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CONTENTS OF THIS NUMBER:

THE RECORD.

To whom it may concern:

Toronto, Dec. 4th, 1896.

This is to certify that the statement given below is a true account of the copies of THE CANADIAN ENGINEER we have printed and mailed for Biggar, Samuel & Co. beginning with May, 1895, issue, and ending with Dec., 1896, issue.

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Per A. W. LAW, Sec'y-Treas.

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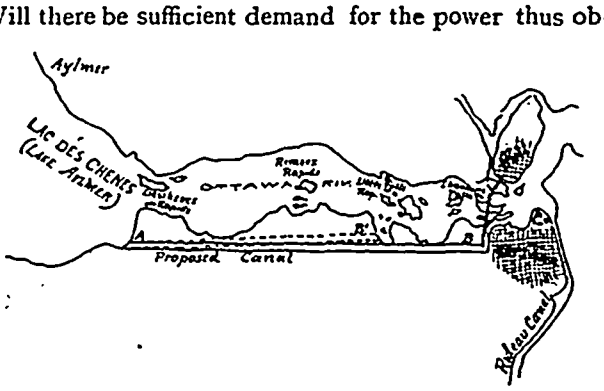
For THE CANADIAN ENGINEER.

OTTAWA'S WATER-POWER.

BY. G. H. FAWCETT, OTTAWA.

The city of Ottawa, for beauty of situation, natural advantages and picturesqueness, has no competitor in Canada. Situated at the confluence of the Ottawa and Rideau Rivers, where two falls meet, divided into two parts by the Rideau Canal, separated from the city of Hull by the "Grand River" of the lumbermen, backed by a magnificent agricultural country, overshadowed by the Laurentians, with their inexhaustible deposits of iron, plumbago, manganese, mica, phosphates, wood, etc., open to the world by five railways (being on the direct line from Halifax to Vancouver), and connected with the great sea-port, Montreal, and also with the United States by water, it presents to the eye of the lover of the beautiful an enchanting vision and to the eye of the business man a field for ingenuity and investment equal to the best. "Where two falls meet," thirty years ago a little milling village called Bytown was planted, and to-day it is a city of 45,000, all because of these falls and the boundless supply of all kinds of wood to be found in the flora of a northern country.

The falls at the Rideau are now of little importance, the great supply of water from the extensive Rideau lakes being carried into the canal of the same name, but the falls of the Ottawa retain all their pristine glory, except so far as they have been made to do "servile" work. The sites available for building so as to utilize the unlimited power found rolling over a ledge of rock three hundred feet wide into the kettle twenty-five feet below, were taken up years ago by the lumbermen, who are annually transforming three millions of logs into between six and seven hundred millions of merchantable lumber, giving employment, in the process, to fully ten thousand men and forty million dollars capital. To overcome this lack of room and still retain the water-power, I propose a canal from A to B (see map), the feasibility of which project is so evident, the only question capitalists need ask is, Will there be sufficient demand for the power thus ob-



tained to repay the investment? Situated as we are in a wooded country, this ought to be the centre of all wooden-ware manufactures. Situated as we are in a cold country, it ought to be the centre of the woolen factories. Situated as we are with iron mines bearing 90 per cent. of pure iron, and magnificent forests to supply the material for charcoal, it ought to be the centre

of the charcoal iron trade. These, however, do not constitute the plan to harness the waters of the Ottawa River. It was a visit to Manchester, N.H., and Lowell, Mass., that created the idea. When the little "Merrimac" does such wonders, what would our old Ottawa do under similar circumstances, was the question?

The proposed canal would be almost straight, about five miles long, and lie close beside the Canadian Pacific Railway throughout its whole length.

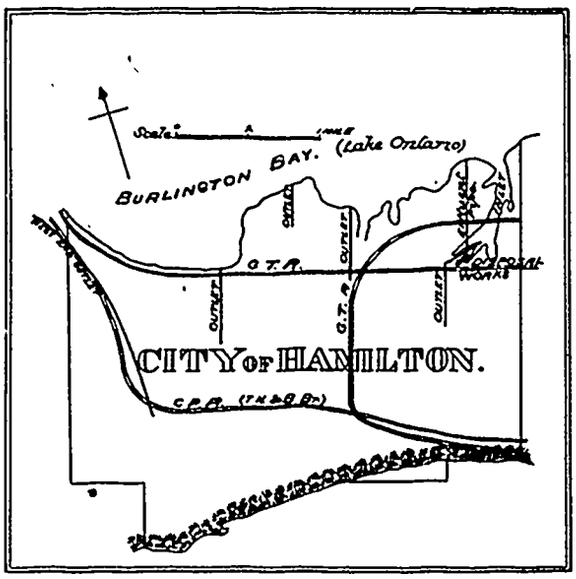
Following the water from the starting point A, the first obstruction is met when the lake narrows into the river again, forming the Deschenes Rapids, with a fall of about fifteen or twenty feet. From here for about three miles the flow is quiet, with a regular fall to where the Remoux, a turbulent rapid, extending a distance of half a mile, with fine descent, breaks the monotony. Another short, quiet flow, and the first ripple of the Little Chaudiere is met, followed by a swift rapid to the main fall, making in all a descent of fifty or sixty feet. It will be observed that the river sweeps to the north, and consequently furnishes the easiest possible means of conveying the water back to the river, or again into the canal at a lower level. The land is comparatively level and is mostly limestone rock, so there are neither engineering difficulties to overcome, nor dams and embankments likely to give way. The enclosed area is unoccupied except as water front or piling ground, except one small hill covered with buildings averaging (in value) $200 a-piece. To get to the lowest level, it would be necessary to cross the waterworks system, which is a serious difficulty, but one the city would likely help in obviating for such an object, as it would be immensely the gainer by the work.

NOTE BY THE EDITOR.—The lowest level of the proposed canal, viz., that passing round the Chaudiere Falls, could not be constructed without the consent of the present owners of the power at that point, which could hardly be obtained except at an enormous expense. The proposed work would probably be confined to the line *A* to *B'*, as indicated by dotted lines.

HAMILTON SEWAGE DISPOSAL WORKS.

The city of Hamilton, a prosperous manufacturing centre of about 50,000 population, is situated on the shore of Burlington Bay, a triangular sheet of water, each side of which is about five miles, and connected with Lake Ontario by the Burlington Canal.

The city, owing to a gentle, uniform slope towards the bay, is well adapted for the simple and efficient sewerage system designed and carried out by the late city engineer, William Haskins, M. Inst. C.E. By this system the city was divided into five independent districts, each district collecting its sewage and storm water into one main outlet, and discharging it into Burlington Bay. For a number of years the bay was fully capable of disposing of the sewage thus discharged, till recently, owing to the increase in the size of the city, the waters were gradually getting polluted, especially along the shore line. In the year 1895 matters were brought to a climax by an order from the High Court restraining the city from discharging crude sewage at the East end outlet, on the ground of its being a nuisance; the sewer in this district emptying into an inlet from the bay, and not into the bay directly. While the best means for carrying out this order were under consideration, the question of the disposal of the entire city sewage naturally suggested itself, and E. Kuichling, C.E., the sewerage expert of Rochester, N.Y., was engaged by the council to report on this subject. After getting the necessary data, he presented a very full report, the purport of which was the recommendation to collect the dry weather flow of all the city sewage to one station, and then pump it a mile or more out into the deepest part of the bay, considering that the bay was amply capable of receiving the sewage from the present population without rendering the waters offensive.



This solution of the sewage question did not meet with the approval of the city council, the citizens or the city engineer, there being a repugnance to this mere emptying the sewage into the bay without any treatment at all. The expense of collecting the sewage at one station was also against such a scheme, the estimated cost being nearly $200,000.

The late city engineer recommended the purification of the sewage by chemical precipitation, and advised the construction of such works at the outlets of two of the trunk sewers at Ferguson avenue and the East end. A by-law being submitted to the ratepayers, was carried for the construction of this work, the amount voted being $50,000 for Ferguson avenue outlet, and $35,000 for the East end outlet. It will thus be seen that the character and location of the works are both in accordance with the recommendation of the late city engineer.

The question of applying the sewage to land was gone into, but no site of a suitable nature or at reasonable cost could be obtained. There was a determined opposition made to the establishment of sewage farms by the surrounding townships.

After careful measurements, the daily dry weather flow of sewage at the East end outlet, where the works are being established, was found to be 500,000 gallons per 24 hours. The sewage is comparatively free from obnoxious components, being largely collected from the rural parts of the city.

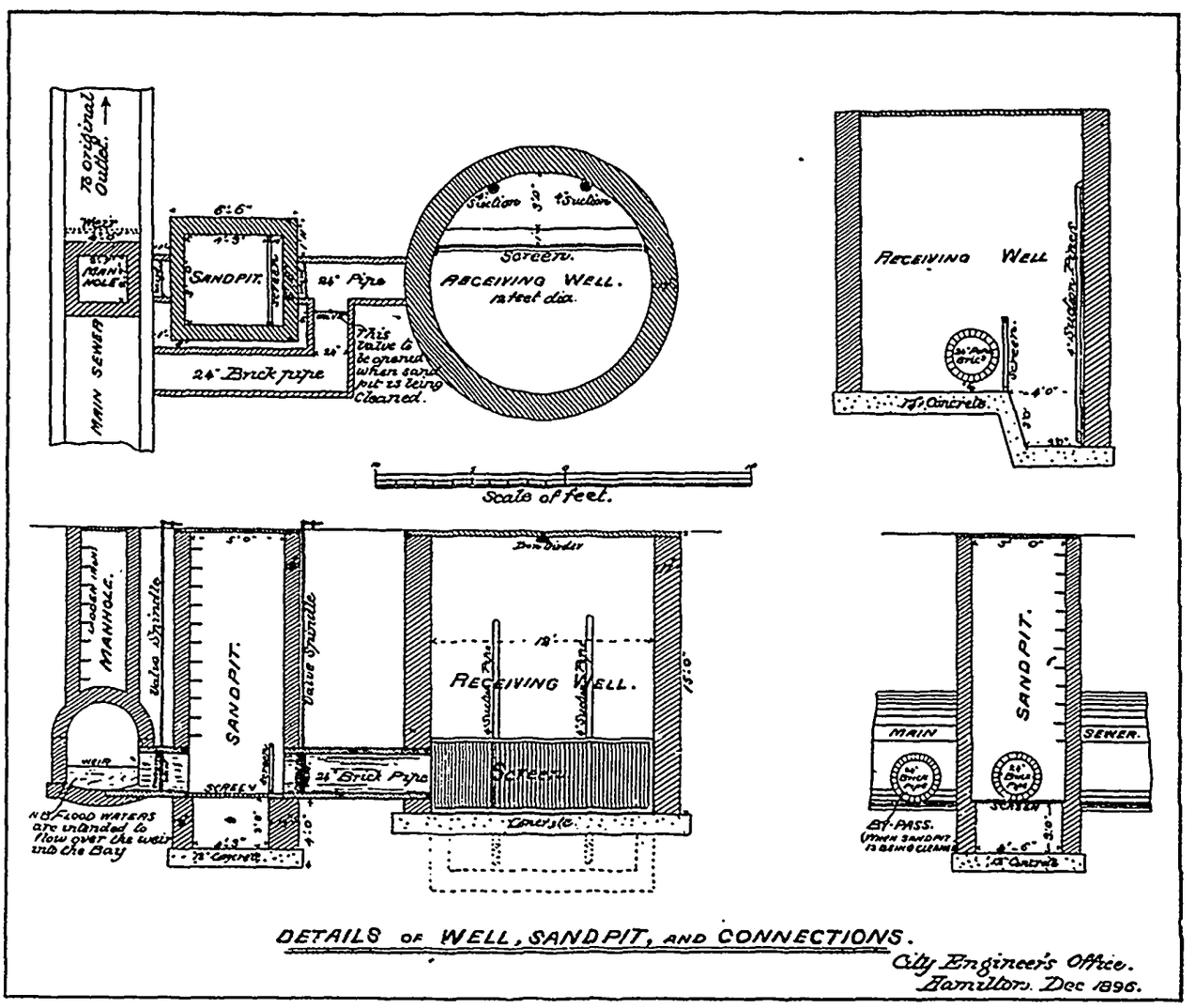
The works at present nearing completion are situated at the east end and consist of a pump house, press house and precipitation tanks. The sewage, before entering the receiving well, is carried across a sand pit, where heavy particles are deposited, and a screen retains large floating matters. When the pit requires cleaning, two throttle valves are shut, and the third (see Fig.) is opened when the sewage passes directly into the receiving well. At the point just below where the main sewer is tapped a weir is built across the sewer, so that in times of heavy storms the water will rise in the receiving well till it reaches the top of the weir,

when it will flow down the main sewer through its old outlet into the bay. In the receiving well the sewage is mixed with lime and sulphate of alumina in the proportion of about 4 grains of lime and 1 grain of alumina per gallon, and it is then raised by two centrifugal pumps into the channel. The chemicals are added in the receiving well in order to be thoroughly mixed by the churning action of the pumps. The sewage is conducted along the channel to the precipitation tanks over the weirs, the proper ones being closed to conduct the sewage to any particular tank. While slowly passing through the tank the black sludge is precipitated to the bottom, and the clear water re-enters the channel and is conducted down steps to ærate it, and thence into an 18-inch pipe, whence it is conducted to the bay. When any of the tanks require cleaning the weirs in connection are shut down, and the water is let off by means of the skimmer pipe. The sludge is then drawn off through an 18-inch pipe into an open brick drain running along the floor of the archway, and conducted to the sludge well. This well is 19 feet diameter and the bottom is 6 feet below the pipe conveying the sludge. The sludge is then pumped into a press, situated over the channel in order that the surplus water may fall back after pressing, and the sludge is forced out at the ends in the form of cakes, whence it is conveyed by a small railway outside the building.

The centrifugal pumps are capable of raising 1,000,000 gallons per 24 hours through a lift of 18 feet, 14 feet of which are below the pumps and 4 feet above them. They are driven by a vertical engine attached directly to the pumps. The sludge is raised by two duplex sludge pumps, having dimensions 7½ x 5 x 10 and 6 x 4 x 7, capable of raising the sludge through 15 feet of suction, and discharging it into the filter press under pressure of a maximum of 140 lbs. per square inch, the steam pressure being 70 lbs. The suction pipe is 4 inches in diameter, and the discharge pipe 3 inches in diameter.

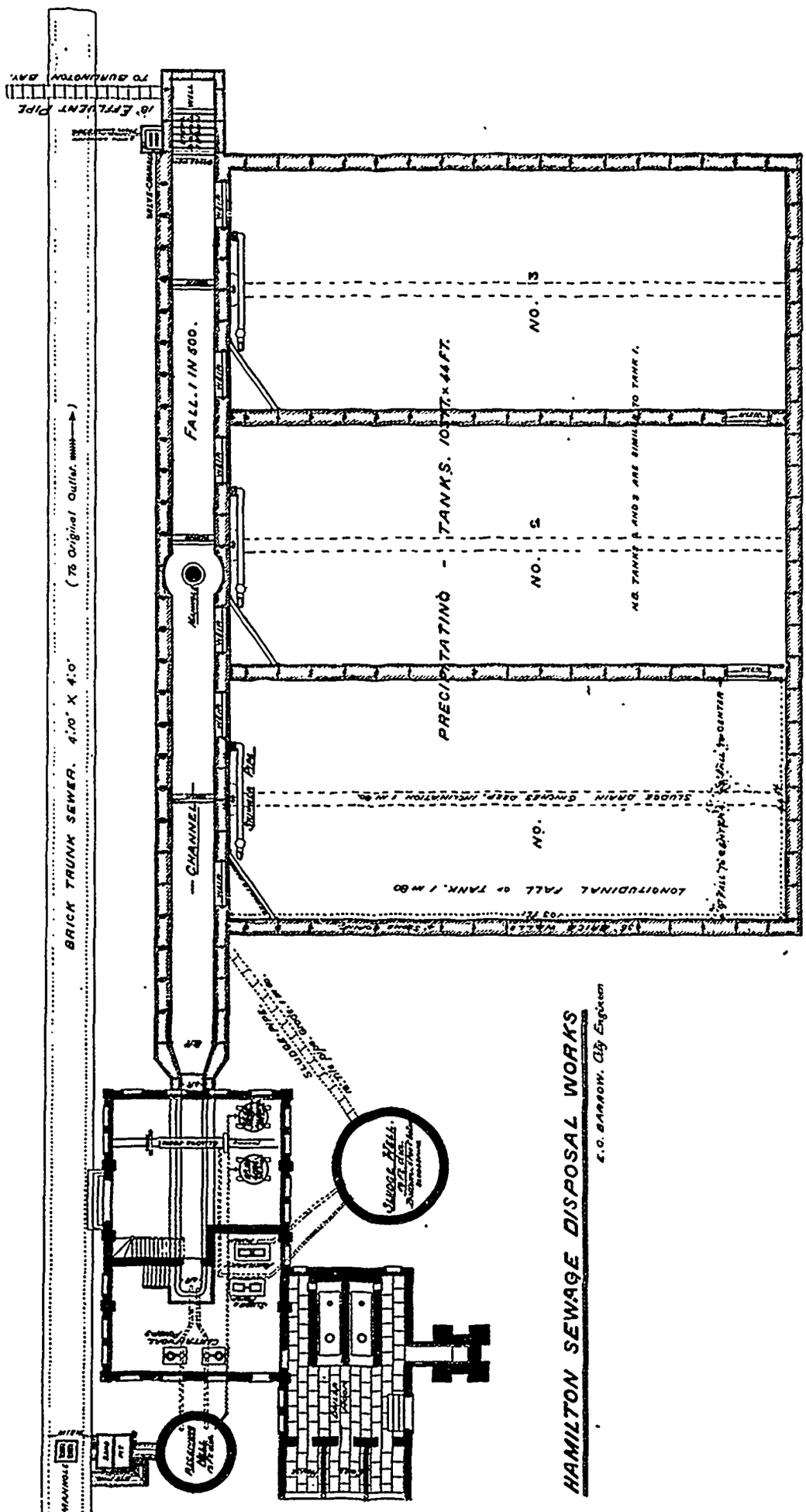
The filter press contains 50 chambers, each having a drip cock, and being capable of making a cake 28 inches in diameter by one-half inch thick. The tightening screw is 4 inches in diameter with a longitudinal motion of 18 inches, and has a hand wheel 45 inches in diameter. The entrance head of the press is provided with an air chamber 10 inches in diameter by 24 inches high, having a pressure gauge on top graduated to 150 lbs. The press is supported 3 feet above the floor on 6 legs, and the sludge is admitted to the press by a 2½-inch wrought iron pipe. The press is sufficiently strong to stand the pressure being raised from 0 to 150 lbs. in 10 minutes. The sludge car running beneath the press is 32 x 12 inches x 6 feet.

The mixers, one of which is made of wrought iron, and the other of wood, are 5 feet in diameter by 6 feet high; the sides and bottom of the iron one being one-quarter inch thick. Each mixer is provided with a 2 7/16 inch diameter steel shaft, carrying beaters, and resting on a removable cast iron shoe, and passing through a cast iron box on a level with the top of the mixers. The pipes conveying the chemicals to the sewage are 2½ inch diameter.

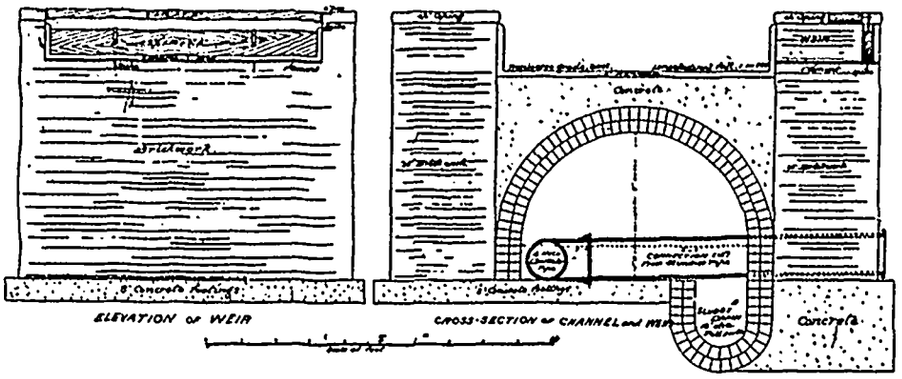


DETAILS OF WELL, SANDPIT, AND CONNECTIONS.

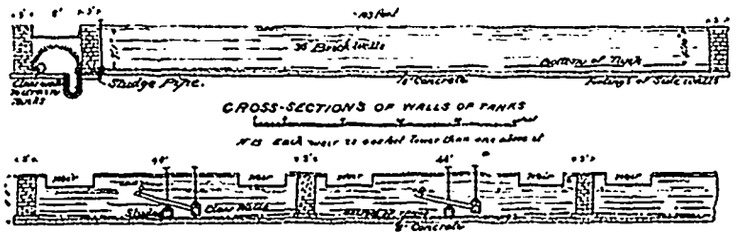
City Engineer's Office.
Hamilton. Dec 1896.


HAMILTON SEWAGE DISPOSAL WORKS
E.G. BARROW, City Engineer
PRECIPITATING TANKS. 10 FT. x 44 FT.
NO. 1
NO. 2
NO. 3
NOS. TANKS 1 AND 2 ARE SIMILAR TO TANK 1.
LONGITUDINAL FALL OF TANK, 1 in 80
FALL 1 IN 300.
CHANNEL
BRICK TRUNK SEWER. 4'-0" X 4'-0"
(To Original Outlet)
TO BURLINGTON BAY.
18" EFFLUENT PIPE
SLUDGE PIPES
SLUDGE WELL
SLUDGE PUMPS
MAIN ROAD

The amount of sewage to be treated at this outlet is 500,000 gallons per day. The works were made on an extra large scale, as it is probable that the district will rapidly increase in population, several large sewers being built lately. The necessity for pumping the sewage arose from the outlet being almost on a level with the waters of Burlington Bay. At some of the other outlets this will not be necessary, and, therefore, will materially reduce the cost of working. The amount voted for the works was $35,000, and the cost has not exceeded this amount.



The works have been carried out by the city engineer, E. G. Barrow, M. Can. Soc. C.E., O.L.S., on the most modern and substantial scale. Mr. Barrow has made himself familiar with the subject for a number of years, and is conversant with most of the systems employed in England and the United States.



E. G. BARROW, M. CAN. SOC. C.E., O.L.S.

E. G. Barrow was born at Clifton, Bristol, Eng., Nov. 7th, 1846. Was for three years an articled pupil of Francis Fox, M I.C.E., chief engineer of Bristol and Exeter Railway. Subsequently became assistant under him on Chard and Taunton branch of that railway. Was on the Midland and Hamilton and North-Western Railway, of Canada, and for several years was assistant city engineer under the late Mr. Haskins. Is a member of Canadian Society of Civil Engineers, and an Ontario Land Surveyor. Was engaged under Ontario Government on construction of water-works at Mimico and Hamilton; also on water-works at Teeswater and Campbellford. Appointed city engineer of Hamilton, July, 1896.

Charles H. Wallace, who was assistant engineer in charge of the works, was educated at Dublin University Engineering School. He received the degrees of Bachelor of Engineering and Bachelor of Arts in 1888, and the same year came out to Canada, when he entered the City Engineer's office in Hamilton as junior assistant. During 1890-91 he was articled to Mr. Sewell, of Port Arthur, as a land surveyor, and received the degrees of O.L.S., D.L.S., and D.T.S. From 1891 to 1896 he was engaged in private practice, when he re-

CHARLES H. WALLACE, B.E. AND B.A., DUBLIN.

entered the City Engineer's office, on the death of the late William Haskins, M.I.C.E.

For THE CANADIAN ENGINEER.

ALGOMA COAL.

BY THOS. FROOD.

The discovery of a mineral fuel in Balfour township has directed attention to the quality of the fuel, but no estimate seems yet in print to indicate the *extent* of the deposit. The Cambrian deposit begins west of Lake Wahnapitae and runs west 30° south for about 20 miles, with an average width of six miles. It is separated from the nickel belt on the south-east by a low rim of Laurentian rocks, which carry free gold, but generally in very small veins—the Creighton gold mine being the only one extensively developed. The northern rim is chiefly granite, rising in terraces to a height of probably 500 feet, and giving a splendid prospect to the south and east. Much wider veins of quartz traverse the rocks on this side, while immense deposits of gravel form a talus to the granitic escarpments. It would not be surprising should some of these gravels prove

valuable. Beyond the granite ridge lie immense beds of peat, which are enriched by the *debris* of resinous shrubbery, and probably more valuable than what is produced from grasses and sphagnum only.

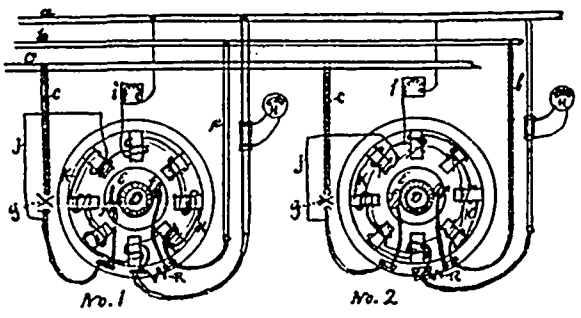
The search for coal will not likely be very successful, as the brecciated slates in which it occurs are very hard and silicious, with few fissures visible, and the spaces between ridges filled with brown and often marshy clay. The ridges rise 50 to 70 feet above the clay level, smooth on north-west and broken on south-east. At the extreme west of the basin they rise in high conical hills, most likely underlaid by granite.

Small samples of a black cubical substance which disappeared entirely in our forge, were found in the diorite at the Lady Macdonald mine, McKim, in 1885; a similar sample in a quartz boulder was found on an island near the Wallace Mine lately. It has a high lustre, and evidently had been fluid when it filled seams in the quartz. Boulders of brecciated slate are frequent in the vicinity, identical with the Balfour-Cambrian deposit, but resting upon Huronian strata. Dr. Robert Bell informs me that there are two small deposits south of the Balfour basin from which they may have been borne by the glacial drift. I saw no traces of carbon in the boulders.

