long and comprehensive paper by Henry K. Wicksteed, Mem. Can. Soc. C.E. As The Canadian Engineer has already taken up this subject somewhat extensively, it is not necessary to reproduce the whole of Mr. Wicksteed's paper, but merely summarize some of the leading arguments which we have not before taken up so fully. The claims of the route as a natural trade outlet are strongly urged and the question of strategic value is also gone into. When Mr. Wicksteed was a boy, brigades of Northwest canoes still started from Lachine, ascended the Ottawa, skirted the North shore of Lakes Huron and Superior, and then made their way through the labyrinth of lakes and rivers between the latter and Lake Winnipeg. Coming down to modern times, the Ottawa Valley was accepted without question as the route for the Canadian Pacific Railway. But the settlement and rapidly growing wealth of the southern portion of Ontario fronting on the two lower lakes, the comparative non-progress of the central plains west of the Red River, and the demands of local trade, led to the construction of the Welland and the Rideau canals, and later of those on the St. Lawrence itself. And although, in 1858, the Ottawa river was examined with a view to further extension of canal navigation, and favorably reported upon, it was deemed that the times were not ripe. Still later, and bearing directly upon the question at issue, is the completion of the Ottawa, Arnprior and Parry Sound Railway and the enormous traffic developed by it. Showing that, in spite of "vested interests" and "established trade routes," trade is eager to avoid the long circuit of the St. Clair river and flats, and the dangers and difficulties of navigating them, and of the Detroit river and its mouth.

The Ottawa river is in its lower stretches below the city of Ottawa, a series of broad shallow stretches, flowing over flat limestone rocks belonging to the lower Silurian group. Almost immediately above Ottawa it loses this character, and becomes a Laurentian river, consisting of a number of deep, almost currentless pools, separated or connected by short abrupt falls and rapids tumbling over the hardest of solid rock. The same applies to the Mattawan, and, in an even greater degree, to the French river. The navigable reaches now existing are almost ideal ones, it is stated, with scarcely any improvement, deep and broad enough to admit of high rates of speed with vessels of considerable draught and magnitude. The one important exception to the prevalence of hard granitic or syenitic rocks at the salient points is that of the summit or divide between Trout Lake on the Mattawan and Lake Nipissing, which is largely, if not wholly, composed of drift, the summit being only three feet above Trout Lake and 27 feet above Lake Nipissing. In view of the moderate depth, this is probably the one point at which he would prefer sand cutting to solid rock, as the two lakes would be brought to the same level, and this somewhere near the present high-water level of Nipissing. In connection with the water supply about which some doubt has been expressed, owing probably to a misapprehension of the meaning of a clause in Mr. Shanly's report of 1858, Mr. Wicksteed states, that Mr. Shanly and Mr. Clarke both describe the supply of Lake Nipissing as being inexhaustible, and Mr Clarke goes into more details, and says: "The quantity of water flowing from Lake Nipissing at a low stage was found by careful gauging to be 9,500 cubic feet per second," or 820,800,000 cubic feet per 24 hours, to which must be added the volume of the Mattawan. And he further remarks that this is equivalent to 5,472 lockages of 250x50x12 in each 24 hours. And, finally, "this sets at once at rest any idea of the necessity for a storage reservoir."

It is suggested by the author that in view of the fact that alternate channels exist in many cases, as in almost the whole of the French River, it would be quite possible, and he believes in a majority of instances much cheaper, to use the bed of the river itself for the lock chamber and allow the surplus flow to find its way through the other channels. Downwards through the Mattawan and its lakes and the Ottawa and its expansions to the foot of Deep River the topography is almost constant in its character, and the methods of dealing with obstructions the same throughout. Controlling dams to retain the levels as nearly as may be the same at all stages of the water and short canals with locks at various points. The narrowness of the canyon and the rocky nature of its walls would, it is thought, make it peculiarly easy to drown out minor differences of level and to concentrate the fall within a short distance. Below the Deep River the Ottawa expands into the Allumette Lake, the improvable channel lying to the north of the Allumette Islands by the Culbute channel. Lower down is the Coulonge Lake, and below this the Portage du Fort, embracing a series of rapids and falls extending to the town of that name, giving an aggregate fall of 98 feet in a distance of 10 miles, the most rapid pitch found on any part of the river below Mattawan. The methods of dealing with these falls is the same as for others, drowning out the smaller ones by means of dams, and connecting the pools so formed by short canals and locks. As in the case of the French River, the existence of parallel channels render the improvements easier of accomplishment than they would otherwise be. Below Portage du Fort comes Chats Lake, 18 miles in length, and with the exception of a couple of minor obstructions of good depth (not less than 25 feet) throughout. At the foot of Chats Lake are the Chats Falls, 50 feet fall in 3 miles. Here again the river is divided by islands into many channels, and the same methods of construction are available with a total length of canal only 6-10 of a mile. The river then enters Lac des Chenes, 26½ miles long, with a general depth of from 20 to 30 feet with some few short bars covered by less water, and is now clear of the Laurentian rocks, and the river enters a limestone country which continues to its mouth. Below Lac des Chenes the river drops 60 feet in a distance of 6½ miles. At Ottawa city very considerable works will be necessary, but below the city the present navigation for light draught vessels already exists, and has been treated of before in these columns. It is suggested that the canal should reach Montreal by the Back River, thus creating very valuable water power. A hint of possible developments in power is given in the statement that the low water flow of the Ottawa at Mattawa is 25,000 cubic feet per second; its elevation at that point is 500 feet above the sea. Without counting on tributaries and increase of volume, this represents a total horsepower of 1 1-3 millions, or, reckoning on a 10-hour instead of a 24-hour day, of over 3 millions. Mr. Wicksteed concludes his paper by again calling attention to the breadth and scope of the project, and that it is not a matter of local development or even of the advancement of the Dominion of Canada. It concerns the Empire and the neighboring Republic, and will affect rates and prices over at least one-half of the North American continent. It is not a competitor in any sense with the railways, for it will, as Sir William Van Horne has said, bring them more traffic than it will take away. As we have seen in the case of the Sault Ste. Marie lock, a large portion, if not the major portion, of its traffic will be of its own creation, and of such a nature as could not exist without it.

SERIES ARC LIGHTING.*

BY W. H. TURBAYNE, E.E.

Although the arc light first made its appearance about the beginning of the present century, it is only within the last quarter of a century that it has become generally adopted as an illuminant. About the year 1802 an Englishman, Sir Humphrey Davy, conceived the idea of opening an active electric circuit between two points of carbon. He had at his disposal some 2,000 cells of a simple primary battery, which he connected in series, and from the extreme terminals he brought wires to the ends of which were connected small pieces of charcoal. These he touched together and afterwards drew apart, and in so doing the current bridged the gap which was made, appearing as a flame having powerful heating properties and causing the charcoal tips to glow to an intense whiteness. Thus appeared the first true arc light.

The charcoal points were evidently held in a horizontal position as the stream of vaporized carbon appeared in the form of an "arch," being impelled upwards in the centre by the ascending currents of air; from this phenomenon we derive the name "arc" light. About thirty years after this discovery of Davy's, Michael Faraday discovered and promulgated the principle of electric-magnetic induction. He found that when a steel bar magnet was passed through a coil of wire, properly arranged, a current of electricity was momentarily induced in the coil, which manifested itself similarly as the current from a primary battery, and this important discovery soon led to the development of the dynamo machine for producing powerful currents. Previous to the introduction of these dynamos the arc light was seldom seen outside the laboratory, the expense and annoyance, coupled with the use of acid batteries prohibiting its most extended adoption. With the advent of the dynamo renewed interest was taken in the development of the arc light. Mechanisms called lamps were devised for feeding the carbons together as they wasted away and improvements were introduced into the current generators so that an uninterrupted light could be maintained for considerable periods. Even at this time, however, the usefulness of the new light was limited, as it was found that the feeding of the lamp so affected the current in the line that only one lamp could be operated on a single circuit, and that it was only in certain isolated cases, such as in light-houses, that the light became of value. This was the condition of affairs until some forty years later, when in 1875 Chas. F. Brush, of Cleveland, U S A., and others discovered the principle of differential regulation, which made the operation of several lamps on one circuit and machine possible, and made each lamp an independent unit as regards its feeding properties.

It is not our intention in this paper to follow the art of arc lighting from the date of its inception, and to successively note the advances which have been made in bringing this method of illumination up to its present state, but to offer a brief exposition of the cardinal principles involved, and to shortly describe the functions of the mechanisms employed in a modern system of series arc lighting, in which a direct current of constant value is employed, a system which has been developed since the introduction of the differential lamp of 1875. Such a system virtually comprises a current generator or dynamo, a number of arc lamps and an arrangement of conductors interconnecting the whole in such a manner that the current on leaving the

*A paper read before C. A. S. E., Hamilton, No. 2.

dynamo enters the first lamp and thence passes to the next, and after having successively traversed all the lamps in like order returns to the dynamo, the path of the current therefore being in one continuous circuit within which the total electrical energy produced by the generator is expended. If we take a pair of carbon rods and introduce them into an active electric circuit as above, no light will be emitted until a separation of the carbons takes place, and we find that, with the current strengths adopted in practice, a separation of approximately one-eighth of an inch gives the best results as being free from objectionable hissing or flaming. Such an arc requires for its maintenance an electro-motive force or pressure of about 45 volts, which represents an energy of something over ½ h.p. This energy is expended, in part, in overcoming the resistance of the arc gap, but the greater part appears in the form of heat and the resulting temperature is so concentrated and intense as to cause a vaporization at the surface of the positive carbon, which in the process is brought up to a highly incandescent state, this being in reality the source of light. This vaporization and a combustion of the carbons is accompanied by a gradual wasting away and consequent shortening of same, and in order, therefore, to maintain an uninterrupted light means must be found for feeding the carbons together at a rate proportional to this consumption.

An arc light, therefore, is substantially a mechanism for initially separating the carbons a predetermined distance during continued operation. In studying the arc lamp we will not touch on the innumerable mechanical devices, such as racks and pinions, brake wheels, clutches and bands or chains, which are employed with the one view of gripping and releasing the carbon under the control of the actuating magnets, but we will describe the action of an ideal differential lamp, such, in fact, as may be taken as a representative of the types in extended use. The carbons are separated by an electro-magnet in the main circuit through which the whole current passes, while the feeding is effected by another electro-magnet acting in opposition to and tending to overcome the lifting action of the first. The second magnet is provided with a high resistance winding of fine wire and is connected as a shunt across the carbons, and therefore exerts a greater or lesser influence, accordingly as the carbons are more or less widely separated. Therefore as the carbons are consumed the arc increases in length and coincidently the second magnet opposes the action of the first until finally it overpowers it and allows the carbons to feed forward. In practice so fine a balance is obtained between these two magnets that the carbons are continually feeding forward in imperceptible degrees.

There are, of course, numerous modifications of this principle introduced into different lamps, but, nevertheless, their electrical actions are similar, inasmuch as the separation of the carbons is brought about by the action of the main current itself, while the feeding is accomplished by the action of the circuit derived from this and having as terminals the upper and lower carbons. We may here state that the illuminating power of an arc lamp varies with the electrical power which is expended within it. This electrical power, expressed in watts, is the product of two factors, the electro-motive force or pressure, and volume of current as expressed in the terms volts and amperes respectively. We have seen that the function of the arc lamp is to look after one factor, viz., the pressure or volts across the terminals, consequently in order to produce an unvarying light we must keep the other factor of current volume constant.

The function, therefore, of the generator or dynamo is to furnish a current of constant strength, and, as the lamps are connected in series, and as each demands some 45 volts as explained, it must operate at a pressure sufficient to maintain the number of lamps for which it was designed to operate, together with sufficient marginal pressure to overcome the resistance of the copper lines connecting same. An arc lighting dynamo, like most other dynamos, consists essentially of an arrangement of copper conductors wound over an iron core and rotating within the influence of the poles of a powerful electro-magnet, but, as contrasted with constant pressure dynamos, which include those used in operating incandescent lamps in multiple and those used in furnishing current to stationary and street railway motors, it must possess peculiar properties, which are required to adapt it to the running of arc lamps on series, and notable among which is that a fall of current below the normal strength must be accompanied instantly by a rise in voltage and likewise with an increase of current the voltage must fall. We may here state that while the function of a constant pressure dynamo is to keep the electro-motive force or pressure factor constant, while the current is variable, the constant current or arc dynamo, on the other hand, must keep the current factor constant while the pressure is variable.

In such a machine the magnets are series wound, and the energizing windings are traversed by the full current passing through the circuit of lamps. The iron magnet cores are so proportioned as to be magnetically saturated, that is, are worked to such a high degree of magnetization as to be insensible to slight changes in the strength of the current which energizes them. On the other hand the rotating armature is wound with a number of turns of wire and in reality constitutes a powerful magnet, which is sensitive to current changes, and which meanwhile reacts against and partially controls the magnetic field, which induces the current within itself. As therefore the switching off of a lamp, or the feeding of several lamps at once, would cause the current to rise, the armature magnetization would increase perceptibly, while that of the field magnet would not do so, the former would, therefore, so react against the latter as to reduce the effective magnetic strength and the voltage therefore would fall; the reverse action would likewise take place should one or more lamps be switched on.

