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CONTENTS OF THIS NUMBER:

ERROR IN DRAINAGE PRACTICE.

BY W. M. WATSON.

A person living in a house that was subject to a foul odor reported the nuisance to the town's medical officer, who sent at various times each member of his staff to investigate, and they each laid the blame on the plumbing and sanitary appliances used in the house, but when an experienced sanitary plumber was engaged he looked for another cause to account for the smell, and after using pick and shovel for a few hours, he put on exhibition the reason for the foul odors, which, as usual, was the blocking of the house trap and settlement of the new drains, causing the dumping of the sewage from all the fixtures in the house into the soil under the kitchen.

Another similar, but more serious example of the many hidden dangers, I propose to relate here, showing the evils of using too many drain traps and using drains of too large a size. I was engaged to find out the cause of foul odors pervading the basement of a large factory. There were water closets, urinals and slop sinks on three of the four flats, each and all delivering into one 4-inch soil pipe extending from the drain underneath the floor to above the roof of the factory. Then every fixture was back-vented into a 3-inch cast iron pipe commencing at the basement floor and passing through each story and terminated above the roof. The plumbing and fixtures were of a high class, and well put together, but when some digging was done below the basement floor and the drains and discharge end of the 4-inch soil pipe were exposed to view, it proved that very little, if any, of the stuff coming down the soil pipe had found its way to the street sewer because the careless way the soil pipe was connected to the tile pipe drain made it almost impossible for it to do so, except at a time when there was a heavy rainstorm or when a large amount of liquid was discharged down the interior drains. Fig. 2 is a sketch showing how the drain and soil pipe were connected when found, leaving out the branch that served the basement water closets and which should be shown to join the horizontal piece of soil pipe between the two bends, immediately before it joins the tile pipe. There was a 9-inch tile-pipe drain from the street sewer to about 7 feet inside the building, laid almost at a dead level, including the trap and T pipe, then a 6-inch drain commencing with a hand-hole running trap intended to keep back the sewer gas from all the other parts of the building. This pipe passed under the factory floor for the full length of the factory, with branches to each rain water leader and slop water gully in the yard, having a grade of only about 1 in 100, and clayed joints. The total length of the 6-inch pipe laid under the floor would be over 100 feet, which would be equal to a storage tank holding about 140 gallons. The 9-inch trap would hold about 40 pounds of water, and the water in the T pipe would have to be 1 inch deep before it could in any way move such a bulk of water as rested in the 9-inch trap, and then the liquid only would be able to get round the dip, while the solids would stay in the dip of the trap and choke it. The largest flush a soil pipe would discharge at one time would be 3 gallons, under 30 pounds in weight, and in this case it discharged vertically through a square T, striking the opposite side or bottom of the 9-inch pipe. The sewage then had liberty on account of the drain being level to choose its own road, and of course preferred the easiest, which was to pass backward through the 6-inch trap that only holds about 20 pounds of fluid or half the amount of a 9-inch trap, which would be soon choked and blocked up with solids. The drains being nearly level throughout their whole length they would hold about 50 gallons of sewage in store before a reaction would take place, even if the 9-inch trap was free, and the fluid begin to dribble outwards towards the street sewer. The 50 gallons would therefore generally be lodging in the pipes or wasting away through the defective joints in the sewer pipes and contaminating the sub-soil under the planked floor. The excrements and paper of sewage will, if well distributed among the fluid, dissolve into a liquid in a few days, so that when there is a space, as there was at this factory equal to 50 gallons, acting as a storage and liquefying chamber, they may continue to dispose of the excrements for a number of years through leaking joints and never have a real choke to enable the owners to find out what hidden damage is done to the building and inhabitants. A 4-inch soil pipe can never flush the sewage it delivers through 9-inch pipe traps, because it is about five times larger than the 4-inch soil pipe. The fluid coming down the soil pipe will pass through the largest trap only by soaking through slowly, devoid of any carrying force, which makes it nearly impossible to carry down any substance heavier than water. Therefore to put in a 9-inch

tile trap to serve a 4-inch soil pipe is about the same as plugging up the end of the drain to prevent anything passing through to the street sewer. The 9-inch drain was too large for the work, but it might answer if the soil pipe was made to enter as shown in Fig. 1, and the trap dispensed with, which was unnecessary in this case, and not demanded by any town by-law.

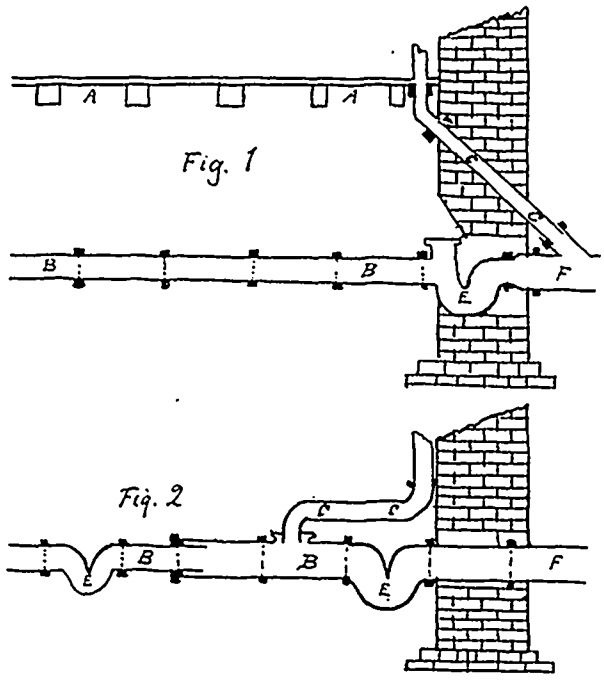


Fig. 1—Plumbing arranged in a satisfactory manner. Fig. 2—Plumbing as actually installed. A A—Factory floor. B B—Tile drain below floor. C C—Soil pipe. E E—Traps. F F—Street drain.

When drains are almost level and in a position as found in this factory, it would be much better and safer to have a reflex flag valve in behind the soil pipe and near the trap, to prevent excrement backing under the factory or the sewage coming back when the flood occurs. No doubt the idea of laying the 9-inch portion of the drain was to leave plenty of room for the contents of the soil pipe when the 6-inch drain was delivering the storm water at full bore, but it was not necessary on that account, because the soil pipe would only deliver occasionally, and then only about three gallons at one time, and that small amount would have very little effect on a stream passing through a 6-inch pipe, and a good rush and flush four times in a year, which is as often as an extra large rain storm comes. When the plumber who did the work, when newly erected, saw the square T junction and 9-inch pipe to connect his 4-inch soil pipe to, he ought to have declined to join the drain in that way. And if his instructions were imperative that the soil pipe should have an intercepting trap and breather, he might have attached a 6-inch, or, better still, a 4-inch hand-hole trap and breather pipe, and after connecting them the pipe might have been coupled to the line of 9-inch drain pipes by a side junction. By making this mistake a large amount of expensive first-class work was rendered dangerous by the error of connecting the soil pipe into the square T junction, and behind a useless 9-inch interception trap, as shown in Fig. 2.

—A correspondent, who is a member of the Canadian Electrical Association, writes to express his admiration of the electrical and mechanical experimental plants at McGill University, Montreal, and to convey the thanks of himself and friends for the courtesy shown by the faculty on the occasion of their visit during the recent convention. Our correspondent was particularly struck with the clearness and simplicity of the answers given by Dr. L. A. Herdt to every question asked by the members when visiting the electrical laboratory. This faculty in Prof. Herdt has struck many others since his connection with McGill. To possess a profound knowledge of a subject and to be able to impart this knowledge in a way that a learner can clearly understand, is a combination of gifts possessed by few. The record which this young professor has already made, both as a practical electrician and an investigator, indicates a most promising future for him, and it should be a peculiar satisfaction to McGill to have a native-born Canadian of such talent at the head of its electrical department.

RESULTS OF EXPERIMENTS ON THE STRENGTH OF WHITE PINE, RED PINE, HEMLOCK AND SPRUCE.*

BY PROF. H. T. BOVEY, LL.D., D.C.L.

In a paper read before the Canadian Society of Civil Engineers, in 1895, the results were given of a number of experiments on the transverse strength of timber beams; but in the calculations it was assumed that the distortion, or diminution of depth at the bearing surface, was sufficiently small to be disregarded. It often happens, however, and especially when the timber contains a large amount of moisture, that the change in depth due to compression is excessive, producing a corresponding increase in the skin-stress. The method of conducting these experiments was fully described in the paper referred to, and therefore the following points only are noted:

All the transverse tests were made with the Wicksteed machine. The middle of the beam was supported on a hardwood bearing of 44 inches diameter. The two ends were forced down by rams under hydraulic pressure, which can be gradually increased at any required rate, or can be maintained constant for any given time. The end-pressures were kept normal to the surface of the beam by means of spherical joints, which allow the end bearings to revolve. In previous experiments, the wire used in observing the deflections was found to be somewhat coarse, and a special wire was therefore drawn of .002-inch diameter.

The flexure theory is admittedly unsatisfactory, and frequently gives results which are contrary to experience. Possibly, when a certain limit has been passed there is a tendency towards equalization of stress, and the so-called neutral surface may be moved towards that portion of the beam which is best able to bear the stress. It may indeed be more correct to assume that the distances of this surface from the tension and compression faces are in the ratio of the ultimate tensile and compressive strengths of the beam. This assumption at all events seems to give results which are more in accordance with practice. For example, in the case of a cast-iron Tee bar, tested in the University Laboratory, the tensile skin-stress should be 22,030 lbs. per sq. inch, and the compressive skin-stress 102,050 lbs. per sq. inch, wheras the ordinary theory gave 33,000 lbs. per sq. inch as the tensile and 20,800 lbs. per sq. inch as the compressive skin-stress.

The following tables give the breaking weights, skin-stresses, (transverse), coefficients of elasticity and specific weights of a number of air-dried, saturated, frozen and kiln-dried beams.

*Extracted from a paper read before the British Association for the Advancement of Science, Toronto, 1897.

Beams 15 and 16 were sawn out of trees felled at Keewatin in 1894, and were received into the Laboratory on the 13th of December, their weights being 415.75 lbs. and 457.78 lbs. respectively. They were both tested on the 2nd of February, 1895, when it was found that beam 15 had lost 36.69 lbs. or 8.8 per cent. of its weight, and that beam 16 had lost 46.59 lbs. or 10.2 per cent. of its weight. When the beams were sawn through after the test they were still found to be completely saturated with water excepting for a depth of 1 inch from the surface. The beams were from the central portion of the trees, the heart running from end to end. Beams 28 to 43 were sawn from trees felled in water, 1893—4, in Quinze Lake Co., P.Q. They remained in water one year, and were received into the Laboratory on October the 4th, 1895. They were all first quality timber, and, generally speaking, straight in grain and free from knots and shakes. In order to determine the excess of moisture in the timber, three slabs, one near the middle and one at each end, were sawn out of the beams immediately after they had been tested and were at once placed in a chamber kept at a temperature of 212° F. by steam-pipes. The moisture was also removed from the whole beams by drying them in the same chamber. Beam 36 failed suddenly under a very small load, the fracture commencing at a knot in the tension surface. On exam-

TABLE I.

White Pine From Ordinary Stock.

No. of Beam.	Dimensions in inches.			Breaking weight in lbs.	Skin stress (f) in lbs. per sq. inch.			Coefficient of elasticity in lbs. per sq. in.	Sp. wt. in lbs. per cub. ft. at date of test.	Per ct. of weight lost when dried at 212 deg. F. at			Character of failure.
	l.	*b.*	*d.*		Max.	Min.	Mean.	*E.*		Centre.	Left end.	R't end.	
15	186	6.225	15.2	23,850	5,021	4,777	4,889	1,296,950	36.43	.....	.....	.....	Crippled.
16	186	6.32	15.25	22,690	4,774	4,480	4,627	1,359,050	38.64	.....	.....	.....	Longitudinal shear.
28	138	9.1	15.21	39,000	4,403	4,018	4,210	1,078,230	27.121	17.29	12.89	13.21	Longitudinal shear.
32	186	6.025	12.25	16,000	5,531	5,153	5,342	1,368,500	27.983	28.262	27.014	27.274	Crippled.
46	186	5.725	5.9	5,200	8,967	7,312	8,389	1,625,220	23.794	.....	.....	.....	Crippled.