While the possibility remains that other veins of anthraxolite will be found, and perhaps worked profitably, a five years' experience of that district inclines me to the belief that the chief values will be realized from the soil, water-powers, pulp, peat, and gold-bearing deposits in the granite rim of the Cambrian basin. Should these be fully developed the "Balfour boom" will have served its purpose, and those who came seeking coal returned with something else equally or more valuable. As extensive fires have prevailed since I was on the survey, etc., in the locality, it may be easier to trace veins and outcrops than in the green timber.

A PROBLEM IN ELECTRICITY.

A correspondent sends THE CANADIAN ENGINEER the following problem. We should be pleased to receive suggestions for its solution from our readers:



a Positive bus bar. *b*. Equalizing bar. *c* Negative bar. *d*. Commutators. *e*. Armatures. *f*. Brushes. *g*. Circuit breaker. *h* Ammeter. *i*. Rheostat. *j*. Shunt field. *k*. Series field. *r*. German silver resistance.

With two machines connected as per diagram with equalizers: First, how is it that when the circuit breaker goes out on either of the machines (when running in multiple), the ammeter will still register a quantity of current? Second, how is it that by moving the rheostat and altering the resistance in the shunt field, the quantity registered on the meter will vary? The negative side of machine is open when circuit breaker is out, and there is no connection whatever to the bus bar on that side of machine.

SALT WORKS OF ONTARIO.*

BY C. M'LEAN FRASER.

It may be showing considerable presumption on my part to try to give you something fresh concerning salt—salt, with which you are all so well acquainted, in so many of its uses and applications. However, I hope I may be able to present something of interest with regard to the manner in which it is procured in the crude state, and the method of treatment which it undergoes to become the salt of commerce.

There are two principal methods of procuring salt, the one by mining as coal is mined; by this method the salt is procured in solid blocks and then ground fine. The other, by pumping brine from deep wells and evaporating to drive off the water, thus procuring the comparatively dry salt. There is another method closely allied to the latter, which is carried on on a small scale in some parts of the world, viz., the evaporation of saline water from certain springs. Salt is procured in Great Britain by mining; and from Great Britain up till a few years ago the greater part of the salt used in America was obtained, and even now, while salt is obtained in large quantities in Ontario and the neighboring States of the Union, yet Canadian manufacturers can scarcely compete with the English, because salt is used as ballast and may be shipped from Liverpool to Montreal with as little expense as from Goderich to Montreal. There are about 600,000 barrels used in Canada annually, about 50 per cent. of which is supplied by Great Britain.

As it is of the "Salt Works of Ontario" I wish to speak, and as no salt is mined in Ontario, I shall not consider to any greater length this method of production, but shall confine my remarks to the method of evaporation. Previous to the year 1866, all the salt produced in America was procured from the evaporation of saline water of, at the greatest, about 15 per cent. saturation, from the springs of Warsaw and Syracuse, N.Y. In that year, however, while boring for oil in the small village on the right bank of the Maitland, in the county of Huron, at that time called Maitlandville, but now called Saltford, Peter McEwen struck pure rock salt at the depth of 1,000 feet below the surface. Immediately, there was a boom in salt manufacture. Ten or a dozen other wells were sunk in the immediate neighborhood, and about twenty more across the river, in and about the town of Goderich.

Since then wells have been sunk at several other places in Western Ontario, till at present there are wells at Kincardine, Wingham, Brussels, Blythe, Seaforth, Dublin, Clinton, Goderich, Stratford, Hensall, Exeter, Parkhill, Sarnia, Courtright and Windsor. Other wells have been in operation at Port Franks, Bothwell and Petrolia, but are not now so. Borings have been made at other places further east than the district in which these places lie, but they all hitherto have been unsuccessful. At a boring made at Mitchell by Peter McEwen there was found to be a white clay resembling pipe-clay, corresponding to the place of salt deposit in the Huron district. The district includes a strip south of a line drawn through Kincardine, Wingham and Brussels, and west of a line through Brussels and Seaforth. It includes about 1,200 square miles in the counties of Bruce, Huron, Middlesex, Lambton and Essex. It crosses into the United States, great amounts being manufactured in Michigan and the neighboring

*A paper read before the Natural Science Association, Toronto University, and published exclusively in THE CANADIAN ENGINEER.

States. The most easterly well is between Seaforth and Dublin, from which brine is pumped to the Dublin works.

I have visited wells at several of the places already mentioned, viz., at Wingham, Brussels, Clinton, Goderich and Saltford. I shall describe in detail the well where the boring was first made in Saltford, and shall refer afterwards to points in which other works differ from it. For the information regarding it I am indebted to Hugh McEwen, a fellow student at the Goderich Collegiate Institute, who is the son of the proprietor and bookkeeper for the firm. This well was running almost continuously since it was bored in 1866, till August 30th of this year, when the works were completely destroyed by fire. For some time it has been the only well working in Saltford In the first place there is a hole large enough to sink iron tubing of 3½ inches in diameter, drilled to and for some distance into the salt bed. I have not the figures for a log of this drilling, but I think it compares almost exactly with Attrill's well, just a short distance away, except that in Attrill's well it is farther to the solid rock and the well has been sunk much deeper. The following are the figures of the constituents of a log from Attrill's well, and from these we can form an idea of McEwen's:—

	Attrill's. ft.	in.	McEwen's.* ft.
Clay, gravel and boulders	78	9	35
Dolomite with thin limestone layers	278	3	
Limestone, with coral chert and beds of dolomite	276	0	975
Dolomite, with seams of gypsum	243	0	
Variegated marls, with beds of dolomite.	121	0	
Rock salt, first bed	30	11	16
Dolomite, with marls toward base	32	1	24
Rock salt, second bed	25	4	
Dolomite	6	10	
Rock salt, third bed	34	10	
Marls, with dolomite and anhydrite	80	7	
Rock salt, fourth bed	15	5	
Dolomite and anhydrite	7	0	
Rock salt, fifth bed	13	6	
Marls, soft, with anhydrite	135	6	
Rock salt, sixth bed	6	0	
Marls, soft, with dolomite and anhydrite	132	0	
Total depth of well	1,517	0	1,050

This boring passes through the post-glacial and possibly the glacial deposit of the post-cainozoic period; the corniferous formation of the Devonian and the Onondaga or Gypsiferous formation of the upper Silurian, in the lowest part of which the salt is found.

The water percolates through the rock and dissolves the rock salt. Mr. McEwen is of the opinion that after 700 feet the rock is perfectly dry, the rocks above that furnishing the water for the brine. There is sufficient pressure to raise the water about 500 feet in the tubing. From this point to the surface it is pumped through a tube of somewhat smaller diameter by a pump working on the same principle as the common water pump. The power required for the lifting of the brine such a distance is considerable, requiring the assistance of an engine of about 20 h.p. From the surface down to the solid rock casing is put round the tube for protection. The brine which is pumped up is of 100 per cent. saturation (about 1-5 salt). If at any time the salinometer, viz., the instrument used to measure the degree of saturation, shows a saturation of less than 100 per cent., the pumping is stopped, for this happens only when there is some defect, generally in the tubing, which is often in need of being replaced.

The brine is pumped into large settling basins, where it remains for two or three days. As these tanks hold a large amount of brine, pumping is done only in the day time. The brine is in these tanks treated with chemical reagents to remove the impurities, chiefly gypsum and sometimes hydrogen sulphide. From these settling basins it is taken to a large heating pan of metal about 26 feet by 100 feet. It is allowed to cover this about one foot deep. Here it is heated almost to the boiling point and then is transferred to another pan of the same size just beside it, where it is heated to the boiling point and the salt precipitated. The pans are made of large area, that there may be a great surface for evaporation. These pans are heated by large furnaces under one end and a network of flues running under the whole surface. In heating at this establishment both coal and wood are used. The wood may be fired to give a greater heat, but the heat from the coal is steadier. The precipitated salt is scraped out on platforms, one on each side, where it is allowed to stand for three or four days. Then it is shovelled into bins, where it dries still further for about a month and then is ready for use. Generally it is shipped in barrels of 280 pounds or in carloads.

The different degrees of fineness are due largely to the different degrees of heating. For the first 24 feet or thereabouts over the fire, the crystals are very fine on account of the intense heat, and this requires to be raked out about eight times a day. For the next 24 feet it is somewhat coarser in the grain, and is raked about four times a day, while at the far end from the fire the crystals are very coarse and have to be raked only twice a day. The land salt is merely the cleanings of the pans, and consists of partially burned salt and gypsum. It is necessary to clean the pans about every two weeks. The dairy salt is finer than that which is procured by the ordinary evaporation process. It is allowed to dry as described above for about a month, when it is taken to a drying kiln. This kiln consists of a cylinder about 30 feet long, and one and a-half feet in diameter, elevated at one end and capable of revolving. Under this a fire is kept burning. The salt is put in at one end, and the revolving of the cylinder takes it slowly down to the other end; here it is caught by an elevator which takes it to a series of sifters, where all the coarse grains are taken out and the fine dairy salt remains.

Mr. McEwen at one time had besides this, a large evaporating pan at the top of a hill near the well, where the evaporation was accomplished by the assistance of the sun. By this method, salt in the form of beautiful large crystals was obtained. The ordinary output at this well was about 1,000 barrels a week

These are the principal points regarding this well. I shall now mention some points in which some of the other wells differ from it. The principal difference lies in the chemicals used for purification, as each manufacturer uses his own re-agents, which are kept secret from the outside world. In Goderich, where at one time there were about 20 wells, there is now but one in operation, and it resembles the Saltford well in all essentials. Until this summer, there was another well in operation in connection with the flour mill owned by Ogilvie & Hutchinson. In this the exhaust steam from the mill was utilized in heating the pans. The mill, however, has been shut down, and, of course, the salt works are not now in operation. The Goderich wells are about 1,150

* The figures of McEwen's well are only an approximation.

or 1,200 feet deep. McGarvey's well, at Clinton, is about 1,100, while Ransford's, at Stapleton, about 1½ miles east of Clinton, is 1,250 feet. Blyth and Wingham are each about 1,200, Brussels and Seaforth about 1,100, and Kincardine 900 and 1,000 feet. The well at Kincardine has the largest pan, probably, as one pan is 191 by 32 feet. Previous to the year 1889, Ransford's well, at Stapleton, was only 1,170 feet deep; but in that year the roof fell in, and in consequence, the pipe had to be taken out. A hole was drilled through the obstruction to the rock below, and a casing was put in that impurities might not enter from above. A boring was then made into the second salt bed a distance from the surface of 1,245 feet. Since then there has been no obstruction to the working of the well. At Courtright, instead of wood or coal, petroleum tar is used for fuel. This, of course, can be obtained near hand, but is really not much cheaper than the coal.

At Wingham, and I think also at Courtright, there are no chemicals used for purification, as the salt obtained is almost devoid of impurities. These, however, are comparatively new wells. Wingham has been running eight years and Courtright about twelve years, and it is believed by some that in time the salt from these wells also will have to be purified. At Windsor and at Courtright two pipes are used, the one inside the other. Water is forced down the inside tube and this forces the brine up the outside tube. The fresh water thus used is comparatively pure and not loaded with gypsum, as that percolating through the rock sometimes is. The brine is thus driven up instead of being pumped up. This seems to work very well, but every time the tubing becomes defective and has to be taken out, which is quite often, it is necessary to erect a derrick to get the tubing out and to put it in again. In the other wells the derrick is always in working order, and very little trouble is necessary to replace defective tubing.

At Windsor experiments have been made lately with what is known as the vacuum process. Brine at ordinary atmospheric pressure boils at about 220° F. or 104.4° C. The idea in the vacuum process is to carry off the steam as soon as it is formed, thus causing evaporation at a much lower temperature and thereby less fuel is required. It has been worked so as to bring it down to 140° F. or 60° C., but the process has been very hard on the apparatus, and on that account has as yet not proved satisfactory. The Windsor dairy salt that we see advertised so widely lately, besides being treated in the manner already described for dairy salt, is subject to the action of some chemical substance which has the power of pulverizing the grains of salt, and thus depriving it of the grittiness common to ordinary salt.

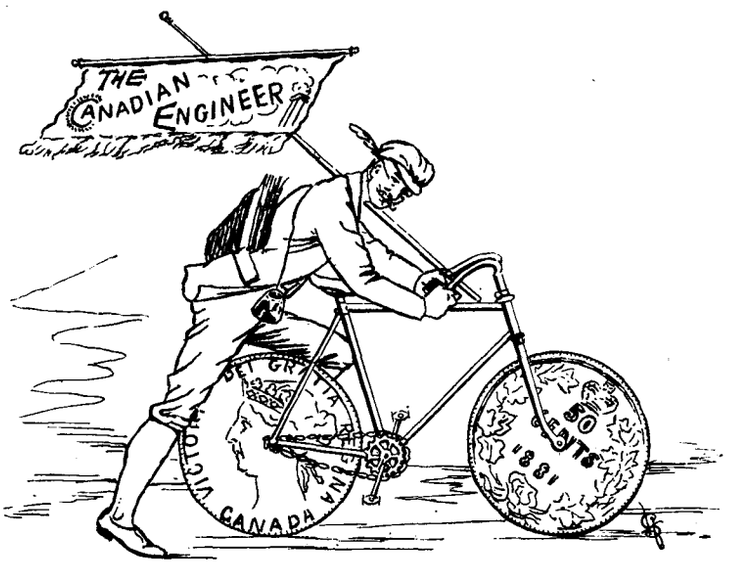
Some years ago it was thought it might be possible to mine the Huron salt, and a boring was made for this purpose a few rods from the mouth of the Maitland, on the north side of the Attrill estate. The effort, however, proved unsuccessful, as no means whereby they could manage to keep the water from dissolving the salt to such an extent to make mining possible could be devised.

We have in our province, which is so replete with natural resources, a bed of salt practically inexhaustible —able at any rate to supply the Dominion of Canada for ages. It is necessary that it should be so because it is the only salt producing district of the Dominion at present, with the exception of a small area in Manitoba, where a small amount of salt is obtained by evaporation.

A WORD IN PASSING.

The following circular was sent out from the business office of THE CANADIAN ENGINEER at the close of the year. The response was most generous, and the silver wheels have rolled in freely. Many compliments have been paid us on the form of the circular, and it has been suggested that we reproduce it, and we do so to afford the majority of our subscribers a reading of it. It may also be of personal interest to those whose subscriptions have since become due.

"All the world's a wheel, and THE CANADIAN ENGINEER rides with the best of them. We have just made



another run around the twelve months' track and are thousands of subscribers ahead of all competitors. We use the little milled silver wheels, as you see, and are now looking round for an extra pair or so for the next race. You have some in your possession which would fit our bicycle. The number we would like from you is indicated by the date on the address label of your paper, which shows the time from which you owe.

BIGGAR, SAMUEL & CO.,
Publishers, Fraser Building, Montreal, Que."

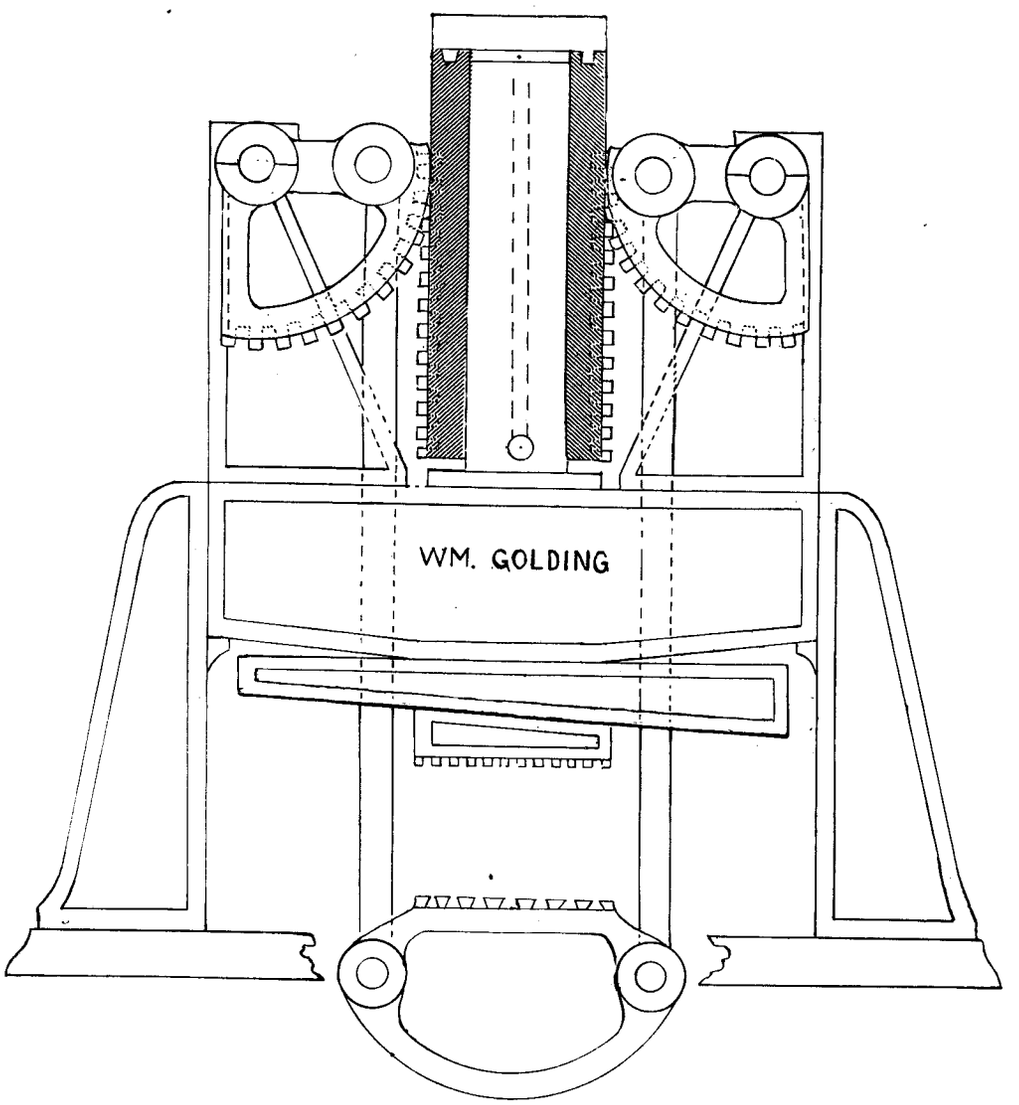
STREET PAVING.

In nothing hardly is there more marked contrast between British and Canadian methods of doing things than in the matter of street pavements. In Great Britain, permanence is the chief object: in Canada, cheapness and speed in construction are often the primary considerations. The smooth surface which is presented by roads laid down before the Christian era began is the British complement of the mud holes into which Canadian vehicles plunge in trying to span the gaps between the logs with which the early settlers filled in the swampy patches in the early Canadian roads, happily called corduroy. Our roads are rapidly improving in Ontario, especially where the Government is taking active measures to promote this desirable end. But we are still far short of perfection. Contrast the following with a sample Canadian street pavement of cedar blocks laid on sand:

The street was first excavated to a depth of one foot; then a layer of rubble was put down, and upon that a layer of coarse cement. The whole was then floated with cement and laid with Jarrah blocks, each 7 inches by 3 inches by 6 inches, and having a thin fillet of pine between each row of blocks. The blocks were next floated with hot pitch and overlaid with coarse gravel, and the road was complete. This was done on

Market street, Bradford, England, last summer, and a sample of the Jarrah blocks has been kindly supplied us by a correspondent.

The chief points of interest to Canadians are that we can improve our street pavements and also at the same time open up a home market for some of the products of our lumbermen; we can make our way in the English market and compete with Australia in supplying hardwood blocks. Edwin Haynes, of the *Timber Trades Journal*, London, recently expressed the opinion to the writer that there were a number of woods in Canada which might be placed on the British market as paving blocks to great advantage.



COMPRESS FOR COTTON, ETC.

The accompanying sketch represents a Lever Hydraulic Cotton Compress, the invention of Wm. Golding, C.E, of New Orleans, La., and described by him in a letter to THE CANADIAN ENGINEER as follows:

As will be observed there are four (4) standards placed upon a bed plate, common to all, upon which is mounted a casting called "The Beam." Upon this beam are placed four (4) housings which support the two moving sectors, which engage by means of heavy cogs the hydraulic cylinder, the plunger of which also rests upon the beam. There are four (4) lifting rods, which are connected to the lower platen and also to the moving sectors by means of pins, which pass right through the lifting rods from side to side. The bale is placed upon the lower platen and the suspended wedge is run into the proper place to average the inequality of size; water from the pressure pumps is admitted to the hydraulic cylinder, thus causing the cylinder to ascend, carrying with it the sectors. It will be understood that the staple or material of the cotton is not compressed, but that the staple (naturally kinky) is forced to assemble more completely. While the size of the bale is being reduced by the ascending platen, the opposing force increases in the proportion of ten to one of progress: thus if the resistance at the beginning including the weight of ascending parts, be 250 tons, the final pressure will be 2,500 tons. To compensate for the increased resistance is the object of the sectors through the progressive leverage, of which a nearly uniform pressure in the hydraulic cylinder accomplishes the compression of the bale.

The bale of cotton when it leaves the plantation presents a rectangular figure, 60 inches by 30 inches on the base by 48 inches in height, weighing 500 pounds, and is retained in shape by six (6) steel bands. At suitable shipping points, where from 20,000 to 100,000 bales are collected during the year, powerful compresses are erected for the purpose of reducing the height of the bale from four feet to one foot for economy of storage. The form and type of the Cotton Compress has been undergoing change and improvement for fully half a century, and it is now claimed that there are fully two hundred first-class compresses in actual service throughout the cotton raising States. The cotton crop of the United States averages 8,000,000 bales of 500 pounds each, worth at point of shipment $40 per bale. The

uniform charge for compressing is 50 cents per bale. The capacity of the press for activity is 70 bales per hour, and the power exerted on the bale to compress it to desired size, is three thousand tons; total weight of this press when ready for service, including boilers and pumps, is five hundred thousand pounds.

For THE CANADIAN ENGINEER.

ELECTRICAL PROGRESS DURING 1896.

BY F. C. ARMSTRONG.

The electrical development of the year 1896 has been marked rather by sound and steady progress along the lines of established practice than by the introduction of new or startling departures from existing methods. That such should be the case may be taken as indicating the emergence of the industry from the state of perpetual infancy, which the public by common consent have come to regard as its natural attribute, into a stage where the elements of permanence and stability enter to as high a degree as in any other of the great fields of production which are subject to the conditions of mechanical evolution. This is a consummation devoutly to be wished for of a certainty, both by the manufacturer, whose profits, dwindling in the face of severe competition, have often been found to vanish entirely when the items of depreciation of manufacturing plant and maintenance of the factory scrap-heap are given their proper proportion on the yearly balance sheet, and by the investor in electrical securities, whose dividends have from the same cause been only too prone to take the same course.

To day, however, electrical machinery of the class conveniently described as standard has been perfected in type and detail to a point approaching finality. Apparatus on the market for railway, lighting, and power service, is characterized generally by excellent mechanical and electrical design, is symmetrical in appearance, substantial in construction, highly efficient and durable in operation, and in its special features admirably worked out to suit the particular requirements of the work which it is called on to perform. A considerable extension of the present range of operation is of course to be expected in various directions, involving new sets of conditions and new methods to meet them. But, viewing dynamic electricity simply as a flexible and convenient means of transmitting energy from a prime mover such as a waterwheel or a steam engine, to a point where such energy is to be used, either to move the wheels of a hundred-ton locomotive, or to heat to incandescence the slender filament of an incandescent lamp, the electrical engineer may fairly claim that the work which he has done in less than two decades has resulted in entire and brilliant success. It may be that the next ten years will see his work carried a step further back, and the energy latent in a pound of coal converted directly into an electrical form, without the present wasteful intermediate steps through the boiler, steam engine and dynamo.

The additions made during the past year to existing electrical equipment have been, if not revolutionary in their nature, none the less essentially valuable to the manager of an operating plant. In arc lighting the most important development is in the generator itself. Large, slow-speed units suited for direct connection are being brought out, having sub-divided circuits individually controlled, in which it has been aimed to embody the essential advantages gained by the iron-clad type of armature. The gain in economy and simplicity of such an installation, especially in large city stations, where units supplying 250 or even 500 lamps could be used, does not need to be dwelt on. The long-burning arc lamp is a successful innovation which has deservedly won considerable favor during the year, a substantial saving in attendance and cost of carbons being secured by its use. The alternating arc lamp can scarcely be said to make so satisfactory a showing, the expense of the cored carbons, still necessary for their successful operation, being a decided drawback. It seems remarkable that no attempt has yet been made to develop in America a rectifier similar to that which Ferranti has introduced into English practice, by which direct current for series arc circuits is taken from the constant potential alternating mains.

In direct current incandescent lighting, the tendency towards direct connection, even for small isolated plants, is very noticeable, and may be given as the characteristic of the past year's work. A striking instance of this is furnished by a large departmental store in this city, where the previous installation of slow speed engines and small belt-driven generators, some of the latter only a short time in service, has been entirely discarded in favor of three direct-connected units having an aggregate capacity of 6,000 lamps.

In alternating work the battle of the phases and of rival types of generators has gone merrily on. The engineering considerations which should govern in any given case have, perhaps, not always been given due weight in the face of commercial exigencies requiring the sale of a particular system or make of machinery. A point which may be conceded is the superiority of generators of the revolving field or inductor type for work requiring the use of currents at very high or very low potentials, the obvious facilities afforded by these designs for additional insulation or ventilation, as the case may require, rendering them especially well suited to certain classes of service. Where lighting alone is in question, the compounded single-phase alternator seems under ordinary conditions best adapted for the requirements of simplicity and close regulation.

In railway work, as elsewhere, the direct connected generator, now perfected to a point beyond which but little improvement is to be looked for, has had the call in all large installations. The motors recently brought out, while of course embodying improvements in detail, have been mostly new sizes rather than new types, and the leading manufacturers now offer a line of machine specially worked out for a very wide range of service. The successful alternating railway motor may possibly be credited to 1897. It can certainly not be claimed as an accomplishment of 1896.