In order that this inherent regulating property will be effective over the whole range of the machine, automatic current regulators are employed, which by moving the collecting brushes around the commutator, or by adjusting the field strength, so adjust the electro-motive force and incidentally the current strength as to meet the conditions of the outside load and further assures sparkless operation at the collecting brushes. The power required to drive an arc dynamo will be in proportion to the number of lamps burning at any time, and will vary as the number of lamps in operation. As we have stated that the electric power is the product of the current volume and the electro-motive force, and as the former factor is constant the power delivered will vary, therefore, as the latter factor, which varies only as lamps are added to or withdrawn from the circuit. Arc dynamos, unlike constant pressure dynamos, do not necessarily demand the refinements in speed governing in the movement which drives them, as the inherent regulation of the machine itself will look after any such irregularities as are met with in practice and in fact, with the brushes locked in a fixed position, constancy of current during change of load may be obtained by varying the running speed only. There are other accessories such as automatic lamp cut-outs, which ensure continuity of the circuit should a lamp be defective; lightning arresters for protecting the lines and station apparatus; and loop switches for controlling groups of lamps, which we cannot now cover in detail and which, although essential to the satisfactory and safe operation of such a system, yet are not necessary to the production of the light itself, the generator and lamps being the indispensable adjuncts of a series arc lighting system.

THE PRACTICAL MAN.

Improvement in the Manufacture of Steel Wool.—There is now an established demand for steel wool, and its manufacture is in successful operation. The process by which it has heretofore been produced consisted in clamping together a number of circular disks of thin sheet steel, slowly revolving them, and then with a sharp-edged flat tool taking off thin shavings from the edges of the disks until they were all converted into "wool." The improved process, lately patented, consists in winding a long sheet of thin sheet steel into a tight roll, and then using a flat cutter to shave the "wool" from the end of the roll. This latter process is evidently the cheaper, involving both less labor and less waste of material.

Rubber Packing.—Where rubber packing is used, it will last many times longer and not blow out, if a piece of common wire screen (same as used in window screens), is put on each side of the rubber. It embeds itself in the rubber and holds it together, so that when hot and soft, it cannot blow out.

Case Harden Cast-Iron.—Heat to a red heat, roll in a composition consisting of equal parts of prussiate of potash, sal ammoniac, and saltpetre, pulverized and thoroughly mixed. Plunge while yet hot into a bath containing 2 ounces of prussiate of potash and 4 ounces of sal ammoniac to each gallon of cold water.

Tempering Liquid.—Water, 3 gals., salt, 2 qts., sal ammoniac and saltpetre, of each 2 oz., ashes from white ash bark, 1 shovel full. The ashes cause the steel to scale white and smooth as silver. Do not hammer too cold. To avoid flaws, do not heat too high, which opens the pores of the steel. If heated carefully you will get hardness, toughness, and the finest quality.

To Weld Cast-Iron.—Take of good clean white sand, 3 parts; refined solution fosterine and rock salt of each 1 part; heat the pieces to be welded in a moderate charcoal fire, occasionally taking out and dipping into the composition, until they are of a proper heat to weld. Then lay at once on the anvil and gently hammer together. If done carefully by one who understands welding iron, they will be nicely welded.

Bluing.—Ten lbs. saltpetre, 1 lb. black oxide of manganese. Heat (in a crucible) to a point that will ignite pine sawdust, stir thoroughly Suspend work in a wire basket (keeping basket in motion), until proper color is obtained.

In laying out work on planed surfaces of steel or iron use blue vitriol and water on the surface. This will copper-over the surface nicely, so that all lines will show plainly. If on oily surfaces, add a little oil of vitriol, this will eat the oil off and leave a nicely coppered surface.

Put a piece of resin the size of a walnut, into your babbit; stir thoroughly, then skim. It makes poor babbit run better, and improves it. Babbit heated just hot enough to light a pine stick, will run in places with the resin in, where without it, it would not. It is also claimed that resin will prevent blowing when pouring in damp boxes.

To make a tap or reamer cut larger than itself.—Put a piece of waste in one flute, enough to crowd it over and cut out on one side only. In large sizes (½-inch or over) put a strip of tin on one side and let it follow the tap through. You will be surprised at the result.

NATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS.

A meeting of the executive committee of the Fire and Police Telegraph Superintendents' Association was held in Boston on January 28. The object of the meeting was to revise and amend the constitution and by-laws in accordance with the resolution passed at the third annual convention at Elmira, N.Y., and to outline the arrangements for the next annual meeting which takes place at Wilmington, Del., September 5 and 6, also to suggest topics for papers to be presented at that meeting. It was decided to change the name from the International Association of Fire and Police Telegraph Superintendents to the National Association of Municipal Electricians, which title renders eligible for membership all officials engaged in the electrical departments of municipalities throughout America, instead of only those engaged in the fire and police telegraph departments as heretofore. The associate members are composed of manufacturers and dealers in apparatus and appliances relating to the interests kindred to the association.

SOME METHODS OF SEWAGE DISPOSALS.

BY W. M. WATSON, TORONTO.

For The Canadian Engineer.

In an article on sewage in the October issue of The Canadian Engineer reference was made to the sewage purification systems invented by the late Geo. E. Waring and Jerome Deery, the latter system being the one adopted at Reading, Pa., U.S.A. As the writer did not fully describe the processes it may be interesting to explain the methods employed. The Deery's system is divided into two parts. First, the screening or sieving process, and afterwards the filtering. The raw sewage of the town is led from the central outfall into a tank made circular, or any shape or size suitable to do the necessary work. About two feet from the concrete floor there is a permanent fine grating fixed that fills the whole tank space; on the top of this grate cinders, coke or the breeze of coke is spread to a thickness of over 8 inches. Then on top of the coke there is another fine grating laid on light girders. A little above the top grating one or more half round troughs are carried across the tank, whose top edges are turned over like the rolled edges of a cast-iron bath, and the sewage is brought to the screen from the sewer by way of these troughs, and overflows over both edges in a very thin stream, dropping on the fine iron grating, which retains the floating matter, while the heavy solids remain in the bottom of the half round or D shaped trough; it then worms its way downward through the bed of coke, and drops through the lower grate to the concrete floor, where it is collected and sent to the filters in pipes.

Each tank is carefully enclosed over the top of the troughs, which forms an air space between the top cover and the face of the upper grating, and between the lower grate and the floor. This open space is used to aerate the sewage as it is falling from the troughs to the upper grate, and as it drops from the lower grate to the floor. The atmosphere is introduced into the two spaces by air passages extending from one side of the tank to outside the building—they are like the air chutes serving a hot air furnace—and on the opposite side of the tank there are corresponding air flues extending to an annular hot-air flue constructed in the long chimney that serves the steam boiler. The smoke and heat pass up the centre of the chimney through the interior of an iron tube or tile pipe, and all around this iron tube there is arranged a wide space, i.e., an annular flue, which attracts a large amount of heat from the central smoke tube, and the heat causes a keen draught; thus all the sieving tanks have a strong current of fresh air continuously passing both under and over the bed of screening coke, with the object of aerating and supplying oxygen to the sewage as it is distributed on to the upper grate, and when it is discharged from the lower grate to the floor. After aerating the sewage the air passes onward and upward through the annular flue of the chimney to the outside.

The coke sieves soon become choked with dirt and fat contained in the sewage, and when necessary the troughs and upper grating are removed, then the wet, dirty coke is taken out and conveyed to a brick vault having a graded floor, over which a false floor is constructed of iron pipe or bars covered with fine wire netting; on this floor the wet coke rests. All round the vault walls are covered with 1-inch steam heating pipes, and there is a flue to convey the vapor to the annular flue of the chimney. When all the dirty coke is removed from the sieving tank to the drying vault the doors of the vault are closed, and high pressure steam from the boiler is passed into the interior pipes, which quickly heats up the coke; the fat melts and dropping to the floor is afterwards collected, placed in barrels, and disposed of. The wet is evaporated and passes up the chimney, and the dirt is dried into fine dust, and afterwards (the inventor informs us), the coke can be re-used for sieving purposes, or used for fuel to generate steam, and in this way the inventor gets rid of the sludge difficulty, which in many other processes is very troublesome. This is certainly a better method than using pumps and sludge presses, though it will be expensive; but the expense might be reduced considerably by dropping the aerating features and all the appliances used for that purpose, because it is of no advantage to aerate sewage during the time it is passing through the sieve and getting screened, in fact, experience has proven that if both air and light are excluded at that time better results are obtainable.

We now come to the filtering process. The filters are built on two flats; one set of filters is constructed immediately over the other, having an air space of over 8 feet between the top of the floor filters and the underside of the elevated filters, which are built on pillars and cross girders, and the reservoirs or filter tanks are constructed in sizes suitable for being easily cleaned or repaired. The sewage from the sieving tanks is conveyed in pipes resting on standards fastened to the tank partitions, and from the pipes the sewage flows over D shaped troughs carried across the surface of the filter—one trough about every 2 or 3 feet—in such a way that the sewage falls on the filtrate evenly and in thin films, thus securing another aeration before entering the bacteria filter, which should kill any putrefactive bacteria that may be left in the sewage. Whether this is any advantage or not I will leave others to judge, but we know that the putrefactive bacteria is food for the purifying bacteria, and on that ground the filter seems to be the place where they ought to be destroyed. The bottom of the higher flat of filters is fine open grating on which the filtering material rests, and as the sieved sewage passes downward through the filtrate it drops out through the porous grating and falls on top of the filtering material contained in the floor filters, in drops, or fine spray, and in this way the fluid is expected to secure another good airing. Under the filtering material of the lower or floor filters there is a net work of tile pipes graded in sections, in a way that the highest point of each branch terminates in the centre of each filter tank, and all the branches draining each filter are connected to a ventilating tube, extending from the head of the combined drains, upward, through the centre to about two feet above the surface of the filtering medium. The object of this is to draw away the light gases and introduce the heavier oxygen to the underside of the filtering material, and to ensure this being done all the drain pipes are perforated with numerous holes, and the discharge ends terminate into a large open culvert from which any amount of atmospheric air may be drawn. Filters built one over another, with open air spaces between each other, were used in England several years since, and found of no advantage whatever; because the only agents that properly purify sewage and prevent it ever after setting up putrefaction, are the reducing bacteria, and the exposure of the sewage for a sufficient length of time (not less than 30 minutes), to the action of the oxidizing organisms that have a proper resting place made in a way that every particle of fluid is compelled to pass in front of the microbes, which are so small that Dr. Richards has proved that it takes a billion and a quarter to weigh one grain. This bacteria workshop is named a filter, and the filter, like every other healthy workshop, must be well and properly aerated to supply the organisms with at least three times the bulk of air to one of sewage, or perfect purification must not be expected. Therefore, if any person gives his whole energy to aerating the fluid sewage itself, and ignores the value of aerating the filter or microbe workshop, he cannot discharge a purified effluent of sufficient purity to be safe, and the discharge from his works will probably afterwards set up putrefaction that will undo any work previously done. The writer of the October article states that 1,143 gallons of sewage is passed through each square yard of filter space per day. In that case then the filters are not bacteria filters, but simply sieves that fine the fluid and extract the solids, but cannot purify the sewage. First, because bacteria could not hold their position in a filter having such a rapid stream passing through it, and if ever any of the microbes should secure a lodgment in the filtrate material they would be washed out and forced along with the stream. Second, even were it possible that such filters could be charged full of purifying bacteria they would not have sufficient time allowed, with such a rapid stream rushing through them to do much, if any good work.

It is almost idle to expect that more than about 200 gallons per yard per day of 24 hours' continual working, can be well purified by the microbes, even when properly housed in a well arranged filter composed of ⅜-inch or ½-inch cubes of coal, clinker, coke, gravel or other hard material, and when the oxygen is introduced by mechanical appliances regularly and evenly throughout all the intersections of the filtrate material. So that the system will need a filtering area about six times larger than described to ensure an effluent that will be properly purified in a way that it cannot afterwards set up putrefaction and nullify the work previously done. This is the opinion of experienced experts, and will also be shown by the description of Col. Waring's system hereafter described.

Geo. E. Waring's system consists of cleaning sewage by purifying bacteria, and is quite different to such methods as Cameron's, of disintegrating and fermenting the sewage, to split it up into particles and let free the gases in a primary settling tank, using the anaerobic microbes for the purpose, before the sewage is sent to the bacteria filters to be purified by the aerobic or purifying microbes. It is also different to Lomax's process of intermediate flushing, practised at Chorley, Eng., by the International Sewage Purification Co., of London, Eng., which was fully explained in several of the back numbers of this paper, and to a committee of the Toronto and London city council early in the present year, and again dwelt upon on page 221 of the December number.

The Waring system, and also the Deery system, does away with the very expensive practice of collecting, pumping and pressing the sludge, for they each destroy it; nor do they follow the Chorley example of using expensive precipitants, a method which is fast dying out, and is only necessary where the sewage has a large amount of tenacious chemicals in it, which is seldom or never in Canada. Col. Waring uses mechanical appliances to force air into the filter, and between all the interstices of the small cubes stored in the filter, continuously, and by so doing he supplies the bacteria housed in the filter with all the oxygen they require, without stopping the flow of sewage on to the filter to be aerated, as is done by the Lomax system of intermediate flushing, and then stopping the flow, and allowing the filter to stand idle for a period. On this ground it is held by the inventors of the forced draught or continuously aerating system that double the work can be accomplished than can be done by the Lomax intermediate system.

This mechanical method of aerating sewage filters was first invented and patented by Sidney R. Lowcock, 35 Waterloo street, Birmingham, Eng., about 1897, and lately taken hold of, and, I believe, patented in the United States by the late Col. Geo. E. Waring, jr. The way Mr. Waring applies the process is very ingenious and worth studying, for he very properly avoids showy and expensive arrangements and appliances; he also studies to assist nature to do the work rather than copy the example of many engineers, who put expensive obstacles in the way of the little bacteria doing the work they were created and appointed to do. Therefore, the process can claim to be a natural system, which cannot be said of others that have been described. He first collects the raw sewage into an elevated tank, and from this tank the sewage flows by gravitation through pipes to each roughing filter, which sieves the sewage, and at the same time gives ample time for the anaerobic bacteria to do their part of the work of cleansing the sewage before being totally destroyed themselves. These roughing filter tanks are in two divisions, divided by a light partition into two halves, which extends from the top to about 6 inches from the bottom. At this point there is a false bottom of grating or bars on which about 3 or 4 feet in thickness of coke is placed, and the sewage passes downward through the coke on one side of the middle partition, then bends under the bottom edge of the partition, ascending through the coke of the other half of the tank, afterwards overflows in a thin film over the lip constructed on the side of the tank, where it receives some aeration, then it is distributed by suitable channels, evenly over the surface of the filters.