TABLE II.

White Pine Dried at 212° F.

36	150	5.95	11.925	.....	2,201	2,164	2,182	1,245,780	22.007	.....	.....	.....	Tensile.
38	75	2.965	5.925	5,000	5,911	5,569	5,740	1,272,440	22.105	.....	.....	.....	Crippled.
42	150	5.7	5.9	8,000	9,538	9,247	9,392	1,282,770	20.674	.....	.....	.....	Tensile.
43	150	6.05	11.725	23,000	9,992	7,091	8,542	1,171,240	22,648	.....	.....	.....	Tensile.

TABLE III.

Red Pine From Ordinary Stock.

No. of Beam.	Dimensions in inches.			Breaking weight in lbs.	Skin stress (f) in lbs. per sq. inch.			Coefficient of elasticity.	Sp. wt. in lbs. per cub. ft. at date of test.	Per ct. of weight lost when dried at 212 deg. F. at			Character of failure.
	l.	*b.*	*d.*		Max.	Min.	Mean.			Centre.	Left end.	R't end.	
17	186	6.15	15.2	21,350	4.531	4,322	4,426	1,252,700	32.279	.....	.....	.....	Crippled.
18	180	5.75	15.0	21,730	4,589	4,466	4,527	1,351,350	.....	.....	.....	.....	Crippled and longitudinal shear.
31	186	5.975	12.275	23,400	7,840	7,469	7,654	1,814,190	35.95	17.38	16.9	12.94	Longitudinal shear.
45	186	6.025	6.025	7,600	10,034	9,871	9,952	2,768,630	37.144	.....	.....	.....	Crippled.
49	188	5.75	14.925	22,700	5,240	5,100	5,170	1,669,010	30,592	8.8	8.7	8.1	Longitudinal shear.

TABLE IV.

Red Pine Dried at 212° F.

37	150	5.75	11.875	21.000	6.160	5,953	6.056	2,049.430	30.072	.....	.....	.....	Longitudinal shear.
41	150	5.885	5.925	8,800	9,572	9,472	9,522	2,261.820	30.858	.....	.....	.....	Tensile.
44	150	5.875	11.785	20,000	5.732	5,617	5,674	2,219.550	34.038	.....	.....	.....	Longitudinal shear.

ination it was also found that the grain on the face was oblique to the neutral surface, while there were shakes running from end to end in the neighborhood of the heart which, on the average, was below the middle of the depth of the beam. The results of this test should be discarded, as the beam was not of fair average quality. Beam 38 was cut out of beam 36 in such manner that the grain was straight.

Beam 43 failed under a breaking load of 23,000 lbs., but a somewhat long continued and slowly increasing deflection under a load of 22,000 lbs. seemed to indicate that at this point the beam failed in compression, although there were no apparent signs of crippling.

TABLE V.

HEMLOCK FROM ORDINARY STOCK.

No. of Beam.	Dimensions in inches. *l.*	*b.*	*d.*	Breaking weight in lbs.	Skin stress (*f*) in lbs. per sq. inch. Max.	Min.	Mean.	Coefficient of elasticity.	Sp. wt. in lbs. per cub. ft.	Per ct. of weight lost when dried at 212 deg. F.			Character of failure.
25	222	8.815	10.1	13,000	5,132	4,995	5,063	1,581,710	53.025	50.43	39.93	47.85	Crippled.
26	186	8.975	10.015	20,000	6,615	6,371	6,493	1,498,640	36.533	......	......	......	Crippled.
29	186	9.85	11.95	20,040	4,133	4,058	4,096	883,291	36.235	34.6	......	......	Tensile.

TABLE VI.

HEMLOCK DRIED AT 212° F.

No. of Beam.	*l.*	*b.*	*d.*	Breaking weight in lbs.	Max.	Min.	Mean.	Coefficient of elasticity.	Sp. wt.	Per ct.			Character of failure.
40	87	4.35	4.925	3,500	7,946	5,054	6,500	1,379,860	31.346	......	......	......	Longitudinal shear.

TABLE VII.

HEMLOCK SATURATED AND FROZEN.

No. of Beam.	*l.*	*b.*	*d.*	Breaking weight in lbs.	Max.	Min.	Mean.	Coefficient of elasticity.	Sp. wt.	Per ct.			Character of failure.
22	138	9.0	11.875	30,800	5,393	5,166	5,280	1,174,700	38.69	......	......	......	Tensile.
23	138	9.025	11.9	21,000	3,482	3,450	3,466	1,242,150	45.23	......	......	......	Tensile.
35	190	9.175	10.05	22,000	7,188	6,960	7,074	1,633,050	50.707	51.07	49.75	57.42	Crippled.

Remarks.—Beams 17 and 18, containing the heart, were cut from trees felled at Keewatin in 1894, and were ordinary 1st-quality timber. There were shakes in beam 17, reaching the heart at points. The grain on the lower half of the beam was straight, but ran cross-wise on the tension surface. From the time the beam was received into the Laboratory to the date of the test, a period of 57 days, the beam lost 13 per cent. of its weight. After the test a 3-inch slab was cut out, and

TABLE VIII.

SPRUCE FROM ORDINARY STOCK.

No. of Beam.	Dimensions in inches *l.*	*b.*	*d.*	Breaking weight in lbs.	Skin stress (f) in lbs. per sq. inch. Max.	Min.	Mean.	Coefficient of elasticity.	Sp. wt. in lbs. per cub. ft. at date of test.	Per ct. of weight lost when dried at 212 deg. F. at Centre.	Left end.	R't end.	Character of failure.
24	222	9.175	10.1125	15,800	6,208	5,846	6,027	1,629,050	32.307	26.7	24.7	27.3	Crippled.
27	186	8.725	10.025	14,600	4,899	4,758	4,829	1,458,360	29.354	......	......	......	Crippled.
30	186	8.725	11.875	15,900	3,758	3,682	3,720	2,020,300	30.603	11.1	......	......	Longitudinal shear.

TABLE IX.

SPRUCE DRIED AT 212° F.

No. of Beam.	*l.*	*b.*	*d.*	Breaking weight in lbs.	Max.	Min.	Mean.	Coefficient of elasticity.	Sp. wt.	Centre.	Left end.	R't end.	Character of failure.
39	78	3.775	4.35	5,800	9,774	9,603	9,689	2,373,080	31.606	......	......	......	Longitudinal shear.

TABLE X.

SPRUCE SATURATED AND FROZEN.

No. of Beam.	*l.*	*b.*	*d.*	Breaking weight in lbs.	Max.	Min.	Mean.	Coefficient of elasticity.	Sp. wt.	Centre.	Left end.	R't end.	Character of failure.
33	186	9.2	10	14,000	7,212	6,887	7,050	2,373,080	39.78	30.618	33.55	......	Crippled.

the weight of this slab on Feb. 15th, 1897, by which time the natural drying can be considered to have been completed, was found to be 28.037 lbs. per cubic foot. Beam 18 was tested after remaining in the Laboratory 42 days, in which time it was found to have lost 8.79 per cent. of its weight. It failed by crippling and longitudinal shear, simultaneously. The grain for about 10 inches

on each side of the centre was clear, straight and free from knots. The logs from which beams 31 to 49 were sawn were felled in the Bonnechere district in the winter of 1894—95, and remained in the water for six months. They all contained the heart, and were ordinary 1st-quality timber. Beam 32 failed by longitudinal shear along a shake in the neighborhood of the neutral surface, but there were indications that this had been immediately preceded by a slight crippling.

Remarks.—Beams 22, 23 and 35, containing the heart, had lain in the water for a considerable time, and were completely water-soaked. When tested, beams 22 and 35 were found to be hard frozen. Beam 23 was also frozen, but not throughout, as was shown when the beam was cut in two at the centre. Beam 22 was straight-grained, free from knots, and failed with a sudden sharp fracture. Incipient decay had commenced near the heart of beam 23, which, however, was regarded as a fair specimen of ordinary commercial quality. It was full of large knots and the grain was curved from end to end. Beam 35 was straight-grained, clear, comparatively free from knots and of exceptionally good quality; beam 40 was cut out of beam 35 after the latter had been tested. Beams 25, 26 and 29 all contained the heart. Beam 25 was a good specimen, and was completely water-soaked. Beam 26 was saturated throughout, excepting for a depth of 1½ inches from surface, and, although an apparently poor specimen, was considered to be of ordinary commercial quality. It was full of knots and its grain was curved.

Remarks.—Beam 24 was wet, but was in good condition and comparatively free from knots. Beam 27 was of ordinary commercial quality, with fairly straight grain and a large number of small knots. Beam 30 was of ordinary commercial quality, but with large shakes running from end to end and dividing the beam practically into four sections. Beam 33 was water-soaked and hard frozen when tested. It was of exceptionally good quality, free from shakes and had clear, straight grain. Beam 39 was cut out of beam 33 after the latter had been tested.

In the transverse experiments the greatest possible care was taken to increase the load at the same uniform rate, the average time occupied in adding each increment and in taking the corresponding reading being slightly greater than 1 minute. In many cases the beam was loaded, then relieved of load, and reloaded again, the readings in all cases being carefully noted. This operation was sometimes repeated more than once. Whenever a beam or a specimen under tension or compression was subjected to repeated loadings, the first series of readings were almost invariably discarded as the increments of deflection, and changes of length were found to be more uniform after the preliminary loading. The initial loading seems to eliminate certain inequalities of resistance.

In beam 15 there was an increment of .401 inches in the deflection, corresponding to an increment of 7,000 lbs. in the load. On reducing the load to 500 lbs., there was an apparent set of .006 inches, which would have undoubtedly disappeared in a short time. Upon reloading the beam, the increment of deflection for the same increment of load was .4 inch. In beam 17 the increments of deflection under the first and second loadings were exactly the same, viz., .415 inch for an increment of 7,000 lbs. in the load. When the load, after the first series of readings, was reduced to 500 lbs, there was an apparent set of .005 inch, which would have certainly disappeared had the beam been allowed to rest for a few minutes. In beam 24 (Spruce), for an increment of 6,000 lbs. in the load, the increment of deflection was 1.04 inch in the first loading and 1.034 inch in the second. Upon being entirely relieved of load, there was an apparent, but evidently only apparent, set of .01 inch. In beam 25 (Hemlock), for an increment of 6,000 lbs. in the load, the increment of deflection was 1.165 inch in the first loading and 1.155 inch in the second, the apparent set when entirely relieved of load being .01 inch. In beam 27 (Spruce), after being loaded and then entirely relieved of load, there was an apparent set of .005, which in two hours had fallen to .002 inch. In beam 26 (Hemlock), after being loaded and then entirely relieved of load, there was an apparent set of .004 inch which had entirely disappeared after an interval of about two hours.

In the case of beam 28 (White Pine), there were three sets of loadings, the increments of deflection corresponding to an increment of 12,000 lbs. in the load being: .238 inch and .234 inch for the first set, .237 inch and .232 inch for the second set, .237 inch and .232 inch and .232 inch for the third set.

When the beam was entirely relieved of load after the first set, there was an apparent set of .002 inch, which had entirely disappeared in 25 minutes. The second set of loadings commenced after an interval of 18 hours. The mean increment of deflection=.2344 inch; the mean compression=.0827 inch, and, using the ordinary formula, the corresponding value of E=1,066,980 lbs.

The increments of deflection for repeated loadings corresponding to an increment of 6,000 lbs. in the load were: .675 inch, .660 inch, .650 inch, for beam 29 (Hemlock), .335 inch, .330 inch, .337 inch for beam 30 (Spruce), .492 inch, .485 inch, .487 inch for beam 31 (Red Pine), .675 inch, .655 inch, .653 inch for beam 32 (White Pine), .313 inch, .308 inch, .305 inch for beam 49 (Red Pine).

The increments of deflection for repeated loadings, corresponding to an increment of 7,000 lbs. in the load, were: .625 inch, .620 inch, .620 inch, .625 inch for beam 33 (Spruce). The increments of deflection for repeated loadings, corresponding to an increment of 5,000 lbs. in the load, were: .590 inch, .556 inch, .555 inch, for beam 35 (Hemlock).