Electro-chemical processes have been developed within the past twelve months at a rate which promises to effect a revolution in many of the industrial arts. The annual report just published of the Anaconda copper mine in Montana shows an output of 107,000,000 pounds of electrolytically refined copper for the past year, as compared with 90,000,000 for the Calumet and Hecla. The increasing demand for current for the production of aluminum by the Pittsburg Reduction Company bids fair to make them the largest consumers of Niagara power. The manufacture of calcium carbide at Niagara Falls, Merritton and Sault Ste. Marie seems well under way on a reasonably large scale. Carborundum, sodium, chlorate of potash, caustic soda, potassium chloride, calcium chloride, in fact an endless

number of chemical products of staple commercial value, are now being found capable of advantageous production in the electrolytic cell or the electric furnace. No branch of scientific work offers greater promise of success to the investigator than is afforded in the field of electro-chemical research.

One or two of the more important features of the work actually done during the past year in Canada, it might, perhaps, be well to touch upon. The unsettling influence of a general election at home; the severe business depression in the United States, and the uncertainty felt as to the result of the silver crusade, were all factors unfavorable to general business prosperity, from the effects of which the electrical industry suffered with the rest. Notwithstanding this, however, several very considerable enterprises have been carried through to completion, and the development of existing interests has proceeded upon sound and healthy lines.

The most important undertaking of the year is undoubtedly that of the Lachine Rapids Hydraulic and Land Company, whose plans now approaching completion for the development of 12,000 horse power, have aroused wide-spread interest amongst hydraulic and electrical engineers. Following this has come the announcement of contracts having been let for the hydraulic work in connection with the development of the Chambly water-power, from which electric power in large quantities is to be transmitted to Montreal. The Keewatin Power Company have had under consideration plans for a transmission plant reaching as far as Winnipeg, a distance of 125 miles. Power development on the Canadian side at Niagara Falls has been retarded by the conditions of the charter under which the Canadian Power Co., an offshoot of the Cataract Construction Company, possess a practically exclusive franchise, but the current year is likely to see at least a beginning made in their scheme, which embraces as its outcome the generation of 250,000 horse-power on this side of the cataract. In electric railway work the two most important enterprises undertaken have been the Hamilton Radial Railway and the Hull & Aylmer road, each indicative of the gradual encroachment of electric traction upon the domain of the steam locomotive.

On the whole, the year 1896, while not to be regarded as *annus mirabilis* in electrical chronology by reason of any especially noteworthy achievement, has been marked by steady and satisfactory progress, which in its results should be gratifying alike to the engineer and the investor.

NIAGARA FALLS WATER POWER.

A casual visitor to the Niagara Falls will be struck by the contrast presented between the Canadian and American shores of the Niagara River. The Cataract Construction Co. is beginning to supply power and light to the city of Buffalo, 22 miles from the great power house at the Falls, while in the cluster of towns and villages around the American side of the Falls there is bustle and activity, and every week one hears of some new industry starting. New streets are being laid out, and building operations are brisk on every hand. On the Canadian side, though nature has paved the way for cheaper power from the Falls and better conditions for manufacturing, everything is stagnation, compared with the New York side. To strike anything new or important, from an industrial point of view, we have to go twelve miles away to the Welland Canal, where are situated the new Willson Carbide Works, o which, by the way, some account will be given in our next issue. Most of our readers are aware that the great activity on the American side is due to the industries which have been called into existence by the Cataract Construction Company, which controls the power derived from the Falls. It may not be so well known that the men who composed the Cataract Construction Co. on the American side are the same gentlemen who control the Canadian Niagara Power Co. on our side of the river. These gentlemen hold a charter from the Ontario Government, under which they leased from the Queen Victoria Park Commissioners for twenty years from the first of May, 1892, the power derivable from the Canadian side of the Falls, at a rental of $25,000 a year for the first ten years, after which the annual rental would be $35,000. Under this arrangement $100,000 has been paid, this money being for the benefit of the Queen Victoria Niagara Falls Park. At the time this bargain was made the members of the Ontario Government and a large section of the public looked upon these terms as very favorable to the province, but the electrical developments of the world have made it evident that the commercial value of this water power has been wofully under-estimated, when one considers the variety and value of the industries that are consequential upon the harnessing of this power. This is made clear by a contemplation of the industries that are springing up on the American side. Under the agreement with the Canadian Niagara Power Co. that corporation was to commence work on or before the first of May, 1897, and were bound to have by the first of November, 1898, "water connections for the development of 25,000 horse power, and have actually ready for use 10,000 developed horse power of electric or pneumatic power." So far they have not turned a shovel, and they are now seeking four years extension of the time for beginning and completing the work. The chief financial interests of the leading members of this corporation are on the American side and not on the Canadian, and it is no injustice to them to say that the development of Canadian industries is not their first consideration. It would be of actual advantage for them to tie up the power on the Canadian side for some years to come. Apart from the advantages of securing a monopoly of the power on both sides of the river, it is now well known that they have spent some millions of dollars on works and machinery which have taken longer to develop and elaborate than they had any idea of at the start, and it is equally well known that so far they have had no returns from this enormous outlay. If the Canadian power is held back they will all the sooner get something back from their huge expenditures on the American side. On the other hand, if their Canadian charter lapsed they might have a rival company sending power along across the river to compete with them in their own more favored field.

A consideration of these facts ought to show the Ontario Government what dangers they will run in giving any extensions of time to the American corporation. These gentlemen are entitled to great credit, not only for their extraordinary enterprise, but for their steady faith in the results of this vast experiment, but the Ontario Government has the interests of Canada, and particularly of Ontario, to consider first, last, and all along in this matter, and it is quite within the mark to say that the immediate development of the Canadian

Falls under purely Canadian control, means millions of dollars in the pockets of Canadian people. Indeed, if we take into account what the future has in store, it means hundreds of millions to this country. One unfortunate part of the agreement with the Canadian Niagara Power Co. is, that while it has the option of renewing this lease for periods up to 80 years, the Ontario Government have no option of terminating it, or of modifying the terms. The company has everything on its side. To allow the company an extension of time will be to strangle Canadian industries in the Niagara Peninsula for years to come. The loss will be incalculable, and no government possessing the patriotism which we are sure animates the members of the present Ontario Government, would care to have their names handed down as perpetrators of an act entailing such consequences for the future of this country. It is not a question of the few thousand horse power that can be available in the next few years, but it is a question of the future control and monopoly of perhaps one-third or one-half the power of the entire Falls, for if utilitarian ideas continue to grow as they have in the last half century, the next half century will see Niagara Falls no longer a curiosity of nature, but rather an industrial curiosity.

If the country around the Niagara, between Lake Erie and Lake Ontario, is to become one vast city deriving its activity from the Falls, we want to see some of it on the Canadian side of the river.

SUPERIORITY ACKNOWLEDGED.

Elsewhere in this number we have mentioned the fact that a Canadian electrical engineer has been selected to direct the construction work of a large British engineering firm, which is going into electric railway work. It has been surprising to most Canadians and Americans that Great Britain has lagged so far behind us in electric railway work. In Canada alone we have over twenty times the number of miles of electric railway which exist in the British Isles, and we are likely to increase this difference during 1897, and yet no country in the world is so much in need of electric railway development as Great Britain, and no country is better suited to their cheap construction and economical operation, at least in England itself, where there are few mountainous tracts. There are in England hundreds of good sized towns and villages varying in population from the size of Canadian cities to large towns, which have no railway communication whatever, and the Light Railways Act recently passed affords no adequate solution of the problem of transportation for these towns, which suffer because of the cost of reaching the markets. No country in the world has better highways than England, and yet the cost of reaching the chief markets of the kingdom is so great that the farmers in many districts are not able to get more than one-half the net prices obtained by their more fortunate neighbors who are near the steam railway system.

Given this condition of things, with such numbers of towns which are still unserved by any sort of railway, it may seem a mystery that Great Britain has done practically nothing in the construction of electric railways. But there is more than one reason to account for it. It is not altogether because of the conservatism of the British people, as many Canadians may suppose, but because of the enormous cost of franchises and rights-of way. Canadian cities and towns have rightly encouraged these railways, and many even give bonuses to new ones, but in England municipalities, so far from giving such assistance, are disposed to exact tribute from a new railway corporation. Not only is this the case, but the cost of buying out rights-of-way and obtaining privileges from private owners is something enormous, and there is great reverence paid to private rights of ownership. To obtain a charter in the first place is no easy matter, for the incorporators have to go to the Imperial Parliament, and those who have ever been through that mill know what an expensive process it is. Hitherto it has been only the wealthy syndicate which could stand this bleeding, but a reformation in this branch of legislation is now in sight, which will make it somewhat easier for construction companies to obtain charters. In the case of the larger cities and towns in England one difficulty also is the congested traffic of many of the narrow thoroughfares, on which it would be impossible to run electric railways at the speed permitted in the wide streets of Canadian cities. These are some of the reasons why electric railway development has been so slow in Great Britain, but it will now begin in earnest, and those who understand the local conditions and can obtain reformations in methods of procedure, will have a great field for their enterprise before them there.

THE city council of Toronto recently advertised for tenders for 24-inch water-pipe. The lowest tender proved to be that of the Gartshore-Thomson Pipe and Foundry Co. of Hamilton, whose price was $44 per length. Instead of giving the contract to this company, as they were bound by all rules of business honor to do, the council allowed the St. Lawrence Foundry Company, whose price was $48.50, to amend their tender to $44. In defrauding the Hamilton firm, Alderman Lamb admitted that the action of the Board of Control "in allowing a contractor to amend his tender after seeing his opponent's figures was bad in principle, but good policy." We were always under the impression that "Honesty is the best policy" at all times, and how such a deliberate piece of meanness and dishonesty can be good policy, even from the standpoint of selfishness, is more than any honest citizen can understand. We do not blame the St. Lawrence Foundry Co. for taking the contract, but in this act the Toronto City Council have brought the name of the city into disgrace. Had such a thing been done by the municipality of Podunk, it would have merited the scorn of the Toronto press and people, but it would have been excused to some extent by considering the narrowness of their surroundings. But Toronto is a metropolitan city, and ought to have some sense of a metropolitan dignity, leaving out altogether the question of honesty. The motto of Toronto is "Industry, Integrity and Intelligence." Another act such as this referred to will bring about a general demand for eliminating at least one word from this motto. It is satisfactory to know that the two Toronto papers, the *World* and the *Star*, have condemned the crooked dealings of the Toronto City Council.

A CORRESPONDENT writes to ask the following question: "Can you or any of your readers give me the submersion depth of a steam yacht having the following dimensions: Length over all, 40 feet; depth at centre, 3½ feet; width outside gunwales, 8 feet; weight, 4½ to 5 tons; also formula by which result is arrived at?—W. A. B."

UNUSUAL CORROSION OF MARINE MACHINERY.*

BY HECTOR MACCOLL, BELFAST.

Corrosion in marine engines and boilers is usually confined to well-known parts, is not rapid in its action, and may be prevented or stopped by the adoption of suitable measures. In a recent instance its action was so wide-spread, so rapid, and so powerful, as to render a short description of it somewhat interesting to engineers.

The steamer "Glenarm" is a steel vessel of the long raised quarter-deck type, built in Belfast in 1890 for the Antrim Iron Ore Co.; and is engaged in their trade between Belfast and ports on the north-east coasts of Scotland and England. She is classed 100 A 1 in Lloyd's register, with a dead-weight capacity of about 800 tons; and her machinery consists of three-crank triple engines, with cylinders 17, 27 and 44 inches diameter, by 30 inches stroke, a three-furnace single-ended boiler of the usual type loaded to a pressure of 165 lbs. per square inch, and a single-furnace horizontal multitubular donkey-boiler. The shafting and other forgings are all of iron; the boilers are of steel, with iron tubes.

On Tuesday, 24th December, 1895, this steamer, carrying a cargo of about 650 tons of "burnt ore" from Irvine to the Tyne, struck on a rock in the Sound of Mull, and was at once beached in Scallaster Bay, where the sea stood a little over her after-deck at low water, and close up to her bridge-deck at high water. On the following Monday, 30th December, after having been submerged six days, she was pumped out and raised. On the same day steam was got up in the main boiler, but when about 30 lbs. pressure had been reached, the steam valve on the donkey pump blew out, and it was found that the copper at the bend of the donkey feed-pipe next the main boiler had disappeared, fires were therefore drawn, and the boiler blown off. On Friday, 30th January, 1896, all leaks having been so far reduced as to be under control of the salvage pumps, the vessel left in tow for Belfast, where she arrived early on Saturday morning, all the salvage operations having been successfully conducted by Capt. Bachelor, of the Liverpool Salvage Association.

On examination the machinery was found to present an extraordinary appearance; all wrought-iron work was deeply and roughly corroded, and planed cast iron work rendered so soft as to be easily cut with a knife. These unusual effects were undoubtedly caused by the cargo of "burnt ore"; and the following explanation has been contributed by S. Courtney, chemist, of Francis Ritchie and Sons, Belfast, who investigated the subject at the request of Robert Browne, secretary and manager of the Antrim Iron Ore Co. "Burnt ore is the residue from the manufacture of vitriol from sulphur pyrites, and is generally found to contain about four per cent. of sulphate of copper, together with a little sulphate of iron due to the sulphur not having been completely burnt out of the ore and becoming oxidized into sulphates. The sulphate of copper would be more or less completely dissolved in sea water; and as the latter contains a considerable quantity of chloride of sodium or common salt, this would re-act on the sulphate of copper, forming sulphate of sodium and chloride of copper. The sulphate of copper and chloride of copper are both soluble in water; and a solution of either, or both, dissolves wrought-iron and cast-iron. The chloride is more energetic in its action than the sulphate; but in time a solution of either, no matter how weak, will dissolve an atom of iron for every atom of copper present. Every hundred tons of cargo contained as much sulphate of copper as would, if available, dissolve nearly 32 cwts. of metallic iron. The burnt ore might also contain a small quantity of free sulphuric acid, which would combine with the soda of common salt in the sea water, and set free hydrochloric acid, and the latter would rapidly act upon copper or brass."

On the condition of affairs being discovered, the engines and boilers, as well as the hull, were at once opened up for survey, the underwriters being represented by Mr. Henry H. West, of Liverpool, and the owners by Mr. James Maxton, of Belfast; the entire work on the hull and machinery was afterwards carried out under the direction of the latter. The general condition of the engines was that wrought iron work had been penetrated by corrosion to a depth of about 3-32nds inch, and planed cast iron so softened that $\frac{1}{8}$th inch had to be taken off before a hard surface was regained. Surfaces in bearing contact, or with oil between them, and all painted surfaces, were completely preserved. The detailed condition of the various parts, and the measures taken to restore them, were as follows:

The cylinders had partially filled through the hot-well, and from the drain cocks being open. The lower part of the intermediate cylinder was softened for 12 inches up, and was re-bored $\frac{1}{4}$ inch larger in diameter, and the piston altered to suit. The piston-valves and liners in the high-pressure and intermediate cylinders were softened at their lower ends, the liners were re-bored, and the valves fitted with new rings. The lower edges of the low pressure slide-valve and face were also softened; the valve was planed, and the lower bar of the face chipped off and replaced by a brass strip pinned on. In all other respects they were sound and good. Piston-rods and connecting-rods were turned all over, reduced 3-16ths inch in diameter, and the former fitted with new neck and gland bushes. Guides had $\frac{1}{8}$ inch planed off them before a hard surface was reached, and the guide shoes were lined up to suit. Valve gear is of the Hackworth type. The valve-spindles and various rods were turned all over, to remove the deep pitting, the angle blocks had their planed surfaces reduced $\frac{1}{8}$ inch, and the various parts lined up to suit.

The crank webs were deeply corroded; but as there was ample strength, they were filled with "hard stopping" and painted. The shaft journals and crank pins were pitted longitudinally in the exposed spaces between the white metal strips, and were also pitted transversely at the clearance spaces next the crank webs; these were cleaned out, filed up and the bearings adjusted. The thrust shaft was much corroded at the exposed parts of the collars and journal, it was turned all over, and the horse shoes and bearings were refilled with white metal. The intermediate length of tunnel shafting was much corroded at the exposed part of the journal; and as it was also reduced by wear, a new journal was turned further forward, and the bearing shifted to suit. The propeller and propeller-shaft were found in good order.

The centrifugal pumping engine was considerably wasted in the rods, guide, etc., and was treated like the main engines. The duplex pumping engine and donkey boiler pump were so seriously corroded as to be useless,

* A paper read before the Institution of Mechanical Engineers.

and they were replaced by new. The brass steam-valve and one pet-cock of the duplex pumping engine were curiously wasted into holes, and the check valve and seat on the main boiler had the appearance of some substance, probably zinc, having been sucked out of them.

From the appearance of the donkey copper feed-pipe it was feared that all the copper pipes were seriously affected. A similar bend in the main feed-pipe was therefore sawn through, but was found to have suffered no deterioration. All the pressure pipes, however, were taken down, tested, and annealed; no defects were detected, and they were all replaced. But in putting together the various steam and vacuum gauges the small connecting pipes were found in several places to be curiously wasted below the coupling nut. It is unnecessary to enumerate the bolts, nuts, cock handles, spanners, and such small details, which were wasted into mere shadows of their former selves, and had to be renewed. The safety-valves of the main boiler having been eased when the vessel was beached, the boiler had filled with water; and the condition of both boilers looked serious. The front end plate of the main boiler was considerably wasted; the furnaces, which are of the spiral corrugated type, had corrosive scores running in the direction of the corrugations; and the tubes were covered with a deposit of what appeared to be pure metallic copper. In the end, however, after careful drilling and gauging, it was found that an unexhausted margin remained in all except the tubes. These were all found to be seriously corroded in both boilers, and every tube was therefore cut out and renewed; after which the boilers were satisfactorily tested. Although the utmost vigilance and care had been exercised in examining as far as possible every point and detail, latent defects might have existed; and it was not with complete confidence that steam was again raised and the machinery tried. Neither then, however, nor in the months of continuous service which have since elapsed, has the slightest defect been perceived; and the machinery is now, thanks to its thorough overhaul, working with the efficiency and economy which it possessed when new.

The lessons to be learnt from this experience are probably obvious enough. Some of them are for the shipowner rather than the engineer, and therefore need hardly be referred to here; but it may be well to emphasize two of the others. First, the advantage of having, in marine engines and boilers, a small margin over the actual requirements for strength. In the various rods, shafts, and similar parts, such a diameter as would allow them to be skimmed up; in the cylinders, valves, &c., such thickness as would allow them to be bored or planed afresh; and in the furnaces, combustion chambers and stays, a slight excess of thickness over that required by the rules. Second, the advantage of good paint. Many engineers prefer polish to paint; but in this instance the latter truly cost little, and was worth much.

UNREFILLABLE BOTTLE.

Some time ago THE CANADIAN ENGINEER published a paragraph stating that a large reward would be paid to the inventor of a bottle which could not be refilled. Upon further investigation, it would appear that we had been misinformed, and that no such reward had been offered. A great deal of thinking has been devoted to this subject recently, and a number of bottle which are claimed to possess the desired qualities have been produced in consequence. We have received a great many letters on the subject, and it would appear that the Kentucky Distillers' Association has received more, judging from the following letter:

Messrs. Biggar, Samuel & Co.:

GENTLEMEN,—The Kentucky Distillers' Association has never offered a prize of $100,000 to the inventor of any kind of an unrefillable bottle. In fact, they have never offered a prize of one cent for any invention. During the past year I have received about 500 letters enquiring about the prize you speak of, but I can assure you that the distillers of this State have never offered prize money in any shape for any kind of an invention.

Yours very truly,

THOS. S. JONES,
Secretary.

Louisville, Ky., Dec. 11th, 1896.

HEAT, LIGHT AND POWER DEPARTMENT OF THE T. EATON CO., LTD.

The following description of the heat, light and power department of the T. Eaton Co., Ltd., along with the other machinery necessary to such an establishment, will be found of interest to our readers. This is the largest mercantile organization in Canada, occupies 7½ acres of floor space, and employs at the present time 1,850 hands.

In 1889 the company purchased from the Goldie & McCulloch Co., Galt, Ont., two Wheelock engines, one 10 x 28, the other 12 x 30. The first drove one 300-light incandescent machine. The other drove two 35-light 1,200 c p Royal machines. They were arranged with a line shaft across the room between the machines

GAUGE BOARD AND SPRINKLER CONNECTION—THE T. EATON CO.

and engines. The shaft was in two pieces with no arrangement for coupling. This meant if one engine broke down you could not run your load, although you had an engine standing idle. This plant was up to date and gave good satisfaction. The steam was furnished by two tubular boilers 54 in. x 12 ft. This, with three direct-lift elevators run with city water pressure, was all the machinery in the store. In the following year, 1890, one of the direct-lift elevators was taken out and two Hale passenger and one freight elevators were put in. A duplex pump was purchased, 10 x 6 x 12, with pressure and return tanks, piping, etc., connecting the three new elevators and two direct lifts, and doing away with the weak city pressure. In order to have some reserve boiler capacity, a 60 in. x 14 feet tubular boiler was put in

In the following year, 1891, a gas producer was installed; it was to gasify the coal, and the gas was then to be burned under the boilers; it was to save labor, save coal, increase capacity, etc. It was put in large enough for the three boilers, but was only attached to the large one until tried. A trial proved it to be a considerable loss, instead of economy, more work, and it raised the temperature of the boiler room to 130° F. After repeated trials, it was taken out as a failure. During the summer of 1891 a new Northey pump, 14 x 7½ x 12, duplex, was put in, and another accumulator, so as to have a reserve in the pumping plant, and another freight elevator was added. A. E. Eilkins was chief engineer of the plant

almost from the start up to date (the fall of 1891). Wilson Phillips took charge at this time, Mr. Edkins going to the Boiler Inspection and Insurance Co.

In 1892 the company built a large addition on James street, and the following changes were made under the direct supervision of Wilson Phillips. As the old plant was nearly fully loaded and the engine room was full, no space having been left for an additional machine, it was decided to change the location of the engine room, and as a large increase in plant was required, almost the entire plant was changed. Two Wheelock engines, 15 x 34, were installed, with a line shaft along the back of room, the engines one on each end. The shaft was in two pieces, with a cut-off coupling in the centre, and a cut-off sleeve at each engine. This was a first-class arrangement, as either engine could drive the load during the day, and a change over could be made without any effect on the lights. The load on one engine was the old 300-light incandescent and a new 400-light incandescent, and a No. 7½ Baker blower. On the other was the two old 35-light arc machines and a new 50-light. All machines T. H. type, built by the Royal Electric Co., of Montreal, with lamps, arc, and incandescent and switch-board. The blower was put in with 54 lines of pneumatic cash tubes for handling the cash in the store, and was the first pneumatic cash system in Canada. This system also ventilated the store, as all the air it handles is discharged outside. In this year 1,780 Grinnell Automatic Sprinklers for fire protection were installed, with a 5,000-gallon storage tank for a reserve water supply. The sprinklers were attached to the pumps and the city pressure.

In 1893 two Heine safety water tube boilers were put in of 200 h.p. each, and the two small boilers were taken out. The small pump was taken out, and a compound duplex pump 12 and 18½ x 12 x 12, was put in. This was the first economical and well-designed elevator pump in Canada. It was built by Charles Smith & Co., Toronto. The old direct lift passenger elevator was taken out, and a modern passenger one, built by the Fensom Elevator Works of Toronto, was put in. In 1894 another building was erected on Albert street, and it was decided to again move the engine room to suit the new arrangement of store, and also to increase its capacity.

The new engine room was laid out in the following manner: One new Wheelock engine 18 x 42 was installed in the centre of the room, with the two 15 x 34's, one on each side; 110 feet of line shaft, all 4 inches, except the centre length, which the large engine drove on, which was 4½ inches. The shaft was arranged as in the previous room, only in three sections, on each of which an engine was belted with a cut-off sleeve and a cut-off coupling between each section, and clutch pulleys for each machine. A new 650-light incandescent generator was installed along with the 400-light one, the 300-lighter being done away with. The three arc machines were arranged the same as before on one of the 15 x 34's. The other 15 x 34 had on its section of line shaft the No. 7½ Baker blower and a new No. 7 Root blower. The pumping plant was not altered, as it still had ample capacity. Another freight elevator was put in by the Fensom Elevator Company, when the building was built. This was the plant as finished in the summer of 1894. All these alterations had been laid out and carried through by Wilson Phillips, who had also at the same time been supervising the erecting of the building, and other changes that were in progress. On June 1st, 1894, E. J. Philip, who had for the two years previous been chief engineer of the Incandescent Light and Power Co., took charge of the plant, Wilson Phillips taking the position of mechanical superintendent of the company. During the summer of 1894, another Heine safety boiler was added, and the last tubular was taken out. Fifty-four lines of pneumatic cash tubes were also added; and due to another addition being built, a 75-light wood arc machine with 75 arc lamps, was purchased from the Canadian General Electric Co., of Peterboro'. In 1895, sprinklers were installed in the Albert street and new James street buildings. In this year, the first Hawley Down Draft furnace in Canada was attached to one of the Heine boilers. An addition of 21 lines of pneumatic tubes was also made to the cash system. The Simpson fire took place in March of this year, and the pumping plant, with the private brigade and fire equipments of the T. Eaton Co., demonstrated that the plant had not been put in for fun. It showed that running through a dark store, covering the ground that this store does, is not very satisfactory in case of fighting fire. It also proved that with a plant running at night, and a man in charge, the fire apparatus could be made much more useful in case of fire in the building. It was finally settled that an engine be put in to run all night, with an engineer in charge to light the store and save the watchmen carrying lanterns. In this way, the store would be light in case of fire, and a man would be on the spot that understood the working of the plant; steam would be kept up and on the pumps all the time. In order to do this one of

SWITCH BOARD—THE T. EATON CO.—MECHANICAL STAFF.

the 15x34 Wheelocks was taken out and a 12x12 Robb-Armstrong engine was put in with a direct connected 50 k. w. general electric generator. A separate switchboard was put in, and the store wired up with two wirings, one to burn all night for the watchmen, and the other on separate switches for sweeping with, as they had arranged to sweep and clean the store at night. Since that time, the lights have run night and day, except Sundays, when there is a man on watch with steam up in case of fire, and the lights can be put on in a moment. This arrangement has proved very satisfactory, and its usefulness in case of fire was demonstrated the night of the McKendry fire.