These roughing filters like Deery's sieves get clogged with dirt and fat until the sewage refuses to pass through the coke, then the sewage is turned on to another pair of roughing filters, and the sewage remaining in the tank is drained out of the clogged coke by an outlet at the bottom, and when quite empty a strong current of air is forced into the vacant space between the concrete and the false grated bottom, and is gradually forced upward through the interstices between the particles of coke, which in time supplies oxygen necessary to start bacterial activity, and oxidization at once begins, and the accumulated filth and fat is destroyed by the purifying organism (so Col. Waring assures us), and in this way he gets rid of all the sludge extracted from the sewage at a trifling expense of running a fan by electricity. This is a big step in advance of using precipitants and sludge presses. The filters are filled about 3 or 4 feet thick with small crushed and sieved coke, covered about 2 inches thick with clean, fine sand, to prevent the sewage from entering the coke in the filter quicker than the bacteria can purify it, so in reality the sand is made to act as the regulating valve, to measure and distribute the sewage in needed quantities to the bacteria lodging in the cells of the coke filtrate below.

Underneath the coke there are placed perforated tile pipes on the fish bone plan, which do double duty, for they collect the effluent falling from the coke filter and convey it through an interception trap (which is here necessary to prevent the escape of air that is discharged by the fans to the filtering material) to the culvert carrying the effluent away, and they also form the carrying flues to distribute the air from the fan to the underside of the filtrate, and it is distributed at a pressure sufficient to force its way upward through the intersections of the 3 or 4 feet of small coke and the 2 inch blanket of sand, efficiently removing all the hydrogen generated by the bacteria, and supplies them with plenty of oxygen to maintain their constant activity. Thus when the filter has got filled with the purifying bacteria it needs only to have the sewage carefully and slowly distributed evenly over the surface, and wind at a proper pressure continuously forced up through the filtering material from the bottom; and it will continue to work forever, without any cleaning, raking or disturbing in any way, but stop the wind for a short time or increase the flow of sewage to 1,100 gallons per yard a day, and out will go the valuable bacteria with the rapid stream, and the filter will be worthless until another set of bacteria is bred and installed, which would take at least two months.

The value of a filter well stocked with the purifying bacteria is very great, and needs careful handling, therefore every appliance must be duplicated and constantly watched, so that should any accident or stoppage occur, another set can be at once started to take the place of the disabled apparatus, and prevent the life of the microbes from being jeopardized. There are simpler methods than either of the three above described that have worked for years giving a fairly pure effluent, but their simplicity prevents them being noticed, for people looking for such sewage purifying systems look for something large and intricate, requiring a number of hands. The one at Chorley is among the most expensive ones, both in plant and management.

DEGREES IN SCIENCE AT MCGILL UNIVERSITY.

The Corporation of McGill University has decided to grant the degree of B Sc. (Bachelor of Science) in the faculties of arts and of applied science. Candidates for this degree in the faculty of arts must pass a matriculation examination in English, with history; another language, mathematics, and either physics, chemistry, botany, physiography, an additional language and additional mathematics. In the faculty of applied science additional mathematics (including trigonometry) must be taken at matriculation, and the above options are not allowed. These regulations apply only to the examinations for this and next year. In 1901 another language will be required in both sections, with the option of elementary science in the applied science faculty; and it is hoped by that time the matriculation examinations in both faculties will be placed on the same footing. Candidates for the B.Sc. in the faculty of arts who intend to take medicine must take Latin as one of their subjects at matriculation. A board of matriculation examiners was appointed to control the matriculation examinations in the various faculties, and assimilate the conditions. The B.A. Sc. degree (Bachelor of Applied Science) is changed to B.Sc. Graduates who have taken the former degree may retain that title or drop the word "applied," at their choice.

The B.Sc. students in the faculty of arts will take the following course: First year, English, French, German, mathematics and physics. Second year, English, logic, French, German, chemistry and mathematics or botany or zoology. In the third and fourth year the B.Sc. student will specialize in selected groups of the following subjects: Mathematics, physics, astronomy, chemistry, zoology, botany, geology, physiology, human anatomy. In the B.Sc. diplomas the word (arts) or (applied science) will appear in the diploma to indicate the faculty in which the candidate has prepared for his degree. The M.Sc. will be granted to Bachelors of Science in both faculties, and to Bachelors of Arts of (a) at least one year's standing, provided that they have for one year taken a graduate course of study in science, previously submitted to and approved by the faculty; have passed an examination at the end of the year; and have, if required of the faculty, presented a satisfactory thesis; or or (b) at least two years' standing, if they have not taken a graduate course of study in science, provided that they have presented a satisfactory thesis, and passed a special examination for graduation. In the faculty of applied science the M.Sc. will supersede the degrees of Ma. E. (Master of Engineering), and M A.Sc. (Master of Applied Science). The degree of Doctor of Science (D.Sc.) will be granted to those who have already taken the degrees of M.A., M.Sc. or M.D. It will be given for scientific attainments or research work submitted to the faculty. It will not be an honorary degree, and will only be open to graduates of at least five years' standing.

—The Self-Propelled Traffic Association, of Liverpool, England, has determined to hold another series of trials of motor vehicles for heavy traffic, probably in September, 1899. The previous tests held under the auspices of this association were conducted last year from May 24 to 27. Those interested should address the secretary of the association, E. Shrapnell Smith, Royal Institution, Colquitt street, Liverpool.

REFRIGERATING MACHINERY.

J. & E. Hall, Ltd., inform us that their orders for machines to be fitted on board ship have been well maintained throughout the year, besides a large number for land, this being notwithstanding the fact that they have produced these machines at an average of fourteen per month. At the present time their orders in hand amount to 84 machines to be supplied for ships, and the orders for land machines have also increased. They mention a few of those ordered: For H.M. Admiralty, machines for H.M.S. "Ocean" have just been completed, and those for H.M.S. "Canopus" and H.M.S. "Andromeda" are in progress. The following additional ships are to be fitted: H.M.S. "Formidable," "Pandora," "Bulwark, "Sheerwater." Other machines are in hand for the Russian volunteer fleet, the Japanese Admiralty and Dutch Admiralty. The White Star Line S.S. "Oceanic" is being fitted for the chilled beef trade, and two new ships of the Atlantic Transport Co., for the same; also eight ships for the Hamburg American Steam Packet Co. For the frozen meat trade five steamers to carry 2,000 tons each, of which two ships for Messrs. Tyser & Co., also three ships of the Chargeurs Reunis Co., and two more ships to carry 3,000 tons each. For the importation of butter and bacon from Denmark ships have recently been completed for Thomas Wilson, Sons & Co., United Steamship Co. of Copenhagen. For the Canadian butter and produce trade two ships for J. & A. Allan & Co., are in hand. The Union Steamship Co. have recently had two ships fitted and two more are to follow; also Donald Currie & Co, two ships for importing fruit from the Cape and for preserving the passengers' provisions, etc. Elder, Dempster & Co. also have ordered machines for six ships, and Japanese companies increase the total by six. Machines for land purposes are to be supplied for the Riverside Cold Storage Co., Liverpool, the ultimate capacity of the stores being equal to one million cubic feet of cold storage, half of which is to be started upon at once, and 50 tons of ice per day is to be produced. The Hastings Cold Storage & Ice Co. are also to have a plant completed there by next spring; the Burmah Oil Co. have just ordered a fifth large machine for cooling oil, at their works at Rangoon. There are over 40 on this list of land machines which comprises machines for cold storage, ice making, dairies, breweries, hotels, chocolate cooling, water cooling, etc.

THE MASTER PLUMBERS' ASSOCIATION, MONTREAL.

The Montreal Master Plumbers' Association at their last annual meeting elected the following officers for the ensuing year: Hon.-pres, J. Date; pres., J. Watson; first vice-pres., E. Lesperance; second vice-pres., J. A. Sadler; third vice-pres., Joseph Thibault; sec., N. Lariviere; English cor.-sec., J. W. Hughes; French cor.-sec., J. Lamarch; fin.-sec. J. Montpetit; treas., P. C. Ogilvie. Committees, Sanitary—P. J. Carrol, J. Young, D. Gordon, Jos. Gibeau, N. A. Egan, Arbitration—J. Atcheson, A. Martin, J. Giroux, W. A. Stephenson, R. Egan; Apprenticeship—E. C. Mount, W. J. Graham, H. Brosseau, J. Lafranc, J. Ballantine; Legislative—J. W. Harris, G. Denman, J. C. Brunet, H. Roddon, T. O'Connell. The association will devote a great deal of time to the revision of the plumbing bylaws of the city of Montreal during the year, in the hope that substantial changes in the present regulations may be obtained.

WATER POWER IN THE OTTAWA VALLEY.

There will shortly be published in Ottawa a map showing the water powers available within a radius of 45 miles of the city of Ottawa. An approximate estimate of each power, and leaving out small powers of from 10 to 20 h.p. to be found on every small stream north of the city, aggregates the enormous amount of 890,000 h.p. This is a very conservative estimate, our correspondent writes, based not even on the mean volume of water on each stream, but on a stage between mean and low water. The most important feature of the powers in this district, however, is the fact that the source of supply of each stream rests in large lakes that at small expense for retaining dams can be converted into enormous reservoirs by means of which the powers can be largely increased and regulated during seasons of extreme high and low water. Within 25 miles of Ottawa is the vast water power of the Chats Rapids. It is estimated (from regular survey), at 120,000 h.p., not a pound of it being now utilized. With unlimited supplies of pulpwood, tan bark, furniture wood, mica, phosphate of lime, plumbago, feldspar, iron and workable mines of galena and gold, and the cheapest and easiest controlled power in the world, Ottawa might be said to be almost destitute of manufactures, and many of these valuable powers are lying idle in the hands of speculators. The vast possibilities of the electric furnace; the fact that so enormous a power can be concentrated at Ottawa by means of the dynamo, and a few miles of copper wire is attracting the attention of manufacturers and capitalists in a way that will, in a very few years, make the Canadian capital something more than a political centre.

MILEAGE OF ELECTRIC RAILWAYS IN ONTARIO.

Editor CANADIAN ENGINEER:

Can you inform me as to the number of miles of electric railways in operation in Ontario. TROLLEY.

Toronto, January 21st.

[The total mileage of electric railways in the province of Ontario to December 31st, 1897, was 291 miles. The figures for 1898 are not yet available, but no important additions have been made during the year.—ED.]

TO SQUARE A SQUARE.

Editor CANADIAN ENGINEER:

I am a subscriber to The Canadian Engineer and wish to ask you for the best way to square a carpenter's square. Yours truly, S. Q. R.

[To test the accuracy of a carpenter's square it may be compared with some standard of recognized correctness; as the standards set up by the various governments, or a square by a maker whose reputation for accuracy is established, as Brown & Sharpe, may be used.—ED.]

ASSOCIATION OF ONTARIO LAND SURVEYORS.

The fourteenth annual meeting of Land Surveyors of Ontario, being the seventh annual meeting since the incorporation of the present association, was held in the rooms set apart for the use of that body in the Parliament Buildings at Toronto on the 28th February, and 1st and 2nd of March. Although, for different reasons several of the regular attendants at the annual meetings were unable to be present on this occasion their places were filled by members from a distance, who enjoyed a rare opportunity of meeting and interchanging ideas with their brethren. Among those present were: A. W. Campbell, H. L. Esten, R. P. Fairbairn, Prof. Jno. Galbraith, K. Gamble, Geo. B. Kirkpatrick, W. A. McLean, C. J. Murphy, Villiers Sankey, Henry Smith, L. B. Stewart, A. J. Van Nostrand, A. P. Walker, A. T. Ward and J. F. Whitson, all of Toronto; Walter Beatty, Delta; Lewis Bolton, Listowel; H. J. Bowman, Berlin; John Davis, Alton; James Dickson, Fenelon Falls; J. D. Evans, Trenton; W. B. Ford, Hamilton; F. L. Foster, Mine Centre; P. S. Gibson, H. H. Gibson and W. S. Gibson of Willowdale; James Hutcheon, Guelph; T. H. Jones, Brantford; Hugh McGrandle, Huntsville; A. J. McPherson, Galt; J. L. Morris, Pembroke; Alexander Niven, Haliburton; J. A. Paterson, Hamilton; John Roger, Mitchell; Geo. Ross, Welland; H. DeQ Sewell, Rat Portage; Angus Smith, Ridgetown; J. W. Tyrrell, Hamilton; W. F. Van Buskirk, Stratford; H. K. Wickstеed, Cobourg, and T. H. Wiggins, Cornwall. During nearly all the sessions the chair was occupied by P. S. Gibson, president of the association, H. J. Bowman, the vice-president, presiding during the remainder of the meeting.

The morning of the first day having been devoted to committee work the general meeting opened at 2 p.m. After an opening address by the president the report of the Council of Management (including the reports of the Board of Examiners and secretary-treasurer), was read by Major Sankey, and the financial statement submitted to A. W. Campbell and H. L. Esten, auditors. Reports were also presented by the committees on Publication, Repository and Biography and Polar Research. A paper on "Progress of Gold Mining in the Central Belt of the Rainy River District," prepared by H. W. Selby of Dinorwic, and read by H. DeQuincy Sewell, gave a good description of the work being done in developing the natural resources of that section of the province. A paper by F. L. Foster, who has recently returned from a two years' sojourn in the Seine river region, entitled "Surveying in the Mining Lands of Ontario," described the life led by practitioners in the remote parts of the province, giving some of the advantages and disadvantages to be met with in that style of practice. The chairman of the Committee on Exploration presented the report of that committee, comprising some valuable hints as to work required to be done in that direction.