For beams dried at 212° F., the increments of deflection for repeated loadings were: .420 inch, .400 inch, .405 inch, .405 inch, .405 inch for beam, 36 (White Pine), and an increment of 6,000 lbs. .178 inch, .173 inch, .173 inch, for beam 37 (Red Pine), and an increment of 4,000 lbs. .039 inch, .042 inch, .040 inch, .040 inch, for beam 38 (White Pine), and an increment of 300 lbs. .048 inch, .048 inch, .048 inch, .049 inch for beam 39 (Spruce), and an increment of 300 lbs. .071 inch, .070 inch, .070 inch, .070 inch for beam 40 (Hemlock), and an increment of 300 lbs. .363 inch, .358 inch, .358 inch, .363 inch for beam 41 (Red Pine), and an increment of 1,200 lbs. .669 inch, .672 inch, .675 inch for beam 42 (White Pine), and an increment of 1,200 lbs. .411 inch, .416 inch, .408 inch, .402 inch for beam 43 (White Pine), and an increment of 6,000 lbs. .243 inch, .240 inch, .238 inch, .241 inch for beam 44 (Red Pine), and an increment of 6,000 lbs.

From these results and from the further observa-

tions up to the point of fracture, the following inferences may be at once drawn: (a) The increment of deflection diminishes and therefore the coefficient of elasticity increases with the elimination of the moisture from the beam. (b) The increments of deflection are much more uniform in amount in the case of kiln-dried beams.

It is, of course, impossible to maintain a beam in a kiln-dried state As soon as it is exposed to the atmosphere, it at once commences to absorb moisture, and the absorption continues until there is an equilibrium between the hygrometric conditions of the beam and atmosphere. The beam is then in its normal state, and the experiments indicate that the increments of deflection, corresponding to this state, are approximately uniform. The rate of absorption depends essentially upon the nature of the timber, and proceeds more slowly as the density increases. The weight of a central 2-inch slab of beam 30 (Spruce), increased 3.6 per cent. in 24 days, and 8.5 per cent. in 47 days. The influence of moisture on the deflection of a beam was well illustrated in the case of 15 inch x 6 inch Douglas fir beam on 186 inch centres. On June 15th, 1895, it was placed in position and was loaded with a weight of 1,000 lbs. at the centre, producing a deflection of .071 inch. The daily observations, extending over several months, showed a continually increasing deflection, until, by the evaporation of the moisture, the beam had attained its normal state. The average deflection now remained constant, varying, for example, between .09 inch on August 24th, and .082 inch on September 2nd, the greater deflection of course corresponding to an increase of moisture in the atmosphere. On the 4th of September, the load was increased to 2,000 lbs., which produced a deflection of .127 inch. This load remained on the beam until January 8th, 1896, the deflection during the same period varying between .129 inch and .114 inch.

Of 20 non-kiln dried beams, 11 failed by crippling on the compression side, 6 failed by longitudinal shear, and 3 hemlock beams only failed by the fracture on the tension side. The experiments on the direct tensile and compressive strength of the timbers show that this is precisely what might be expected to take place. In every case the direct tensile strength is very much greater than the direct compressive strength, and failure by crippling is likely to take place under a load much less than the material could bear in tension. Under all circumstances, therefore, in practice, it is advisable to place a beam so that the portion of the timber which is strongest and in the best condition should be in compression Again, the experiments conclusively show that kiln-drying enormously increases the direct compressive strength, but greatly diminishes the shearing strength, while the direct tensile strength does not appear to be much affected, although in the majority of cases it was diminished, and sometimes considerably. The large increase of strength in compression due to kiln-drying might have been naturally expected, as in the process of drying the walls of the cells are stiffened and hardened, and thus become better able to resist a compressive force. The walls, however, are at the same time much more brittle, and it is possible that a sudden blow might cause the failure of a kiln-dried column, which would have remained uninjured had the moisture not been eliminated. It may also be of interest to note that in the re-tests of specimens after the injured portion had been removed, the compressive strength was, almost without exception, increased. Hence, by kiln-drying a beam its compressive strength is made to approximate more closely to its tensile strength, and its transverse strength is consequently sometimes considerably increased. It must be remembered, however, that this kiln-drying invariably largely diminishes the shearing strength, and therefore proportionately increases the tendency to shear longitudinally. Thus, of the nine kiln-dried beams in the preceding tables, only one failed by crippling while four failed by fracture on the tensile side and four failed by longitudinal shear. Indeed, generally speaking, kiln-dried beams will fail either by a tensile fracture or by a longitudinal shear, and this result has been further verified by experiments subsequent to those referred to in the present paper.

In practice, of course, beams cannot be maintained in a kiln-dried state, but they rapidly pass into the normal state. The question of how far it is desirable to eliminate the moisture depends essentially on the balance to be maintained between the tensile, shearing and compressive strengths, and a beam should always be placed so as to exert its relative strength to the best advantage. Kiln-drying, unless some special method of prevention is adopted, develops shakes in the timber and causes existing shakes to become more pronounced. Some of these shakes often extend to a great depth and run the whole length of the beam, so that it not infrequently happens that only a slight layer is left to hold the beam together. Such a beam, although otherwise sound and clear, offers very little resistance to longitudinal shear, and might more justly be regarded as being made up of two or more superposed beams.

When this paper was read by Prof. Bovey before the Canadian Society of Civil Engineers, the following discussion ensued:

Prof. Bovey replying to a question stated that the direct tensile strength of timber is much greater in every case than the direct compressive strength, for instance, if 10 represented the tensile strength, 5 would represent the compressive, and for that reason, as his experiments showed, it was always best and safer to put the best side of the timber in compression.

Mr. Peterson replied that while Prof. Bovey's tests indicated that the failure usually took place on the compression side he found that in actual practice the timber invariably failed on the tension side, therefore, he maintained, the direct compressive strength of timber is greater than the direct tensile strength.

Prof. Smith said incipient failure having occurred on the compressive side the neutral axis shifts its position and throws an additional strain in tension.

Prof. Bovey.—A beam which had apparently failed on the tension side, had in reality been first weakened by crippling in compression (which is not always visible), and this threw an additional strain on the tension side, which thereupon ruptured first. No two pieces of timber give the same results, they vary greatly, e g, if you can cut a piece of timber into three parts longitudinally you will find they vary largely, as far as strength is concerned.

Mr. Irwin pointed out that after a timber had failed the part injured in compression would return so as to escape observation easily, whereas an actual rupture gradually took place on the tension side.

Mr Peterson said, speaking of bridge trusses, that he had never known the top chord to fail, and that it was not nearly so liable to do so as the bottom chord, therefore it does not coincide with the experiment made.

Prof. Bovey replied that the cases of a bridge truss and a beam of timber were not parallel, and that the top chord of a bridge truss was subject to direct compressive strains very different to those in a beam under the load.

Mr Duggan remarked that a bridge truss never failed in the solid, but only in the joints, these being the weakest points.

PROGRESS OF CALCIUM CARBIDE.

The manufacture of calcium carbide has been making steady and rapid progress during the past year, and it is satisfactory to note that as the discoverer of the first commercially successful method of production is a Canadian, Canada now takes the lead in its manufacture. In our issues of January, 1896, February, 1897, and January, 1898, as well as in other numbers, historical and technical descriptions were given of the manufacture of calcium carbide and its product, acetylene gas, along with a biographical sketch of the discoverer, Thomas L. Willson, now head of the Willson Carbide Works Company, of St. Catharines and Merritton. A visit of a representative of this journal to the works at Merritton shows that the manufacture of carbide has greatly developed since our last report. There are now three power stations, producing a total of 1,500 h.p. and operating six furnaces, which are running night and day. The export of calcium carbide from these works had last year risen to $22,000, but this year the output will be $50,000, and it only requires sufficiently large factories to multiply this production by ten. That Mr. Willson has always had a most complete faith in the future of acetylene may be inferred not only from what has appeared in these columns from time to time, but from the fact that he ventured an outlay of $250,000 when as yet the character of the public reception of acetylene was a problem. It is no longer a problem, however, for Canadian calcium carbide is now being shipped to the remotest ends of the earth. On the day our representative called a shipment was being made to Hong Kong and another to Shanghai, while just before that a large shipment had gone to South Africa. Two carloads per month now go regularly to New Zealand, while three shipments had been made to the Klondyke, and an offer had just been received from Dawson City for 100 tons to be forwarded immediately. A single firm in Manitoba takes 42 tons per month. The consumption is increasing in each province of Canada and little by little the insurance companies have yielded up the prejudices that existed before the character of acetylene gas became so well known. Recently the Underwriters' Association of Toronto abolished the extra premium of 10 per cent. which had been charged against users of acetylene gas. One remarkable recent development in this gas is its extensive use for bicycle lamps. For use in this line of lighting alone three car loads were recently ordered by one Canadian firm, and this consignment was expected to be exhausted in two months. In Toronto, where cyclists are not compelled to carry lamps at night, there is comparatively small consumption for this purpose, but in Montreal, where the city by laws require each wheelman to carry a lamp at night, the popularity of the acetylene bicycle lamps is remarkable. The contrast between an acetylene and oil lamp is very striking. The oil lamp, which is only used by about one out of five in Montreal, makes a very dismal gleam by the side of the acetylene gas lamp. Four ounces of carbide will last seven hours in a bicycle lamp, the carbide being retailed at 25 cents for a 2½ pound can. The cost varies from ¼ a cent. to 1 cent per hour, and apart from the brilliancy of the light a charge will last much longer than a charge in an oil lamp. Some very convenient students' lamps are now being put on the market for acetylene, while its use for domestic lighting generally is steadily increasing. We have before referred to the fact that the explosive power of acetylene gas in gas engines is much greater than that of oil or gas. While of ordinary gas 18 to 20 cubic feet are required to produce a horse-power, the same power can be obtained from 5 cubic feet of acetylene gas. Acetylene therefore yields about four times the power of other gas. To put the question in another shape. a great saving of space and weight can be gained by the use of acetylene gas engines, and for light power these engines can be built so small as to be practically noiseless, As compared with coal a given power can be obtained from about one-seventh of the weight of carbide. That is to say, where about seven pounds of coal are required per horse-power, one pound only will be needed of carbide, a pound of the carbide producing five cubic feet of gas. The explosions from acetylene are quicker than from coal gas or oil, and consequently greater speed can be obtained. Our readers may be interested to know that the Union Carbide Company of Chicago have bought the plants at Niagara Falls, at Sault Ste. Marie, Michigan, and in Virginia, the united company being capitalized at $6,000,000 or $8,000,000. Large developments are in consideration in Canada, also, and at Grand Mere, in the Province of Quebec, a water-power capable of yielding 100,000 horse-power has been acquired to extend this interesting industry. The promoters have unlimited capital at their back, among those interested being William McKenzie, the well-known capitalist of Toronto.

ASSOCIATED PLUMBERS' CONVENTION.

The second meeting of the National Association of Master Plumbers of Canada was held at Quebec on June 29th and two following days, Joseph Wright, of Bennett & Wright, Ltd., being in the chair. By carefully reading the reports of the officers and committees and the minutes of the business done during the three days' deliberations of the association, the public will come to the conclusion that its interests appear to be taken into scant account. The published reports show that the chief aim of the meeting of the association and the previous executive meetings was to create a monopoly in the trade for the benefit of the members and to make rigid rules which would bring all the trade into line with the combination. There is a total absence in the asociation's discussions and the officers' reports of subjects touching on improved sanitary methods and scientific plumbing, heating or gas fitting.