During the winter of 1895 and '96, the company secured more property, and arrangements were made for building three additions to the store. As the dynamos were nearly full loaded, the question arose as to whether it was advisable to add more machines of the same type or put in direct connected. The pumping plant was out in the store, where it had been installed near the first engine room; this was always a disadvantage, both in the way of taking care of the pumps, and from the fact that it was in the middle of the basement. It was finally decided to take out all the belted machines and line shafting and put in all direct connected machines, and connect engines direct to the blowers. The work was started in March, and by September the entire plant was changed, without stopping any of the system. The new plant has double the capacity, and takes up less than half the room. A new compound duplex pump, 14 and 20 x 14 x 18, built by the Northey Mfg. Co., was installed, and two new pressure tanks and return tank, with the 12 and 18½ x 12 x 12 compound, and the other pair of tanks

was put along the wall where the line shaft had been. A pair of 14 inch mains runs to the centre of the building and distributes to pairs of 12 inch and 9 inch, and these distribute to the elevators. Two new passenger elevators had been put in during the summer by the Fensom Elevator Co, also four new freights, one old freight being taken out. The new lighting plant consists of 2 Ideal engines, 16 x 16, with 130 K W direct connected Canadian General Electric generators, with the 50 K W that had been in previously. A new switch board built by the C G E Co with three machine panels, and two feeder panels, were also installed. Each machine panel has ampere meter rheostat field switch and three single pole 1,000-amp switches. The feeder panels have six 200-amp. switches and sixteen 100-amp switches, all double pole At the end of the board, on a swinging bracket, is an illuminated dial Weston volt meter The board is white marble and has a magnificently carved oak frame, which adds very much to its appearance The machines are connected to the board by bare bus bar, ½ x 2½ The lamps used are all Manhattan 2,000 C P long burning arc furnished by the Johnston Electric Co, in the upper store.

Pneumatic System.—Two No 7 Root blowers, direct connected to 12 x 12 Robb-Armstrong engines.

One No 7½ Baker blower, direct connected to 12 x 12 Robb-Armstrong engines.

All cash is handled by the pneumatic system. The main cash office is situated in the basement, with lines running to and from each department. There being no less than 194 return lines in use, all 2¼-inch brass tubing.

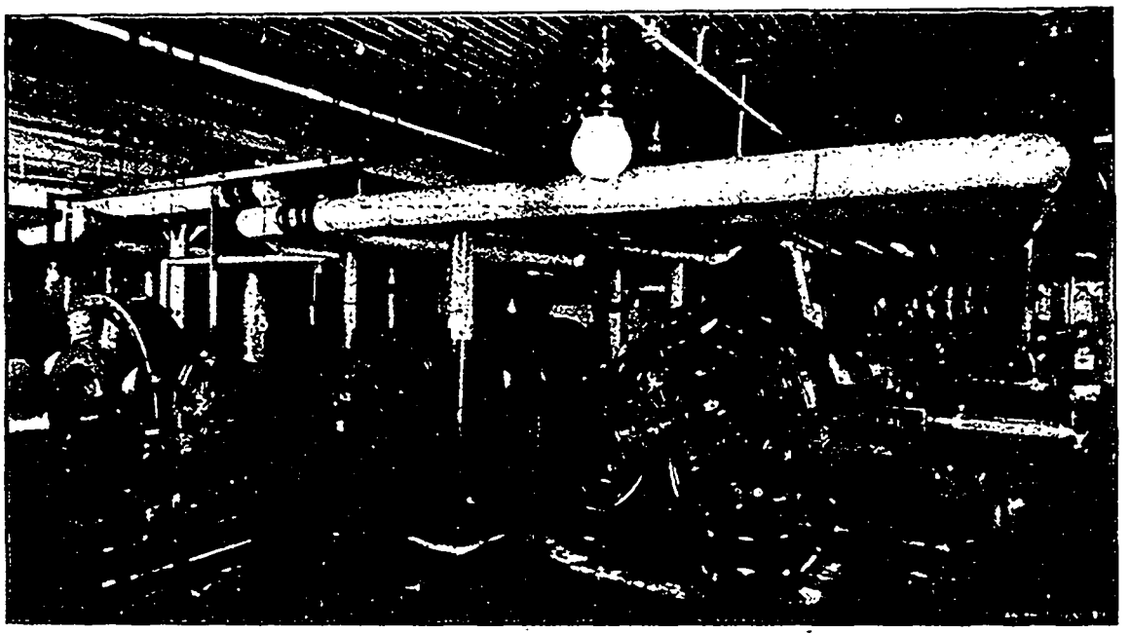
Hydraulic System.—One compound duplex pump, 14 and 20 x 14 x 18.

One compound duplex pump, 12 and 18½ x 12 x 12, with a combined capacity of 3,000,000 gallons of water per day.

One Westinghouse air pump.

Seven freight elevators, furnished by the Fensom Elevator Works, Toronto.

Five passenger elevators, two of which are Hales, and three Fensom's. The two Hales are about to be taken out and replaced by Fensom's, similar to the new ones near the Queen street entrance, as they are the safest and best working elevators in the city



ENGINE ROOM—THE T. EATON CO.

The basement lights and night lights are incandescent; there are 207 arc lights and about 3,000 incandescent.

There is a motor load on the machines of

Three 6 h.p Edison, by C. G. E. Co.

One 3 h.p Edison, by C. G. E Co

One 7 h.p. T H., by Royal Electric Co

One 2 h.p. Eddy, by C. G. E. Co.

Two ½ h.p Edison, by C G. E Co.

One ½ h.p. Crocket, Wheeler Western Electric Co.

One 1 h.p. direct connected fan.

One 1½ h p. direct connected fan, built by the Johnston Electric Co.

The pneumatic system is handled by the No 7½ Baker blower and the No 7 Root blower, along with another No. 7 Root blower installed this year, each with a 12 x 12 Robb-Armstrong engine direct connected to the blower shaft, and specially designed for the purpose. There was also put in during the summer three boiler feed pumps manufactured by the Northey Co., and a Westinghouse air pump for pumping air for the elevator accumulators, and Hawley down draft furnaces were attached to the other two Heine safety boilers. A National feed water heater of 500-h p. capacity was put in by the Robb Engineering Co. A private fire-alarm system was also added this summer, comprising 30 fire-alarm telegraph boxes, with an 18-inch gong situated in centre of store, and a 12-inch gong in engine room. There is also a 12-inch gong connected with the city fire-alarm system.

The plant at the present time comprises the following:—

Lighting System—Two 130-K W generators, direct connected to 16 x 16 Ideal engines.

One 50-K W. generator, direct connected to 12 x 12 Robb-Armstrong engine.

Two hundred and seven 2,000-C. P. long burning Manhattan arc lamps.

Three thousand 16-C. P. incandescent lamps

The steam for the above is furnished by three Heine Safety water-tube boilers, fitted with the Hawley down-draft furnace.

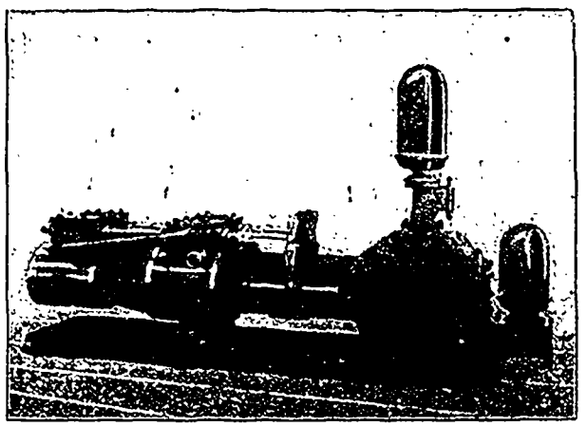
Fire Protection.—The entire store is equipped with Grinnell's Automatic Sprinklers, numbering over 4,000; three stand pipes, with nearly 3,000 feet 2½ hose. This, with the fire alarm system and ample pumping capacity, and private fire brigade, makes the store as nearly fireproof as modern ingenuity can make it.

Other Machinery of Store.—There are 350 sewing machines in the manufacturing department driven by motors, along with electric irons and cutting machines: there are also power-driven ice cream freezers, ice crusher, drug grinders, coffee grinders, soda water machinery, etc. For ventilation, as well as the air that is exhausted by the cash system, one Root blower and a cycloidal blower are constantly supplying fresh air for different parts of the store.

Besides the machinery at store, the company has the following machinery at its farm at Islington: One 12 h.-p. portable engine and boiler for threshing and cutting ensilage, also a 7½ h.-p. Daimler gasoline motor for separating cream and cutting feed. This was the first Daimler motor brought into Canada. The company has also a stationary boiler with jacketed kettles for cooking feed, and two windmills for pumping water. At the city stable there is a 5 h.-p. electric motor for cutting feed, and also for running two of Priest's No 8 horse clipping and grooming machines.

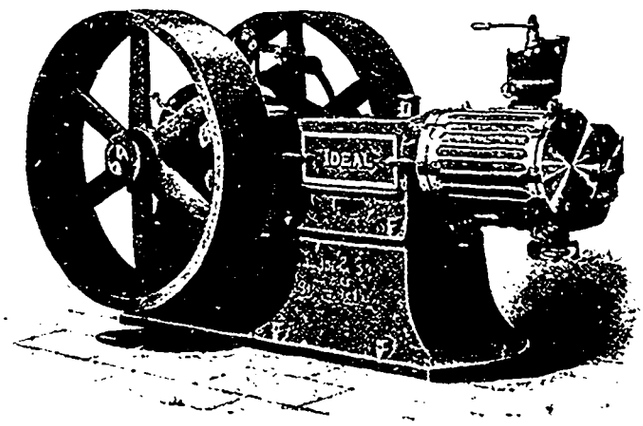
The Ideal engine used in the lighting plant of the T. Eaton Co's establishment is made in Canada solely by the Goldie & McCulloch Co. of Galt, and is highly spoken of by Mr. Philip. Among the points claimed for this engine are its range of speed, its silent running, exact regulation, perfect balance and automatic lubrication. The automatic cut-off governor is simple and produces a regulation seldom realized. The range of cut-off is wide and enables the engine to carry a load largely in excess of rating, as the point of cut-off is automatically extended to three-fourths stroke when an increased load requires it. This is an important feature in

electric light and power work, for should the load be unexpectedly increased 50 per cent for a few hours during the run, as is frequently the case, the engine meets this extra requirement. This engine has a peculiar system of lubrication. The crank disc is covered by a light hood, fitted oil tight to the top of the engine frame, but without bolts or fastenings of any description, it is therefore readily removed The crosshead and guides are likewise fully enclosed, but a side plate for obtaining ready access thereto is



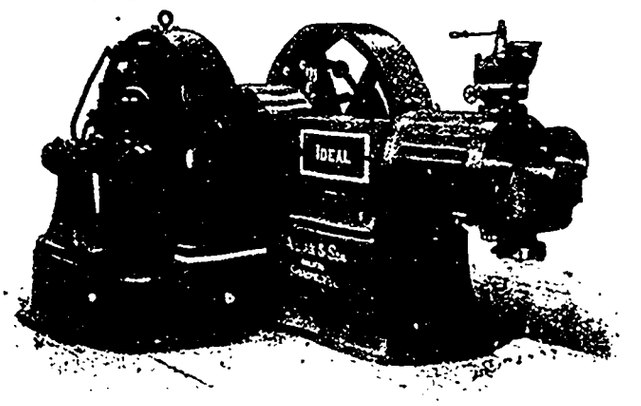
NORTHEY PUMP—THE T. EATON CO.

also fitted oil tight and held in position only by two cam handles, a quarter turn of which releases it. The engine is consequently more accessible than the ordinary centre crank engine, having oil-fenders attached in the usual way; yet no oil can get to the belts or floor. The enclosure is dust-proof, no oil is wasted, the crank-disc dips only about one inch into the oil and none of the parts are submerged. The motion of the discs delivers it by centrifugal force into the pocket extending across the inside of the hood and through a pipe attached to the hood into the oil pocket, through which the



GOLDIE AND M'CULLOCH CO.'S IDEAL ENGINE - THE T. EATON CO.

oil is carried down in streams to the crank shaft bearings, and thence through the crank-pin to its bearings and back to the oil chamber under the crank-disc. The journals are consequently getting copious, positive and visible lubrication all the time, while the oil cannot get on the dynamo and destroy the insulation of the wires. The governor, the throttle, the steam separator and oil separator connected with the Ideal engine are features of interest which are fully explained and illustrated in the catalogue published by the manufacturers.



DIRECT CONNECTED IDEAL ENGINE—THE T. EATON CO.

"CASE" PROPELLER WHEELS IN CANADA.

ST. JOHNS, P.Q., August 25th, 1896

A. WELLS CASE, Esq., Highland Park, Conn.

Dear Sir: I have much pleasure in giving testimony regarding the 3-bladed 24-inch Case wheel purchased this spring for my yacht "Rose." As I stated in my last letter to you, I was unable to say what speed my yacht would obtain until I had my engine fixed. This has been done, and I am happy to say that my expectations have been more than realized.

My yacht is 25 feet over all, with roof and pilot house, and I have made the one-mile run in 4 minutes, 40 seconds, with 140 lbs. of steam, also a run of six miles with a strong head wind in 39 minutes against the stream; twelve miles with and against the stream in 72 minutes.

With my old Sorel wheel I thought I was doing well when I ran seven miles an hour. There are several yachts here of the size of mine, but I can outrun them all either in short or long distances. Some of them have the "Sorel," "Pennsylvania" and "Buffalo" wheels.

It is astonishing how quick the action of your wheel is in both going ahead and astern, and I do not hesitate to say that any one that wants to get the greatest power and speed from the least amount of steam used, is to use a "Case" wheel.

They have begun to ask what wheel I have got, and I tell them the best in the market, a "Case."

Yours truly,

GEO. CLAYTON,

Supt. Standard Drain Pipe Co.

PARRY SOUND, ONTARIO, September 7, 1896

A. WELLS CASE, Esq., Highland Park, Conn.

Dear Sir: In reply to your enquiry, will say that I have a 32-inch Case propeller wheel in use on the "Lorna Doone." The wheel runs very smoothly and drives the boat faster than it has ever run before

I have other boats, and when in want of wheels for any of them, shall certainly order of your make.

Yours truly,

E. S. PRATT,

Owner of Parry Sound Towing and Yachting Fleet.

FOR THE CANADIAN ENGINEER.

THE BOILER INSPECTOR.

BY "YOUNGSTER."

Though the rain and sleet are falling,
And the roads are full of mud;
Though the trade "hard times" are crying,
Nipping fond hopes in the bud;
Though the river may be frozen,
And the frost doth bite and dip,
They can never stop the advent
Of "The Inspector and his Grip."

Though the trains may all be smashing,
Though the horses all be lame,
The Inspector, like the famous bug,
Will get there just the same.
And when his task is over,
Will come smiling from his trip,
For he always makes connections,
"The Inspector and his Grip."

And it teaches us a lesson,
That with energy and grit,
Things that paralyze most people
Don't astonish him a bit.
And he's ever bright and cheerful,
With a smile upon his lip;
He's a dandy from 'way back,
Is "The Inspector and his Grip."

SETTING VALVE MOTION ON DUPLEX PUMPS.

Editor CANADIAN ENGINEER.

SIR,—The valves on a duplex pump are controlled by the piston of the opposite pump, and the valves are constructed line and line, that is, without lap, and work without lead. The piston of one pump stands still during nearly the full time while the other is making its stroke. Take the right hand cylinder, for instance, with the pistons of the two pumps standing at the same end of the stroke, then the valve on the right-hand cylinder should be wide open at the required end, as the valve commences to open as the piston of the left-hand pump gets near the end of

its stroke. The left-hand piston remains stationary until the right-hand piston has nearly completed its stroke, and opens the valve at the opposite end of the left-hand cylinder. The action continues in this way throughout the consecutive strokes. The play on the valve, or valve rod, is introduced to permit of the valves remaining stationary while the opposite pump is making the greater part of its stroke, for the movement of the valve required to give full port opening is very small compared with the travel of the short end of the arm which actuates the valves. This last motion, or play, is necessary to the successful working of such a pump.

Toronto, Dec 15th, 1896 YOUNGSTER.

PARISTONE WALL PLASTER.

It is not generally known that the smoking room of the Union Station, Toronto, is plastered with the Paristone wall plaster. W. J. Hynes, the contractor, was at the time well satisfied, especially as it withstood the hammering consequent upon fixing hardwood beams and panelling without cracking. This is worthy of notice. Builders have long wanted a plaster superior to the ordinary lime and hair mortar, which so frequently develops weak patches and falls off. Many prepared plasters have been put on the market, but often at a prohibitive price, and the old plaster is still in evidence on the walls, and sometimes on the floors, of dwelling houses and public buildings. This Paristone plaster is a trifle more expensive than ordinary lime mortar, but has many advantages over it. It dries hard and solid, needs no hair, and is capable of the finest surface. It dries in less than one-third the time required for ordinary mortar, and then sets so hard that no amount of pounding by carpenters will dislodge it. It is fire-proof, and, a few hours after it has been put on, frost-proof also. There are many other advantages, which are fully explained in a circular issued by Alex. Bremner, 50 Bleury street, Montreal, who is sole agent for this plaster.

CEMENT TESTING.*

BY PROF. C. B. SMITH.

Since our Canadian Society of Civil Engineers cement standards were fixed in 1895, the writer has carried out all tests as nearly as possible according to these standards, which includes specific gravity, residues, blowing or checking test by submergence in hot water for 24 hours and strength tests both neat and 3 to 1 with standard crushed quartz sand. These last tests are to be carried out in a way different from that prescribed in other countries, namely, that the briquettes of 3 to 1 sand are to be formed by a dead pressure of 20 lbs. per square inch, and that the mortar is to be of a soft consistency, similar to mason's mortar, which the writer, in his series of tests in 1893-4 (which had been the basis of the society's action), had found to be 20 per cent. of water added. With a view to comparison, however, parallel tests of rammed 3 to 1 briquettes with 12 per cent. of water have been made in many cases, and the table here presented contains the results of 32 tests in which this has been done. At first sight, this table presents a very heterogeneous appearance, and such might be expected of cements coming from seven different countries, of probably different chemical compositions, and of different ages, but if we plot them as diagrams in various ways many interesting facts appear. The table was arranged according to 4 week 3 to 1 pressed sand strengths

Referring to Diagram 1, it will be seen that as the specific gravity increases, the amount of residue on a 10,000 mesh sieve remains nearly constant, if anything decreasing. At first sight this might appear strange, but it may be easily accounted for by the fact that those manufacturers who burn their clinker well have sense enough to grind well also, even though it is much harder to do than with the underburnt products. The next deduction that may be drawn from diagram 1 is that 10 per cent. residue on 10,000-mesh sieve is a fair average, and, therefore, easily obtainable. Any specification permitting more than 10 per cent. residue on this sieve is not up to date, The finest cement, No. 8, with $\frac{1}{10}$ per cent. residue, shows what can be obtained if sought for. The writer lays stress on this point because a recent triangular discussion in the *Engineering News* elicited conflicting opinions on this subject.

Diagram 2 also shows clearly the fallacy of a statement made in the same discussion, "that the specific gravity test was useless." In this diagram the strength of 3 to 1 sand tests increases very rapidly with the specific gravity. In order to partially eliminate the question of fineness, calculations were made (see corrected diagram line) in which a mortar made of a cement having 5 per cent. residue on 10,000-mesh sieve was considered to be a 305 to 95 mortar, and an estimate made of the corresponding 3 to 1 strength; this is, of course, only a rough elimination, but it does not appreciably affect the diagram, the corrected and uncorrected lines being parallel. The diagram also indicates that a specific gravity of less than 3.07 will seriously affect the sand tests, care being taken, however, to know the age of the cement, as an old cement (Portland) decreases in specific gravity. A range of specific gravity of 3.08 to 3.15 is wide enough to cover most good cements.

Diagram 1. Variation of Fineness with Sp Gr

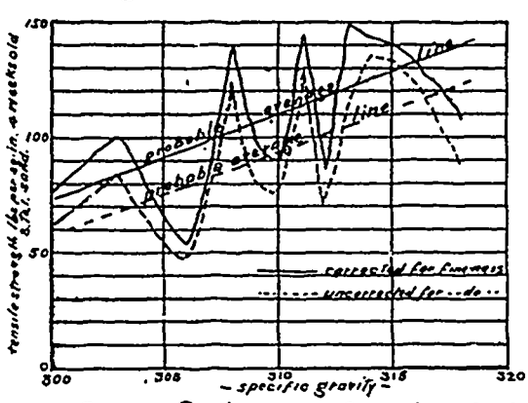


Diagram 2. Increase of Strength with Sp Gr

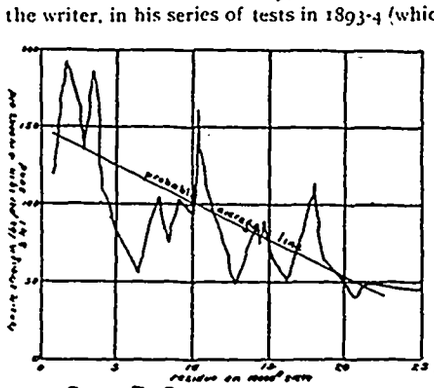


Diagram 3. Decrease of Strength with Fineness

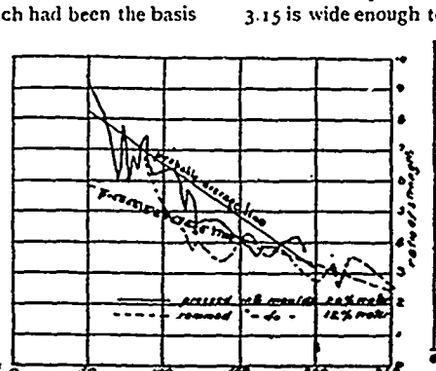


Diagram 4. Ratio of Neat to Sand Strength

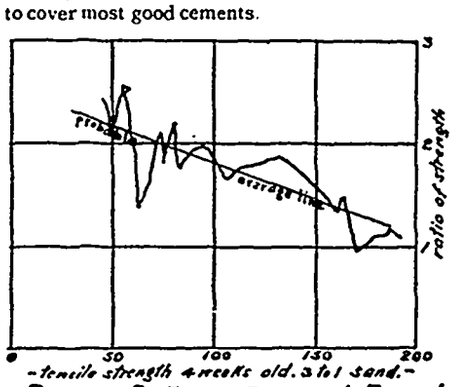


Diagram 5. Ratio of Rammed to Pressed 3 to 1 Sand Tests.

Diagram 3 illustrates the well-known effect of grinding. It would appear from this diagram that grinding is *well worth paying for* if strength is the thing required. The average of 14 cements having less than 10 per cent. residue is 121 lbs. per square inch, 3 to 1 pressed sand tests, while the average of 18 similar tests on cements having from 10 to 30 per cent. residue on same sieve is only 73 lbs. or only $\frac{3}{5}$ as much Coming now to Diagrams 4 and 5, an examination will show that the ratio between the neat and sand strengths decreases as the cement increases in strength, in other words, the *definition* is more rapid as to strength with sand tests than with neat tests. It is a fact that high neat tensile strength is a rough indication that the sand strength will be high also. The table shows this, but the diagram clearly points out the quicker or more sensitive fluctuation of sand tests as compared with neat. At 50 lbs. the neat strength is over 8 times as great, but at 200 lbs. the neat strength is only 3 times as great; or, while the sand strength has increased 300 per cent., the neat strength has only increased 50 per cent. Diagrams 4 and 5 also show that

* Published in the *Brickbuilder*.

the tests by pressure are more sensitive than those made by ramming. This might be expected, as no extraneous effect of severe ramming interferes with the adhesive quality of the cement. With the higher grades of cement the strength at 4 weeks is nearly as great as though the briquettes were rammed, but with poor, coarse cements the strength falls very rapidly.

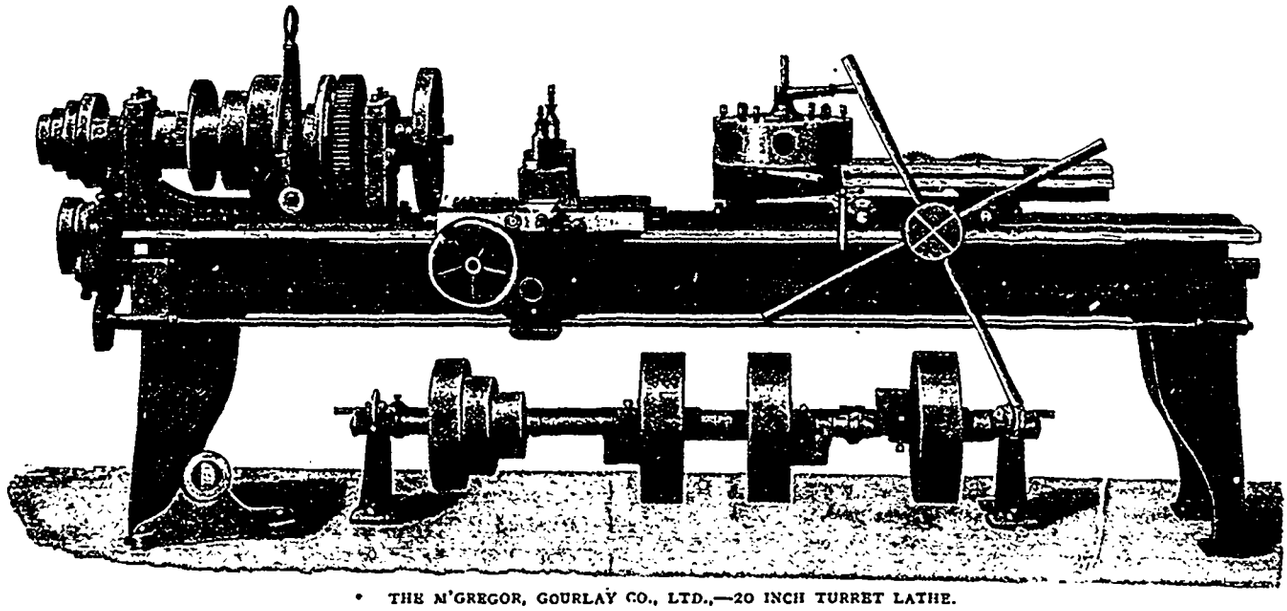
RESULTS OF CEMENT TESTS

Tabulated in order of strength, 3 sand, 1 cement, 20 per cent. water, 20 lbs. pressure, 4 weeks' test.