In the evening a paper prepared by C. Unwin, one of the veterans of the profession, was read by his former partner, H. L. Esten, as illness prevented the attendance of the author. Experiences never to be forgotten were detailed, and recalled to the minds of the older members present lively recollections of hardships endured by each in his earlier battles with the wilderness.

A paper on "Some Incidental Benefits from the Growth of Forests," prepared by Thos. Southworth, clerk of Forestry, was read by J. F. Whitson, as the writer had not yet recovered from the effects of grippe. We will discuss this article more at length in a future issue. L. B. Stewart, lecturer in surveying at the School of Practical Science, Toronto, read a carefully prepared paper on "Azimuths," giving formulae for establishing meridians by observations of stars in the vertical of polaris. There is no doubt that when this method becomes familiar to surveyors engaged in work in which observations are frequently required it will be found to be a great boon. "Explorations" was the subject of a paper by James Dickson, inspector of Crown Land Surveys, and it was treated in an able manner. The prevailing idea that the life of a land surveyor during a season in the woods is a perpetual picnic was held to be erroneous, as shown by the effect on the average young man who tries it with that idea uppermost in his mind. It was suggested that for obtaining necessary information respecting the unsurveyed lands of the province, the Government should cause exploratory lines to be so run as to divide the territory into blocks eighteen miles square, these lines to serve as exterior boundaries for future townships.

The morning session of Wednesday, 1st March, was opened by a paper by James Warren of Walkerton, on "The Calculation of Strains in Bridge Trusses," read, in the unavoidable absence of the writer, by J. L. Morris. It was followed by a paper by A. W. Campbell, provincial instructor in road-making, on "Bridges and Culverts for Highways." Both these papers were well received and discussed by members who engage in municipal engineering work. A short paper on "The Use of the Compass for Railway Surveys," was read by J. D. Evans, who was well supported in his statement that the compass, when properly used possesses great advantages over the transit for preliminary work, as its results in the field are more accurate than the plotting of the work can be, while the time required for running a given distance is very considerably lessened by the use of the former instrument. In the afternoon a paper by A. Niven on "The Survey of the Boundary Line Between Nipissing and Algoma Districts," gave a graphic description of the hitherto almost totally unexplored region traversed by a meridian line from the Canadian Pacific Railway to a point on Moose River, near its outlet into James Bay. Major Sankey, who during the past summer represented the City of Toronto in an exploration survey to determine the feasibility of a railway to that seaport, added some valuable information during the subsequent discussion. Next on the programme came a most interesting paper by Lewis Bolton, entitled "A Trip to Yukon and Return," dispelling the common idea that the hardships to be met with in a journey to the land of untold mineral wealth are such as need deter any man of determination and a moderate degree of vigor from undertaking it.

In the evening the annual dinner of the association was held at McConkey's parlors, and proved a most pleasing relaxation. The toast "Canada" was responded to by Sir Sanford Fleming, whose reminiscences of early days were very warmly welcomed. Aubrey White, assistant commissioner of Crown Lands, responded to "Ontario." "Sister Societies" was spoken to by W. T. Jennings, president Can. Soc. C.E., J. Galbraith and Chas. Rust, city engineer, Toronto; Kivas Tully responded to "Learned Professions" on behalf of the architects T. Harry Jones, Brantford, won immense applause by reciting Kipling's poem, "Sergeant What's His Name," which fitted well into the strongly imperialistic sentiments of the gathering.

At the Thursday morning session, 2nd March, the presentation of the report of the Committee on Topographical Survey was made by John Roger in the absence of the chairman, Otto J. Klotz. No actual work has yet been begun in this class of survey, but it is expected that in the near future the Dominion Government will inaugurate this much needed work. Vice-President H. J. Bowman next read a paper on "Open Questions," one of the chief of which was the improvement of high ways by means of systematic State aid following the methods now in vogue in the wealthier States of the Union. The report of the Committee on Drainage with "Question Drawer" was read by the chairman, George Ross, and discussed by the members. A. Niven, chairman of the Committee on Land Surveying, presented the report of that committee with Question Drawer containing problems met with by members in all parts of the province; the opportunity of having an advisory board composed of the most experienced practitioners in the association appearing to have been appreciated by those whose practice included these knotty points. "Drains of Field Tile," was the title of a paper read by Captain W. F. Van Buskirk, dealing with an ever increasing class of work within the practice of the majority of the members, as agriculturalists become more convinced that drains, to be effective, must be scientifically constructed.

Afternoon Session.—T. H. Wiggins read a paper descriptive of the "Payne River Drainage Scheme" thus adding a considerable amount of valuable information to the collection already appearing in the annual reports of the association, and from which the work of formulating schemes for the reclamation of waste lands and estimating the probable cost will be greatly diminished. The report of the committee, composed of V. Sankey, G. B. Kirkpatrick and A. Niven, specially appointed last year for the purpose of taking cognizance of any legislation affecting Ontario land surveyors, was presented by V. Sankey, and a bill for the incorporation of the Canadian Society of Civil Engineers in Ontario, was discussed at length. The committee was continued in office with the addition of H. K. Wicksteed and J. L. Morris to its numbers. The president read a circular from the Ontario Historical Society explaining the objects of the exhibition to be held, and bespeaking the co operation of the members of the association.

Owing to lack of time the following papers and reports were, upon motion, ordered to be taken as read and printed in the Proceedings, viz.: "Permanent Way," by W. E. McMullen: "Our Professional Standing," by B. J. Saunders; "Perche Drain Dredging Work," by J. H. Jones; "Dominion Lands Surveys," by C. F. Aylesworth, jr.; "A Suggested Amendment to the Ditches and Watercourses Act," by Geo. Smith, and the reports of the committees on Engineering and Entertainment. A resolution was passed conveying the sympathy of the association to the families of the following members whose deaths had been reported since the date of the last annual meeting; Jos. DeGurse, Albert Fowlie, Thos. B. Gilliland, T. R. Hewson, Sherman M. Malcolm, J. H. Ogilvie and James A. Macmillan. The secretary was instructed to address letters to Jos. Kirk, M. C. Schofield, F. H. Lynch-Staunton and C. Unwin, expressing regret that they had been unable to be present at the meeting and conveying the good wishes of the members in attendance.

In the nominations of officers for the association year 1899-1900 H. J. Bowman, of Berlin, was elected president; F. L Foster, Mine Centre, vice-president; A. J. Van Nostrand, secretary-treasurer, and A. W. Campbell and H. L. Esten, auditors, all without contest. F. L. Foster having resigned his position as member of council the following candidates were nominated for the three vacancies on the Council of Management, viz., James Dickson, Fenelon Falls; H. K Wicksteed Cobourg; W F. Van Buskirk, Stratford; A Niven, Haliburton; G. B. Kirkpatrick, Toronto; Jas. Hutcheon, Guelph; Jno. Davis, Alton; A. P. Walker, Toronto, and George Ross, Welland. The voting will be by letter ballots, which will be opened by the secretary-treasurer in the presence of Captain Gamble and J. F. Whitson, scrutineers, on Thursday, April 6. After votes of thanks had been tendered the retiring president and chairman of the council, and graceful acknowledgments returned, the meeting, one of the most interesting yet held, was closed with "God Save the Queen."

—John Burns, the English labor leader, has a forcible article in the Co-operative Wholesale Annual on the risks and casualties of labor. He estimates the number of industrial accidents every year in the United Kingdom at 400,000—which is probably somewhat below the mark. He points out that a thousand miners are killed every year, that 1,334 British sailors were lost at sea last year, that more men were killed in making the Barry Dock than at Balaclava, and that more workmen are killed and injured every week in London alone than in the recent Egyptian campaign.

THE CANADIAN MINING INSTITUTE.

The Canadian Mining Institute held its annual general meeting at the Windsor Hotel, Montreal, March 1st, 2nd and 3rd, when the following papers were read: On Mine Costs; by John E. Hardman, S.B., Montreal; Swedish Iron Metallurgy and its application in Canada, by Dr. James Douglas (president American Institute of Mining Engineers), New York; on the Sampling of Argentiferous and Auriferous Copper, by Dr. A. R. Ledoux (vice-president American Institute of Mining Engineers), New York; on the West Kootenay Ore Bodies, by Messrs. R. G. McConnell and R. W. Brock, Ottawa; Explorations for Iron Ore in Newfoundland and Cape Breton, by C. A. Meissner, Londonderry, N.S.; Notes upon the Development of the Iron Ore Industry, by John Birkinbine, M.E., Philadelphia; on Hydraulic Mining, by John B. Hobson, M.E., Quesnelle Forks, B.C.; some notes on Prospecting for Wolframite or Tungsten in Cape Breton, by C. A. Meissner, Londonderry, N.S.; An Improved Method of Feeding Water to the Stamp Mill Mortar, by Bernard MacDonald, M.E., Montreal; on Hydraulic Elevators for Gold Gravels, by James Champion, C. & M.E., Barkerville, B.C.; on the Gold Measures of Nova Scotia and Deep Mining, by E. R. Faribault, Ottawa; Across the Pitch versus Up the Pitch, by O. E. S. Whiteside, Ba. Sc., M.E., Anthracite, N.W.T.; the Designing of Metallurgical Machinery, by A. C. McCallum, Peterboro, Ont.; the Adjustments and Control of the Stamp Mill, by Prof. De Kalb, Kingston, Ont.; on the Occurrence of Cinnabar in British Columbia, by A. J. Colquhoun, M.E., Savonas, B.C.; on the Establishment of Science Classes in Mining Centres, by A. H. Holdich, Nelson, B.C; on Metallurgical Standards, by F. T. Snyder, Vancouver, B C; on the Occurrence of Free Milling Gold Veins in British Columbia, by W. Hamilton Merritt, Toronto; Electrical Transmission and Electric Drills, by F. Hille, M.E., Port Arthur; Smelting Conditions in British Columbia, by R. C. Campbell Johnstone, M.E., Nelson, B.C.; A New Device for Thawing Dynamite, by Daniel Smith, Kingston, Ont; on Acetylene as a Mine Illuminant, by Andrew Holland, Ottawa; A Review of the Canadian Iron Industry in 1898, by George E. Drummond, Montreal; Description of the Sultana Quartz Lode and the Sinking of the Burley Shaft on Bald Indian Bay, by J Burley Smith, M E., Winnipeg; on the Lillooet Gold District, B C., by F Cirkel, M E., Vancouver, B.C.; on Palaeontology in its Relation to Mining, by Dr. Henry M. Ami, Ottawa; on the Gold Bearing Sands of the Vermilion river, by J. W. Evans, C. & M E., Trenton, Ont.; Notes on the Driving of the Simplon Tunnel (Swiss Alps), by Leopold Meyer, M E., Ottawa; Notes on Mining in Quebec by J. Obalski M E., Quebec; A Notable Canadian Deposit of Chromite, by J. T Donald, M.A, Montreal; on the Petrographical Character of the Ore from the Republic Camp, by Dr. Frank D. Adams, Montreal.

The following subjects illustrated by lantern projections, were also presented: The Designing of Metallurgical Machinery, by A. C. McCallum, Peterborough; Prominent Mines and Smelting Works of the Dominion, by Dr. Geo. M. Dawson, C.M.G., Ottawa; View of Work on the Chicago Drainage Canal, by James F. Lewis, Chicago.

The fact that the meeting was in progress as this issue of The Canadian Engineer was going to press makes it impossible to give a satisfactory report of the convention in this issue, and we shall return to the subject next month and discuss some of the papers quite fully. The following were the officers elected: President, John Hardman, S.B.M.E., Montreal; vice-presidents, Messrs. W. A. Carlyle, Rossland, B.C.; Dr. George M. Dawson, C.M.G., Ottawa; Hiram Donkin, Glace Bay, Cape Breton and George E. Drummond, Montreal; secretary, B. T. A. Bell, Ottawa; treasurer, A. W. Stevenson, C.A., Montreal; council, E. T. Galt, Lethbridge, N.W.T.; S. S. Fowler, Nelson, B.C.; Robert R. Hedley, Nelson, B.C.; Wm. Blakemore, Coal Creek, B.C.; C. A. Meissner, Londonderry, N.S.; J. R. Cowans, Springhill, N S; Wilbur L. Libbey, N. Bookfield, N.S.; Clarence H. Dimock, Windsor, N.S.; George R. Smith, M.L.A., Thetford Mines, Que.; J. Obalski, Quebec; Dr. Frank A. Adams, Montreal; R. T. Hopper, Montreal; James McArthur, Sudbury, Ont.; A. Blue, Toronto; Chas. Brent, Rat Portage, Ont., and Eugene Coste, Toronto.