If the proceedings of the Associated Master Plumbers of Canada, so far as made known, be a sample of the treatment the public may expect at their hands, then we must accept the association as a combination in restraint of trade, whose aim is to increase its members' profits at the expense of the public liberty and purse. It is quite legitimate and even commendable for trades and business men to associate together, and combine their influence, knowledge, and advice, to protect themselves and to exchange ideas with each other with a view to raising the standard of the trade and improving the class of work and remuneration, but when associations make it their business to interfere with the liberties of others and damage private enterprise by using their combined strength to compel others to adopt their views, rulings and methods of working, or retire from business, it is quite time that the public should make its voice heard in the discussion. The report leads us to believe that this association intends if possible to secure Acts of Parliament and by-laws in every town that will enforce the Master Plumbers' Association's dictatorship on the population of this country, which is already sufficiently ruled and regulated. The city of Toronto appears to be the birthplace of the association, and during the past few years we have been able to note

how such a monopoly works, and therefore gather some idea of what may result when the association fully develops and its rules are enforced by the Legislature. When the Toronto association was only a few months old, and standing alone, it persuaded the Toronto city council to embody some of its ideas in by-laws, and no person was permitted to commence or carry on the business of master plumber or do a job of plumbing work on his own account, except he passed the Toronto Board of Plumbers' examinations and had an established place of business. The board consisted of Joseph Wright, W. J. Burroughs, master plumbers, and E. J. Lennox, city architect. This body has also the privilege of saying who was qualified to fill the appointment of inspector of plumbers' work and enforce the city by-laws. It will be obvious that such extensive powers in the hands of business men require the most judicious and conscientious exercise, and that even then friction would be occasioned. The journeymen were to be examined also, but a strike made it impossible to carry this out and the idea was dropped.

Some difficulty has been experienced in enforcing the Toronto by-law, and in some cases the city has failed to secure convictions under it, though there was no doubt that the defendants were not licensed and were carrying on business as plumbers. We find by the reports of the Quebec meeting that the difficulty in compelling all plumbers to enter the combination is about to be overcome in another way. The manufacturers of plumbers', gas and steam fitters' supplies must act in harmony with the Master Plumbers' Association of Canada and agree to sell goods at manufacturers' prices only to members of the association. This will practically prevent anyone doing business who can not or will not join the combine, because he will not be able to secure the necessary material at trade prices. We may also expect that in time the license fee will be advanced to an amount that will prevent anyone but a capitalist paying it, and thus prevent those who have served an apprenticeship, but are not fortunate enough to possess the money to pay the license fee, from taking the advantage of their years of education and work. We have also observed the great difference in the two tenders for the plumbing and heating of the new city hall, Toronto, the one being made at the time the other contracts were let, and the other accepted a few years after, when the Toronto Master Plumbers' Association had had time to get its members into line.

WHO IS "EXPERT"?

I notice in your last issue that John McDougall, the agent for the International Sewage Purification Co., demands my name. It is Henry Lee McKinstry, born at Armagh, Ireland, my father being a land owner there and medical health officer for the district. I, myself, was formerly a traveler in England representing a wine manufacturing syndicate, and I came to Canada a few years ago with the intention of learning the habits and customs of the people, and the value of the land, the products, minerals, etc. I hear and secure considerable information on many important subjects and know probably more about sewage purification and the international system than Mr McDougall does himself, and I am prepared to prove every word spoken in the letter complained of, and to discuss sewage purification with Mr. McDougall in any public hall, after November 15th, when I propose to make a long stay in Toronto, and allow the audience to say by show of hands whether Mr McDougall or myself is the most competent person to judge such an important subject. I have no interest in any sewage scheme in this or any other country, or desire to interfere with any private or public business, nor am I acquainted with Mr. McDougall or any other agent, but when I became acquainted with all the facts of Mr. McDougall's offer made to a special committee of Toronto City Council on March 17 last, I thought I was only doing right, with the experience and knowledge I possessed of the subject in England, to say a few words that would help the public to judge intelligently for themselves in Canada. Being a British subject and living until lately on the tight little islands of England and Ireland, I naturally supposed that the general public of a British colony possessed certain lawful rights of criticism, and that when a drummer made an offer to sell goods to the representatives who had to pay the bills, that the public or any single individual might point to errors, or discuss the value of goods or systems offered to the public without being threatened by the vendors or their agents. I suppose Mr. McDougall will bring Chas. G. Horetzsky, C. E., to task in the same way for the letters he has published in the London, Ont., Advertiser on the same subject. I think it is now time that Mr. McDougall and his principals proved at least one-tenth of the statements which they make in their printed pamphlets about the efficiency of their systems now working in Great Britain, and any Canadian municipality that wishes to protect the health and interests of its constituents should at least have wisdom enough to send an experienced and disinterested person to England to investigate a system upon which it proposes to spend thousands of dollars. It is now in Mr. McDougall's power to prove to the public and the press whether he or I am the biggest coward, and whether the system which he is pushing is an efficient purification system or a financial success.

H. L. McKINSTRY.

Toronto, July 20th.

NEWFOUNDLAND COAL.

Very favorable accounts have been received from the new coal mines near Grand Lake, Newfoundland, now being opened and worked under the Reid contract. Extensive borings have been made on three of the seams resulting most satisfactorily, the quality of the coal being excellent, and the thickness of the seams increasing. The Imperial Institute, in a circular recently issued, furnishes the results of an analysis of this coal. A small sample, about three ounces, had been sent to the institute from the 6 feet seam for analysis. The circular states that the coal was found to be bright, clean and tough, presenting an irregular conchoidal fracture, and the following results on analysis:—

Fixed carbon	47 19
Ash	10 82
Coke	58 01
Volatile matter	41 99
Sulphur	735
Calorific value	6347

The sample caked fairly well, furnishing a coherent, somewhat brittle, coke. The ash is nearly white. This will probably prove to be a good heating coal of fair quality, containing very little sulphur, though rather a low proportion of fixed carbon.

Number two sample from 2½ feet seam weighed about two ounces The coal was dull, rather brittle, but clean and not dusty. The analytical results were as follows:—

Fixed carbon	49 32
Ash	13 05
Coke	62 37
Volatile matter	37.63
Sulphur	62
Calorific value	6435.

The coal burns slowly and cakes fairly well, furnishing a somewhat brittle coke. The ash is gray. This coal closely resembled the former sample It must be remembered, too, that these are almost surface specimens and the coal is likely to improve as the mine deepens. Should the coal seams develop according to expectations it is needless to say that the benefit to the colony will be immense.

—In a lecture before the London Chamber of Commerce, Wm. Ogilvie spoke very plainly about the way in which his name and his reports had been used by promoters for their own ends. He said. "My name has been quoted pretty prominently in a great many prospectuses, and I have been made to say a good many things that I have never said at all. I simply say this as a warning: Do not pay the slightest attention to any extracts from my reports. They may be correct quotations, but they are often misleading I have no interest in any company; my sole object is to benefit my own country, Canada, and the Empire of which it is a portion."

MINERAL PRODUCTION OF THE UNITED STATES IN 1897–8.

(PRELIMINARY STATEMENT.)

Compiled for THE MINERAL INDUSTRY, Vol. VI.

By Richard P. Rothwell, editor of the *Engineering and Mining Journal*.