No.	Country.	Specific Gravity.	Per cent. Residue on No. 100 Sieve.	Tensile Strength. Neat 1 week.	Neat 4 weeks.	Tensile Strength. 1 to 1 1 week.	3 to 1 4 weeks.	Tensile Strength. 3 to 1 1 week.	3 to 1 4 weeks.
						20 per cent. water 20 lbs. pressure in molding.		12 per cent. water rammed into molds.	
1	Denmark	3.11	1.7	596	706	71	193	137	212
2	United States	3.08	3.5	775	790	98	187	199	224
3	Canada	3.04	3.8	492	656	90	170	109	160
4	Belgium	3.08	10.3	561	631	110	165	178	258
5	Canada	3 14	2.6	479	566	109	161	167	217
6	Germany	3.15	2.8	482	637	64	134	145	252
7	England	3.09	9.2	432	551	81	122	169	216
8	Canada	3.12	0.9	482	625	82	121	.....	.....
9	Canada	3.13	18.0	424	653	53	115	.....	.....
10	Canada	3.14	4.0	467	558	61	114	132	204
11	Germany	3.07	8 0	612	682	71	106	112	175
12	Belgium	3.05	10.1	493	582	54	94	113	187
13	Belgium	3.09	14.8	498	602	45	90	90	171
14	Canada	3.18	14.3	515	658	47	88	.....	.....
15	Germany	3.10	9.2	570	655	53	87	.....	.....
16	Belgium	3.07	7.1	418	573	50	83	108	164
17	Canada	3.11	8.2	420	495	44	83	88	122
18	Canada	3.08	13.7	466	549	40	80	118	178
19	France	3 03	13.7	385	450	44	76	86	136
20	England	3.07	14.5	420	489	42	74	.....	.....
21	England	3.12	8.5	519	665	36	74	114	155
22	Belgium	3.08	12.0	380	422	31	70	72	116
23	England	3 09	18.5	336	447	31	65	.....	.....
24	Canada	3 10	16.3	510	608	.....	64	.....	88
25	Belgium	3.00	12.2	385	485	30	62	.....	.....
26	Belgium	3.05	6.5	369	481	33	55	81	141
27	Belgium	3.07	16.3	398	484	30	50	60	105
28	England	3 05	21.3	286	392	25	48	.....	.....
29	Belgium	3.06	12.8	324	511	21	48	55	.....
30	Canada	3 12	20.2	265	.....	25	46	71	111
31	Canada	3.12	30.0	250	435	21	41	.....	.....
32	England	3.09	20.7	361	397	30	39	.....	.....

BICYCLE MACHINE TOOLS.

The great demand for bicycles the last year or two has caused much capital to be invested in their manufacture, which likewise has caused a demand for machinery specially adapted to the manufacture of the parts used in their construction. Probably the machine which is most extensively used is the turret lathe or screw machine, and we give herein a description and illustration of one of the latest designs, and one which we are informed by the makers is used most extensively by the largest manufacturers of bicycles in the Dominion.



THE M'GREGOR, GOURLAY CO., LTD.,—20 INCH TURRET LATHE.

The head of this machine has a crucible cast steel spindle, which is finished in a grinding machine to ensure accuracy. This spindle has a 2⅛-inch hole clear through, and is arranged as shown with a wire feed, which takes 1¼ inches through the quill. The chuck on the nose of the spindle is made from crucible cast steel, hardened and ground out on its place, which insures truth. The collets are also cast steel, hardened and ground. This head has a 3-step cone for 3½-inch belt, and the back gears are so arranged that three speeds may be had without changing the belt, or nine speeds from the three-step cone. The movement of the lever in one direction or the other engages different sets of back gears alternately, and the engaging of a latch when the lever is in a central position, gives the speed of the belt without back gears. This is very convenient, on account of the variation in speed required on all classes of turret lathes or screw machine work. The turret slide turns automatically at the back end of stroke; it contains eight holes 1¼-inch diameter, the tools being clamped by plugs drawn

down by screws. The locking mechanism throughout is of the best cast steel hardened, then ground and lapped for fits; all surfaces are finished by scraping, only surface plates being used to ensure truth. The cut-off slide has two tool posts, and is operated by a quick-threaded screw and pilot wheel.

This machine is also made with automatic feed to the turret slide, and with a pump tank and piping attached to the machine. It is also made in different sizes The countershaft is arranged with friction grip pulleys, 16 inches diameter, for 4 inch belts The weight of machine complete is about 2,500 lbs It is manufactured by the MacGregor, Gourlay Company, Ltd, successors to MacGregor, Gourlay & Co, and Stevens, Hamilton & Co, Galt, Ont

THE LATE SIR JOSEPH HICKSON.

Sir Joseph Hickson, formerly general manager of the Grand Trunk Railway, died at his home in Montreal, January 4th. Sir Joseph Hickson was born in England in 1830, and received his education and early railroad training there He was appointed chief accountant of the Grand Trunk Railway by Sir Edward Watkins in 1861 He was afterwards secretary and treasurer of the company, and on the resignation of C J Brydges, he became general manager in 1874 After selling the Point Levis-Rivere du Loup section to the Dominion Government, Sir Joseph changed the road from the narrow to the broad gauge, and secured the connection between Sarnia and Chicago During his management, from 1874 to 1890, the mileage of the road increased from 1,383 to 3,487 miles, and the traffic was enormously increased

WATER HAMMER.

SOME EXPERIMENTS TO SHOW WHEN IT MAY OCCUR.

A report of some experiments upon the causes of steam-pipe explosions, made to the British Association for the Advancement of Science, shows under what conditions water hammer may be expected in steam pipes and under what conditions it becomes dangerous. The tests were made upon steam pipes six inches in diameter and .197 inch thick. The ends were closed by flanges and provided with drain cocks and air-relief cocks, and suitable pressure gauges that would record to 2,133 pounds, one on the end flange and one on the top of the pipe. The pipe was inclined upward, and entering the bottom flange was a steam pipe with a valve, so that if any water was in the pipe the entering steam must pass through it.

The second experiment was conducted upon 12-inch pipe, one-quarter inch thick, with four pressure gauges, steam being supplied at the bottom through a three-inch pipe The position of this pipe was afterward considerably changed. The tests made were as follows: 1. Pipe without water, air cock closed and the drain cock open. 2. Pipe without water, air cock open and the drain cock closed. 3 Pipe without water, air and drain cocks open. 4. Pipe without water, air and drain cocks closed. 5. Vacuum in pipe and some condensed water formed by creating vacuum, air and drain cocks closed. 6 Vacuum in pipe, and the latter filled with water to about one-third of its cubic capacity, so that the point where the steam entered was under water in the first pipe, it being made to incline toward that point. In the second pipe the water filled the bottom of the pipe. Air and drain cocks were closed to one-third of their capacity at one end, and running to nothing at the other end. 7. Pipe without vacuum filled with water as under 6, air and drain cocks closed. 8. Pipe without vacuum filled with water the same as under 6, air and drain cocks open.

In the experiments with the first steam was admitted from a boiler under 70 pounds pressure, by rapidly opening the stop valve on the main steam pipe, the influx of steam having been regulated beforehand by adjusting the valve close to the experimental pipe. Beginning with one-fifth of the area of this valve, the opening was increased one-fifth in each of the succeeding tests, the whole tests being frequently repeated to check results. In carrying out tests 1 to 4 no motion was observed, whether the filling of the pipe with steam was retarded or accelerated. The pipe became heated slowly or quickly, according to the rapidity with which it filled with steam, until it became thoroughly warmed, and the pressure gauges on the pipe showed same as boiler. As soon as vacuum formed and a small amount of condensed water was present in the pipe (test No. 5), light hammering was present in the pipe when steam was admitted. This was not, however, indicated on the gauges, but caused a slight movement in the pipes. This hammering and backward and forward movement of pipe became more intense the greater the quantity of water present (tests 6 and 7), manifesting itself in distinct blows at short intervals, and causing the gauges to show between 126 to 242 pounds. Whether the vacuum in the pipe (test 6) had any influence on the action of the steam when admitted, could not be determined by any of the trials.

The heaviest hammering, as well as the greatest movement of the pipe—which also continued for some length of time—were observed when the pipe was about one-third full of water, and both air and drain cocks kept open (test No. 8), and for all five openings of the valve. During these tests there was a uniform discharge of water from the drain cock and of air from the air cock, for a longer or shorter time, depending on the opening of the stop valve in the pipe. For instance, with one-fifth opening of the stop valve the first hammering was noticeable after four minutes; at three fifths opening, after 30 seconds, and 15 seconds after the valve was wide open, powerful hammering and violent motion of the pipe set in, in each case accompanied by an impulsive discharge of water and air, the latter by steam from the air and drain cocks. These phenomena are due to the fact that the steam is condensed by the water present, and only when the water has attained the temperature of steam does the impulsive action of the latter set in. The pressures observed on the gauges at the end of each trial (test No. 8) fluctuated between 284 and 1,066 pounds. At one time the greatest pressure would be observed on the gauge tapped in the flange at end of pipe, and then on the gauge on side of pipe.

The second experimental pipe was changed somewhat from time to time, but showed no radical change in results.

As a result of these tests it is shown that destruction of a completely drained, though entirely cool, pipe cannot occur, whether the stop valve near the boiler under steam is opened gradually or in a sudden, careless manner, because hammering, which alone can cause an explosion, does not follow. But it is to be observed that a rapid filling of the pipes with steam may prove disastrous, for the sudden heating up of the various parts may cause rupture, due to unequal stresses on and resistance of the material.

When, however, a large quantity of water is contained in the pipes and the strain is forced to find its way through it and to carry it along, an explosion may occur, even if the stop valve is opened in the slowest and most careful manner. If there is so little water in the pipe that steam need not force its way through it, no disastrous hammering will occur, nor will the water present be carried along by the steam when the stop valve is opened, as was demonstrated by the amount of water left in the pipe after the end of all tests. The results of the tests with the first arrangement of the second experimental pipe lead to the conclusion that where water has accumulated in U bends of pipes, if the stop valve is opened gradually, the entering steam will distribute itself at once uniformly over the surface of the water, and by virtue of its pressure, in spite of the original condensation, is not only maintained, but steadily increased, and will prevent any agitation of the water, and, consequently, hammering. If, however, a sudden change of pressure and a rapid influx of steam occur, then the water will be agitated, and, once in motion, it will cause violent and dangerous hammering in the pipe. Therefore, steam pipes with pockets are to be avoided. The variations of the pressures indicated on the gauges after all the tests lead to the conclusion that the water is thrown backwards and forwards, wave-motion like, caused by the influx of steam, and that the pressure is greater or less, depending on the intensity with which the moving mass of water strikes the opening to which the gauge is attached.

LITERARY NOTES.

We are in receipt of Battersby's Monthly List for December, which gives dates of railway and other details of the transatlantic steamers, etc.

The Municipal Engineering Statistics of the City of Quebec comprise an interesting variety of details about Canada's most historic city, and reflect much credit on the city engineer, C. Baillairge, from whose office it comes.

The B.C *Mining Record*, of Victoria, issued a very creditable special number last month, containing a number of photo-engravings of British Columbia mining scenes, with a very good portrait of Prof. W. A. Carlyle, the provincial mineralogist, formerly of McGill College, Montreal.

Rossland, B.C, Business Directory (the Kootenay Publishing Company, Rossland, B C), which has recently been issued, is a small volume, but one which will receive a great deal of attention from the business men of Eastern Canada The classified directory is a very valuable feature of the publication

The British Columbia Year Book is now in course of preparation by R. E Gosnell, Victoria, B C, librarian to the Legislative Assembly The well known ability of the author and the great interest now taken in everything connected with British Columbia, makes such a work as this an assured success from its inception.

The J I Case Threshing Machine Co., of Racine, Wis., U.S.A, has issued a cream and gold bound catalogue, in which they place before the public the Raymond Improved Gas and Oil Engines, single, double and quadruple cylinder, one to 100 horse-power actual.

The Wm. Hamilton Manufacturing Co., Ltd., Peterborough, Ont., has issued a handsome catalogue of the Corliss engines, which are so successfully put upon the market by this firm. The Boiler Catalogue of the same firm will attract most favorable notice. The diagrams of the stationary, portable and locomotive boilers are very clear. A number of refuse consumers for saw mills are also described.

The James Morrison Brass Mfg. Co., Ltd., Toronto, has issued a catalogue of some seven hundred large pages, handsomely bound in scarlet boards. It contains an illustrated catalogue and price list of steam gauges; engineers', plumbers', steam and gas fitters' brass goods, electric fittings, iron pipe, malleable and cast iron fittings, plumbers earthenware, copper and cast iron goods, tools for engineers, plumbers, steam and gas-fitters.

The indefatigable Mr. Baillairge, city engineer of Quebec, has published the last seven of his essays in one volume; among the contents being "Technical Education in Untechnical Language," "Le Communisme," "The Stereometricon, a new system of measuring all bodies by one and the same rule," and "La Baie Hudson." The energy of this French Canadian engineer is shown in the fact that a bibliography published by the Royal Society of Canada, names 88 books, pamphlets, essays and articles of which he has been the author, while at the same time he has carried on his duties as city engineer and consulting engineer for other works.

The proceedings of the Purdue Society of Civil Engineering, published annually by the Civil Engineering Society of Purdue University, La Fayette, Ind., U.S.A., contains a number of very able papers, which were read before the society by representative members of the engineering profession in the United States. Among the papers are the following: "A Railway Bridge and Building Department," by Onward Bates, M. Am. Soc. C.E.; "Business Wisdom and Responsibility of the Engineer," by W. F. Goodhue; "Landscape Engineering in Connection with an Engineer's General Practice," by W. K. Eldridge, C.E.; "Fireproofing as a Specialty," by Jos. K. Freitag, B.S., C.E.; "Irrigation Works of the Pecos Valley," by Elwood Mead, M. Am. Soc. C.E.

"The Canadian Almanac for 1897," published by the Copp, Clark Co., Ltd., Toronto, is the best issue of this standard annual, now in its 50th year. The cover is very artistic, and shows a female figure seated on the Canadian arms and holding aloft a maple wreath. Among many new features are valuable insurance statistics, a sketch of the Lake St. John territory, an account of the fisheries protection service, educational and other institutions, the law of intestate estates, list of Quebec notaries, Ontario Law List, a sketch of the history of the United Empire Loyalists of Canada, by E. A. Hart, Montreal; and much other additional information, by which the scope of the contents has been enlarged beyond former editions. The price of the paper edition is still only 20 cents, and the only comment we can make is that it is too cheap.

The McMillan & Haynes Co., Ltd., St. Catharines, Ont., has issued a neat catalogue, giving a number of the newest ideas in iron and brass bedsteads.

THE TERM AT THE SCHOOL OF PRACTICAL SCIENCE, TORONTO.

BY E. ANDREWS.

One of the first things a man does on returning to college is to go and have a look at the freshmen. They are on view to great advantage during draughting hours, when they are assembled, each man at his desk, in the 1st year draughting room, and may be seen struggling through the first drawing. Painfully slow is their progress, to the practical eye of the third year man, and many the misplaced lines and blots and consequent erasings, intermingled with muttered imprecations and despondent looks. We note that their number is large, some sixty all told, which is one of the largest classes that has ever entered the School of Practical Science. On enquiry we find that one of the most notable increases is that in the number of students in the department of Mining Engineering. These number twelve, and are considerably the largest class in this department that has entered since it was founded. It is, of course, the glowing reports of gold mining in British Columbia, and the hints of large quantities of paying ore in the western part of this province, that have brought these men here, and the general impression is that to be a mining engineer is to be in the way of making a fortune. Meanwhile they are eager for their year of graduation from the school, when there will be a general stampede for Rossland, or the next camp, perhaps, by that time. The mining boom brings us other visitors, whom we can hardly class as freshmen. We have among us men from Rossland and other parts, who have already been among the mines, and have come to the school for the winter to increase their knowledge of geology, assaying, etc. They spend most of their time in the assaying and mineralogical laboratories, and attend Professor Coleman's lectures on ore deposits, and mineralogy, and geology. There are some half dozen men of this class. There are also in the freshman class an unusually large number in civil engineering, while the number in the mechanical and electrical departments, and the departments of architecture and applied chemistry, is about the average.

Changes other than those in the students, are the enlargement of the museum, which now takes in Prof. Coleman's old lecture room, so connecting the palæontological with mineralogical part by arched openings forming a far more picturesque, as well as more spacious room, and one more worthy of our fine collections. The new stamp mill which was installed last year, has been given several trials, and will be running regularly next term. In this part of our work, the loss of Mr. Mickle, who has been in ill-health, has been severely felt. We are glad to say that he is now convalescent, and has delivered a few lectures during the last few weeks. The school has been singularly unfortunate in this respect this term, having also lost the services of Mr. Boustead, fellow in metallurgy and assaying, through sickness. Owing to the absence of these two gentlemen, the students in these departments have hardly enjoyed the full benefits of their course this term, though Mr. Boustead's place has been well filled by Mr. James, mineralogist and assayer of this city; but by good steady work next term, it is hoped they will be able to make up for lost time.

The meetings of the Engineering Society of the school show activity and lively interest on the part of its members. Much of the time of the society has been taken up with a revision of the constitution, and hence the number of papers read before the society has been small, but they have certainly been above the average in interest and instructiveness. The first meeting of the year, as usual, was devoted to the president's inaugural address, and holiday experiences on the part of the students. At the second meeting a paper by Mr. Carlisle Wallace was read, entitled "Some Causes of Failure in Tunnel Shafting." This paper dealt with the subject very minutely, and was well illustrated by drawings of broken shafts taken from cases within the experience of the author. At a later meeting Prof. Coleman gave an account of his prospecting trip through the Rainy River district during the summer. A detailed report of this trip will appear in the sixth annual report of the Bureau of Mines. A preliminary report has already appeared in these columns. The doctor is evidently a believer in Ontario as a gold mining country. The last meeting of the term was held on December 9th. Dr. E. E. King gave us "Some Remarks on the use of X-Rays," with fluoroscope experiments with the Crooke's tube. Several of the students had an opportunity of studying the anatomy of their hands and other members by means of the fluoroscope.

In other fields than engineering the school has had a very successful term. At the annual University games, though the School of Practical Science did not secure the championship or the majority of events, as it has in late years, yet won the team race for the fourth time in succession, and D. McIntosh proved himself by far the best man in the University at a mile and a half mile.

On the football field the School of Science Rugby team secured the Mulock cup, by winning from the Meds in the second round in a very close and hard-fought game, and by two easy victories over the Dentals and '99 Arts, in the third round and finals respectively.

The School of Practical Science dinner was as usual a success this year It was honored by the presence of President Loudon, who, in his speech in reply to the toast of "Toronto University," said that he considered the school to be the Faculty of Applied Science of the University, and hoped that we should always remain as a part of the University. J. Galt, C E., Archibald Blue, of the Bureau of Mines, E. H. Keating, city engineer, of Toronto, were also among the guests, and gave some good advice from the fruits of their experience.

The foregoing says little or nothing of the regular work of the school, as it is beyond the scope of this article, but this much may be said, that the students have every confidence that they are being led in the right direction by Principal Galbraith and the other

members of the staff, and are obtaining what the school claims to give in its three years' course, the solid groundwork of a technical education. In the fourth year, research is more advanced, and we are glad to say that the additional year is being regarded more as a regular part of the school course, since the introduction of the regulations which make it necessary for men to hold the degree of B.A.Sc. before proceeding to the degree of C E., M.E. or E.E., as the case may be, and is now taken by a much larger proportion of the students.

Industrial Notes.

ALEX McKAY will, it is said, build a saw mill at Rosebery, B C.

THE Locked Wire Fence Co. has removed from Ingersoll to London.

THE waterworks and electric light by-laws have been defeated in Winnipeg.

A NEW public school, to cost $14 000, is to be built at once in Brantford, Ont.

WATER has been led into the pipes of the new waterworks system at Petrolea, Ont.

THE C. Ross Co., Ltd., dry goods, Ottawa, which was burned out recently, is to rebuild at once.

H T WILSON, Franktown, Ont., will erect a saw and shingle mill at that station in the spring.

A NEW pump will shortly be required at the pump house, Niagara Falls, Ont., at a cost of from $3,000 to $5,000.

JACKSON & COCHRANE, Berlin, Ont., have shipped eleven woodworking machines to the Bennett Mfg. Co., London, Eng.

WM THOMPSON, of the Thompson Co., Longford, Ont., has been visiting Gravenhurst to inspect a site for a new sawmill.

J. A. SPEIGHT & Co, Acton, Ont., have built a tank for Beardmore & Co, twenty-four feet in diameter and twelve feet deep.

IT is reported that Mr Harding, of Coal Creek, N.B., intends building a steam saw and grist mill at Douglas Harbor this winter.

IT is rumored that the C.P.R. is about to build an hotel at Ashcroft, B.C A waterworks system may also be put in for the town.

PAQUET & GODBOUT, St Hyacinthe, Que., have received the contract for the carpenter work in the Somerset Church, Quebec, at $17,000

GEO RUMPEL, of Berlin, Ont., recently purchased the Hanover felt boot works, and will remove them to Berlin, where his factory will be enlarged.

A. L. HURTUBISE & Co., lumber merchants, Montreal, have failed. Total liabilities about $160,000. Ordinary creditors will get little or nothing

THE water consumption of Hamilton, Ont., was decreased by 398,000,000 gallons in 1896, which is attributed to the placing of meters in factories, etc.

THE firm of Wright & Cunningham, founders, St. Catharines, Ont., has been dissolved, and the business is being carried on by James Cunningham alone.

AT a meeting of the creditors of the St. John Nut and Bolt Works a few days ago, in the office of Judge Trueman, an offer of 12½ cents for a settlement was made

THE contract for a stone church at Montmerency Falls, Que., has been let to Joseph Coutere, Notre Dame de Levis, at $17,000. The architect is Thos Raymond, Que.

THE C.P R. are asking Owen Sound for a bonus of $40,000 towards the building of a million-bushel grain elevator and flour sheds which they propose to erect there.

THE heating apparatus in the Eastern Block of the Parliament Buildings, at Ottawa, is being adapted to burn anthracite coal instead of bituminous Over 8,000 tons are burned yearly.

THE Wm. Hamilton Manufacturing Co., Ltd., Peterborough, Ont., is supplying a boiler for the new steamer of the Columbia and Kootenay Steam Navigation Co. It is of the locomotive type, 28 feet by 6 feet.

CLARK, SKILLINGS & Co. are building a new spool-wood mill near Beaver Brook Station, N.B., a portion of the machinery for which is being made by the Miramichi Foundry and Machinery Works, Chatham, N.B.

THE McClary Manufacturing Co., London, distributed 500 turkeys amongst its employees at Christmas.

THE Nelson *Miner* says the town of Grand Forks, B.C., will be placed on a better footing at once; electric lighting and water supply plants will be put in and a bridge built.

THE City of Fredericton, N.B., did not accept any of the tenders recently submitted for a road-building plant, including roller, stone crusher, etc. Tenders will probably be again called for.

AN Ideal engine of 30-horse power has been shipped by the Goldie & McCulloch Co., of Galt, for the O'Keefe Brewery, Toronto. Another Ideal engine is being put up at the Kemp Mfg. Co.'s works, Toronto.

THE board of management of the Toronto Technical School are asking the city council for aid for a new and larger building, to accommodate their extending work. The estimated cost of permanent buildings is placed at $75,000.

THE directors recently elected by the People's Heat and Light Co, which has absorbed the Halifax Gaslight Co., are Senator McKeen, president; B. F. Pearson, W. B. Ross, Geoffrey Morrow, R. E. Harris, George E. Boak and C. C. Blackadar.

THE Small & Fisher Foundry Co., Ltd., Woodstock, N.B., has recently placed a 150-light dynamo in the Woodstock woolen mills which will also light the wrapper factory, which is already supplied with power from the plant of the Woodstock Woolen Co.

THE *Canadian Gazette*, published in London, mentions the formation of a syndicate of English manufacturers to purchase the brake invented by Dr. Doolittle, and an adjustable handlebar, the device of John Galt, C.E., of Toronto. The capital is £50,000.

THE Garlock Packing Co., of Hamilton, have had a very satisfactory year, their record for 1896 being ahead of all previous years. The Garlock company's specialties are getting to be appreciated as they are becoming universally known among the engineers of Canada.

THE Fraserville Co, Ltd., will manufacture pulp and articles from pulp, at Fraserville, Que., under a Quebec charter. Capital, $50,000. The incorporators are:—John Macfarlane, Westmount; G White Fraser, Mon real; F. Waterson, David Cooke, Fraserville, and E. H. Barker, Montreal.

PRESIDENT KENNY, of the Acadia Sugar Refining Company, in a recent interview with a deputation of Moncton city aldermen, stated that he could give no guarantee that the refinery would be rebuilt at Moncton. He says the new refinery, wherever built, will be equipped with the latest improved machinery and would be the best in Canada.

STUART HOWARD, C.E., Montreal, has prepared plans for a railway viaduct in Montreal from St. Henri to the Bonaventure depot The cost of the proposed viaduct, if built of stone, will be about $971,700; if iron posts were used, $926,081, and if constructed of trestle work, $806,000, with an additional sum of $92,000 for filling in the trestle work.

AT the inquest on the death of Alex. Forbes, who was killed in a boiler explosion, in Yarmouth township, near St. Thomas, the jury found the Stevens Manufacturing Co. and Edward Dutton criminally negligent in allowing the engine and boiler to leave the shop in such a condition. Edward Dutton will be indicted on a charge of manslaughter.

R. F. CARTER, of Niagara Falls, Ont., has invented an apparatus whereby acetylene gas may be produced from the carbide and handled, it is claimed, without any danger, used at a very low rate of expense. His apparatus consists of a cheaply constructed generator for the carbide, and an automatic water feeder, supplying the carbide in the generator with measured quantities of water, producing the gas equal to the consumption.

THE nail manufacturers of Canada have for some time been acting in collusion with the manufacturers of the United States; but the breaking of the combine over there, and the subsequent cut in prices, has compelled them to meet lower prices from U.S. makers. They met Dec. 12th, in Toronto, and agreed to reduce prices in Canada by 45 cents a keg, to meet the cut from over the line.