A. E. WILMOT, MEM. CAN. SOC. C. E.

A. E. WILMOT.

The portrait and biographical sketch of A. E. Wilmot was received too late to appear in the February issue of The Canadian Engineer along with the other new officers of the Canadian Society of Civil Engineers, to whose council Mr. Wilmot was elected at the last meeting. In 1868 Mr. Wilmot was assistant engineer on Eastern Extension Railway (now part of the Intercolonial Railway), between Painsac Junction on the St. John and Shediac Railway, and Amherst, N.S. From 1869 to 1874 he was assistant engineer on the survey and construction of the Intercolonial Railway, Miramichi district, and in 1874 to 1876 had charge of a division on the construction of the M.N.C. Railway between Montreal and Ottawa. In 1876 to 1879 he was employed on construction of Canada Central between Renfrew and Pembroke, and on surveys of C.P.R. 1879 to 1881 had charge of a division of 40 miles on construction of the C.P.R. west of English river. In 1881 to 1884 Mr. Wilmot made final location, and had charge of construction of 30 miles of C.P.R. between Harrison river and Yale, B.C., and in 1884 to 1886 he was engaged by the Dominion Government on survey on railway belt from Port Moody, 180 miles easterly, and by Provincial Government of British Columbia on township surveys on Vancouver Island. He was employed in 1887 to 1888 on construction of C.P.R. short line between St. Johns and Sherbrooke, Que., and in 1888 to 1890 was engaged in private practice in British Columbia, including survey on New Westminster and Southern Railway for a water supply for New Westminster city, and survey of town sites in New Westminster and Nelson districts. From 1890 to 1892 Mr. Wilmot was resident engineer on construction of a sewage system for Victoria, B.C., and from 1892 to the present time, city engineer for Victoria, B.C.

The superintendent of the Montreal waterworks wants $210,000 to spend on repairs to turbines, reservoirs, inspection of mains and new services.

THE BRITISH FIRE PREVENTION COMMITTEE.

The British Fire Prevention Committee, under whose auspices a testing station was opened at 35 North Bank, Regents Park, London, Eng., January 31st, was founded after the Cripplegate fire of November, 1897, and will now shortly see its full incorporation. It counts a membership of some five hundred architects, surveyors, engineers, municipal officers and others directly or indirectly interested in fire prevention, among whom are practically all the leading members of the profession named. The offices are at No. 1 Waterloo Place, where the library includes a file of some fifty technical journals from all parts of the world, and the regulations and building acts, etc., of all countries. Regular publications are issued by the committee (twelve already having appeared), and meetings are frequently held. The founder was Edwin O. Sachs, architect. Three of the primary objects of the committee are defined as follows: To direct attention to the urgent need for increased protection of life and property from fire by the adoption of preventive measures. To use its influence in every direction towards minimizing the possibilities and dangers of fire. To undertake such independent investigations and tests of materials, methods and appliances as may be considered advisable.

It is with the idea of meeting these objects that a testing station has been established.

The purpose of the tests is to obtain reliable data as to the exact fire-resistance of the various materials, systems of construction, or appliances used in building practice. Such data have not as yet been available, owing to the fact that nearly all investigations of this description have been carried out by individual makers, or inventors with specific commercial objects in view. The present tests will be of an entirely independent character, arranged on scientific lines, but with full consideration for the practical purpose in view. Absolute reliability will be assured, records being mostly taken automatically, or by photography, and the temperatures being easily regulated by the application of gas. All reports on tests will solely state the bare facts and occurrences, with tables, diagrams and illustrations.

The general arrangement and direction of the tests will be in the hands of the executive, and in accordance with certain principles laid down after careful study and experiment. The actual tests will be attended by the members of the council and the members of the committee in rotation, care being taken that the attendance is always thoroughly representative of the technical professions primarily interested in the specific object under investigation.

LITERARY NOTES.

The Marine Review, Cleveland, O., U.S.A., has made an enlargement of four pages and will publish an issue of 30 pages in future.

The Geological Survey of Canada has recently issued Part S. Annual Report, Vol. X., being the section of mineral statistics and mines of the annual report for 1897. It bears on the cover the names of E. D. Ingall, M.E., and Theo. C. Denis, B.Sc., and J. McLeish, B.A.

By the amalgamation of The Electrical World with another electrical publication W. J. Johnston has retired from active journalism in the electrical field. Though a young man, Mr. Johnston is the father of electrical journalism, as he founded the first paper devoted to electricity. It was for many years published in the interest of telegraphers.

The Royal Electric Co has just issued a very neat desk memorandum book, which contains in addition to blank spaces for memoranda a vast amount of condensed information of interest to all users of electricity. The tables are exceeding useful. The same company has also sent out a pad calendar, which bears the dates and the praises of the apparatus supplied by the Royal Electric Co.

We have just received from the publishers a copy of a beautiful Religious Reverie, called "Holy Angels" suitable for piano or organ, composed by George D. Wilson. The retail price of this piece of music is 60 cents. All readers of this journal will receive a copy of it, by sending 25 cents in silver, or postage stamps (Canadian or American), to the Union Mutual Music and Novelty Co., No. 20 East 14th street, New York.

H. F. J. Porter, of the Bethlehem Iron Company, lectured to a large audience at the 521st meeting of the Society of Arts, Massachusetts Institute of Technology, recently. His subject was "Modern Forging," and he presented in a very interesting way, with numerous illustrations by the stereopticon, the methods in vogue at the Bethlehem works of forging such articles as hollow and solid shafts, dynamo field rings, guns and armor plate. Defects in the old methods of forging and the steps leading to the present methods were well explained.

We cannot too highly commend the work done by the Thorold and Beaver Dams Historical Society in giving to the public such a comprehensive record of the events which have made that quarter of the Niagara peninsula the Peloponnesus of Canada. The heroic tramp of Laura Secord, 19 miles through a snake-infested woods to warn Lieut. Fitzgibbon of the enemy's approach, the capture of the whole American force by a handful of British as a result of this warning, and many other deeds of daring during the war of 1812, are recounted here, while the less dramatic but equally heroic achievements of peace—the tedious assaults on the primeval forests, the transformation of the woods into wheat fields and of the marshes into gardens—are recorded with a faithful pen. Nor is the industrial and social progress of the township and town overlooked, many instructive bits of history and biography being scattered through the 289 pages of the volume. In fact it is only by the light of such work that the real history of the Canada that is yet to be can be compiled. Much interesting information is given about the Welland canal. The family of Keefer, of whom Thos. C. Keefer, C. H. Keefer and others have been so prominent in the engineering annals of the country, are found among the many sturdy early settlers. The pre-factory days, when the spinning-wheel and the hand-loom were in evidence and the stage coac! and ox-wagon were the only means of transport, are truthfully sketched, while the record of the first mills and industrial establishments is very instructive It is interesting to find, for instance, that Thorold had in 1847 what was undoubtedly the first cotton mill in Ontario, though not the first in Canada, as alleged, for a cotton mill existed in Sherbrooke in 1844, and it is equally worthy of record that this town had the first regular electric railway in Canada, the Thorold and St. Catharines line having been opened on the 5th October, 1887 Taken altogether, the Jubilee History of Thorold is a model of its kind, and is eminently creditable to John H. Thompson, the compiler, and to The Thorold Post Printing and Publishing Co., whose establishment did both the printing and binding.

Industrial Notes.

Lesperance & Theriault, plumbers, Montreal, have dissolved partnership.

Ronald McDonald will establish a machine shop, it is said, in Pictou, N.S.

Edward J. O'Brien has registered as proprietor of the Peoples Plumbing Co., Montreal.

The Bennet Furnishing Co., London, Ont., is about to install a Leonard Engine of the self-oiling type.

T. Dexter, of Sebringville, Ont. has bought the North Branch flour mills, London, Ont, formerly owned by Robb Bros.

Gananoque, Ont., is applying to the legislature for permission to make a loan to Wm. McKenzie to establish a furniture factory.

The Sarnia, Ont., Salt Co is building a dock, warehouse, etc. and will very shortly be turning out salt and other products.

The Dominion Government has closed a contract for 40,000 bags of cement from the United States at $2.20 per barrel, laid down in Montreal.

There is an amendment to the Ontario Municipal Act which is aimed at the bonus evil By it only cases of loss by fire are fit subjects for aid from a bonus and then only when a two-thirds vote of the ratepayers qualified to vote has been obtained.

The Iron Manufacturers' Association of Canada met recently in Montreal and advanced prices on manufactured goods owing to a rise in iron prices.

The lumber mill of C. T. White, Apple River, N.S., which was destroyed last spring, will be rebuilt it is understood during the present winter.

The Nova Scotia Pork Packing Co., Middleton, N.S., has employed F. F. Judd, Boston, U.S.A., to supply the plans, superintend the construction of the building and the installing of the machinery.

The very novel and suggestive advertisement of the Penberthy automatic injector on another page conveys very clearly the idea that an ocean of water is supplied to steam boilers all over the world by the Penberthy injectors.

A. L. Davis, W. J. R. Sims, J. R. Stratton, W. G. Morrow and A. A. Cox, Peterborough, Ont., are applying for incorporation as the Trent Valley Peat Fuel Company, Ltd., to manufacture peat for fuel purposes; capital, $5,000; chief place of business, Peterborough.

During the recent elections in New Brunswick a great deal of discussion centred on the bridge contracts which had been carried out by the Record Foundry Co., Moncton, at 6½ cents per lb., at the works. The Dominion Bridge Co. quotes 2.65 to 3 cents per lb. for similar work.

An Ontario charter has been granted to S. A. King, M.D., and O. E. Fleming, Windsor, Ont.; C. M. Walker, W. C. Kennedy, Walkerville, Ont., and J. H. Brown, of Rural Retreat, U.S.A., as the Diamond Harrow Company of Windsor, Ltd., to manufacture agricultural implements; capital, $30,000.

T Simms & Co., of St. John, who recently purchased the old saw mill, spool and box factory on the German Brook, Hardington, N.B., together with 700 acres of woodland, formerly owned and operated by L. P. Hayden, are putting machinery in the spool and box factory to make brushes.

An interesting folder has reached us from the J. Stevens Arms & Tool Co., Chicopee Falls, Mass., U.S.A., which gives details of the Stevens rifles, of which some new features of great value are the new model pocket or bicycle rifle, and the ideal sporting and hunting rifle, which is very low priced, but accurate in aim, and fully guaranteed by the company.

The boiler in R. O. Konkle's sawmill, Beamsville, Ont., exploded February 18th, causing damage to property in the vicinity. The engineer had just left the boiler room and was unhurt. John Konkle, son of the owner, was injured. The mill building was demolished, and the trees for five hundred yards were damaged, the boiler being thrown that far.

James Wright, of the wholesale and retail hardware firm of James Wright & Co., London, died a short time ago. Mr. Wright, who was one of London's oldest business men, came to Canada in 1858, and after teaching school six years, commenced business in partnership with James Cowan. On the dissolution of that partnership, he went into the wholesale trade, in which he was very successful. From his first settlement in London he took an active part in everything tending to the substantial growth of the city, and was for twenty years a member of the school board.

We have seen plans of the proposed alterations to the Toronto premises of the Union Bank of Canada. When completed, the building will be nearly as wide again as at present, and the front will be on the street line. The banking offices will be inside the easterly entrance, while a new doorway will be placed at the west front. It is intended that the offices other than those for the bank's use, shall be fitted up in a modern manner for general business purposes. The whole effect of the reconstruction will be very fine. Bond & Smith, architects, Temple Building, Toronto, are the architects.

An amendment to the Municipal Act now before the Ontario legislature provides that the corporation shall have power to supply water upon special terms to any corporation or person, whether resident without or within the municipality, including powers to construct, erect and maintain all pipes and mains requisite for the undertaking and for conveying and distributing water to such corporation or person in, upon and through any highway lying between any of their reservoirs, waterworks, pipes and mains and the lands or premises of the corporation or person to be supplied with water.

J. Watson, Kingsbury, N.S., is building a cheese factory near Danby.

The Brantford, Ont., Board of Trade are working for a technical school in that progressive town.

Hespeler, Ont., is anxious to sell W. A. Kribs a site in the park for a box factory, at a nominal figure.

The Robb Engineering Co., Amherst, N.S., has received an order from J. E. & G. Lake, Fortune Bay, Nfld., for a 40 h.p. engine and boiler.

D. G. and F. Loomis, Sherbrooke, Que., are buying new machinery to fit up their new wood-working shops in the Gas and Water Co.'s building.

The jail, Toronto, requires a new 70 h.p. boiler, as the Boiler Inspector has condemned the present one as too small for the present service required.

McKay Bros., East Hatley, are putting in one of the Jenckes Machine Co.'s steam plants, consisting of a slide valve engine and horizontal tubular boiler.

The farmers at Fort Saskatchewan, N.W.T., are organizing a company to build a flour mill; $30,000 stock has been subscribed. The secretary is W. Griesbach.

Halifax, N. S., will grant exemption from all taxes to new industries investing at least $10,000, except a tax of 1 per cent. on the value of the real estate occupied.

Thomas Lord, of L'Epiphanie Station, Que., is increasing his plant by the addition of a 35 h.p. engine from the well-known builders, the Jenckes Machine Co., Sherbrooke, Que.

The MacGregor-Gourlay Co., Galt, Ont., has a rapidly increasing export trade. One of the firm's largest wood working machines has just been shipped to Glasgow, Scotland.

Macphee and Meader, of Moulinette, Ont., propose to build a $10,000 flour mill of a 100 barrel capacity at South Finch, Ont. They will ask for a site, exemption from taxation and a cash bonus.

The Owen Sound, Ont., Iron Works Co., Ltd., has been granted Ontario letters patent; capital, $20,000. The incorporators are J. M. Wilson and Margaret Wilson, George Menzies and Lora Menzies, and Edward Todd.

A sawmill is being built at Springhill, York Co., N.B., by John Campbell, jr. He has ordered a 100 h.p. engine and boiler, and other machinery, from the Robb Engineering Co., Amherst, N.S.

David Ouellet, architect, Montreal, is preparing plans and specifications for a new wing to be added to the seminary of Rimouski, and also for the extension of the College at St. Anne de la Pocatiere, Que.

Geo. Long, Sherbrooke, Que., whose increasing wood-working business requires more motive power, is about to instal a 25-inch Crocker turbine, in order that production may cope with the demand. The order was placed with the Jenckes Machine Co.