Num'b	Products	Customary Measures.	1896. Quantity. Customary Measures.	1896. Quantity. Metric Tons.	1896. Value at Place of Production. Totals.	1896. Value at Place of Production. Per M. Ton.	1897. Quantity. Customary Measures.	1897. Quantity. Metric Tons.	1897. Value at Place of Production. Totals.	1897. Value at Place of Production. Per M. Ton.
	NON-METALLIC.									
	Abrasives:									
1	Carborundum	Sh. T.	595	539	$365,612	$680.68	621	563	$163,812	$290.87
2	Corundum	Sh. T.	250	227	35,000	154.19	230	209	32,200	154 07
3	Crushed steel	Sh. T.	350	296	50,624	171.00	324	294	51,894	176.60
4	Diatom. earth	Sh. T.	3,540	3,211	34,300	10 65	3,000	2,721	30,400	11 17
5	Emery	Sh. T.	1,550	1,406	108,500	77.17	1,500	1,361	105,000	77.15
6	Garnet	Sh. T.	2,440	2,214	85,400	38.57	2,200	2,000	70,100	38 57
7	Grindstones	Sh. T.	31,300	28,396	291,338	10.36	30,651	33,250	366,075	11.00
8	Pumice	Sh. T.	*Nil.*	....	....	....	1,700	1,542	8,500	5.51
9	Quartz crystal	Sh. T.	6,000	5,432	16,500	3.04	6,000	5,432	16,500	3 04
10	Tripoli	Sh. T.	1,405	1,275	4,824	3.70	1,631	1,479	5,475	3.70
11	Whetstones	....	....	....	105,201	....	....	....	80,220	....
12	Alum	Sh. T.	14,000	12,782	422,700	33 07	15,450	14,021	463,680	32 07
13	Aluminum sulphate	Sh. T.	42,210	38,319	1,056,000	27.56	46,355	42,053	1,158,875	27.56
14	Ammonium sulphate	Sh. T.	257	233	10,280	....	3,111	2,822	124,440	....
15	Asbestos	Sh. T.	716	650	12,070	19.49	770	698	15,400	22.06
16	Asphalt	Sh. T.	20,414	18,519	362,590	19.58	27,397	24,854	486,620	19.58
17	Asphaltic limestone	Sh. T.	5,000	4,536	55,000	12.12	2,390	2,168	11,450	5 28
18	Bitumin's sandstone	Sh. T.	51,956	47,134	132,500	2 81	41,185	37,363	125,555	3.36
19	Barytes	Sh. T.	21,000	19,867	87,600	4.41	27,310	24,781	109,264	4.41
20	Bauxite	L. T.	17,096	17,369	42,740	2 46	20,590	20,919	41,180	1.97
21	Borax (crude)	Sh. T.	13,330	12,084	266,400	22.04	19,400	17,599	388,000	22.05
22	Bromine	Lb.	559,295	253	143,074	*j*0 57	487,140	221	136,402	*j*0 62
23	Calcium carbide	Sh. T.	800	780	48,000	61.54	1,025	1,746	134,750	77.17
24	Cement, nat. hydraul	Bbls *a*	7,407,311	1,007,980	4,385,962	4.35	7,781,377	1,058,868	4,127,124	3.90
25	Cement, Portland	Bbls *b*	1,577,393	286,181	2,502,479	8.74	2,272,071	412,405	3,578,889	....
26	Cement, slag	Bbls *c*	*Nil.*	....	....	....	40,000	6,350	60,000	9 45
27	Chrome ore	L. T.	702	718	7,775	10.90	50	51	520	10.78
28	Clay products	Sh. T.	....	....	65,000,000	....	....	....	90,000,000	....
29	Coal, anthracite	Sh. T.	48,183,930	42,667,101	86,082,749	2.03	52,045,133	47,710,035	85,857,717	1 79
30	Coal, bituminous	Sh. T.	139,168,659	126,525,967	113,401,602	0.89	147,557,699	133,764,599	120,505,382	0 89
31	Coal, cannel	Sh. T.	51,691	46,588	140,191	2.05	56,511	51,267	153,145	2.98
32	Coke	Sh. T.	10,360,015	9,400,770	17,311,823	1.84	12,742,340	11,563,678	23,367,870	2 02
33	Cobalt oxide	Lb.	12,825	5,817	17,314	*j*2.98	10,300	4,754	32,810	*j* 3.75
34	Copperas	Sh. T.	11,170	10,133	52,662	5.19	11,924	10,818	56,565	5.29
35	Copper sulphate	Lb.	48,732,840	22,150	1,053,225	48.18	51,012,945	23,139	2,040,518	....
36	Feldspar	L. T.	24,907	25,305	124,251	4.91	20,900	21,234	118,773	5.36
37	Fluorspar	Sh. T.	6,000	5,432	48,000	8 83	9,025	8,187	74,456	9.09
38	Fullers' earth	Sh. T.	11,320	10,275	68,470	6 66	17,049	15,467	91,654	5.93
39	Grahamite (*k*)	Sh. T.	1,282	1,163	38,460	33.07	1,756	1,592	52,680	33 09
40	Graphite, crystalline	Lb.	405,000	*j*183,709	18,225	*j*.10	993,138	*j*450,487	44,691	*j*.10
41	Graphite, amorphous	Sh. T.	574	520	3,850	7.40	1,200	1,090	11,400	10 45
42	Gypsum	Sh. T.	195,533	177,405	563,136	3.20	223,061	202,360	711,952	3 52
43	Iron ore	L. T.	16,000,056	16,256,057	31,200,889	1.93	18,316,967	18,610,038	31,138,841	1.67
44	Litharge	Sh. T.	6,500	5,895	510,300	91 57	9,900	8,981	899,100	100.11
45	Magnesite	Sh. T.	2,067	1,877	9,715	5.12	1,907	1,730	7,628	4.41
46	Manganese ore	L. T.	162,526	165,121	339,083	2 05	156,787	159,296	332,700	2.09
47	Mica, ground	Sh. T.	570	517	9,687	18.73	2,092	2,442	38,218	15 65
48	Mica, sheet	Lb.	17,630	*j*7,995	12,528	*j*1.57	92,335	*j*41,883	45,015	*j* 1.09
49	Mineral wool	Sh. T.	5,853	5,309	61,014	11.60	5,607	5,141	45,491	8.81
50	Monazite	Lb.	17,500	8	875	109.37	40,000	18	2,000	111.11
51	Natural gas	....	....	....	10,000,000	....	....	....	10,000,000	....
52	Paints, metallic	Sh. T.	31,865	28,908	342,167	11.15	36,293	32,925	370,594	11.26
53	Paints, ocher, etc.	Sh. T.	17,835	16,179	178,703	11.03	11,151	10,116	110,165	10 89
54	Paints, venetian red	Sh. T.	5,998	5,309	93,585	17.62	4,596	4,169	55,630	10.96
55	Paints, white, red ld.	Sh. T.	95,955	87,049	7,868,310	90.39	103,225	93,654	9,291,150	99.21
56	Paints, zinc oxide	Sh. T.	15,563	14,391	1,189,728	82.67	26,262	23,825	2,100,960	88.18
57	Petroleum (crude)	Bbls *d*	55,254,705	7,730 425	65,753,206	8.50	56,985,643	7,972,579	44,801,962	5.62
58	Phosphate rock	L. T.	2,937,370	952,370	2,812,116	2.95	906,080	920 577	2,718,240	2.95
59	Precious stones	....	....	....	200,000	....	....	....	101,000	....
60	Pyrites	L. T.	109,228	111,030	222,060	2.03	128,468	130,523	370,699	2.83
61	Salt	Bbls *e*	15,707,008	1,995,017	5,328,320	2 67	13,153,524	1,670,592	4,859,364	2.91
62	Silica, sand & quartz	L. T.	720,356	731,925	1,076,038	1.47	750,000	762,000	1,125,000	1.48
63	Slate, roofing	Sq'es.	699,100	....	2,200,862	*n*3.23	805,372	....	2,695,580	*n*3.01
64	Slate, manufactures	....	....	....	407,578	....	....	....	547,645	....
65	Soapstone	Sh. T.	11,340	13,018	143,500	11.02	18,074	17,213	169,740	10 91
66	Soda, natural	Sh. T.	3,000	2,722	65,000	23.88	5,000	4,536	110,000	24 25
67	Soda, manufactured	M. T.	....	157,475	3,621,925	23.00	....	277,072	5,774,656	20.84
68	Stone, for building	....	....	....	30,529,804	....	....	....	30,000,000	....
69	Stone, limestone flux	L. T.	3,794,17	3,854,882	1,669,437	0.43	4,247,688	4,316,651	1,868,983	0.43
70	Strontium sulphate	Sh. T.	*Nil*	....	....	....	40	36	200	5 55
71	Sulphur	L. T.	3,80	3,861	72,200	18.70	1,690	1,717	34,814	20.27
72	Sulphuric acid	Sh. T.	1,019,50	924,885	17,331,517	18.74	1,128,741	1,023,987	21,446,079	19.19
73	Talc, common	Sh. T.	7,0 8	6,439	63,585	9 87	9,563	8,675	82,705	9 54
74	Talc, fibrous	Sh. T.	51,810	47,007	250,080	5.45	58,826	53,370	288,185	5.39
75	Uranium ore	Sh. T.	*Nil.*	....	....	....	17	15	9,010	600.66
76	Zinc ore, exported	L. T.	2,32.	2,361	47,408	20.08	9,251	9,399	211,350	22.48
77	Est. prod. unspecified	....	....	....	5,000,000	....	....	....	5,000,000	....
	Total non-metals	....	....	....	484,999,136	....	....	....	481,642,497	....
	METALS.									
78	Aluminum	Lb.	1,800,000	*j*589,676	$530,000	*j*$0.85	4,000,000	*j*1,814,400	$1,400,000	*j*$0.77
79	Antimony	Lb.	1,226,000	556	84,717	152.37	1,500,000	680	107,250	157.72
80	Copper (*m*)	Lb.	479,800,188	217,632	51,003,337	234.35	510,150,719	231,421	56,325,055	243.39
81	Gold	Oz. *f*	2,538,433	*j*79,576	52,888,209	*j*664.60	2,864,576	*j*89,662	59,210,795	664 60
82	Iron, pig	L. T.	8,623,127	8,761,097	91,577,610	10.45	9,662,640	9,807,123	92,077,312	9.45
83	Iridium	Oz.	....	....	....	....	20.23	....	605	....
84	Lead, value at N Y	Sh. T.	174,592	158,479	10,411,643	54 07	197,718	179,368	11,784,093	65.73
85	Nickel	Lb.	17,170	*j*7,788	4,464	*j*0.57	33,700	*j*15,286	11,668	*j*0.76
86	Platinum	Oz. *f*	200	*j*6 21	2,800	450 89	200	*j*6.21	3,000	482 89
87	Quicksilver	Flksg	29,863	1,036	1,104,997	1066.58	26,079	905	991,002	1096.94
88	Silver, comm'l value	Oz. *f*	58,488,810	*j*1,819,208	39,245,992	*j*21.58	56,457,292	*j*1,756,004	33,765,815	19.22
89	Zinc	Sh. T.	77,637	70,492	6,117,706	86 86	100,357	91,070	8,271,889	90.83
	Total metals	....	....	....	252,059,625	....	....	....	264,538,485	....
	Grand totals	....	....	....	737,958,761	....	....	....	746,230,982	....

(*a*) Barrels of 300 lb., (*b*) 100 lb., (*c*) 200 lb., (*d*) 42 gal., (*e*) 280 lb. (*f*) Troy ounces. (*g*) Flasks of 76½ lb. (*h*) Bituminous coal includes brown coal and lignite. The anthracite production is the total for Pennsylvania, Arkansas, and Colorado. (*j*) Estimated. (*j*) Kilograms or per Kilogram. (*k*) Including bitumen from Texas. (*m*) The value of the copper production is calculated at 0.25c per lb. less than the average price of Lake copper at New York. (*n*) Value per square. (*p*) Value per cubic foot. (*q*) This figure is only approximate and will be revised.

Abbreviations: Sh. T., short tons (2,000 lb.); L. T., long tons (2,240 lb.); M. T., metric tons (2204.6 lb.); Sq'es, squares (100 sq. ft., lapped and laid).

UNITED STATES MINERAL PRODUCTION IN 1897.

We give in the accompanying table the completed statistics of the production of minerals and metals in the United States, as collected and arranged for Volume VI. of "The Mineral Industry," which is now in press. The total value of the mineral production of the United States in 1897 was, therefore, $746,230,982, against $737,958,761 in 1896. The values given are generally at the mine or works; but with a few of the principal metals—such as lead, copper or zinc—this is not possible, and their values are taken at the leading markets. The total value of the output in 1896 exceeded that of the mineral and metal production of all continental Europe, and nearly doubled that of the United Kingdom, the value of whose mineral output in 1896 was, in round figures, about $340,000,000, while that of Germany was about $300,000,000, that of France about $110,000,000, and that of Belgium $100,000,000.

Deducting necessary duplications, we find that the total value of the production of the United States in 1897 reached the sum of $678,966,644.

This output is limited entirely to ores and other substances mined in the United States and to metals reduced from those ores. In addition there was also a large quantity of metals reduced or refined in the United States from imported ores or base bullion. These are chiefly sent here for treatment from Canada and Mexico. The total production of this class reported was 584,983 ozs. gold, 40,218,776 ozs. silver, 26,938,254 lbs. copper, 4,099,390 lbs. nickel, 92,117 short tons lead, the total value of these metals being $47,127,174. This output of metallurgical works is altogether additional to that recorded in the table. These metals were obtained chiefly from ore, bullion, furnace products and silver-lead imported from Mexico, Newfoundland and Canada. A comparatively small amount of gold and silver ore and bullion comes from Central and South America. Also there was received a large amount of pyrites from Spain and Portugal, all of which contains a little copper. From British Columbia and Mexico came chiefly lead-bearing ore and silver-lead, from which a large part of our lead supply is obtained. The nickel is all from ores or matte produced by the mines at Sudbury, Ont. We have not included in the above quantities the iron smelted from foreign ores, which is small in actual amount and insignificant in comparison with the total output; nor have we included the manganese in foreign ores which enters into the composition of the spiegeleisen and ferro-manganese that is made in the United States. The lead industry is the one most affected by the foreign material that is imported, the quantity of copper being comparatively small.

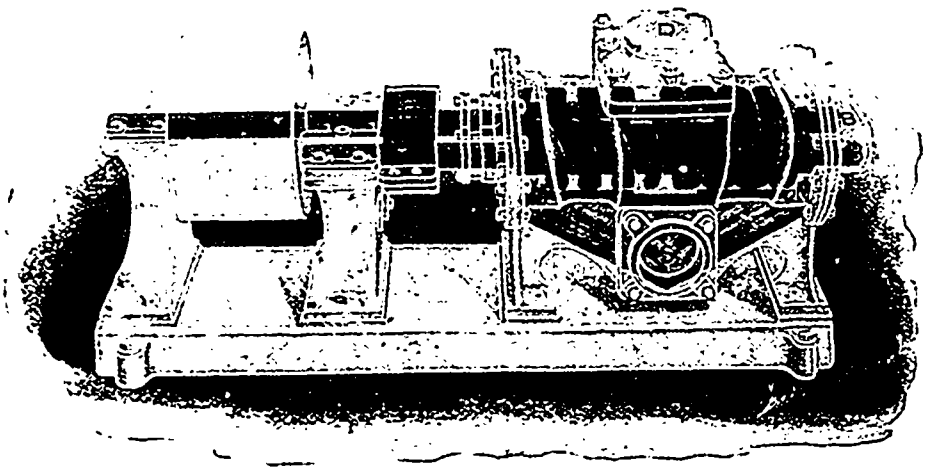
We have given the production of the different articles in metric tons (or kilograms in the case of precious metals), as well as the customary measures, for the reason that the metric measures are those recognized and used by almost all of the civilized world, and are rapidly gaining recognition in the few remaining countries which have not yet fully adopted them. In the United States they are already legalized, with the prospect of their compulsory and exclusive use at an early date. How desirable such a change will be can be best appreciated by those who have had occasion to collect or use statistics of this kind.

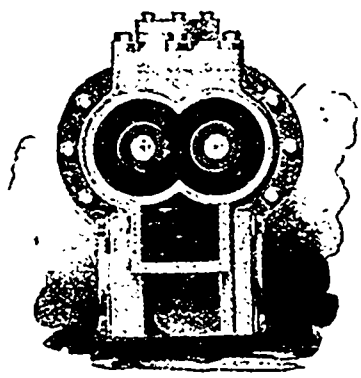
THE QUIMBY SCREW PUMP.

By W. T. Bonner, Montreal.

The novel feature of the pump is its simplicity, utilizing as it does a very simple mechanical principle in a very unusual manner for performing useful work.

As will be noticed by an inspection of the accompanying illustrations, the Quimby pump consists of two parallel shafts, on which are mounted the four screws that act as pistons in propelling the water, so arranged that in each pair the thread of one screw projects to the bottom of the space between the threads of the opposite screws. The screw threads have flat faces and peculiarly undercut sides, the width of the face and the base of the thread being one-half the pitch. The pump cylinder fits the perimeters of the threads, as shown in figure 2. Space enough is left between the screws and the cylinder and between the faces of the intermeshing threads to allow a close running fit without actual contact. There is no end thrust of the screws in their bearings, because the back pressure of the column of liquid is delivered to the middle of the cylinder, and the endwise pressure upon the screws in one direction is exactly counterbalanced by a like pressure in the opposite direction. The suction connection is shown at S in Fig. 1, and opens into a chamber underneath the pump cylinder. The power to drive the pump is applied to one of the shafts, and the second shaft is driven by means of a pair of gears, shown at G in Fig. 1. The pump has no internal packing, no valves, and no small moving parts.