AT the annual meeting of the Owen Sound Portland Cement Company, on the 22nd ult., the following were elected officers for the current year: John Lucas, Toronto, president; J. E. Murphy, vice-president; R. P. Butchart, manager; W. P. Pierson, director; Geo. S. Kilbourn, secretary-treasurer. The reports of the year were very satisfactory. The company's output is steadily increasing, and improvements are being made in their machinery and methods of manufacture.

COWANSVILLE, QUE., has voted to build a system of water works.

PETROLIA, ONT., had Lake Huron water admitted to its new mains on Dec 17.

IT is said that a wooden-ware factory, to employ 40 hands, is to be started in Brantford, Ont.

THE machinery brought into Rossland, B.C., during 1896 is said to be valued at $1,250,000.

THE new biscuit factory of Ross & Sons, St. John, N B., will be complete in February, and will employ 50 hands.

FREDERICK GOURGEON, contractor, Hull, Que., has assigned, with liabilities amounting to $10,000 and assets small.

FROST & WOOD, agricultural implement manufacturers, Smith's Falls, Ont., are now making sleighs, cutters and carriages.

HARLAND BROS., Clinton, Ont., have a contract for the heating apparatus of a twenty-room house near Enniskillen, Ireland.

A NEW bridge across the Petewawa river, at Petewawa, Ont., is proposed. The Ontario Government will be asked to assist.

IT is pretty well assured, says the St. John *Record*, that a pulp mill will be established in Charlotte County, on the Lepreaux River

FINDLAY BROS., founders, Carleton Place, Ont., are enlarging the building, and adding a nickel plating department to their stove works.

A THRESHING machine boiler on the farm of Archibald Ferguson, Yarmouth township, Elgin county, Ont., exploded, killing A. Forbes.

THE by-law granting a bonus of $20,000 to the Canadian Pacific Railway for extending their shops at Carleton Place, Ont., was carried—493 to 6.

GODERICH, ONT., offers exemption from taxes for ten years to any person who will erect and run a fifty-barrel grist mill within the municipality.

THE D. Hibner Furniture Co., Berlin, Ont., is being supplied with machinery by the McGregor-Gourlay Co. and the Goldie & McCulloch Co., Galt, Ont.

THE contractors for the locks at the cascades of the Columbia, in Oregon, U.S., were Canadians and natives of New Brunswick. The contract price was $1,500,000.

THE C.P R. will, it is said, build an elevator with a capacity of one million bushels, at Owen Sound, Ont. The town will be asked for a bonus, probably $40,000.

STURGEON FALLS, ONT., is issuing debentures to the amount of $17,500 for the construction of waterworks in that town. An electric light plant will also be established.

AS the Grand Trunk Ry. received only one tender for the new station from the Berlin contractors, the building of the station is deferred till spring, and tenders will again be called for.

AT New Westminster, B.C., the Automatic Canning Co. will build a cannery at once. It is also reported that the A. B C. Packing Co. intends putting up another cannery on the Fraser River.

TORONTO City Engineer's department has prepared the plans and estimates for the proposed bridge and approaches across the western channel of the harbor, and for constructing the extension of the street railway on the Island.

THE London Box Manufacturing and Lumber Company, Ltd., applies for a Dominion charter. Head office, London, Ont.; capital, $35,000 The incorporators are: F. G. Rumball, J. Watson, J. Shannon, E. Grant, J. A. Smith, London, Ont.

THE Booth Wagon Company of Ontario, Ltd., applies for a Dominion charter to manufacture vehicles in Toronto. Capital $25,000. The applicants are: W. Booth, Gladmine, Penn., U.S.; W. Barker, C. H. Riggs, L. F. Riggs, F. R Boselly, Montreal.

PROCEEDINGS are being taken to prevent the payment by the town of Preston, Ont., of $10,000 recently voted to induce John Stevens, of Galt, formerly of Stevens & Hamilton, to establish a manufactory (of what kind has not been made known) in Preston.

THE Brantford Machine Tool Company, Ltd., applies for an Ontario charter. Place of business, Brantford, Ont.; capital, $150,000. The incorporators are. C. H. Waterous, F. Grobb, J. A. Bain, L. Harris, W. H. Shapley, R. Kerr, T. A. Hollinrake, Brantford.

THE development of the immense water power at the Chats Falls on the Ottawa, Fitzroy Harbor, Ont., seems assured. A pulp mill is spoken of as a certainty, and a director of the O. A. & P. S. Ry. says the line will build a spur from Galetta, three miles, to Fitzroy Harbor.

GUELPH, ONT, will spend $1,600 on a couple of small bridges.

THE Ontario Radiator Company, Ltd., applies for an Ontario charter to manufacture heating apparatus. Head office, Toronto; capital, $300,000. T Kinnear, W. A. Mitchell, S. Crane, Toronto; S. Jackson, St. Catharines; J. T. Jackson, J. A. Keyes, F. J. Travers, J. W. Coy, H. Barber, Toronto.

APPLICATION is being made to the Legislature of Quebec at its next session for an act to incorporate the Canadian Society of Civil Engineers, "for the purpose of securing a standard of efficiency in those practicing the profession of civil engineers, and furthering and advancing the interests of the profession."

THE Citizens Brewing and Distilling Company, of Maisonneuve, Ltd., applies for a Dominion charter. Headquarters, Maisonneuve, Que.: capital, $300,000. The incorporators are F. A. Hecht, Chicago, Ill., C. A. Senecal, N. Sarrazin, Lake Linden, Mich.; Hon A Desjardins, B. Prefontaine, T. Gauthier, G. Deserres, J. P. B. Casgrain, Montreal.

THE Nelson *Miner* says that the Kootenay Iron Works is looking for a location in Nelson, on the shore of the lake in the neighborhood of the C. and K. road, and as soon as one is found, the construction of a large iron foundry will be commenced. The members of the company are A. R. Barrow, George W. Richardson and George A. Bigelow

THE ratepayers of Victoria, B C., have rejected the by-law recently submitted for borrowing $125,000 to build a steel bridge over the Victoria Arm, at Point Ellice. The temporary pile bridge now in use was put up on the condition of a proper structure taking its place at an early date, and there is no doubt the Public Works Department will insist upon this being done.

THE Owen Sound Beet Sugar Mfg. Co., Ltd., has elected the following officers at its annual meeting: T. I. Thomson, president; Nicholas Read, vice-president; W. H. Riley, secretary; M. Robinson, treasurer; W. D. Forest, John McKenzie and F. W. Harrison, directors. The company proposes to begin building in the spring, so as to be ready to treat the '97 crop of beets.

VANCOUVER has passed a by-law for borrowing $60,000 for water works extension. Armstrong & Morison, who will remove to Vancouver from New Westminster, have obtained the contract for steel piping at $35,100; the Gartshore-Thompson Pipe and Foundry Co., of Hamilton, that for cast iron piping, at $39 a ton, whilst the B C. Ironworks Co., of Vancouver, has received minor contracts for pig lead and fittings.

THE promoters of the Montreal-Longueuil bridge over the St. Lawrence, are asking the Dominion Government, the Quebec Government and the Montreal City Council each 15 per cent. of the cost of the bridge, or $900,000 from the Dominion, $900,000 from the Province, and $900,000 from the city of Montreal, payable in twenty annual instalments, and only to be commenced at the completion of the bridge two years hence.

THE Missiquash Marsh Company, Ltd., applies for a Dominion charter to own and improve certain lands in the counties of Cumberland, N S, and Westmoreland, N.B., and to erect other necessary plant. Head office, Sackville, N.B.; capital, $180,000. The incorporators are W. C. Milner, Sackville, N B.; W. M. Blair, Nappan, N.S.; H. Trueman, Westmoreland, N.B.; N. A. Rhodes, Amherst, N.S.; R. T. Coates, Nappan, N.S.

"A PROJECT is on foot to dam the Assiniboine river, at Portage la Prairie, Man., to develop a water power and flood the old river bed adjoining the town, transforming it into a lake. Surveys, plans and estimates have been made, and a by-law to authorize the issue of $40,000 of debentures to carry out the work, was carried by a large vote of the ratepayers on the 15th. December. The work will be proceeded with next summer."—*Ex.*

Mining Matters.

THE Hall Mines, Nelson, B C, are to be lighted throughout with incandescent lights.

A 50-BARREL oil well was struck on the Porter farm, near Petrolia, Ont., last month.

A LARGE deposit of coal has been discovered at Codroy, on the west coast of Newfoundland.

WORK has been stopped for the season on the mica mines in North Burgess, Lanark county, Ont.

EXPORTS of coal from Vancouver Island for November were 47,000 tons, against 37,000 in October.

EXPERTS claim that J. F. Caldwell, owner of the Sultana mine, has as fine a property as the world famous Le Roi.

THE Lethbridge coal mines are now working to their fullest extent, the daily output amounting to about 630 tons.

C. O. Foss, C.E., was the purchaser of the gold mine at Pleasant River, N.S., which was recently sold at auction.

PHILLIPS ARM is a mining district on the northern British Columbia coast which is attracting a good deal of attention.

A TRAMWAY 4,300 feet long, has been completed at the Foley mine, which is now one of the best of the Western Ontario properties.

ASBESTOS of unusually long and fine fibre has been discovered in Renfrew county by Carswell & McKay, lumber merchants, Renfrew, Ont.

THE War Eagle smelter is to be built at Northport, Wash., and will treat 250 tons of ore per day, both silver, lead and gold-copper ores being used.

THE oil company at Gaspe, Que., has struck another good flow of oil at a depth of 2,900 feet. There is said to be about 200 feet of oil in the well.

MANAGER PARRATT, of the Emery Works at Stroudsburg, Penn., reports that the corundum found in Hastings county, Ontario, is of fine quality.

C. S. DRUMMOND, who was in Rossland, B.C. recently, representing the Flauvel smelting process, claims that under their patents ore can be treated at $1 per ton.

THE total of Cape Breton and Pictou coal shipped to the St. Lawrence during the past season was 706,457 tons, an increase over the figures of 1895 of 69,938 tons.

THE Nova Scotia government is making a survey of the Cheticamp district in which gold was recently found. F. Christy, of the mines' office, is in charge of the survey.

NEW veins of asbestos are to be opened up near Danville, Que., in the spring. L. Gordon, G. Yale, and T. and J. Saffin have disposed of part of their farms to the prospectors.

THE F. W. Borden, Co., Ltd., lumber merchants, of Blomidon, N.S., applies for an act to change its name to the R. W. Kinsman Co., Ltd., and for permission to do a general mining business.

MILTON HERSEY, M.E., Montreal, recently examined the find of anthraxolite on the Island of Orleans, Que., and found it softer than that at Sudbury, Ont., and free from quartz, but appearing in smaller veins.

THE Western Canada Gold Mining Co., Ltd., applies for an Ontario charter. Capital, $99,000; head office, Toronto. The incorporators are Frederick Wyld, Jno. Flett, A. A. Allen, Jas. Carruthers and J. K. Kerr.

A BEGINNING, with modest capital, raised locally, is now being made of gold mining about Vernon and Okanagan Lake. Preliminary assays show varying results from sample ores of from $25 a ton to rather over $90 a ton.

THE making of coke at Comox by the Dunsmuir Co. should greatly promote ore smelting and refining in British Columbia generally, especially on Vancouver Island. Coke is at present being imported from Belgium and South Wales.

THE Golden Goblin Mining Company, of Ontario, Ltd., applies for an Ontario charter. Head office, Toronto; capital, $500,000. The incorporators are: A. C. Thompson, F. R. James, R. A. Dickson, G. L. Lennox, F. Mitchell, M.E., Toronto.

THE Burley Gold Mining Co. of Ottawa, Ltd., applies for an Ontario charter. Head office, Ottawa; capital, $1,000,000. The incorporators are L. Crannell, W. A. Clark, A. W. Fraser, W. J. Craig, Ottawa, and J. B. Smith, M.E., Glenalmond, Quebec.

HAMILTON MERRITT has been instructing a class of fifty at Port Arthur in mining prospecting and geology. He shows his class at night practical work with the blow-pipe, the pan and the assayer's furnace; and in the day time lets them go prospecting on their own account.

THE Queen Bee Gold Mining Company of Ottawa, Ltd., applies for an Ontario charter. Head office, Ottawa; capital, $1,000,000. The incorporators are: L. Crannell, W. G. Bronson, W. A. Clark, A. W. Fraser, Ottawa, Ont.; J. B. Smith, M.E. Glenalmond, Que.

THE Ambrose Mining and Development Co., Ltd., applies for an Ontario charter. Head office, Toronto; capital, $1,000,000. The incorporators are: Hon. S. C. Wood, Toronto; P. McL. Campbell, C. Cameron, Collingwood, Ont.; F. E. A. Cott, New York, U.S.; L. Walsh, Port Arthur.

THE Toronto Tudor Mining Company, Ltd., applies for an Ontario charter. Head office, Toronto; capital, $1,000,000. The incorporators are: A. J. Pattison, J. W. Curry, F. Diver, G. R. Warwick, A. F. Rutter, Toronto.

THE River Range Oil Company, Ltd., applies for an Ontario charter to drill for and sell oil and gas. Head office, Toronto; capital, $10,000. The incorporators are: Fred. Diver, Wallace, McLean, J A. MacIntosh, H. Goss, H. H. Shaver, Toronto.

THE Bannockburn Gold Mining Company of Toronto, Ltd., applies for an Ontario charter. Head office, Toronto; capital, $500,000. The incorporators are: Mercer Adams, W. E. Hammill, M.D., J. E. Thompson, N. L. Steiner, R. M. Gilkinson, Toronto.

THE Bald Indian Bay Mining and Investment Company, Ltd., applies for an Ontario charter. Head office, Ottawa; capital, $6,000. The applicants are L. Crannell, W. A. Clark, A. W. Fraser, W. J. Craig, Ottawa, Ont., J. B. Smith, Glenalmond, Que.

THE Nuggett Gold Mining Company of Rat Portage, Ltd., applies for an Ontario charter. Capital, $50,000. The incorporators are: D. E. Adams, Winnipeg; J. Dick, R. Hall, Rat Portage; A. Harstone, H. K. Bold, R. A. Harvie, J. C. Simpson, Winnipeg.

THE Plutus Gold Mining Company, Ltd., of Sault Ste. Marie, applies for an Ontario charter to do general mining business; head offices, Sault Ste. Marie, Ont.; capital, $750,000. The incorporators are D. McGregor, J. Dawson, W. Brown, B. Boyer, H. C. Hamilton, Sault Ste. Marie.

THE Mississaga River Gold Mining Company of Ontario, Ltd., applies for an Ontario charter. Head office, Thessalon, Ont.; capital, $490,000. The incorporators are: Mary C. Dobie, J. B. Dobie, T. McCort, M.D., Thessalon; R. Musgrove, T. E. Williams, J. S. Dobie, C.E., Toronto.

THE well known firm of A. W. Ross & Co., mining brokers, Toronto, is applying for incorporation as The A. W. Ross Company of Toronto, Ltd. Head office, Toronto; capital, $20,000. The incorporators are: J. Hugo Ross, M. McInnes, J. A. Macdonnell, E. C. Cattanach, R. A. Dickson.

THE Sovereign Gold Mining and Development Corporation of Ontario, Ltd., applies for an Ontario charter. Head office, Toronto; capital, $2,500,000. The incorporators are: A. E. Jones, London, Eng.; J. S. Dignam, Toronto; H. Jones, Niagara Falls, N.Y.; F. Phillip, J. F. Lattimer, Toronto.

THE Nanki-Poo Gold Mining Co., of Ottawa, Ltd., applies for an Ontario charter. Head office, Ottawa; capital, $1,000,000. The provisional directors are A. H. Edminson, Rat Portage; J. M. Clark, Toronto; W. A. Clark, A. W. Fraser, Ottawa; J. B. Smith, M.E., Glenalmond, Que.

THE Thessalon Gold Mining Company, Ltd., applies for an Ontario charter; capital, $800,000; chief place of business, Thessalon, Ont. The applicants are N. Dyment, Barrie; D. Gordon, A. E. Dyment, J. S. Dobie, B. Sc., Thessalon, Ont.; J. Knight, J. Gunn, Gladstone; Mary C. Dobie, Thessalon.

THE Rupert Land Mining Company of Ontario, Ltd., applies for an Ontario charter to do general mining business, with headquarters at Rat Portage, Ont. Capital, $200,000. The incorporators are R. J. Campbell, H. A. Costigan, T. H. Lock, R. R. Wilson, J. Thompson, J. E. Huxley, Winnipeg; J. Brown, Russell, Man.

THE Western Ontario and Manitoba Gold Mining and Development Company, Ltd., applies for an Ontario charter. Head office, Rat Portage; capital, $750,000. The incorporators are: J. F. Howard, J. Dick, Winnipeg; A. Kelly, Brandon; E. James, Moosomin; D. H. McDonald, Fort Qu'Appelle; T. H. Gilmour, Winnipeg.

AT a meeting of the provisional directors of the Hawk Bay Gold Mining Co. at Hamilton, December 22nd, there were present: President, J. H. Tilden, F. K. Bruce, H. N. Kitson, H. C. Beckett, S. C. Mewburn, George L. Staunton, H. A. Wiley, H. C. McLean and F. S. Wiley. It was further decided to forthwith purchase a compressor, boiler, hoist and other machinery necessary to the property's rapid development. A three hundred foot shaft will be sunk on the mine.

THE Leap Year Consolidated Gold Mining Company of London, Ltd., applies for an Ontario charter. Head office, London, Ont.; capital $1,000,000. The incorporators are: J. D. Balfour, F. J. Hammond, G. Rowntree, C. W. Belton, M.D., J. A. Croden, G. H. Belton, A. W. Mayell, A. T. McMahen, T. Beattie, M.P., London; C. McGregor, Byron; J. D. Meekison, Strathroy; A. R. McFarlane, Hamilton; G. J. Schlief, J. Y. Brown, Rossland, B.C.; E. D. Croden, A. C. Barnes, A. Gillean, H. C. Screaton, A. Screaton, D. C. Ross, J. C. Belton, H. C. McBride, London; W. Dawson, W. H. Stepler, Strathroy.

THE Wellington Silver Mining Co., Ltd., applies for a Dominion charter to buy and operate the Wellington and Metis claims in the Kaslo-Slocan district, and do a general mining business; capital, $300,000. The applicants are G. P. Brophy, C.E., W. A. Allan, S. H. Fleming, C.E., J. W. McRae, Ottawa; H. Kennedy, Quebec and W. McNally, Montreal.

THE Gold Hills Exploration and Development Company of Toronto, Ltd., applies for an Ontario charter. Head office, Toronto; capital $2,000,000. The incorporators are: Hon. J. D. Edgar, J. Foy, Oronhyatekha, M.D., W. J. Douglas, G. McMurrich, F. W. Strange, M.D., Toronto; J. R. Minhinnick, London, Ont.; J. G. Bowes, Hamilton, and J. B. McArthur, Rossland, B.C

IN the week ending November 30th, the following new mining companies received British Columbia charters. Albion Gold Mining Company, with headquarters at Vancouver, and capital stock of $5,000,000. Big Buck Mining Company, of Rossland, $1,000,000. Burrard Mining Association, of Vancouver, $50,000. Cameronian Gold and Silver Mining Company, of Sandon, $850,000. Cariboo Milling, Mining and Smelting Company, of Spokane Falls, $800,000. Pine Mountain Gold Mining Company, of Vancouver, $1,000,000. Ibex Mining Company, Rossland, $1,000,000. Kootenay Brewing, Malting and Distilling Co., of Trail, $50,000. Noonday Mining Co., of Rossland, $1,000,000. Sault Ste. Marie Gold Mining Co., of Rossland, $1,000,000. Slocan Development Company, of Rossland, $1,000,000. Trail-Bear Creek Gold Mining Company, of Rossland, $1,000,000. Yale Homestake Gold and Silver Mining Company, of Vancouver, $400,000.

Electric Flashes.

GUELPH, ONT., will furnish its own electric light at a cost of $20,000.

THE Berlin, Ont., electric light station has received its new 200 h.p. engine.

THE Auburn Power Co., Peterboro, is putting up its poles and getting ready for business.

W. W. PARTTEW, flour mills, Dorchester Station, Ont., is putting in an incandescent lighting plant.

IN Easton v. Brantford Street Railway, a suit for $2,000 damages for personal injuries, the jury gave a verdict of $2,000.

THE bicycle railway at Crystal Beach has been sold. Eber Cutler, Ridgeway, Ont., bought the cars and dynamo for $600.

E. S. STEPHENSON & Co., St. John, have been appointed agents in New Brunswick for the Toronto Electric Motor Co.

MACRAE & MACKENZIE are proceeding against Jas. Bronfield, Eganville, Ont., to restrain the construction of the power dam on the Bonnechere River mentioned in our last number.

A CASE of tampering with electric meters is reported from Peterboro by Wm. Johnson, inspector of electric meters. The penalty for an offence of this kind is a fine of $50 to $100.

THE electors of Portage La Prairie are considering plans by which $40,000 will be spent in developing water power and installing an electrical plant to furnish light and power to the town.

BY decision of the Exchequer Court at Ottawa, Dec. 14th, the Toronto Street Railway recovers $59,044 from the Government on account of duties paid on rails which should have been admitted free.

SIR Charles Ross and Sir Charles Tupper are said to be interested in the plan of Jas. F. Wardner to organize a syndicate to control the electrical power companies in the neighborhood of Rossland, B.C.

APPLICATION will be made to the Ontario Government for a charter for the Toronto Radial Railway to buy the Toronto Belt Line Railway and other railways, and to convert them into an electric system.

THE directors of the Montreal Park and Island Railway Company for the next year are: H. Holt, president; Hon. J. R. Thibaudeau, vice-president; W. Strachan, treasurer; Hon. Louis Beaubien, D. Morrice, Hon. Alfred A. Thibabdeau and W. J. Morrice. H. Holgate is secretary and manager.

LONDON Electric Motor Company, Ltd., is applying for an Ontario charter, to manufacture electric machinery. Head office, London, Ont.; capital, $45,000. The incorporators are:—S. R. Break, W. H. Wortman, C.E., A. Carr, S. Potter, E.E., A. Gorman, T. J. Cahill, W. Barton, London, Ont.

THE Royal Electric Co. are installing an electric lighting plant for Wm. Irving, of Sundridge, in that town. They are furnishing one of their latest type two-phase "S.K.C." 25-K.W. dynamos. Contracts have already been secured for about 200 lights, and also for one motor to run off the same two-phase alternating circuit.

THE Fort Erie and Bridgeburg Street Railway Co., Ltd., is applying for an Ontario charter to build an electric railway in Fort Erie and Bridgeburg, Ont. Capital, $50,000. The names of the applicants are S. H. Runcie, W. Douglas, M.D., Fort Erie; C. E. Norris, Buffalo, U.S.; E. W. Oviatt, C.E., W. M. German, Welland.

THE officials of Toronto are preparing a form of agreement between the city and the Georgian Bay and Ship Canal Aqueduct Co., to give the latter the same rights as a vendor of electric current as those have who already enjoy the franchise. The plan is to dam the Humber River and develop power there. Some preparatory work is now going on.

AT the annual meeting of the Hamilton Street Railway directors, held last month, a dividend was passed. The following officers were elected: W. Gibson, M.P., president; E. Martin, Q.C., vice-president; J. B. Griffith, secretary and manager; the officers named, with B. E. Charlton, W. J. Harris, F. W. Fearman, I. Beer and J. A. Bruce, are the directors.

THE Consolidated Milling Co., of Peterboro, are having their large mills lighted by electricity. The Royal Electric Co. is furnishing the dynamo and material, and J. H. Greer, of Peterboro, is installing the plant. The Consolidated Milling Co. expect to run about 24 hours per day, from which it would appear that they have plenty of business in view.

THE Superintendent of the Government Telegraph Service is engaged in preparing for the extension of telegraph lines from Esquimaux Point, the present easterly terminus of the line on the north shore of the gulf, to Belle Isle. In the course of the next year it is expected to add about 80 miles of line, which will carry the wires as far as Natishquan, 666 miles below Quebec.

THE Bell Telephone Co. recently proceeded against the St. Catharines Electric Light Co. to prevent the latter from using poles so placed as to interfere with the former. The pleading of the Light Company was that it was obliged to place its poles where the city officials directed. The defendants agreed not to use the offending poles in the meantime, and the matter will be settled in the courts.

THE Chateauguay and Northern Railway Company has twelve and a-half miles of electric road in operation from Maisonneuve to Bout de L'Isle, Que., where it now wishes to build a bridge for its railway and for vehicles, in order to extend its road through L'Assomption and Montcalm counties. The cost of the bridge is estimated at $225,000, and the Quebec Government is asked for $50,000.

NOTICE of application has been published in the *B. C. Gazette* for a company to take water from the Lemon Creek and Spring Creek, to obtain 2,000 horse power. Also to take water from the Kootenay River where the C. and K. Railway crosses, to obtain 2,000 horse power; also from Murphy Creek to obtain 3,000 horse power for the purpose of supplying power, light and heat in the West Division of Kootenay and Yale districts.

A NEW telephone system will connect British Columbia and the Northwestern States. The Spokane and Columbia Telephone Company, operating on the United States side of the line, and the Columbia Telephone and Telegraph Company, incorporated under the British Columbia laws, will join and run long distance lines, bringing into touch the Kootenay, Yale and Boundary districts and Washington, Oregon and Idaho. Trail and Rossland will, it is said, both have exchanges.

DICK, KERR & COMPANY, the well-known Scotch engineering and contracting firm, are about to enter the electric railway field in Great Britain, and have appointed W. Rutherford, for the past five years chief engineer of the Canadian General Electric Company, manager of their electrical department. Mr. Rutherford is to be congratulated on the enlarged opportunities which will be afforded him in his new position, for which his experience and ability render him thoroughly qualified. The development of electric traction in England, while hampered up to the present by the traditional conservatism of the old land, seems now likely to proceed with great rapidity under conditions which are otherwise peculiarly favorable, and Canadian electrical engineers must feel a justifiable pride in the fact that one of their number has been selected for such an important and responsible post as that to which Mr. Rutherford has just been appointed.