An Ontario charter has been granted to W. J. McMurtry and W. T. Eagen, Lillian L. McMurtry, T. C. Harding and F. C. Cooke, Toronto, as the Gold Medal Furniture Manufacturing Co., Ltd.; capital, $100,000; to carry on the business of W. J. McMurtry.

At the annual meeting of the Montreal Rolling Mills Co., after the presentation of a satisfactory statement for the year, the following directors were elected: Andrew Allan, president; Hugh McLennan, vice-president; Hon. G. A. Drummond, E. S. Clouston, Wm. McMaster, Henry Archbald and H. M. Allan.

A test was made in Montreal recently of a fire-proof coating for ceilings, etc., called Salamander, by the American Fireproofing Co., Boston. The test is said to have been very successful, and a double wooden floor with Salamander interfilling withstood a hot fire for an hour. This material is said to have been in use in Boston for about sixteen years.

Judgment was given in the Exchequer Court, Ottawa, March 1st, in the cases of the Wellsbach Incandescent Gas Light Company, the Auer Incandescent Light Company, and the Manitoba Auer Light Company v. Anderson, finding that there has been an infringement of the patent. An injunction is issued, and the defendants are ordered to give up all stock made under the infringement.

Windsor, N. S., will buy a steam fire engine to cost about $5,000.

Incorporation is being sought for a company to take over the business of Rhodes, Curry & Co., Amherst, N.S.

The directors of the Toronto Cold Storage Co. are: Thos. Long, president; H. M. Pellatt, vice-president; Wm. McKenzie, Fred. Nicholls and A. E. Ames.

Last year the Hamilton, Ont., sewage disposal works handled sewage at one outfall at a cost of $9.65 per million gallons, and at another, $14.75 per million gallons.

Secord & Quackenbush, Niagara Falls, N.Y., will, it is said, move the Chippewa, Ont., flour mill to Niagara Falls, Ont., and enlarge it to a capacity of 200 barrels per day.

F. Maundrell, A. Leishman, F. Minns and A. L. Schram, Woodstock, Ont., and A. Elliot, Toronto, are applying for incorporation as the Woodstock Metal Working Company, Ltd.; capital, $5,000.

E. Wallace, T. Ahearn, W. Y. Soper, R. Quain and R. W. Shannon, Ottawa, have been incorporated as the Ottawa Building Company, Ltd., capital, $200,000. The company will do a building and loan business.

The North American Fence Supply Co. is applying for incorporation; capital, $40,000. The incorporators are: A. H. Cook, A. Hood, Markham, Ont., A. Hood, Toronto, W. Chester, J. Hall, T. Hood, W. McCowan, T. Britton, township of Scarboro, Ont.

J. C. Walker, E. J. C. Walker, W. Bell, Isabella M. Bell and W. J. Bell, Guelph, have been incorporated as the Electric Boiler Compound Co., Ltd.; capital, $15,000. The company will deal in engine supplies generally and in Walker's Electric Boiler Compound.

F. A. Hilton, C. J. R. Stirling, J. H. Thompson and E. B. Freeland, Toronto, John G. Bowes and T. W. Lester, Hamilton, Ont., have been incorporated as the Voelker Light Company of Toronto, Ltd., to deal in devices for illuminating and heating; capital, $40,000.

Hon. George A. Cox, E. Gurney, E. B. Ryckman, Richard Garland, of Toronto, and W. Y. Soper, of Ottawa, have bought out the entire American interests of the Dunlop Tire Company. The company has been incorporated under a Dominion charter, with a capital of $500,000. The American and Canadian businesses will be conducted separately.

W. P. McNeil & Co., of New Glasgow, are reported as being very busy on a lot of bridge work for the Provincial Government, in the Industrial Advocate, Halifax, N.S. They have recently placed in position a 15 h.p. horizontal engine from the workshops of the I. Matheson Co., which will be used to operate a Sturtevant blower in the foundry of the establishment.

We see by the Hamilton, Ont., papers that the Greening Wire Co. has in contemplation additions to its buildings and improvements to its manufacturing facilities, and has asked the city council to fix its assessment for the next ten years. We are pleased to see the prosperity of its business warrants the Greening Wire Co. in further enlarging its premises.

R. G. Reid & Sons have formed a large company, under the name of the Newfoundland Bleached Pulp Company, with a capital of two million dollars. The scheme also includes the formation of the Newfoundland Pyrites Company, with a capital of one million five hundred thousand dollars. Mills are to be erected at Grand Lake, Newfoundland. Another important venture under the immediate direction of this firm, is the Western Newfoundland Oil Company, which has recently purchased two extensive oil plants, which will shortly be in operation.

At the inaugural meeting of the Toronto Technical School Board, held last month, A. F. Wickson and Charles March were elected chairman and vice-chairman, respectively, and the following committees were struck: School Management—D. J. O'Donoghue, Prof. Galbraith, Robert Glockling, A. M. Wickens, W. A. Langton; property, F. B. Polson, Chas. March, John Tweed, Ald. Crane, Ald. Hallam; finance, Ald. Hallam, Ald. Sheppard, W. J. Wilson, P. T. Trowern, Dr. Orr; printing and supplies, Robert Glockling, D. J. O'Donoghue, Ald. J. J. Graham, W. J. Wilson, W. A. Langton. The financial statement gave the receipts for the year as $12,098.87, and the expenditure $12,181.22, leaving a deficit of $81.22.

H. J. Johnston, R. C. Miller, D. Ogilvy, J. W. Harris, T. A. Morison, A. Collyer and W. J. McGee, Montreal, are applying for a charter as the Diamond Light and Heating Company of Canada, to manufacture and deal in lamps, stoves, etc., which burn petroleum and other illuminating oils; capital, $200,000; chief place of business, Montreal.

R. MacKay, J. Beattie, H. Paton, D. Macmaster, Montreal, and C. MacKenzie, Toronto, are applying for incorporation as the Shedden Forwarding Co., Ltd., to transfer freight and luggage and produce, which is also to be held in cold storage by the company. The chief place of business, Montreal; capital, $700,000.

The Willson Carbide Works Co., of St. Catharines, Ont., will build new works on a very large scale as soon as a suitable power location can be obtained, but the Merritton plant will not be closed, but operated, as at present. The extension is due to the fact that the present works cannot keep up with the rapidly growing demand.

Geo. F. Baird, James Manchester, Joseph Allison, Thos. H. Bullock, D. J. Purdy, Jas. F. Robertson, R. C. Elkin and A. H. Hanington have applied for incorporation as the Portland Rolling Mills, Ltd., with a capital of $90,000 in $100 shares, to carry on the business hitherto conducted on the Strait Shore by the James Harris Co., Ltd.

The Alberta Irrigation Company, of which E. T. Galt of Lethbridge, N.W.T., is president, has commenced work on a mammoth scheme to reclaim lands between Cardston and Lethbridge, in South Alberta. Sixty miles of canals will be built. The sum of $500,000 will be expended, and 500,000 acres of lands irrigated. The main canal is to be finished next year, and the laterals in the following season. It is proposed to sell the lands on low terms, the settlement of the district being of primary importance.

A gas explosion at the Goodison Implement Works, Sarnia, recently did considerable damage to the company's property. In the blacksmith shops the forges are blown by patent blowers. Shortly after the fires had been started the machinery was stopped to adjust a pulley. During the temporary shut down the fires burned low and a quantity of gas accumulated, so much so that when the machinery started and the blowers were put in operation a terrific explosion took place. Fortunately no one was hurt, but the windows of the shop—sashes and all—were blown out by the force of the explosion.

At a general meeting of the shareholders of the Abbott Mitchell Rolling Mills Company, Belleville, Ont., held for the purpose of completing the organization, the following were elected directors: C. Bard, banker, Norwich, Conn.; John Mitchell, banker, of Norwich; Frank A. Mitchell, foundryman, of Norwich, president and managing director; Wm. Abbott, foundryman, of Montreal, vice-president and secretary; Henry Pringle, manufacturer, Belleville, treasurer; and S. S. Lazier, of Belleville. Considerable time was spent in the drafting of by-laws and regulations relating to the company and works. The plans for the buildings, etc., are all completed and in the hands of the engineers, and it is the intention of the company to start work as soon as possible.

A number of Canadian manufacturers met recently in Toronto at the Board of Trade to consider the situation in respect to the Standard Oil Company not being able to supply manufacturers with fuel oil. There were present: A. E. Kemp, chairman; W. A. Kemp, of the Kemp Manufacturing Co; E. R. Thomas, of the Lozier Bicycle Company; George E. Evans, of the Dominion Bridge Company; J. B. Muir, of the Ingersoll Packing Company; R. H. Verity of the Verity Plow Works, Brantford; Clarkson Jones, of the D. F. Jones Company, Gananoque; J. K. Osborne, of the Massey-Harris Company; G. Gillies, of Gillies & Co., Gananoque, etc. A thorough discussion took place, in which it was shown that in fuel oil, 2½ cents per imperial gallon should be taken off, to enable anti-trust producers to compete with the trust now controlling the Canadian market. A deputation was appointed to wait upon the Government in the matter.

The Beaver Portland Cement Company was recently incorporated with a capital of $150,000, to manufacture Portland cement in Canada with works at Dry Lake, near Marlbank, Ont. It will be under the management of Wm. G. Hartranft, Philadelphia, and the mills will turn out 600 barrels per day. The president is James Dobson, of the carpet manufacturing firm of John and James Dobson, Philadelphia; the vice-president, R. Peverly, president of the Commercial Wood and Cement Co., New York and Philadelphia; R. T. Hopper, Montreal, is the managing director and treasurer of the company. The Commercial Wood and Cement Co. has been appointed sale agent for this company's cement, and their offices will be located in the Canada Life Building, Montreal, under the management of J. F. Twamley. The head offices of the Beaver Portland Cement Co. will also be in the same place.

R. H. Griffin, president of the City Bank, Buffalo; the Hon. T. G. Smith, Buffalo; George Gudewill, New York; A. F. Gault, George E. Drummond, Thomas J. Drummond and James T. McCall, of Montreal, have organized the Canada Iron Furnace Co., Ltd., of which Geo. E. Drummond is managing director, to establish a smelting plant at Midland, Ont. The town will grant a bonus of $50,000. The company guarantee a minimum output of 60 tons of charcoal pig-iron per day. The work would be carried on at least 200 days in the year with an output of not less than 18,000 tons per annum; it also guarantees to employ an average of 70 men directly at works in connection with the smelting and other necessary operations, and further, an additional 130 men in connection with the tributary general operations of the company.

A. Green's fuel economizer was placed in the main pumping station of the Toronto waterworks some time ago. The apparatus was to stand on its merits, and now the engineer in charge of the pumping plant reports that it has effected a great saving in one test, 12.65 per cent., and the assistant city engineer, who has control of the waterworks system, states that the true saving is very small, and in some instances a loss has occurred. Comparing the years 1896 and 1898 Mr. Fellows computes an actual loss of 36·10 per cent., rather than a gain, by using the economizer. Under favorable conditions, he admits, the apparatus may be fuel-saving, but these conditions do not obtain, he says, at the pumping station. He therefore does not recommend its acceptance. The public will wait with interest for the settlement of the matter.

A bill now before the Nova Scotia legislature will incorporate the Dominion Steel and Iron Co. Its capital is fixed at $10,000,000, with power to increase to $20,000,000. Before the company can commence operations it must have $1,000,000 of its capital subscribed, and 25 per cent. of this paid up. The men who are in this new company are practically the same as those who compose the Dominion Coal Company. At the head of the list of incorporators is Henry M. Whitney, of Boston; H. F. Dimock, of New York; Almeric Page, of New York; and W. B. Ross and B. F. Pearson, of Halifax. The charter gives the company almost unlimited power in carrying on iron manufacturing operations. They have already bonded extensive iron areas in Belle Isle, Newfoundland, for $1,000,000, and it is their intention to erect blast furnaces and smelting works in Cape Breton. Muggah's Creek, C. B., has been spoken of in connection with the establishment of the works. The iron areas at Belle Isle, for which $1,000,000 will be paid to the Nova Scotia Steel and Iron Company, who now own them, are estimated to contain 30,000,000 tons of ore.

The manufacturers of Montreal are up in arms against the proposal to tax machinery and manufacturing plants generally. A vigorous protest has been sent in to the Quebec legislature signed by the following, among others: John McDougall, The Shearer & Brown Co., The James Shearer Co., Consumers' Cordage Co., Ltd.; Canada Switch & Spring Co., Ltd.; The Singer Manufacturing Co., The Montreal Rolling Mills Co., The Thos. Davidson Mnfg. Co., Ltd.; The J. C. McLaren Belting Co., Dominion Wadding Company, The Bishop Engraving and Printing Co., The Sunlight Gas Company, Ltd.; John Date, Thos. Robertson & Co., Ltd.; McFarlane, Son & Hodgson, Gazette Printing Co., Montreal Lithographing Co., W. W. Ogilvie, Montreal Horse Nail Co., Pillow & Hersey Mnfg. Co. B. J. Coghlin, The Canada Sugar Refining Co., The James Cooper Mnfg. Co., J. & T. Bell, The James Robertson Co., Ltd.; F. Tremblay, The Canada Paint Co., Ltd.; The Canada Machinery Agency, Graham & Co., Wm. Clapperton & Co., W. H. Buchanan & Co., Thompson Shoe Co., J. C. Wilson & Co., Major Manufacturing Co., Ltd.; Canada Paper Co., Collyer & Brock, Belding, Paul & Co., Phillips Electrical Co.

Electric Flashes.

A project is going forward to light St. George, Ont., with electricity.

The Maritime Electrical Association will hold a convention about April 18th in Halifax, N.S.

The British Columbia Electrical Supply Co. is applying for incorporation to do business in Rossland, B.C.

H. D. Symmes of St. Catharines has recently installed one of the Royal Electric Company's 35 light, four pole, direct current dynamos.