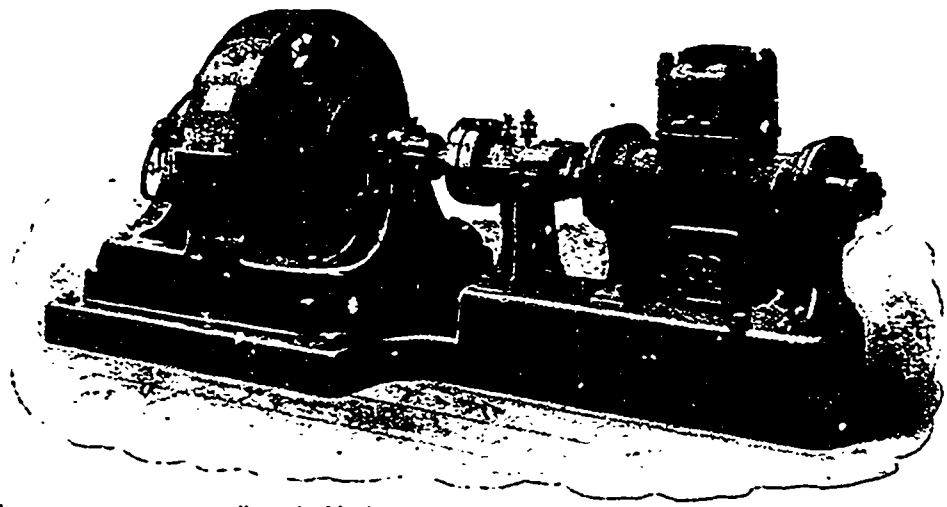




The Quimby electric pump is especially valuable in connection with the hydro-electric operation of elevators. When used in connection with the pressure tank system, the suction is connected with the elevator discharge tank, the pump discharging into the pressure tank. The pump is controlled by means of a pressure regulator and starting box. When the pressure in the tank falls, the regulator operates the starting box and the pump runs until the pressure has been restored in the tank to the required number of pounds. By the peculiar construction of the Quimby pumps there is no pulsation. When used in connection with the gravity system, the pump section is connected with the lower discharge tank, and the discharge from the pump is elevated into the roof tank. The pump is controlled by means of a float in the discharge tank, and a starting box.

The Quimby electric pump, when applied to an elevator, can be automatically operated, thus doing away with the constant care and attention required by a steam pump. Whether operated by belt or direct connected to electric motors or steam engines, the Quimby pump has many advantages. For waterworks, oil refineries, or other service where liquids are pumped through long pipe lines, any pulsation in the delivery adds to the difficulty of maintaining tight joints. The Quimby pump, however, has an absolutely pulseless delivery, and at the same time a very high efficiency. Long series of tests show an average efficiency of more than 55 per cent. from wire to water. In many instances tests have shown as high as 65 or 66 per cent. efficiency.

The pump will readily handle thick products, such as paraffine, hot tar, pitch, white lead, melted sugar, glucose, soap, lard, etc. For this service, reciprocating pumps are not desirable, for the reason that heavy liquids are likely to be churned by the action of the plungers, and the friction of the material passing through the valves and ports, greatly reduces the capacity and efficiency. Altogether the Quimby pump appears to offer a wider range for the utilization of electric power than any other apparatus presented for some time past and in a field also where cost of installation and operation are both very important factors.



*Extract from a paper read before the Canadian Electrical Association.

W. Edmonds, contractor, has begun the brick work of the addition to McDougall's foundry, Galt, Ont.

The output from the Chicoutimi, Que., pulp mills is to be exported from Quebec, a steamer being loaded every second week.

The Brockville, Ont., city council has purchased a site for the factory of the Brockville Provision and Packing Company. Plans and specifications are being prepared by Montreal and Chicago experts, and an extensive plant including first-class cold storage facilities will be installed.

THE STEAM END.*

BY JAMES MILNE.

In a paper read at a former convention of this association, it was stated that purchasers of electrical apparatus made very careful enquiries as to the efficiency of same, the price being of secondary importance. If this applies to the electrical, why should it not apply to the steam end as well? I am sure that there are very few plants where the proprietors, or those in charge, enquire as to the efficiency of the boilers and engines, the price with these items being the very first consideration, generally. It is very seldom, in specifications for steam plants, that there is anything said about the efficiency of the boilers, or the water consumption per horse-power at the engine. This I consider one of the most important points in connection with the steam plant. There are engines running which are supposed to be first-class and up to date, where the water consumption per horse-power is nearly double what it ought to be, and if the management in some of these plants would go to the trouble of calculating the coal consumption per electrical horse-power at the bus, I am of the opinion that the results obtained would simply astonish them. I, myself, have records of the coal consumption of a plant, together with the total meter readings, extending over a number of years, and allowing for the loss on the line, together with that on the generators, and although the plant was a non-condensing one, yet the records there are not out of the way. In another plant where I was making a two days' test as to the relative values of coal, I found the coal consumption per E. H. P. at the bus just double the former plant, which might be considered high by some. This second plant was condensing. The load was of such a nature as to make the engine very unsuitable for the work.

I am inclined to think that builders of engines should be made to guarantee a certain steam consumption per indicated h.p. at say 25 per cent. over-load, full load and half load, and that tests should be made to determine if the guarantee has been fulfilled. If the guarantee has been more than fulfilled, let a bonus be given to the builders, and if not fulfilled, so much to be deducted for every 1 per cent. below the guarantee; and if it falls below a certain amount, that is to say, the steam consumption exceeds a certain fixed value, the engine to be removed, or the builders to accept a nominal figure for same. I think if means of this kind were adopted we would get engines of a very high order. Engineers, as a rule, are content so long as they get a fine looking card from their engine, but they very seldom from these cards calculate the steam consumption, which is of vital interest. We have quite a large number of good engine builders in the country, but the number guaranteeing their efficiency is very limited indeed; in fact, I am not aware of any. If tenders are invited for a certain style of engine and the tenderers are called upon to guarantee the steam consumption per B. H. P., the party to receive the contract is the one guaranteeing the least steam consumption per h.p. hour, the cost being of secondary importance. After the engine has been installed and run for some time so as to get down to its proper bearing, carefully conducted tests should be made to ascertain if the guarantee has been fulfilled.

The matter of efficiency of boilers is also one of great importance, but it is not so easily arrived at, owing to the difference in coal. At the same time, however, it would not be a very difficult matter to fix on a certain coal for a standard, and to guarantee so many pounds of water evaporated per lb. of that coal. All boilers, I believe, should be sold by the Centennial Standard, and should be capable of developing their rating with easy firing, showing good work with ordinary coal, and should be capable of being forced 50 per cent. above their rating. There was a recommendation something to this effect made by the Committee of Judges at the Centennial Exhibition, the horse power being 34½ lbs. from and at 212 degrees, which is equivalent to 33,305 heat units. We should get an efficiency close on to 80 degrees with good boilers, and this could be roughly determined with anthracite coal, and if we get 12 lbs. of water evaporating from and at 212 degrees, we have approximately this efficiency, the heating value of the combustible being about 14,500 heat units, which is equivalent to 15 lbs. evaporated from and at 212 degrees, therefore 80 per cent of this gives us 12 lbs. With bituminous coals we have not such uniformity, and it is necessary to determine its heating value either by the coal calorimeter or chemical analysis.

After our boilers and engines are installed, we have to face the problem of running them. It has often been stated that men could be got to do anything, men being more easily replaced than machinery, costing practically nothing as it were. I am of the opinion that this is wrong. Cheap men are numerous we know, but are in the long run very expensive. Good men are scarce, and nowhere is this more noticeable than in the boiler room. Good firemen are very scarce, coal shovellers numerous. In my humble estimation, credit is not given to the firemen that should be. If a plant is run fairly economically as far as coal consumption is concerned, the engineer is more apt to get this credit, but as a matter of fact all he does is to turn on the steam and see that the bearings are oiled. Now and again he may walk into the boiler room to ascertain if the fireman is asleep or not. To have good firing the greatest of skill has to be manifested to get the best results from the coal, and where we are dependent on skill to get first-class results we are depending on a very uncertain quantity. Too much latitude is given the fireman in the matter of coal, and he has it in his power to make or lose nearly a dividend for the company that employs him. Attention is being given to this subject by the largest steam users in the country, whereby the duties of the fireman are being greatly relieved by mechanical devices; their action being positive and not dependent on skill, the machines thus taking the place of the brains of the fireman. This you will agree is a great step in advance, and makes central station management very independent regarding firemen.

*A paper read before the Canadian Electrical Association.

IMPULSE WATER WHEELS.*

BY J. T. FARMER, M.A.E.

(Concluded)

II.—Nozzle .7532 in. diameter. (a) Pressure 75 lbs. per sq. inch. Equivalent head = 175 feet. Discharge = 120 gallons per minute.

Speed.	Horse Power.	Efficiency.
402	3.68	58.5
501	4.10	65.0
618	4.34	68.8
675	4.34	68.9
750	4.33	68.7
770	4.30	67.7

(b) Pressure 100 lbs. per sq. inch. Equivalent head = 235 feet. Discharge = 138 gallons per minute.

Speed.	Horse Power.	Efficiency.
370	4.82	49.4
371	4.86	50.0
475	5.67	58.4
515	5.95	60.7
588	6.20	63.9
654	6.60	67.8
698	6.66	68.6
756	6.88	70.8
815	6.72	69.3
911	6.35	65.6

In connection with the above results it is interesting and important to notice that the highest actual efficiency appears at a speed which is about .9 of that which theoretically should give the maximum efficiency.

A most important difference between an impulse water wheel and a turbine of either the impulse or pressure type is that the construction of the latter allows a larger area of water to be applied to the wheel for the same dimensions of wheel. In the turbine the wetted surfaces bear a much larger proportion to the size of the wheel than in an impulse wheel, and those surfaces in the turbine are constantly in action, while in the impulse wheel their action is intermittent. When the head of water is small a correspondingly large quantity has to be used to give a required horse-power, and in this case the turbine has the advantage of passing a much larger quantity than the impulse wheel. When the head is very large this feature of the turbine becomes a disadvantage, as it becomes a difficult

*From a Paper read before the Canadian Society of Civil Engineers.

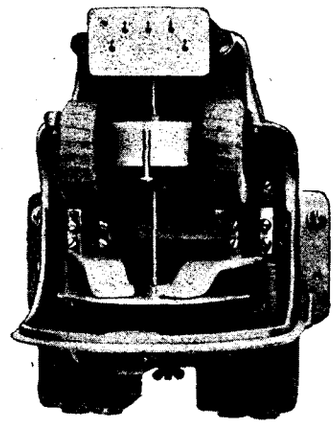
problem to curtail the total discharge of water so that the total power developed may be handled without mechanical inconvenience by the working parts of the motor.

In order to develop considerable power, with a comparatively small head using an impulse wheel, one of two things must be done: either the area of the nozzle and consequently that of the vanes must be made very large, which is only practicable to a limited extent, or else the number of nozzles and wheels must be multiplied. Thus the use of impulse wheels under small heads involves a large amount of machinery for the power obtained. On the other hand, the impulse wheel has many points in its favor, chief among which is its simplicity of construction, which leads directly to the absence of mishaps and to ease of maintenance. The bearings are simple, being merely those on the horizontal shaft, in such a position as to be easily got at when necessary to make any repairs or adjustments. There are no bearings running under water; and the bearings are not subject to any other reaction than that due to the useful effect of the water on the wheel; no difficulty is met with corresponding to that of balancing the static pressure of the water on a turbine, which becomes such an important problem when large heads are being used. The impulse wheel has no water-tight joints, as there is no water pressure to be maintained among the working parts. The mechanism also does not contain any parts which are likely to work loose or otherwise become deranged and so lead to trouble.