THE business of the Packard Electric Co., St. Catharines, Ont., has increased so largely this winter that it will be obliged during the coming summer to double its plant for the manufacture of lamps as well as transformers. The business this fall and winter has been 150 per cent. larger than it was a year ago. The transformers have been brought up to the highest state of perfection, and in efficiency, core loss and regulation they are among the best. The Packard company reports the sale of the Scheefer Watt Meters as most satisfactory.

APPLICATION will be made to the next session of the B. C. Legislature for the incorporation of the West Kootenay Power and Light Company, Ltd., and to use water from Sheep Creek for the purpose of supplying power, light and heat within an area of 50 miles from Rossland, also for the incorporation of the Kootenay Power and Light Co., Ltd., to appropriate water from Kootenay and Columbia Rivers for the purpose of supplying power, light and heat, and to operate tramway and telephone systems in the East and West Divisions of Kootenay district.

MAYOR ELLIOTT, of Brantford, is urging on the council of that city to imitate Hamilton in extending electric railway connections to various surburban villages and towns. He has a charter, and his company contemplate a road from Brantford to Ayr, via Paris, and another from Brantford to Port Dover via Simcoe. These roads would bring to the city an important trade, while even in Paris Mr. Elliott has found on the part of the business men no hostility, as they seemed to think the road would bring them from points north at least as great a volume of trade as would be deflected toward this city from the south. It is the intention, when matters are sufficiently far advanced, to ask the city for a bonus.

THE Hamilton and Dundas street railway will soon be operated by electricity, and the "dummy engine" will be a memory of the past, to be hauled out some day as a curious relic. The track is now laid with 65-lb. steel rails and will be trollied early in the spring. From Hamilton to Dundas is the first stage of a line which, in the near future, is to be pushed out to Galt and Berlin. From Dundas to Galt is only about 14 miles, and here the existing Galt, Preston & Hespeler road will be utilized to make the missing link to Berlin from Preston, a distance of 8 miles, so that 22 miles of electric road will complete this chain, uniting Hamilton with a large number of villages. It is quite possible that this will be accomplished, and perhaps even Guelph be reached before the end of 1897.

R. E. T. PRINGLE, Montreal, agent for the Packard Electric Co., Ltd., of St. Catharines, Ont., has recently opened a large store at 216 St James street, Montreal. Besides carrying a full line of Packard lamps, transformers and Scheefer meters, he will also have a complete stock of Phillips' insulated wire, both waterproof and cotton covered magnet wire. Mr. Pringle is also agent for the Toronto Electric Motor Co., and will have a full line of motors on hand constantly. He will handle the well-known supplies made by the Bryant Electric Co., of Bridgeport, Conn., and in fact have everything in stock required by lighting and power installations. Mr Pringle is fortunate in having the best located electrical store in Montreal, and will no doubt largely increase his business.

THE waterworks and electric light systems of the corporation of Sudbury, Ont., were successfully started a few days ago. This is the first municipal corporation in Canada which has installed a strictly up-to-date electric lighting system. They are operating from their alternating current two-phase dynamo furnished by the Royal Electric Co., of Montreal, over 1,000 16-candle power incandescent lamps, 16 arc lamps of the Helios type of 2,000 candle power, each, and a number of small motors, driving printing presses, meat choppers, etc. The power house in which are erected the pumps, as well as the electric light and steam power, is a solid brick structure, 2½ stories high in the main, with a boiler extension, solid stone basement, cement and hardwood floors, and situated close to the lake on property bought for the purpose. The plant consists of two boilers of 60-horse power each, made by a Sherbrooke firm; two Northey duplex pumps, with a capacity of 30 000 gallons per hour; one 125-horse power Wheelock automatic engine, with condenser; one 75 K W "S.K.C." generator, with station apparatus complete. The water is forced by the pumps into a steel tank built on a steel tower, which holds 70,000 gallons. The elevation of the tower gives 82 lbs. pressure at the hydrants, which is ample to put a fire stream over the highest building in the town. The city fathers and the people in general are highly pleased with the entire plant, and much credit is due to the engineers, J. R. Gordon, C.E., and L. V. Rorke, D.L.S., for the first-class manner in which this plant was installed.

THE Brantford Electric and Operating Co. have purchased from the Royal Electric Co., of Montreal, and now have in operation in their station, a 150-K W "S.K.C." two-phase alternating current dynamo. This company had a number of serious misfortunes with its lighting apparatus, and desired a new machine delivered there quickly. The order was given to the Royal Electric Co., of Montreal, on December 5th, at 5 p.m., and on Friday, December 11th, the dynamo was furnishing light to the city of Brantford. It was ready for operation in a little more than five days after the order was given. It was set up in running order in the factory of the Royal Electric Co. in Montreal, had to be dismantled and boxed, shipped to Brantford, and there unboxed and put together again, set on foundations and connected to the old systems. The time of transit was from 6 p.m., Monday, until 12 noon, Thursday. The balance of the time was consumed in dismantling and boxing at Montreal, and unboxing and setting up in Brantford. It is the intention of the Brantford Electric and Operating Co. in future to furnish power from the two-phase system. In this they are following the lead of a number of the best companies in Canada, who have decided that the power transmission of the future would be by polyphase and not direct current. This "S.K.C." dynamo was purchased under the new management of the Brantford Electric and Operating Co.

Marine News.

THE charter of the Wolf Island Ferry at Kingston, Ont., expired January 1st.

STR. "Maple Leaf," Bobcaygeon, Ont., has had her engines and fittings placed in a new hull.

A PROJECT is on foot to erect wharves and other facilities to make St. Andrew's, N.B., a shipping port.

HON J. B. SNOWBALL, of Chatham, N.B., has in course of construction two steamboats suitable for the river trade.

M. M. BOYD & Co., Bobcaygeon, Ont., are building a boat to take the place of the "Esturion," when navigation opens next season.

WM. BAXTER and Potter Bros., of Canning, N.S., are preparing to build next spring a steamer. She is to be 74 feet in length, and is to cost about $6,000.

THE Columbia and Western Railway, it is said, will build two large passenger and freight steamers to run on Robertson and Upper Arrowhead Lakes.

JAMES NEILSON is soon to begin the construction of a steamer for the Anderson Bros., of Burnt Church, N.B. He will have her finished about the first of May.

THE Grand Manan Steamboat Company is considering the purchase of a larger steamer to replace the "Flushing," to accommodate the increasing business of the line.

THE C P R proposes to establish a line of freight steamers between Owen Sound, Ont., and Gladstone, Mich., and will build an elevator and flour sheds at the former port.

THE by-law to authorize the North Vancouver, B.C., council to grant a bonus for the establishment of a ferry between Victoria and North Vancouver, was carried by a majority of 11 votes.

HON L. H. DAVIES, Minister of Marine and Fisheries, is preparing plans for an expedition to Hudson Bay, to examine the resources of the fisheries, etc., and to report on the navigability of those waters.

ROBERT G. REID, the builder of the Newfoundland Railway, has given a contract to a Glasgow firm for the construction of a first-class screw steamer to run between the western terminus of the Newfoundland Railway and Sydney, C.B. The boat, which is to be ready for service next summer, will be 231 feet long, 32 feet beam, and will be able to run from Port aux Basques, Nfld., to Cape Breton in a few hours.

A DESPATCH from Sault Ste. Marie, Mich., states: The traffic during the season which closed December 10, through both canals here, is as follows: Number of vessels, 18,615; in 1895, 17,956; in 1894, 14,491. Number of tons of freight moved, 16,239,121; in 1895, 16,062,580; in 1894, 13,195,680. The movement of grain of all kinds aggregated 90,704,534 bushels, against 54,546,914 bushels in 1895. The Canadian Sault Canal closed on Dec. 10, 5,132 vessels having passed through the lock from May to December. The total tonnage of the vessels was 4,395,156 and the tonnage of the freight carried through the lock 4,577,397.

THE St John, N.B., Board of Trade recently appointed a committee to secure the placing of the routes to St. John upon the various maritime maps and charts from which these routes have hitherto been omitted.

ANGUS A CAMERON, chief engineer of the C.P.R. steamer "Alberta," and Miss Maggie Kenny, daughter of Robert Kenny, chief engineer of the C.P.R. steamer "Manitoba," were married at Owen Sound, on the 23rd of December.

GEO F. BAIRD, of St John, N.B., is building a new boat for the Star Line river service. The steamer "St. Lawrence" has been broken up and portions of her engines will be used in the new boat, while the hull will be converted into a barge. Jas. Fleming is building the new boilers, etc.

THE deep waterways commission of Canada held a joint meeting with the American commissioners in Detroit a few days ago, when reports were exchanged. A vast amount of information on the subject of lake levels and canal navigation was presented, and the Canadian commissioners are preparing their report to the Government, to be presented shortly.

H. & A. ALLAN have let the contract for a 10,000-ton freight steamer. This new vessel will be 470 feet long, 52 feet beam, and will have a depth of 36 feet 6 inches. Her engines will be of 3,000 horse-power, and will drive her at a speed of 12½ knots. She will be a large freight ship, pure and simple, of tremendous carrying capacity, and will be ready by next fall.

THE Steamship Cheronea Company, Ltd., is applying for a New Brunswick charter, to own and sail the "Cheronea." Capital, $160,000; chief place of business, Rothesay, King's county, N.B. The incorporators are: R Thomson, Rothesay; J. H. Thomson, St. John; J. M. Robinson, Rothesay; P. W. Thomson, R. T Leavitt, W. M. Mackay, H. U. Miller, A. W. Lovett, St. John.

THE Willow Beach Harbor Co. applies for incorporation to construct wharves, approaches, etc., at the mouth of the stream known as Twenty Mile Creek, in Lincoln county, Ont., and to own steam vessels. Capital, $50,000. The applicants are: W. Fretz, W G Haynes, E. W Fry, S. H. Rittenhouse, township of Louth, and W B Rittenhouse, township of Clinton, county of Lincoln.

C. F GILDERSLEEVE, general manager of the Richelieu and Ontario Navigation Company, is of the opinion that the period of navigation between Montreal and Quebec can be greatly extended by means of a very powerful, properly-constructed floating ice-breaker of a type similar to those in use at the Strait of Mackinac, with propellers at both ends. By a boat designed especially for the St Lawrence, the river can be kept open two or three weeks later in the fall, and opened two or three weeks earlier in the spring than heretofore. As a consequence of opening it earlier in the spring, the floods due to the ice coming down in the spring would be obviated. An extension of two to four weeks would mean a great deal for the trade of the St. Lawrence.

AT Rockland, Ont., the work of rebuilding the steamer "Mansfield" is now going on. This steamer has been ferrying between New Edinburgh and Gatineau Point, on the Ottawa, and last July was partly burnt. Her dimensions are 112 feet in length, 35 feet beam, and 9 feet in depth, with an average speed of 11 miles an hour. She is a double-ender, having a 4-foot 4-inch screw at each end, connected by one shaft and worked by an engine. When the steamer moves the aft wheel propels, while the forward wheel pulls. The steamer is provided with a rudder and a pilot house at each end, so it is unnecessary to turn the boat around at any time. This style of boat is original with the English ship-builders, and was introduced in Canada by Captain Powers, builder of this boat.

Railway Matters.

IT is believed that the Pontiac & Pacific Ry. will be extended from Aylmer to Hull, Que

THE C.P.R. recently made a record run of 60 miles an hour over a distance of 1,000 miles.

A MOVEMENT is on foot to extend the Quebec & Lake St. John Ry. from Chicoutimi to Ha Ha Bay, some 12 miles.

THE twenty-mile line from Trail, B.C., to Robson will be built by a Butte firm, at a figure slightly over the half million.

THE Fort Francis and Pacific Railway Co. applies for a Dominion charter to build a line from the C.P.R. between Raleigh and Vermilion Stations to Fort Francis, on Rainy River, Ont.

THE Baie de Chaleurs Ry. has been equipped for winter service, and it will, it is said, be operated by the Intercolonial Ry.

THE Canada Southern Ry. is asking for extension of the time in which it may construct some of its uncompleted lines or branches.

THE Quebec Central Railway is raising the grading of the road leading out of Sherbrooke, and raising the Newington bridge four feet.

THE courts have set aside the Toronto by-law assessing the C.P.R. for the costs of sewers, etc., in the King street subway, Toronto.

THE Northern Pacific and Spokane Falls and Northern extension into Rossland, B.C., has been completed and trains are now running regularly.

APPLICATION will be made for a Dominion charter for a railway from Revelstoke along the Columbia River to the junction of the Canoe River.

THE engineers and contractors on the Ottawa, Arnprior & Parry Sound Ry. recently held a banquet in Ottawa to celebrate the completion of the road.

THE C P.R. in connection with the Soo Line, is cutting rates from St Paul to Boston to meet the commission payments of the competing roads in the Traffic Association.

THE Lotbiniere and Megantic Railway Company applies to the Quebec Legislature to change the southern terminus of the railway and to extend the time allowed for construction.

THE by-law for a bonus of $20,000 to the C.P.R. for new shops at Carleton Place, has been carried in that town. It is expected that $40,000 will be spent in buildings in the town by the company this year.

CENTRAL Ontario people are moving to secure a connecting line from Haliburton to Whitney, Ont., about 25 miles, to give the G.T.R. a short line from Toronto to Ottawa by the O., A. & P. S. Ry., competing with the C.P.R.

NOTICE is given by the sheriff of St. Haycinthe that on January 26 the United Counties Railway extending from Iberville to St. Robert, Que., a distance of twenty miles, will be sold on a judgment obtained by the Sisters of the Precious Blood.

THE complications with the Hamilton and Milton toll road, arising from the building of the T. H. & B., has been settled by the Railway Committee of the Privy Council, ordering the payment of $60,000 for all the rights of the toll road, which will become free.

THE interlocking system of switches and signals at the junction of the spur line of the T., H & B with the Grand Trunk, was recently inspected by Government Engineer T. Ridout, Chief Engineer Jos. Hobson, of the Grand Trunk, and Engineer Wingate, of the T., H. & B.

STEHELIN BROS., lumbermen, near Weymouth, N.S., are building a "rail" railroad. The rails are timbers about 8 inches diameter, and the wheels are concave to fit. A similar "rail"-road is operated at Economy by the Bass River Infusorial Earth Co.—*Amherst Press.*

P. GARNEAU, president of the Great Northern Railway of Quebec, has written to the city council of Quebec asking for definite assurance of the city's action with regard to the bonus of $256,000 voted by the city some years ago. He threatens to build car shops wherever the company can secure a bonus, if Quebec does not pay up.

A RECENT dispatch from St. John's, Newfoundland, says: The government is to pay for the Newfoundland railway, which it has purchased, $1,775,000. This amount will be payable in bonds running fifty years and drawing three per cent. interest. The Railway Co., besides handing over its lines to the government, will relinquish all its claims to lands, minerals and timber within the colony.

THE connection between the T., H. & B. and the G.T.R. at Hamilton, Ont., was made on Dec. 16th. Among the prominent men present at the formal opening were: Sir William Van Horne, president of the C.R.R.; President Ledyard of the Michigan Central Railway; General Superintendent E. VanEtten of the New York Central; R. H. L'Hommedieu, general superintendent of the M.C.R.; Thomas Tait, assistant general manager of the C.P.R.; J. W. Leonard, general superintendent of the C.P.R.; Chief Engineer Torey of the M.C R.; Chief Engineer Peterson of the C.P.R.; J. N. Beckley, president of the T., H. & B.

THE management of the G.T.R. have announced the following changes, dating from 1st January. W. R Tiffin, formerly assistant superintendent at London, has been appointed superintendent of the Northern Division, with headquarters at Allandale, in the place of Jas. Webster, who has been assigned to other duties. Mr. Web-

ster has been in the employ of the company for over 20 years. W. A. Ball, up to the present in charge of the erecting shop and round house, Toronto, has been made locomotive foreman at Belleville, in place of W. D. Robb, who goes to London as Assistant Mechanical Superintendent, *vice* A. H Smith, retired, owing to ill-health. W. A. Price has been transferred from Gravenhurst to take charge of the Toronto round-house, while J. McGrath, his leading fitter, will take charge of the erecting shop in place of Mr. Ball. Bryce Stimson, of Montreal, will go to Gravenhurst and fill Mr. Price's old position Robert Patterson, formerly of Toronto, but now at Gorham, has been transferred to Fort Gratiot to take charge of the shops there.

THE survey for a railway route from the foot of Slocan Lake to a connection with the Columbia & Kootenay Railway, just completed, will enable construction to proceed with little delay. This valuable link in the chain connecting the C.P.R. system with the extreme southerly portion of West Kootenay and the proposed Crow's Nest Pass Railway, affording a direct outlet for the lower Slocan territory, deserves more than passing notice. When constructed, this road will be a great factor in promoting the rapid development of the rich prospects in South Slocan and lying along the Slocan River Valley; its length from foot of Slocan Lake to its junction with the Columbia & Kootenay Railway is nearly thirty-two miles—the course of the proposed line following directly along the river valley, which is undoubtedly one of the most beautiful in the province, averaging from one and a half to two and a half miles in width. Well wooded and watered generally, the main mountain chain recedes from the river, leaving a succession of benches, flats and easy slopes. Wherever the rocky ridges abut directly on the waterway on the one side, the opposite bank is flat. In its numberless twistings and doublings the stream presents so many varied aspects of wooded slope, gentle upland, sunny glade and steep declivity, as to afford a perfect kaleidoscope of natural effect.—*B.C. Mining Record.*

Personal.

D D. HANNA, Winnipeg, is general manager of the Dauphin Railway.

JOSEPH UPPER, railway contractor, died at Kingston, December 14th.

GEO. GREIG, formerly manager of the Northern Railway, died last month in Toronto.

J. HARDY, manager of the West Wellington coal mines, Wellington, B.C., has resigned his position.

GEORGE BRUCE, of Petrolea, Ont., has gone to Sumatra to develop the petroleum deposits in that island.

CAMPBELL LECKIE has been appointed engineer in charge of the sewage interception works, Hamilton, Ont.

EDWIN S. FRASER, C.E., has resigned his position as secretary for the Coast Railway Company, Ltd., of Yarmouth, N.S.

JAS. VALLANCE, of Wood, Vallance & Co., wholesale hardware, Hamilton, Ont., has gone to Sandon, B.C., to manage a hardware business.

A. E. EDKINS, inspector for the Boiler Inspection and Insurance Co., is very seriously ill with pneumonia at his home in Toronto.

A. R. WETMORE, chief engineer of the board of works, New Brunswick was recently married at Fredericton, N.B., to Miss Ida Allen, niece of Sir John C. Allen.

HENRY DENSMORE, engineer of Alfred Dickie's steam saw mill, was killed on the railway at Lower Stewiacke, N.S., on the 18th Dec., being run over by the Quebec express.

GEORGE CAMPBELL, manager of the Winnipeg Electric Railway, has resigned. He will be succeeded by Ross McKenzie, formerly of the Niagara Falls Park and River Railway.

THE Court of Appeal recently set aside the decision allowing $487.50 for salary due, and $3,000 damages, to Adolphe Davis, late superintendent of the Montreal water works, on account of the manner in which he was dismissed.

THE last two meetings of the Canadian Society of Civil Engineers have been of a private character, the chief subject of discussion being the question of "Close Corporation." The annual meeting of this society will be held on Tuesday, January 12th, at 10 a.m.

EDWIN HAYNES, director of the *Timber Trades Journal*, London, England, recently spent some time in Canada to write up a series of illustrated articles on the Canadian lumber industry.

C. W. LEE, of the wholesale hardware department of Rice Lewis & Son, Ltd., Toronto, died December 14th from typhoid fever. Deceased was a brother of A. B. Lee, the president of the company.

THE Canadian Marine Engineers' Association, Toronto, commenced its meetings for the season on the evening of the 30th of December, and these meetings will be continued weekly during the winter, Wednesday being the meeting night, and room 72 Confederation Life Building, being the place of meeting The annual election of officers will be held on the 13th inst., when reports will be presented, among which will be that of the committee appointed to make representations to the Government on the question of unlicensed tugs and barges. The rooms of this association will be open to visiting engineers daily from 9 a.m to 6 p.m

THE chief engineer of the Grand Trunk Railway system, Joseph Hobson, Mem. Can Soc. C.E., Inst. C.E., and Am. Soc. C.E., was entertained at luncheon by the Board of Trade and the representative citizens of Hamilton, Ont., on Dec. 26, in Hamilton. An address was read by the president of the Board of Trade, John Hoodless. It had been the intention of the people of Hamilton to express their admiration for Mr. Hobson and their pleasure at his appointment to his present most responsible position by making him recipient of some suitable gift, but Mr. Hobson, with his well known modesty, declined such an honor, and so the testimonial took the form of a banquet and the reading of an address. Readers of THE CANADIAN ENGINEER will remember that a portrait and biographical sketch of Mr. Hobson appeared in the February number of THE CANADIAN ENGINEER of last year.

FIRES OF THE MONTH.

Dec. 2nd.—Buildings of the Pioneer Beet Root Sugar Company, Coaticook, Que No insurance.——Dec. 8th.—The Barron Block of office buildings, St. James st., Montreal Loss $500,000.——Taylor Bros.' saw and shingle mill, Udora, Ont. Loss $1,200.——James McNally's wood-working factory at Aylmer, Ont. partially destroyed. Loss about $2,500.——Dec. 11th.—Goggins' saw-mill at Penobsquis, N.B. Loss about $3,000.——Dec. 12th.—Barthemin & Sons' agricultural implement factory at Sorel, Que. Loss $10,000.——Dec. 15th.—C. D. Fuller's grain elevator and coal sheds at Aylmer, Ont. Loss $8,000, insurance $5,000.——Dec. 17th.—Dry kilns of the British Columbia Cooperage Company at Victoria, B.C. Loss $5,000.——Dec. 17th.—Tug "Metamora," used in the James Playfair & Co. wrecking outfit, Midland, Ont. Loss about $10,000, partly covered by insurance. ——Dec. 17th.—Saw-mill and sash and door factory of E. B. Dolloff, Fitch Bay, Que. The loss about $8,000; covered by insurance ——Dec. 21st.—J. Perkins' foundry, Toronto Loss $11,000; fully insured.——Dec. 23rd.—The waterworks, Laprairie, Que. Loss is $4,000; insured for $1,700.——Dec. 25th.—The coal mines of the Cumberland Coal and Railway Co., Springhill, N.S Extensive fire and heavy damages.

THE NATIONAL GAS ENGINE.

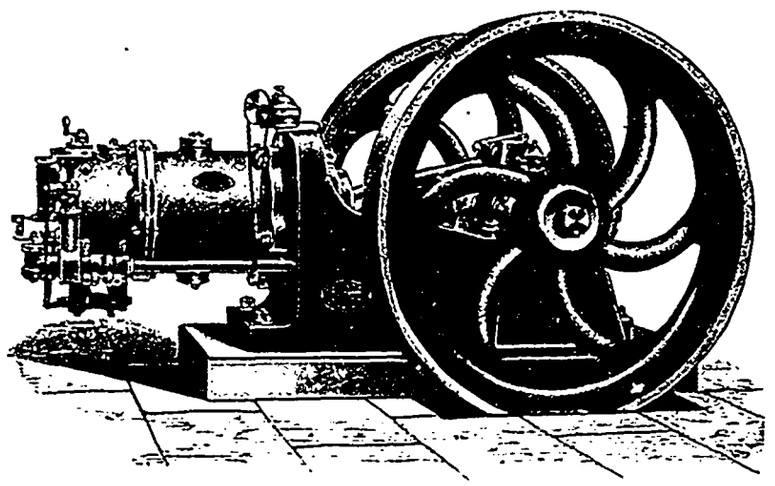
One of the most successful gas engines on the British market is that manufactured by the National Gas Engine Co., of Ashton-Under-Lyne, near Manchester. This is saying a good deal when we consider that the English manufacturers have made greater progress in gas engines and oil engines than those of any other country hitherto. The National Gas Engine Co. manufacture engines not only for electric light installations, but for miscellaneous power purposes and for domestic uses, such, for instance, as operating household machinery, in straw cutting, laundry work, printing presses, elevating, etc. These engines are made for using oil and gas, and are remarkable for their simplicity of construction. The "National Special" is said to be the most noiseless gas engine yet produced. This is a small horizontal engine adapted for any purpose where not more than one and a half actual horse-power is required. It is fitted with a sensitive governor and heavy fly-wheel, and being a high-speed engine, is well suited for small electric installations. This company manufacture several special types of engines, one of which is described by them as follows:—

"This engine is constructed to work with common petroleum oil. In design and workmanship it is similar to the well known 'National' Gas Engine, most sizes being fitted with two fly wheels, solid forged crank, and centrifugal governors, which regulate the supply of oil in accordance with the power required from the en-

gine. The oil used is contained in a tank mounted either on the cylinder, or any convenient position near the engine; it is thus always ready for work.

"The starting of the engine is easily accomplished, the heating of the vaporizer being performed by a special lamp which dispenses with the laborious hand labor usually adopted. The consumption of oil is controlled by the governor, and is strictly in proportion to the work done by the engine. From exhaustive tests made by us with other oil engines, we are convinced that owing to the peculiar construction of our patented vaporizer, the 'National' Oil Engine will work under varying loads with a less consumption of oil than any other make. This engine is started in a few minutes by igniting the starting lamp, which burns without pumping or blowing with a fan, usually adopted with other oil engines.

"Owing to the extreme simplicity in construction of the 'National' Oil Engine, little attention is required after starting. The absence of oil pumps, air pumps, and small spray producers, all of which have hitherto been a source of great annoyance and trouble, make the 'National' Oil Engine a practical machine even in the hands of a very inexperienced attendant, and can safely be shipped to all parts with the ordinary printed instructions, which are issued in duplicate (English and French)"



NATIONAL GAS ENGINE.

The company's head offices are at Ashton-under-Lyne, but they have branch offices in London, Manchester, Nottingham, Liverpool, Leeds, Blackburn, Newport, Aberdeen, Amsterdam, Rotterdam and Sydney, Australia. The company are open to negotiations for the sale or manufacture of their engines in Canada.