The Port Perry Electric Light & Power Co. has given the Royal Electric Company an order for a 2½ k.w. four pole exciter, to replace the exciter at present installed there.

S. W. Bradley, Aylmer, Que., formerly one of the chief officials of the Hull Electric Railway, has been appointed manager of the Cornwall, Ont., Electric Street Railway.

A. W. Hepburn, Picton, Ont., is fitting out his steamer with electricity. The order for a 12½ k.w. generator has been placed with the Royal Electric Co., to be installed at once.

The McPherson Shoe Company of Hamilton are installing in their works one of the Royal Electric Company's 50 h.p. "S.K.C." two phase motors. This is to replace the present steam plant.

The Eclipse Whitewear Company of Toronto, has been changing its motive power and increasing its factory. It has placed an order with the Royal Electric Company for a 10 k.w. four pole 250 volt motor.

John Forman, 644 Craig street, Montreal, announces a very interesting catalogue which should be in the hands of everyone interested in electrical supplies. When writing to ask for it mention The Canadian Engineer.

The C. O'Dell Electric Co. of Annapolis, N.S., recently placed in position a 120 h.p. Leonard-Ball automatic engine, which, together with a new boiler, will permit them to double the producing capacity of the plant.

Brown & Boggs, Hamilton, Ont., have decided to operate their factory by electric power, and are installing a 30 h.p. two-phase "S.K.C." motor. Power for the same being furnished by the Cataract Power Co., Hamilton, Ltd.

Lawry, Sons & Co., of Hamilton, pork packers, are changing from steam to electricity for power, and have placed an order with the Royal Electric Company for a 30 h.p. two-phase "S.K.C." induction motor. They are also lighting their factory throughout by electricity.

An electric cab company has been formed in Toronto by Geo. A. Cox, H. H. Fudger, A. E. Ames and others, which will build horseless carriages in the shops of the Canadian General Electric Co., Peterborough, under the Fischer patents. The equipment is storage batteries.

The Canadian Development Company of Victoria, B.C., has been building a steamer on Lake Bennett, Yukon Territory, and expects to have it ready for its trial trip by April 1st. The boat is lighted throughout by electricity; the plant being furnished by the Royal Electric Company of Montreal, consisting of a C. W. multipolar dynamo, direct connected to a horizontal ideal engine.

A company has been organized to operate the Buffalo Railway Co., the Buffalo Traction Co., the Buffalo, Bellevue & Lancaster Railway Co., the Buffalo & Niagara Falls Railway Co., the Buffalo & Lockport Railway Company, the Niagara Falls Park & River Electric Railway Company (Canadian), the Niagara Falls & Clifton Bridge Company, and the Lewiston & Queenston Heights Bridge Company.

The corporation of the town of Barrie has been advertising for tenders for alternating current apparatus. The contract for one 120 k.w. "S.K.C." two-phase alternating current generator for power and lighting apparatus was awarded to the Royal Electric Company of Montreal. The entire lighting and steam plant which has been taken over by the corporation from the Barrie Gas & Electric Company, is being rebuilt and the capacity enlarged.

The Kay Electric Co., Hamilton, Ont., is very busy, and is working overtime.

The Electric Light Co., of Megantic, Que., has been incorporated; capital, $10,000.

Peterborough, Ont., proposes to develop water power for electric supply on the Otonabee river.

The Magnetawan, Ont., Tanning and Electric Co., Ltd., has increased its capital from $50,000 to $100,000.

F. Poste, recently a student at the Canadian General Electric Co.'s works, Peterborough, Ont., has assumed the management of the Prescott Electric Light Co.

The Central Mnfg. Co., Chattanooga, Tenn., U.S., furnished the pins for the Niagara Falls power plant, as well as the pins and cross-arms for the Lachine Rapids power plant.

At the annual meeting of the Hamilton, Ont., Street Railway Company the old directors were re-elected, and Edward Martin, Q.C., was elected president, John A. Bruce was elected vice-president.

The Sturgeon Falls, Ont., Electric Light and Power Company, Ltd., has been incorporated with a capital of $20,000. The provisional directors of the company are, E. A. Bremner, W. G. Finley and P. H. Patriarche.

At the annual meeting of the Cataract Power Company, Hamilton, the following directors were re-elected. Hon. J. M. Gibson, pres., James Dixon, vice-pres., John Moodie, treas., John Patterson, sec.; J. W. Sutherland and J. A. Kamerer.

J. D. Guay, C. [illegible]on Parent, F. X. Gosselin, J. E. Alfred Dubuc, managing director of the Chicoutimi Pulp Company, Chicoutimi; C. Angers, M.P., Saint Etienne de la Malbaie, and Onezime Cote, Bagotville, are applying for a charter as the Chicoutimi Water and Electric Co.; capital, $125,000.

At the annual meeting of the Hamilton, Grimsby and Beamsville Electric Railway Company a dividend of 5 per cent. was declared, and the directors were elected as follows: C. J. Myles, pres.; W. J. Harris, vice-pres.; L. Bauer, Robert Ramsay, A. H. Myles, John Gage. A. J. Nelles was reappointed secretary and manager.

The Niagara Falls, St. Catharines and Toronto Railway Company is applying for incorporation with power to take over the St. Catharines and Niagara Central Railway Company, and to extend to Port Dalhousie and Hamilton; also to acquire, generate, use and sell electric power, and operate steamboats, wharfs, etc.

The Packard Electric Co., Ltd., St. Catharines, Ont., is placing on the Canadian market Brunt's regulating socket, which is claimed to control the electric light as easily as a gas burner does gas light. There are five degrees of light, from two candle-power to sixteen, and a positive saving of current is claimed. This socket is specially valuable for the sick room, vestibules, sleeping apartments, etc.

The number of electric lighting companies in Canada for the fiscal year ending June 30th, 1898, was 267. The revenue derived from the inspection of electric light was as follows: The fees for the inspection of meters, etc., $5,388.25; for registration of companies, $3,900, and for penalties, $114; making a total of $9,472.25. The expenses of inspection (annual), were $3,236.10, the amount expended on standard instruments, etc., $3,768.80, leaving a net revenue of $2,467.35.

At the annual meeting of the Bell Telephone Company the following statement was submitted: 1,637 subscribers have been added during the year, the total number of sets of instruments now earning rental being 32,082. The company now owns and operates 343 exchanges and 340 agencies. Six hundred and sixty-six miles of wire have been added to the long-distance in 1898; of these, 326 miles are in the Ontario department, and 340 miles are in the Eastern department. The long-distance lines now owned and operated by the company comprise 17,233 miles of wire on 6,096 miles of poles. The financial statement showed that the net revenue for 1898 amounted to $331,151.74, out of which $263,779.93 were paid in dividends, leaving a balance of $67,371.81, which with the balance from 1897 of $82,364.17 makes a total balance carried forward of $149,735.98. The following directors were elected: C. F. Sise, Robert MacKay, John E. Hudson, Robert Archer, William R. Driver, Hugh Paton, Charles Cassils and Thomas Sherwin.

The Ontario Government gave the electrical industries quite a shaking up in the budget speech, which announced taxes on telephone, telegraph and electric railway companies.

The Royal Electric Company of Montreal has just completed the installation of a 100 h.p. "S.K.C." synchronous motor in the Iron Mask Mine at Rossland, B.C., to operate the hoisting machinery and air compressors.

The amalgamation is announced of the W. A. Johnson Electric Company and the Toronto Electric Motor Company, Ltd. About a year ago the business of the Toronto Electric Motor Company was reorganized as a joint stock company, J. W. Thompson at that time purchasing an interest and combining with it the manufacturing business formerly carried on in Hamilton under the style of the Thompson Electric Company. Recently Mr. Thompson has secured control of the entire business of the Toronto Electric Motor Company, Ltd. This company and the W. A. Johnson Electric Company have amalgamated their manufacturing business under the style of the "United Electric Co., Ltd;" capital, $150,000, with head offices at 134 King street west, Toronto. Both factories will be operated at present. Arrangements are, however, being made for a considerable extension of their manufacturing plants. The officers of the new company will be: W. A. Johnson, president and managing director; J. W. Thompson, secretary and treasurer; J. Norman Smith, engineer-in-charge of works.

The Mercury, Renfrew, Ont., says recently: We have always understood that the average life of an incandescent lamp was 800 hours. Some live considerably less. Others more. Two of these have their death recorded in the following fashion by A. A. Wright in a letter to the Packard Co.: These lamps have burned an average of ten hours a day since installed and every day. Consequently their life has spanned some 20,350 hours. It was somewhat remarkable, too, that having both lived so long they should have gone out so nearly together. Their epitaph is as follows: In faithful memory of Incandescent Packard, jr., and Incandescent Packard, sr., twin sisters. They were born of an honorable parentage, viz., The Packard Electric Co., now of St. Catherines, Ont. They each entered this life and commenced their remarkable career, Dominion Day, July 1st, 1893. Having commenced their labors on the switchboard in A. A. Wright & Co.'s Electric Light Station, Renfrew, Ont., on the installing of their electric light plant on the above mentioned date, they there burned faithfully and well every night without intermission until the time of their death. I. P., jr., departed this life, Feb. 1st, 1899, at the ripe old age of 5 years, 7 months; I. P., sr., shuffling off this mortal coil a few days later, Feb. 9th, 1899, at the advanced age of 5 years, 7 months and 9 days. During all these years they let the light shine in the above mentioned place every night, laboring side by side, thus setting an honorable example to all their neighbors, and saying in their peculiar way, "Go thou and do likewise."—(If you can).

Orillia, Ont., has awarded the contract for the electric power transmission plant subject to the by-law being approved of by the ratepayers. The Central Construction Co., Buffalo, is contracting for the entire equipment. The Stillwell, Bierce & Smithvale Co., are sub-contractors for the water wheels. The electric machinery will be furnished through W. A. Johnson Electric Company, of Toronto, the plant to consist of two 400 h.p. revolving field Westinghouse, three-phase 60 cycle generators, each having an overload capacity of 60 per cent. These will be located at the Ragged Rapids on the Severn river, eighteen and a half miles from Orillia. There will be provided the necessary high tension switchboards and controlling apparatus. Six step-up 100 k.w. static transformers, self-cooling type, will raise the voltage to 22,000 for the transmission line. At the receiving station at Orillia there will be six step-down 100 k.w. transformers of a similar type, to reduce the pressure to 1,000 or 2,000 volts, so that the alternating incandescent circuits now used for commercial lighting can be connected direct to the above transformers. There will also be provided a 25 h.p. Tesla induction motor, for driving the waterworks pump, now operated by steam, and a 50 h.p. motor of same type to drive the three ball, 25 light, arc dynamos, which have been used for street lighting for some years. The switchboard apparatus, lightning arresters, etc., have been carefully selected and so arranged that uniform service and safety in handling can be relied upon, notwithstanding the high voltage.

Railway Matters.

It is reported that a union station will be built at Megantic for the use of the Canadian Pacific and Quebec Central Railroads.

The Dauphin railway is going to establish workshops at the town of Dauphin, and machinery has already been ordered for their equipment.

A million dollar scheme is on foot in Montreal to elevate the G.T.R. tracks in Montreal and do away with the level crossings, some of which cause a great deal of complaint.

The Midland Railway Co., Nova Scotia, has bought from the Canadian agent of the Carnegie Steel Company, the rails for the road now being constructed between Windsor and Truro.

The Nickel Range Railway Company is applying for a charter to build a railway from the Algoma branch of the C.P.R., between Whitefish and McNaughton stations, to the main line of the C.P.R. at Chelmsford station, Ont.

W. G. Reid, contractor for the Midland, N.S., railway, has awarded to the Dominion Bridge Company the contract for the steel superstructure required for all the bridges between Windsor and Truro, including those across the St. Croix and Shubenacadie, or about seventeen spans.

The British Columbia Government has cancelled grants made to McKenzie & Mann by the former Government for the construction of a line of railway from Penticton to Boundary Creek; from Penticton to Point Roberts, 200 miles, and from an ocean port in British Columbia to Teslin Lake, 400 miles.

A British Columbia charter is asked for a railway from Log Cabin, on the White Pass, in the province of British Columbia, by the most feasible route, to a point at or near the Taku Arm of Tagish Lake; then to Atlin City, on the shores of Atlin Lake; and thence to Telegraph Creek, on the Stickine River, all in the province of British Columbia.

At a meeting of the directors of the C.P.R. Co., February 6th, the usual 2 per cent. on the preference stock was declared, and a dividend of 2 per cent. was also declared on the ordinary stock, making with the dividend already paid 4 per cent. for the past year. The results for the year were: Gross earnings, $26,138,977; working expenses, $15,663,605; net earnings, $10,475,372. The income from other sources was $423,367, making total net income $10,898,738. The fixed charges, including interest on land bonds, were $6,774,321, leaving net revenue available for dividends, $4,124,417. Out of this a dividend of 2 per cent. on the preference and 2 per cent. on the common stock for the June half year was paid in October last. After the payment of the dividends now declared the surplus for the year carried forward is $1,051,708.

J. R. Booth has given the Canadian General Electric Co., Ltd., a contract for the installation of an electric plant to transmit current for motive power and lighting purposes from his mills at the Chaudiere Falls on the Ottawa to the new Canada Atlantic Railway shops, 3½ miles distant. The contract covers two 150 k.w. three-phase revolving field, 4,000 volt, 60 cycle slow speed generators with switchboard arranged in such a manner that they may be operated single or in multiple. There will be installed at the car and lomotive shops three 130 h.p. 4,000 volt three-phase self-starting synchronous motors, each of which will be connected with the main shafts by means of rope drives and clutch pulleys. The company has also supplied for the large locomotive transfer table, a suitable motor drawing current from conductors placed beneath the floor, and fed from a transformer system at 500 volts. For lighting purposes there will be used sixty alternators, enclosed six ampere arc lamps specially adapted for factory use, together with some 400 16 c.p. incandescent lamps, all of the C.G.E. Co.'s make. The transmission here will consist of three No. 4 B.S. bare copper wires carried on porcelain insulators and extra heavy pole line, which will follow the line of the Canada Atlantic Railway the entire distance.