An important point in determining the practical usefulness of water motors is their adaptability to be run with a fair degree of efficiency under a fraction of the full load. This state of things is generally liable to occur either intermittently, as where a number of loads are being continually put on and off the mechanism driven by the motor; or periodically, as where for portions of a day or week or year the work required from the motor is heavier than at other times. Three methods will be mentioned which are employed to vary the output of work from the wheel. It was mentioned that three nozzle tips of different sizes were supplied with the wheel with which the tests were made. By changing these the quantity of water discharged under a given pressure can be varied as the area of the orifice. The power of the jet will consequently vary in the same ratio; and so any change of load which can be anticipated and will last for a considerable period can be provided for. The changing of the nozzle tips need not be a very difficult operation. It is, however, a very inconvenient plan to have to resort to to regulate the output of power from the wheel. These wheels are sometimes built with several nozzles placed at intervals round the periphery of the wheel. When this is the case the power can be reduced by shutting off the stream from one or more of the nozzles. The third method is to employ a valve or gate in the supply pipe which can be shut off to any desired extent by hand or by some automatic regulating machinery. This method is almost always necessarily employed in addition to those aforementioned. It will be noticed that the effect of the valve to reduce the power is reached by throttling the water as it passes the gate, thus reducing the pressure of the water as it reaches the orifice and consequently reducing also the discharge. It need hardly be pointed out that there is a great loss of efficiency when the motor is running under a light load, as the pressure energy which is not required to drive the machine is all absorbed without useful effect in the resistance of the partially closed valve. An idea of the actual efficiency reached can be gained from a consideration of the foregoing results, obtained for the small nozzle, for the range of heads from 120 to 300 feet. In calculating the efficiencies previously given, the available work was calculated on the assumption that the pressure under which the test was made was the total pressure available. But if that pressure is not the total available pressure as when the pressure is reduced by throttling from 125 to 100 or 75 lbs. per sq. in., then the total available work must be considered to be the product of the weight of water used and the head equivalent to the total available pressure before any throttling took place. In the preceding remarks an attempt has been made to describe and discuss the action of impulse water wheels, and more particularly of the wheel on which the experiments described were carried out; the question of efficiency has been illustrated and examined, and the advantages and disadvantages connected with the use of such a system have been pointed out. It is hoped that these notes may throw some light on this interesting and important subject.

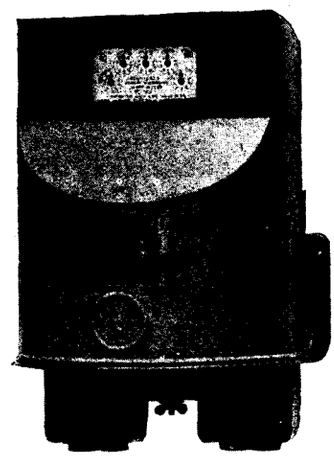
DUNCAN INTEGRATING WATT METER.

This instrument embodies all the essential points that go to make it perfect in every respect. Its operation, like the lamp and ampere hour meters made by the Fort Wayne Electric Corporation and which are giving such good satisfaction, depends upon the induction principle, so that it is very simply constructed and entirely free from any commutator, brushes or other rubbing contacts. It is also the lightest and most compact induction watt meter on the market, so that it is very easily handled and installed. It also has an accuracy on all loads that is excelled by none. When once standardized it will remain accurate for years, this being due to the permanent



magnets forming part of the retarding device being artificially aged by a new process. Another feature that readily recommends it, is a variable friction compensator with which it is equipped. This is something entirely new and provides for cases where the meter should run slow on one lamp after being installed some time, due to the jewel becoming rough. This is a complaint so familiar to the users of electric meters that it does not require to be dwelt upon here. Suffice it to say, however, it does the work and does it well, and without interfering or modifying the speed on any of the other loads. This meter is also applicable to systems having a varying rate of alternations due to uneven speed of the motive power, registering with extreme accuracy.

The principal elements employed in its construction are: Series coils that are mounted upon a laminated iron core which forms the greater portion of the magnetic circuit; an aluminum closed conductor or armature in the form of an inverted cup; and a shunt or volt coil mounted inside the said aluminum armature. The series coils are traversed by the main currents supplying the lamps or other translating devices, and magnetize the iron core in proportion to the amount of current through them. The volt coil is traversed by a current proportional to the electromotive force of the circuit, and is caused to lag



behind the pressure by the addition of an impedence coil connected in series with it. This lagging or difference of phase between the magnetisms of the series and shunt coils causes them to combine into a common resultant which rotates the aluminum armature with a torque proportional to the watts. To make the speed correct and reliable, an aluminum disc is mounted upon the spindle with the armature and rotated be-

tween the poles of permanent magnets, the resulting action of which gives a speed exactly proportional to the watts or energy passing through the meter. The meter is made by the Fort Wayne Electric Corporation. One of these instruments is being presented to the electrical department of McGill University by the Fort Wayne Electric Corporation. It is a 10-light, 60-cycles, 125 volts kilowatt hour meter.

THE IMPORTANCE OF PROPER METHODS OF ILLUMINATION.*

BY F. A. BOWMAN, A. I. E. E., NEW GLASGOW, N. S.

In the last few years, since the electricity supply business has got beyond the stage of "systems" and controlling patents, there has been accumulated a great deal of most valuable information in regard to improvements in the generating and distributing plant, and to the best methods of realizing in practice the benefits from these improvements. From time to time there have arisen most animated discussions on the best system of rates, and methods of charging for the use of the current. The keynote of these discussions is the fact, brought to light by the accumulated experience of those companies that have been supplying electricity for some years, that the fixed charges grow steadily with the maximum demand on the plant, and that therefore the customers should be educated to use the current as many hours per day as possible. This is a matter of the most vital importance, and every central station man in this association should procure a copy of Mr. Arthur Wright's paper on "The Profitable Extension of Electricity Supply Stations," read before the National Electric Light Association at Niagara last year, and also one on the "Cost of Electricity Supply," read by him before the Municipal Electrical Association in England, and to study them until he knows them by heart.

It should be distinctly borne in mind, especially by the smaller companies, that to do a growing and really successful business, something more is necessary than to merely induce your customer to put in so many lamps and then to get as much pay as you can from him for them. It is now clearly demonstrated beyond a peradventure that the margin of profit is as narrow in the central station business as in any other, if not a great deal narrower, and that even when there is no competition from gas or a rival company the closest economy and best management are necessary to yield a profit to the shareholders and provide for future contingencies. In view of this the manager should realize that he must educate his clientele and give them the best satisfaction in every way. Too many managers are satisfied when they have succeeded in persuading a customer to take a certain number of lights. If in addition they are giving full pressure at the lamps and a reliable service they consider that their duty to both the company and the public is done. Now, this is a wrong principle. Attention should be paid to the purpose for which the light is required. Take for example a shop. The purpose for which it is to be used, its size, the height of ceiling, finish of the walls, kinds of goods to be displayed and sold, arrangement of counters and show-cases—all must be noted and considered. It is useless to attempt to light a modern drug store and a ready-made clothing store in the same way, and expect equally satisfactory results in both cases. The manager should be looked upon as authority on methods of lighting, and if he gives the matter a reasonable amount of attention he very soon will be. He must remember that he is a dealer in light and to be a successful one must know all about it—how it is best used and what are the latest fashions in it. If you go to a tailor for a suit of clothes you expect him not only to sell you the cloth and to make up the suit so that it will fit you fairly well, but you expect him to be able to tell you what are the latest styles and fashions and which of them are best adapted to the purpose for which you want them. Some managers will say, "Oh, I have a class of customers who do not care about fitting up nicely and will not spend money on it. All they want is that I will run the wires in and hang the lamps on cords as cheaply as possible." This man is mistaken. There is no community that will take electric light at all where a decided amount of education cannot be carried out. Education of his customers is a very material part of the work of every successful manager in the electrical business, and is one of the principal reasons why the business cannot be properly carrried on by some one who has a number of other interests to look after as well. The manager must study this question of proper illumination so as to master the main principles necessary to a clear understanding of it. He must study his customers so as to know what their tastes and requirements are. He must carefully watch the advertisements in the technical journals and the catalogues that are so plentifully distributed, and many of which contain accurate and valuable information, and then correspond with the advertisers to see if the articles that strike him as suited to some of his customers can be brought within their reach. Then he must canvass carefully and patiently, and if he fails one year must try again the next, because by that time he will know better how to work, his customers' ideas will have advanced somewhat, possibly prices will have dropped a little. The net result of all this is that he at last secures a contract for fitting up that is a pleasure to him to undertake and gives eminent satisfaction to the customer when done.

When first installing lights in the smaller towns and villages, cheap, but not poor work must be done to get the light introduced, but it should be looked upon as introductory only, and later on an earnest and continued effort be made to weed it all out.

A very common case that arises is that of a customer occupying a shop who is always making trouble about the bills. He has a certain number of lights strewed about without any definite arrangement, one switch to shut off the whole thing when he leaves, no shades, no reflectors, and the shop is half dark when all the lights are on, and if he is on meter and turns off a few to save money he has not light enough to do his work. The result is he is constantly growling himself and making others do the same.

When a case of this kind comes up the manager should go to him and suggest that by rearranging things he can have better satisfaction for less money, talk the matter over and work out a scheme that will put the light just where it is wanted, and add a few switches so that the groups of lights can be readily turned on and off. After the exercise of considerable tact and unlimited patience the customer will begin to be convinced and finally consent to refit. When this is done and the lights placed just where wanted, very possibly lamps of smaller candle power than before can be used on some of them. The result is a well lighted shop, which is a good advertisement for both the customer and company at a somewhat reduced cost to the customer and satisfaction all round.

The fewer lights the customer can install and yet get satisfaction from, the longer hours he will burn them all, and so tend to smooth off the peak of his individual load line. And the cheaper he can do it while still yielding a profit, the better for the company, as he is an advertisement and attracts others. Five customers, each of whom has ten lights and uses them all three or four hours each night, are better than one with fifty lights who uses them all for one hour and then turns off as many as possible.

It must be clearly borne in mind that the candle power of a lamp and the amount of illumination we get from it are two entirely distinct things. The useful illumination is the amount of light reflected back to the eye by the objects on which the light falls, and the quantity and quality of the light so reflected is the important and controlling factor, not the candle power of the source of light. The unit of illumination is the "candle-foot;" that is, a light of one candle power one foot distant from the object to be illumined. This is a comfortable light for reading. The illumination is given by the formula:

$$\frac{\text{Candle power}}{\text{Distance in feet}^2}$$

Thus a 16 candle power lamp 4 feet away gives 1 candle foot of illumination.

The illumination yielded by a certain lamp can be very materially increased by the use of reflectors. The illumination of an object which when below a small light is 1 can be increased to 23 by a paper reflector, to 30 by a white glass one, to 64 by a polished one, and to 260 by a silvered glass hemispherical one. White reflectors throw a very nice soft light and smooth off the edges of the shadows so as to produce a very pleasing effect. In using them it should be remembered that the ordinary law of reflection of light, viz., that the angle of reflection is equal to the angle of incidence does not apply to them; but that the rays of light at whatever angle they may strike the reflector spring off from it in lines perpendicular to its surface. Consequently there should be no attempt at the

*A paper read before the Canadian Electrical Association.

mathematical shapes of optical reflectors, but large flat surfaces must be used. They should always be painted a dead white. The enamelling of reflectors to have a shiny surface is a mistake; they do not give as good an effect to begin with and even the best rapidly lose their gloss.

The following table, due to Dr. Sumpner, gives the reflecting power of various surfaces and shows what a wide variation in the number of lights required for a given illumination may be caused by a change of interior decoration:

White blotting paper	82 per cent.
Ordinary foolscap	70 "
Newspapers	50-70 "
Yellow wall paper	40 "
Blue paper	25 "
Dark brown paper	13 "
Dark chocolate paper	4 "
Plain deal (clean)	40-50 "
Plain deal (dirty)	20 "
Yellow painted wall (clean)	40 "
Yellow painted wall (dirty)	20 "
Black cloth	1.2 "
Black velvet	.4 "

When studying out the lighting of a given place we must consider whether we merely wish for a general sense of the space being nicely or brilliantly lighted, as in a ball room or dining room; or whether particular spots or objects need to be clearly illuminated, as the goods in a shop or the tables in a library.