PRACTICE WITH SCIENCE.*

In my last presidential address I incidentally mentioned that the motto of the Royal Agricultural Society of England is "Practice with Science." This motto is equally applicable to engineering and most other trades, therefore I concluded it would be a fit subject for this year's address The days of the rule-of-thumb man are over; he simply cannot stand against the thorough business man who has practice and science at his back. Few combine all these qualities, but the prudent man will look around and secure in others what he is short of himself. There is always the difficulty of knowing where to look for the man you require. I mentioned that I had found this society a very good fishing ground, and that I was very content with my little haul, and hoped to come again and often I also mentioned that science alone cannot make an engineer, practice being even more necessary, and that good common sense and tact are as valuable to the engineer as any other quality We find really clever men so wanting in tact that they are everlastingly getting across with people who employ them, and end as failures. We find the scientific engineer designing large engineering works in such a costly fashion that it is impossible to make them pay a dividend on the large capital expenditure necessary to complete them; strictly speaking, such men are also failures.

You will observe I put great stress on practical training. By practical training I do not simply mean learning to chip and file, and the use of various tools. The young engineer, when he is receiving his practical training, must keep his eyes open, and use his powers of observation. He will find very often the same detail in every engine has to be renewed over and over again. There is something wrong about the design, and he ought to make a note of it. When he gets into the drawing-office he will be able to make use of his experience or practice acquired in the works. These same remarks apply to details difficult to machine or erect. Sometimes a very slight alteration in the design would save hours of labor in the works. I have often remarked that engines designed by manufacturing engineers are made at less cost than engines designed by professional men, who have not the practical difficulties of manufacture constantly before their eyes. The manufacturing engineer has the repair-shop always in sight. He notes the parts that fail or are worn out prematurely, and alters his designs accordingly, so that in time he turns out engines that are more durable and less costly to manufacture than engines designed by the man who has less practical experience.

Now I come to the difficult part of my subject. I wish to show you where the purely practical man fails, and where the purely scientific man fails, but as outside influences play an important part in their mistakes, I cannot give you a bald statement of what the practical man did, or what the scientific man would do, without doing an injustice to one or both of them.

I think I can express my ideas best if I put them in the form of fiction based on fact: Chapter I., the practical man; Chapter II, the scientific man; and, if I have time, Chapter, III. will be a short sketch of the man who combines practice with science.

CHAPTER I.

There was a certain manufactory which had been going for nearly a century, and was driven by old low-pressure engines and boilers; these I need not describe. The engines worked smoothly and well, and were handed down from one generation to another.

The proprietors got good prices for their manufactures and made plenty of money, but in time prices got lower, and they had to look round and economize to enable them to compete with newer factories that were fitted with more modern appliances. Their coal bill was rather heavy, their boilers very old, and their engines out of date, so they decided to go in for a new, up-to-date installation of engines and boilers. Other manufacturers were now working with a boiler pressure of 80 lbs. per square inch; one or two had even got up to 120 lbs. The proprietors consulted with their local engineer and millwright, and he advised a pair of horizontal engines, Lancashire boilers to work at 80 lbs, and a Green's economizer with I don't know how many pipes.

Before settling the order, the proprietors had a look at the engines and boilers at several of the more recently built mills in the neighborhood. They found that the engines were mostly fitted with Corliss gear, and some of them compounds, working with a pressure of 120 lbs. per square inch. They were surprised at the small amount of coal used, and astonished to see how steam-tight the boilers were at that high pressure; at the same time the boiler inspector assured them that they were even safer at 120 lbs. than their own boilers were at 20 lbs. In fact, they were quite taken with these boilers, and practically made up their minds there and then to go in for 120-lb. pressure, and save their fuel. They were not so well pleased with the engines. In their eyes they appeared to run much too fast to last long, and the amount of valve gear and the clatter on the high-pressure engine fairly frightened them. They could not help comparing it with their own slow silent engine, which had done so well. They considered that their engineer's bill ran up to a big figure per annum, but if they got an engine with all these traps on, it would surely ruin them.

This engine was compound, and had Corliss gear on the high-pressure side only. The low-pressure side was fitted with slide valve and expansion gear adjustable by hand; they liked the low-pressure engine the best, for it ran so sweet.

After considering matters for a few days, they decided on the firms whom they would ask to tender for the new engine, and the local engineer was included in their list. They considered him a thoroughly practical man, and knew that he had made numbers of engines that were working in a satisfactory manner. He called upon them, and got their opinions on Corliss gear, and they told him their fears. He had never made an engine with Corliss gear and quite agreed with them. He also advised them not to go in for more than 80 lbs. boiler pressure. He then began to turn things over in his mind. He had made a compound engine, but had not got very good results; he had never made an engine so large as this one would be. He would, therefore, require to make all new patterns, and if it was compound there would be two cylinder patterns required, two sets of cylinder covers and slide valve

*Abstract of a presidential address delivered by Henry McLaren before the Yorkshire College Engineering Society.

patterns. The bedplate pattern would require to be altered to suit the low-pressure cylinder In fact there would be a lot more pattern making, and the practical man looks upon pattern making as dead loss All this passed through his mind in less time than it takes me to tell it to you, and he decided to stick to his guns and go for the ordinary double-cylinder engine The proprietors had nothing to say against this only that the engine must be economical; they could not afford to burn more coal than their competitors. He explained to them that he would make the engines long stroke and fit them with automatic expansion gear and work as economically as any engine they could buy. "Automatic" took their fancy. It is a beautiful word, rolls off the end of the tongue so nicely. It finished up by our practical engineer getting the order. His was much the lowest price, and when the engines were finished they were not unsightly There was plenty of cast iron and polish about them, and the governors, with their pillar, were of heroic design. I must give you a short history of the building and running of these engines In the first places, the sizes settled on for the cylinders were much too large, considering the work to be done and the pressure they were to work at. Then drawings were made. You must not suppose that this was one of those places where the master chalks out his designs on the back of the smith shop door The artist who made the drawings got on very well till he came to the automatic expansion gear He could not make up his mind how he would make this. First he struck out for a new design of his own, made wooden models of it. He found it would cut off all right at one end, but all wrong at the other. There he left the valve gear for a week or two, and got out other details of the engine, so that they could be getting on with the work in the shops, and then he had another try at the gear. At last questions on automatic expansion gear appeared week by week in the *Mechanical Hemisphere* or the *Practical Fitter*, under a *nom de plume*, of course. The questioner was referred to pages so and so, in vol so and so, of these valuable journals There was a marked improvement in trade in the reference department of the free library for the next week or two More questions appeared in the journals mentioned, to further elucidate some obscure points, and shortly afterwards the drawings of the automatic expansion gear for the big job appeared in the shops. The expansion valve was on the back of the main valve, and was driven by an eccentric through a rocking link, the governor moving a die up or down the slot, and so varying the point of cut off. Our practical friend now made an important discovery You will remember that one of his reasons for going for non-compound engines was to get both cylinders, etc., alike; he now found he must fit the automatic gear to both cylinders, or he would not be able to govern To do this, he must carry a weigh bar from the governor over to the other engine, and make another set of expansion slides and gear. This at once eclipsed in cost all the saving in pattern-making. I have already stated that there was any amount of metal in the engines but it was not distributed to the best advantage The bedplate was heavy, but not very deep, and the height from the top of the bedplate to the centre line of the engines was considerable. The crankshaft was very strong, and the main bearings very short, their length being cut down as much as possible, so as to get the eccentrics in front of the valve spindles, and thus avoid cranking the rods, etc. The flywheel was grooved for ropes, and when looked at from the side it appeared fairly heavy, but owing to the grooves it came out light for the size of engine, and when the engine ran at its normal speed the bolts that held the two halves of this wheel together were stressed to 19.5 tons per square inch of sectional area at the bottom of the threads At this shop they always used one size of governor for all sizes of engine. They knew exactly the speed to run this governor at, and so long as they had only a throttle valve to work it did fairly well for all sizes Our practical man was no fool, and he knew their old standard governor would be no use for automatic gear, besides, it would look nothing on this size of engine He therefore decided on the new governor of heroic character. He designed it with cross arms, and centre spring, as looking more fashionable and up to date, and had the sense to drive it by gearing from the crankshaft. He had seen sufficient breakdowns caused by governor belts or chains giving way to prevent him from going in for that form of sin. When they got these governors finished, they were rigged up in front of an 8 inch lathe, a temporary pulley belt was fitted on the governor spindle, and the belt was tried on the various cones of the lathe till they found one that about suited the speed. The shop engine was then speeded or slowed a little to suit the exact speed required. When the governors started to lift, they went right up to the top, and when they came down, they dropped right to the bottom. He knew this would not do, so he got new springs, and then altered the weights Then he altered the length of the arms, and by dint of a lot of experimenting, he got them to rise and fall nicely as the speed went up or down. He counted the revolutions at which they started to rise, and also when they were at the top, and arranged his driving wheels accordingly.

On the whole, the engine was designed so that all parts could be machined and erected with facility. There were no touch-and-go clearances about this job The bolts and studs were far enough out from the roots of the flanges, so that the nuts could be screwed down without the necessity of carving a bit out of the corner for each nut, thus saving days of labor in the erecting shop. I need not go further into the details of the design.

In due course it was got to work, and immediately gave trouble. Now, as a rule, if you give the thoroughly practical man all his own way, he will not have much trouble, for he will keep in the beaten track. But in this case the pressure was fixed for him, and it was 50 per cent. more than he was accustomed to work with, and to checkmate the Corliss gear he had been forced into automatic expansion, and these two alterations were the cause of most of his troubles I must mention that he had the ports for the expansion valves wide, and hence the travel of the expansion spindle long. The slot link being short, it had to throw through about 90°, and the dies slipped up and down in the link instead of driving the valves; of course the governors went up and down with the dies, and more resembled a harlequin than a governor of heroic design. Our engineer arranged to fit a dashpot to prevent this nonsense, and the first time they tried the engine they had a run away. He had not allowed for the displacement of the very stout piston-rod of the dashpot, and this prevented the governors from rising. They took some oil out to allow for this, and then the piston lifted the oil and the jumping went on. They saw that a great deal of the trouble was owing to the short link, and debated whether to make new valves, or alter the valve gear and governor. Finally they decided on new valves, and this time they made a number of narrow slits on the back of the main valve, and reduced the travel by carrying the eccentric rod further up the link.

When the steam chest covers were removed to put in the new valves, the port faces were found to be cut in an extraordinary manner, both cylinders alike. The port faces had, therefore, to be refaced before the new valves could be fitted, and then in a few weeks they were as bad as ever. Our practical friend could not understand it. Certainly the pressure was high, but not so high as that carried by locomotives, and they run with ordinary slide valves. He should have known that the two cases are not parallel. With automatic expansion gear there is always boiler pressure in the steam chest, and it is at light loads, when there is little or no counterbalancing pressure in the cylinder, that the valve faces get cut. When the locomotive is running light the regulator is of necessity nearly shut, and the pressure in the steam chest is low, and thus the valve faces are saved.

The fact remains that he found he had got beyond the pressure where it is safe to use ordinary flat valves fitted with automatic expansion gear, and they went on planing port faces till there was little left to plane. They then tried bronze valves. This helped the port faces, but evidently the bronze valves took a good deal more driving, as the valve gear was soon racked up and the governors jumped in a hopeless manner. The main bearings gave any amount of trouble. I have already said that the cylinders were much too large for the work, and the high boiler pressure acting on the large piston area set up initial strains that our practical man had never anticipated. They changed the brasses several times. They only wanted a better mixture to make them happy at this point, but they never found it. The bedplate hogged at every stroke in a most alarming manner. You might have seen the oil pumping out and in between the bedplate and the foundations at every stroke, and the engineman, when he was oiling the slide bars, instinctively kept his toes well clear for fear they might get in between the bed and the foundation. In fact our practical man was having heaps of trouble with this engine, and every week-end he had some half-dozen men overhauling it.

(To be continued)

HEAT.*

BY JAMES GILL, B.A.

It was with some diffidence that we agreed to read this paper before you, knowing, as we do, that you are all practical men and that our knowledge for the most part is but theoretical However, we will go on the assumption that most teachers take, that you know nothing about the subject.

Our first question with regard to heat is, what is it? In past time it was considered a material substance that entered into a body, and by its presence there rendered the body warmer; its absence left the body cold. There was this difficulty, however, in supposing heat to be a material substance, in that the body when warm weighed no more than when cold. Sir Humphrey Davy melted two blocks of ice by rubbing them together, and concluded that heat was not a material substance, but a form of motion. Heat is generally understood at the present time to be due to the motion of the molecules of a body. These molecules are in constant motion, and when their motion is quickened the body becomes warmer; when their motion is retarded the body becomes colder.

In the next place let us enquire into the ways of producing heat. We will place down six ways of obtaining heat:

1st. From *Mechanical Action* as shown in friction. You are all acquainted with the result of rubbing a button of brass on your coat sleeve. It used to be a common trick with school boys to rub the button for some time and then place it on the back of a playmate's hand It had about the same effect as the sun's rays through a lens. Also the savage of the Isles of the Sea was accustomed to produce fire by rubbing two dry sticks together

2nd. *Percussion*—As shown in placing a piece of lead on an anvil and hammering it. It soon becomes quite hot. The lead bullet after striking the metal target is too hot to pick up.

3rd. *Compression*—As shown in placing a piece of tinder in a tube in which a tube moves up and down. The mere shoving of the piston downwards is enough to ignite the tinder.

4th. *Chemical Action*—Wherever chemical action goes on heat results. Pour some sulphuric acid into a vessel of water and then place your hand against the outside, you will find that the vessel is warm. Again the heat in the human body is maintained by chemical action

5th. *Heat from the Electric Current*—If you take several cells and connect for battery purposes, and then hold in your hand the two terminals from the positive and negative poles, you will soon find them too hot to hold. You have no doubt heard of a whole meal being cooked in Ottawa by means of heat obtained from the current.

6th. *Radiant Heat*—As obtained from the sun. The sun radiates heat on all sides, and this is borne to us through the ether which is supposed to fill all space.

The first three of these classes may be placed under the one head of "mechanical action."

Then let us notice the effects of heat applied:

1st *Expansion*—As shown in a bar of metal placed rigidly between two fixed supports and heated. The bar bends and twists out of the straight.

2nd. *Change of State*—As shown in a block of ice to which heat is applied It is first converted into water, and then if sufficient heat be applied, into steam.

3rd *Change of Temperature*—Which we measure by means of the common thermometer.

We would like you to notice here the difference between temperature and quantity of heat A cup of water and a pailful of water may be at the same temperature, but the pailful has the greater quantity of heat because it has the greater amount of mass. Again, we would notice that there is always present a tendency to equalization of temperatures. This takes place in three ways.

1st *Radiation*—If I light a fire in the stove here it soon makes itself felt throughout the room, by radiating heat in all directions.

2nd *Conduction*.—Place in the fire one end of an iron bar and it will not be long before you are unwilling to keep hold of the other end This is due to the molecules of the bar conducting the heat from the end in the fire to the end held in the hand.

3rd. *Connection*.—This is the warming of a room or house by the bodily movement of a heated substance, such as is shown in the warming of buildings by hot air. The air is heated at the furnace and moves bodily from there to the rooms of the building.

Physicists are in the habit of using certain units in which to express amount of heat. One of these units is the amount of heat needed to raise one pound of water through one degree Fahrenheit. By means of these units a relation between heat and work can be expressed. First, a definition of work: If one pound of matter be raised vertically against gravity through one foot, one foot-pound of work is said to be done, or if a body be drawn through one foot against a resistance from friction of one pound, one foot-pound of work is said to be done. It is found from careful experiments that one of the above heat units is equivalent to 772 foot-pounds of work. You are also acquainted with the unit used in expressing rate of doing work, viz., the horse-power. One horse-power is equivalent to 33 000 foot-pounds of work per minute.

Just here we might give the method of finding the horse-power of an engine. Find the area of the piston-head in square inches and multiply by the length of stroke doubled and by the number of revolutions per minute, and also by the pressure in pounds, which product divide by 33,000, and the answer is in horse-power. Thus, if effective pressure of steam be 60 lbs., diameter of piston 14 inches, length of stroke 2½ feet, and revolutions 70 per minute, then the horse-power of engine will equal

$$\frac{(14 \times 14 \times .7854) \times (2\frac{1}{2} \times 2) \times 70 \times 60}{33{,}000}$$

But the all important point with the engineer is the conversion of heat into work. Where heat is applied to water it confers upon the steam which is produced the power of doing the work, such as driving the piston from one end of the cylinder to the other against resistance. For example, the heat energy of the boiler in the engine is transferred into mechanical motion. The steam is admitted to the cylinder, and by means of its expansive force drives the piston to the other end, then by a special movement of slide valves caused by the eccentrics, the steam is allowed in at the other end of cylinder and the piston moves in the other direction, and so the motion is maintained. Work is done by the steam during its admission into the cylinder, and also by expansion after its admission.

Steam in its expansion obeys the well known law of Boyle, viz.: that if the temperature be kept constant the volume of a given body of gas varies inversely as pressure, density and elastic force. If the steam be allowed to enter at full pressure of 80 lbs. for say one-fourth the stroke, and is then cut off, the piston will have to be forced to the other end by the steam working expansively.

What is known as back pressure must be taken into consideration in finding the work done. The back pressure is usually fifteen pounds to the square inch in a non-condensing engine, so that the steam in cylinder must not be allowed to expand so far as to bring its pressure down to that amount. The relation between pressure and volume in a given body of gas may be very easily shown to the eye by a graphic representation by taking horizontal lines to represent volumes and vertical lengths to represent pressure, but it seems to us that you are better acquainted with what is called technically the "indicator diagram" than we are.

Up to this point we have been reasonably sure of our ground; it appears to us that so far as the practical working of a steam engine is concerned, we have more reason to learn from you than you to learn from us.

* Paper read before the Hamilton Branch, Canadian Association of Stationary Engineers.

MODERN OVERHEAD CONSTRUCTION FOR ELECTRIC RAILWAYS.*

BY BENJAMIN WILLARD.

The steel pole presents a neat appearance, and takes up a small amount of space. The insulating qualities are not as good as with the wood pole As to its lasting qualities, I have made some observations on wrought iron columns that have been in the ground for several years, and I am convinced that in a moist climate a limit on the practical life of such poles would not be over 30 years. I believe that from a practical and financial standpoint, wood poles should be used in many instances. Through the business sections of cities steel poles are in some respects better, as they cannot be either wilfully or accidentally mutilated. In suburban or residential districts the wood poles when properly dimensioned answer every purpose, and look fully as well as the steel poles. A heart pine or cedar pole will, if properly selected and kept painted, last in some climates 20 years. This is a known fact from observation of poles that are now in sound condition after having been erected for that length of time.

Suppose we select New Orleans as a suitable location to build a road and base our estimates on cost of material there. The cost of steel poles would be greater than in many northern cities owing to freight rates and distance from the manufacturers of such poles. Wood poles can be furnished for less in New Orleans owing to their near production, so that I think an estimate covering the cost at that point would be a fitting proposition elsewhere. The following

* Abstract of a paper read at the annual convention of the American Street Railway Association at St. Louis.

are estimates for cost of construction in New Orleans, where steel poles cost more and wooden poles less than in northern cities. For one mile of span wire construction 104 steel poles, at $15 each, would cost $1,560, and assuming their life to be 30 years, the interest on the investment for 30 years at 5% per annum would be $2,340, or a total first cost and interest of $3,900 The setting of steel poles necessitates the use of concrete. I estimate the cost of this and the labor of placing it at $4 50 per pole, or $468 per mile, which, with interest for 30 years at 5 per cent per annum, would be $1,170, or a total for interest and first cost of material and labor of $5,070 for the steel poles.

Assuming the life of heart pine poles to be 12 years (instead of 20 years), I will make a comparison on that basis. Such poles for one mile of span wire construction at 104 poles to the mile at $4.50 each, would cost $468, labor and material for erecting, at $2 50 per pole, $260, or a total first cost of $728, to this must be added interest for 30 years at 5 per cent per annum, $1,092, making the first investment at the end of 30 years $1,820. At the expiration of 12 years the construction must be renewed at a cost of $728, and to this must be added interest for 18 years at 5 per cent. per annum, $655 20, making the second investment at the end of 30 years cost $1,383 20 At the expiration of 24 years the construction will be renewed for the third time at a cost of $728, and to this will be added the interest for six years at 5 per cent. per annum, $218.40, making the third investment at the end of 30 years cost $946 40, a grand total for wood pole construction of $4,149.60. The difference between the total costs of steel and wood pole construction for a period of 30 years would be $920.40 per mile, which would be more than a liberal allowance for changing span wires and other work necessary in renewing the wood poles, but assuming it would take this amount we would stand even at the end of 30 years and still have six years more life in the wood pole construction.

If steel span poles are used I would recommend for the average span of 40 feet a pole weighing about 700 lbs., made in two parts. The lower section to be constructed of 6-inch extra heavy standard steel pipe, and the upper section of 5-inch, swaged at the joint for a distance of 18 inches. Such a pole should be 28 feet long, 18 feet for the lower and 10 feet for the upper section, and provided with a cast-iron and wood pole top for the attachment of the span wires There should be a wood filling to fit the bottom of the lower half to prevent it from sinking, and the pole should be set 6 feet in the ground with a rake of 10 inches from the perpendicular to allow for being straightened when under strain. The average size of hole to be dug would be 20 inches in diameter, with a depth of a little over 6 feet, requiring (after the pole is inserted) a mixture of about ½ cubic yard of 1, 2 and 4 Portland cement concrete. The cement should be set at least three days before attaching the span wires Whenever it is practicable, allow poles to bear against the curbing, as it affords an efficient stay for the pole. Otherwise a good sized rock having a bearing surface of about 1 square foot would assist very much, and keep the pressure from cracking the cement

If wood poles are used where it is necessary to provide neat and substantial construction, I would recommend for the average span of 40 feet a long leaf yellow pine pole dressed and chamfered, 30 feet long, sawed square, 11 x 11 inches at the base, and 7 x 7 inches at the point, free from sap, rot or knots, and corners evenly chamfered, 1½ inches, beginning at a point 14 feet from the base, and terminating in an octagonal form and roofed evenly for a space of three inches In setting wood poles where concrete is not used (and I do not consider it necessary) a great deal depends upon the soil encountered In a soil of medium clay, and average condition, poles should be set 6 feet in the ground with a rake of 12 inches from the perpendicular, and the hole should be dug to a vertical depth of 6 feet (or more if necessary to allow the pole to stand a given height above the track), and should be about 2 feet square at the top and not less than 18 inches at the bottom. Where it is practicable, allow poles to bear against the curbing (or paving). Place a substantial bearing at the heel to prevent the pole from pressing through the earth, for this purpose a small quantity of coarse broken stone or brickbats will answer every purpose. Where this is not easily obtainable, and the earth is soft, a piece of plank 12 inches wide by 3 inches thick, 4 feet long, sharpened and driven in the earth to a depth of about 2 feet at the back and base of the pole, will give good results.

Whenever it is necessary to erect poles in the absence of substantial material at the surface, such as paving or curbing, I would recommend that the base of the pole be well rammed with broken rock for a distance of 18 inches, taking pains that the greater quantity is placed at the back where the pressure is greatest and leaving a small quantity in front where no pressure takes place. The space to within 20 inches of the top may be filled with earth taken from the hole and well rammed. To prevent the pole from yielding at the surface a breast plank of oak (or cypress) timber 3 x 12 inches x 6 feet should be placed and spiked in front and at right angles to the pole about 8 inches under the surface of the ground. About 20 inches from the top of the hole and in front of the breast plank should be filled and well rammed with the same material that is used at the base of the pole. The necessary quantity of broken rock required would be about 1-5 cubic yard per pole.

Poles of wood or steel which may be used for holding strains at curves should necessarily be heavier than those used for straight line construction, and should also be set at greater depth in the ground A steel pole for curve construction should be 29 feet long, made of 6-inch and 7-inch extra heavy pipe, the larger section to be 19 feet long and the smaller section to be 10 feet long and made to weigh 1,050 lbs Such poles should be set 7 feet in the ground, and raked 10 inches from the perpendicular in a direction radiating from central point of curve where strain is required. The filling would be the same as specified for straight line iron pole construction. Wood poles for curve construction would be made similar to those specified heretofore for straight line construction, excepting dimensions of such poles should be 31 feet long by 14 x 14 inches at the butt, 9 by 9 inches at the top. Such poles should be set 7 feet in the ground and raked 12 inches from the perpendicular in a direction radiating from the centre of curvature where strain is required The hole should then be entirely filled with about 7-10 cubic yard of broken rock well rammed.

The holes for eye bolts should be bored in wood poles before their erection and the bolt should incline slightly downward towards the eye to prevent the water from following in and rotting the top of the pole. The correct location for eyebolt holes would be determined by the height at which the trolley wire is to be placed; 22 feet from the base of the pole would be correct, assuming that we allow 2 feet for drop in the earbody and ear, and also dip in the span wire would make the height of trolley wire about 20 feet. To facilitate the setting of poles to a uniform height it is a good plan to place grade stakes near the location selected for poles, indicating a given height relative to the grade of the track.

Centre pole construction is required in many locations, but I consider span construction better owing to its flexibility and for being less unsightly. There are now on the market appliances for making bracket suspensions flexible, which are an improvement over the old type of rigid construction. One of the most practical which I am familiar with is an attachment to receive a short span of flexible wire and the ordinary straight line hangers.

Poles used for centre and bracket construction should be made according to the same specifications as those used for span construction, excepting that an ornamental pole top would be required for the steel pole instead of an insulated one. For the bracket arm a 1½ inch pipe of the required length attached to a malleable iron collar made in halves and encircling the pole, and supported by truss rods leading from the end and centre of the arm to near the top, makes an excellent and neat construction.

Wherever guard wires are required it will be necessary to leave about two feet additional space on the top of the pole above where the trolley span wires are attached, for the attachment of the guard wire span It would hardly be practical to provide an insulated pole top for both span wires, so the trolley span would be supported by means of a wrought iron clamp collar encircling the pole at the proper point and provided with suitable insulating fastenings I do not especially approve of this method of construction (as I do not favor guard wires), but I would recommend it where it is compulsory to erect guard wires

All poles should be painted with one coat before their erection, as it affords better opportunities to carefully apply the priming coat and at less expense than after the poles are set. A paint of dark green composed of graphite mixture I find to wear well, and although it costs more than some other paints, it has better lasting qualities (especially in iron work) A second coat of this paint after the poles are erected will cover marred places made necessary in setting, and will look well and last for at least two years.

Span Wires.—Span wires should be of flexible steel, 5-16 in. in