Trains are now running on the White Pass Railway.

It is said that the Lake Erie & Detroit River Railway Company, the purchasers of the Erie & Huron, will spend $50,000 in building shops at Sarnia and Port Huron. As soon as the shops are completed the car ferry "Huron" will make regular trips between Port Huron and Sarnia.

The Bedlington and Nelson Railway Company is applying for running powers over the Crow's Nest line of the Canadian Pacific Railway. The proposed line would lessen the distance between Kootenay Lake and Bonner's Ferry by 53 miles. The Bedlington road is owned by English capitalists, and when a change was made two years ago, work on the railway was stopped, although the line was staked. Meanwhile the C.P.R. secured the charter for a line from Lethbridge to Nelson through the Crow's Nest Pass.

The Canadian Pacific Railway Company is applying for permission to operate a railway from its Stonewall branch. Manitoba, northerly and northeasterly to a point on Lake Winnipeg between Gimli and Arnes; and also a railway from a point on the one last named, thence in direction generally northwest to a point on the east shore of Lake Manitoba between Marsh Point and the north boundary of township twenty-five; and also a railway from Reston, on the company's Souris branch, in a general westerly direction to the Moose Mountain district, thence in a westerly direction to Regina.

Mining Matters.

There have been received some very fine specimens of gold quartz from the Atlin country, B.C.

Ottawa will have a large mica factory. It will be operated by the Eugene Munsell Company, of New York.

A very rich find of gold is reported from McDonald Creek, Northwest Territory. It is close to the boundary line of British Columbia and the Northwest Territory.

Next summer will witness a greater boom than ever at the Bell Island iron mines in Newfoundland, as the company expect to have 600 men employed on April 1st.

The Centre Star mine at Rossland, B.C., is to be developed and the stock placed on the market, by the same group of capitalists which gave the War Eagle mine such a boom.

W. D. Pettigrew, Winnipeg, who is developing mines at Wabigoon, Ont., has placed an order with the Jenckes Machine Co., Sherbrooke, Que., for hoisting, crushing and pumping plants.

The Lake Manitou Gold Mining Co., St. Paul, U.S., has placed an order with the Jenckes Machine Co., Sherbrooke, Que., for a ten stamp mill to be erected on its property near Wabigoon, Ont.

John D. Chipman of St. Stephen, representative of the English company now in control of the Chronicle Co., N.B., nickel deposits, learns that the shipments of ore have proved satisfactory.

The John Sykes Mining and Milling Co., Toronto, has purchased from the Jenckes Machine Co., Sherbrooke, Que., a ten stamp mill, engine, boiler and saw and shingle mill, to be erected immediately on its property near Dinorwic, Ont.

The East Bay Coal Mining Co., is said to be embarking in earnest upon its extensive oil-shale enterprise at McAdams Lake, C.B. Next summer will see extensive developments. The company's expert has recently been over the ground.

The Guffey-Jennings Gold Mining Co., at Caribou, N.S., it is reported, will tear down the old mill located on its areas and replace it with a modern plant comprising 40 to 50 stamps, together with the improved Wilfley Table Concentrator.

The present installation of 30 stamps in the new mill of the Dufferin Mine at Salmon River, was started the other day and everything found to run smoothly and in a satisfactory manner. The mill is arranged for a capacity of 60 stamps, which will give when running a crushing ability of 240 tons every day of 24 hours.

The Hammond Reef Gold Mining Co., Toronto, has decided to install at once, thirty additional stamps, a new crusher, aerial tramway and water power plant, to operate the new mill. It is expected that the whole of the machinery will be delivered early in April. The Jenckes Machine Co., Sherbrooke, Que., has been awarded the contract.

The Hall Mines, Ltd., Nelson, B.C., was expected to start the treatment of lead ores in its smelter about March 1. The company has made a contract with the management of the Queen Bess, a Slocan mine, for the output of that property for the next three months. In addition to this ore, the company is receiving regular shipments from several of the silver-lead mines in the Slocan, as well as from some of the properties around Ainsworth

Early in December a very rich find of platinum was made on the Hootalinqua, Yukon. Black sand is found in nearly every stream of the Yukon Territory, and while considered a good indication of gold, is always a nuisance to washers. On account of its great specific gravity it remains in the sluice boxes with the gold, and even hand panning will not always separate the two. Twelve pounds of it was taken from near the mouth of the Hootalinqua and found very rich.

The improved condition of the New Glasgow and Bluenose mines, at Goldenville, N.S., is well illustrated in the returns for the month of December last. From 1,500 tons of quartz 650 ounces of gold were obtained, valued at $12,500. The cost of mining and crushing this quantity is stated to have been about $3 per ton or a total cost of $4,500, leaving a balance of profit on the month's operation of $8,000, which, it must be confessed, is a very handsome return.

At the annual meeting of the Hammond Gold Reef Mining Company, the directors in their report to the shareholders announced a policy of active operations for the immediate future. Upon that report the stock has been very active and has made rapid advances in price. A meeting of the directors was held in this city yesterday and a contract was closed with the Jenckes Machine Company of Sherbrooke, for thirty additional stamps, the necessary ore crushers, aerial rope tramway, frue vanners, water wheels, etc. This will give the company a thoroughly equipped 40-stamp mill, and will make it one of the largest and most complete free milling gold mill plants in Canada. A contract has also been let to the Canadian General Electric Company for generators, motors, electric line and complete equipment for the production and transmission of electric power from Clearwater Falls, a distance of less than two miles.

Marine News.

The St. Lawrence canals will be opened for traffic May 1st.

Northwest Transportation Co., Sarnia, Ont., is putting in new boilers in the S.S. "United Empire."

Toronto recently sent a strong deputation to Ottawa to urge the claims of the city to harbor improvement.

The dry dock at St. John's Nfld., was resorted to by 26 vessels in the past year, many of which were in need of considerable repairs.

Application is made to incorporate a company to construct a ship canal from Lake St. Clair to some point on Lake Erie between Point Pelee and Rondeau Harbor.

The C.P.R. declines to allow the city of Toronto to land the proposed chain ferry at the Queen's wharf at a lower rental than $1,500 per year, and so the ferry will remain in abeyance for another season.

The steamer "Minnehaha," which is being built at Seaton Lake, Lillooet, B.C., is a neat model. In the neighborhood of fifteen tons of freight can be carried.

The Canada Steamship Company, of which Sir Robert G. Head, of London, England, is president, and which is now organizing a transatlantic line between Milford Haven, Wales, and Paspebiac, has just prepared designs for the construction of an elevator at the latter place. It is intended to build it of corrugated iron. Its capacity will be 1,000,000 bushels of grain. The construction will begin shortly.

Extensive alterations are being made in the steamer "Greyhound" at St. Catharines, Ont. The steamer "Lakeside" is expected to commence running from St. Catharines to Toronto about the 15th inst.

Two semi-annual dividends of 3 per cent. each, amounting together to $104,400 were paid by the Richelieu & Ontario Navigation Co. during the financial year just closed, leaving the amount of $7,627.55 to be carried to the surplus.

J. L. Booth, Ottawa, stated recently that he would, during the coming season, build sixteen hundred feet more of dockage at Depot Harbor, for the further accommodation of grain to be shipped over the Ottawa, Arnprior & Parry Sound Railway.

Maine, U.S., shipyards are turning out five-masted schooners, and there are no less than four five-masters building in the Maine shipyards at present. The "Nathaniel Palmer," just launched at Bath, Me., is 205 feet long, 44-4 feet beam, 22 feet deep and 2,440 tons gross.

Collingwood Schreiber, Deputy Minister of Railways, has stated that M. P. Davis, contractor for the Gallops Canal, had been granted an extension of time to 1900 to complete his contract, but he will be obliged to provide tugs to tow vessels up stream, there being a sufficient depth of water, but a strong current. The Soulanges Canal contractors have been given to May 15th next to complete their work. There is, however, no certainty that they will be through in that time.

Personal.

T. A. S. Hay, C.E., has been appointed city engineer in Peterborough, Ont.

Geo. White Fraser, D.L.S., Toronto, is engaged on the survey of the boundary between British Columbia and the Yukon district.

We recently had a visit from J. B. Moore, representing the Ashcroft Mnfg. Co., the Consolidated Safety Valve Co., the Hayden & Derby Mnfg. Co.

Jenkins Bros., valves and packing, the famous New York and Boston house, is now represented in Canada by H. C. White, who is just now making the round of the trade.

Wm. Butterick was accidentally killed in Deseronto, Ont., February 6th, at the Standard Chemical Works, by being caught in a shaft. His father is superintendent of the Rathbun Co.'s lumber mill.

Hugh Ryan, the contractor who built the Sault Ste. Marie canal, and in the earlier days a large section of the G.T.R., died in Toronto, February 13th, leaving an estate of almost one and a half millions of dollars.

D C. Smith, who travels in Canada for Henry G. Thompson & Son, New Haven, Conn., U.S.A., has recently visited Toronto in the interest of that firm's famous hack saws, and band, power and jig sawing machines for cutting metal.

It is reported that Mr. Louis Coste, chief engineer of the Public Works Department of Canada, has forwarded his resignation to the Minister of Public Works. His purpose is understood to be to take the management of the Dominion Yukon Mining Company.

George C. Morrison, Hamilton, Ont., died recently at his home. Mr. Morrison was a native of Kirkentulloch, Scotland, but came to this country when a very young man. About 34 or 35 years ago he came from Galt to be foreman in Beckett's Engine Works, and 30 years ago he went into business for himself, starting the engine and boiler works which he has ever since carried on in Hamilton.

FIRES OF THE MONTH.

Jan. 31st. American Bent Chair Co., Owen Sound, Ont., loss, $150,000.——Feb. 7th. The Columbia River Lumber Co.'s (Vancouver) sawmill at Moberly.——Feb. 11th. Dunn's sawmill, Sault Ste. Marie, Ont.; loss, $5,000.——Feb. 12th. L.E. & D.R.R. Co. round-house, Sarnia, Ont.——Feb. 13th. The Geo. Gillies Co.'s bolt works, Gananoque, Ont.; $12,000 damages.——Feb. 13th. A large portion of Digby, Ont., was burned down.——Feb. 14th. Wm. Law & Co.'s wharf, Yarmouth, N.S.——Feb. 14th. J Saunders' wood-working and blacksmith shop, Sunderland, Ont.; loss, $1,000.

A NOVEL METHOD OF SEWAGE DISPOSAL, ESPECIALLY DESIGNED FOR THE CITY OF TORONTO.

(Concluded from January issue).

In the foregoing, the lift from the pump well to the filtration area, recommended by Mr. Rust, has been assumed to be only 70 feet vertically. This is not correct, the elevation being much greater, as I am now reliably informed. So much so, indeed, as to bring the annual cost of maintenance by my combined method, up to $100,000 or more. This, in view of the much more economical second alternative plan, is almost prohibitive. The artificial filters referred to may now be considered as offering the better method of subsidiary, and final purification. The long, narrow spit of land between Ashbridge's Bay and Lake Ontario presents an excellent location for the small area required, and can be reached by gravity within a moderate distance from the coke and combustion works, should local circumstances prevent their location in close proximity to the latter.

The half acre of coke and six acres of sand and gravel filters already mentioned, would be sufficient, as at Reading and Glasgow, but, inasmuch as coke would require frequent renewal, and the other materials are to be had in abundance in the locality designated, it would be more economical to lay out 8 or 10 acres of sand and gravel beds at a maximum cost of, say $40,000. The probability is that quite sufficient material is on the spot *in situ*, and that the filters, on a much more extensive scale, and at very much less cost, could be made out of the sand.

The total cost of the whole plant, including coke and combustion works on the line of the outfall sewer, the filtration area, and a possible mile of conduit pipe from the works to the filter beds, would be, approximately, as follows:

Coke and combustion works	$191,200
Land for above	10,000
Conduit pipe	40,000
Filter beds	40,000
Cost of land, right of way, etc	25,000
	$306,200

The artificial beds at Reading, Penn., U.S.A., cover an area of 57-100 acre, only, they filter 1,500,000 gallons of sewage effluent daily, and the preliminary coke straining of the "entire" crude sewage is by no means as thorough as it should be, the strainers being changed but once a week, and yet the effluent from these very small filters is satisfactory. In this case (Toronto), the heavy matters of the sewage are entirely held back from the coke strainers, there is constant aeration, and, with a larger filtration area, proportionately, can we not look for even better results?

No sludge, a minimized cost of construction, and a yearly cost for maintenance not exceeding $73,000, which covers the care of the filter beds.

The construction of half an acre of coke filter at the works (at the discharge end of the pumps), would add greatly to the purity of the effluent from the sand and gravel filters at Ashbridge's Bay, and be well worth the outlay. Such a filter would cost about $15,000, and bring the total outlay for construction up to $321,200. It would probably suffice to renew such a filter at the rate of, say ten tons daily, which, as the coke from the strainers in the receiving reservoirs, would be utilized as fuel, and pay for itself.

The fact that bricks are more or less magnetic in their properties has been recently demonstrated by H. E. Lawrence of the Physics Laboratory of Rochester University, Rochester, N.Y.; the investigation is still proceeding, and we will give details of the experiments when they have been completed. The magnetic instruments in the Observatory at Toronto are housed in a structure in which no brick was used, and the director states that they have had no trouble of the kind which led to the discoveries at Rochester.