The most important step to good illumination is to secure to the utmost extent possible that no bright spots or lines of light shall strike the eye. The moment the eye sees the source of light it closes itself up for protection from the direct rays and consequently cannot receive as much of the light reflected from neighboring objects, and therefore does not see them distinctly. The following experiment will illustrate this very clearly: Take a shop with two show windows and hang the lights in one window about the level of the eyes, as is so commonly done, and in the other put the same number of lights in good reflectors close up to the ceiling. Now go across the street and note the result. In the first window the goods on exhibition are fairly well lighted, but it is a discomfort to look at them long and nothing is seen behind them. In the other window the goods are shown up beautifully and you can look at them as long as you wish and at the same time can see right back into the shop and see the goods on the shelves and counters.

In the smaller towns and in many cases in the larger ones the question of getting exactly the best illumination and effect from the lights must be subordinated to that of the cost both of the fitting up and of the current consumed. Also a certain amount of deference must be paid to the ideas of the owners.

Thus in lighting show windows the very best method is to light them from overhead, or from the corners, with lamps in deep and powerful reflectors that will throw the light directly on the goods to be shown and will shield it from everywhere else. If it is necessary for the proprietor to be as economical of light as possible this can hardly be done, as these lamps are useless for general illumination in the shop. In such a case as this clusters under good flat reflectors on the ceiling of the window are best. These show the goods in the windows very nicely, they make the front look much brighter, and at the same time throw a very considerable quantity of light into the front part of the shop where it is most required.

An exceedingly common case is a shop from 20 to 25 feet wide, 40 to 50 feet deep with two show windows, the ceiling being from 10 to 12 feet high, and used for dry goods, tailoring, groceries, etc. A very good arrangement for this is to put a three-light cluster and flat reflector in each window, and three similar three-light clusters down the centre of the shop. The main switch should be placed at a convenient spot near the door by which the employees enter and will of course turn on all the lights. Another switch should then be arranged to turn off the window lights, and another to turn off two lights in each of the clusters in the centre. This will be found to be a most convenient and economical arrangement for the customer, who can proportion his light to the weather and amount of business doing. While the central station man will find that, if the shop is open in the evenings at all, the whole of the lights will be on long enough to cover the maximum demand, or standing charges.

These clusters should not be more than 10' 6" from the floor; were these lights raised to 15 feet the direct light from them would be reduced one-half, calling for double the number to produce the same illumination, but since in this case the reflection from the ceiling and walls would be somewhat increased, probably an increase of 50 per cent. in the number of lights would be sufficient.

Drug stores generally call for special treatment, and the lighting must be made to harmonize with and to show off the fittings. Brackets on the top of the shelving and a handsome electrolier in the centre are generally very acceptable, but as the result desired is more in the way of brilliant effect than of mere illumination for the showing of goods, each case must be studied out to suit the purse and the tastes of the persons concerned.

In the matter of churches the great desideratum is the even distribution of the light, with absence of shadows and the total avoidance of all spots or lines of light that will strike the eye of the congregation, or of the minister, especially during the sermon. The minister, the choir and the organist of course require plenty of light, and it often calls for considerable ingenuity to supply their needs without having a bank of lights most unpleasant to the congregation. If such a group of lights cannot be avoided it should be provided with a switch within convenient reach so that it can be turned out during the sermon. In Anglican and Roman Catholic churches which have chancels separated by an arch from the main body of the building, the lights can often be arranged on this arch so as to be entirely hidden from the congregation and yet throw a very pleasant light on the choir and reading desks.

Lodge rooms should be well lighted, and as they are often finished in very dark colors this is a difficult matter. The lights should be divided into groups controlled by switches, and those at the desks of secretary and treasurer are often wanted to be independent of the others in the room. A dimmer is a valuable addition and should be arranged to control all the lights except those just mentioned. It should be a regular theatre dimmer of ample capacity. Lodges are not as a rule paying customers because their use of the light is irregular and the income per light from them very small. Nevertheless it pays to give a good deal of attention to the fitting up of them, because many get educated to good lighting through them whom it would be difficult or impossible to reach in any other way. It will require a good deal of work to get the first one well done and especially to get the dimmer introduced, but after that it will be comparatively easy.

SOME NOVELTIES IN SWING BRIDGE CONSTRUCTION ON THE TRENT VALLEY CANAL.*

By R. B. Woodworth.†

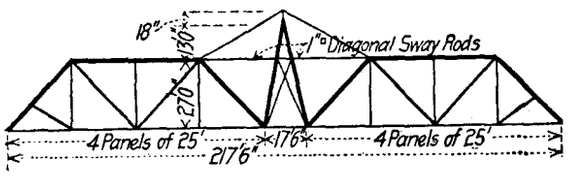
The Trent Valley Canal, now in process of construction by the Dominion of Canada, is projected to extend from Georgian Bay through the province of Ontario to Lake Ontario, and is expected to be of great public value as a waterway. Its construction has naturally demanded numerous high-level and swing bridges.. Several of these were erected during the past year by the Central Bridge & Engineering Co., of Peterborough, Ont., and the purpose of the present paper is to describe certain peculiarities in the construction of the two more important of these, in the design and detail of which the present writer was directly interested.

These were the swing bridges to carry the Grand Trunk Railway over the canal at Nassau, Ont., and the Canadian Pacific Railway over the canal at Ashburnham, Ont. The former had a clear span of 217½ feet c. to c. of end lifts, and the latter a span of 187 feet c. to c. of end lifts. Both were of the same general design, riveted lattice trusses with minor differences due to the different lengths of span and the idiosyncracies of the men who framed the new Canadian tariff. When the material for the long span was ordered angles were most economical; when we came to detail the short span the tariff had made it preferable to use channels. Both were figured for the loadings given under Class II. of the 1896 specifications of the Department of Railways and Canals, viz.: the dead load of the spans themselves, cross ties, rails, etc., at 500 lbs. per lineal foot of span, and a rolling load of two 112-ton locomo-

*From the Engineering News.

†Draughtsman Carnegie Steel Co., Pittsburg, Pa.

tives with a uniform train load of 3,000 lbs. per lineal foot. For the longer span this gives a loading on the turntable, when the bridge is swinging, of about 800,000 lbs. The general style

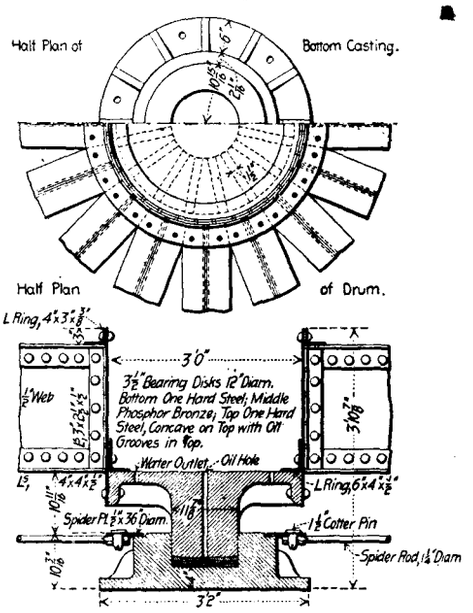


of construction is shown in the diagram, Fig. 1, and need not detain us except to say that all connections were riveted with the exception of the top laterals and the pin connections for the eye-bars and sway-rods connecting the trusses to the central tower. The peculiarities of the construction were three: The turntable centre, the central tower, and the end lifts. The design of the latter is the especial property of W. H. Law, of Toronto, at that time the engineer and manager of the company. The device is based on the use of the toggle-joint, is very simple to construct, and most effective in operation.

Central Tower.—In most swing bridges of ordinary types, whether rim or center bearing, we have to do in the ultimate analysis with beams of complete or partial continuity, and have to take care of shearing stresses transmitted across pivot or drum, and provide special devices to prevent hammering of the truss ends. In the bridge under consideration the rolling load can produce stresses only in the span on which it may be; and the trusses when closed may be figured as simple spans resting on their own supports and completely discontinuous. The turntable is surmounted by a braced tower, Fig. 2, on which rests forged steel links turning on 4 15-16 inch pins, and themselves carrying similar pins to receive the ends of the eye-bars. When the bridge is closed these eye-bars can receive no stress; when the bridge swings, the trusses are simply hung by them to the central tower—a form of construction most simple, effective and economical, easily computed and most practicable in the shop.

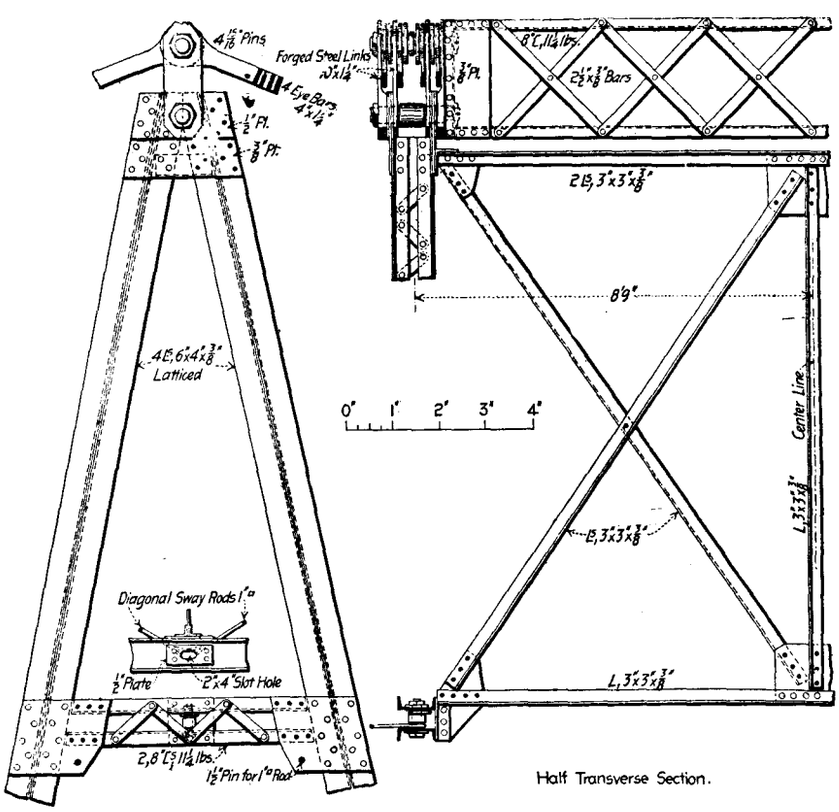
It is quite possible, of course, that by some accident or other —a knock from a boat, say—the links at the top of the tower might be drawn over so far to one side as to fail to return to their normal position when the bridge is swung back to its position when closed. To obviate any mishap of this kind, diagonal sway rods 1 inch square are introduced extending from the pins at the hip to the central tower. Here they connect to 2 inch pins which travel in slotted holes 4 inches in length, giving each pin a movement of 1 inch each way from the center. These rods only come into play in the case of accident to the links, and are emergency safeguards and wind braces.

The central portal is double, as shown; one set of bracing acting with the links, the other set giving rigidity to the tower; the whole forming very efficient protection against accidents common to canals as well as against high winds.



Turntable Center.—This was designed for the express purpose of reducing shop cost by keeping the radial girders of full depth throughout their length. The load from the bridge is delivered to the drum by 16 radial girders which receive it from 8 bearing beams—that is, from 8 points of support. The turntable is combined rim and center bearing—and 250,000 lbs. reach the center, while 550,000 lbs. go to the 36 rollers. The center, Fig. 3, of cast-iron or steel, terminates in its own pin, and the form of construction reduces somewhat the amount of power required to turn the bridge; with this additional feature that the necessity of using bolts is entirely done away with. The steel center plate was riveted to the cast-iron center in the shop and the field riveting was then easily done without any special danger to the center.

The whole structure as thus designed merits attention from the manufacturer's standpoint, and its description may be of use in the further perfecting of shop detail, most centers being



an outgrowth from the design of locomotive turntables, while this is an original creation out of hand.

THE EAST WILL BE EAST AND THE WEST BE WEST.

Editor CANADIAN ENGINEER :

Now that the convention held in Montreal last month is a thing of the past, I desire, whilst congratulating those who helped to make it such an immense success as it undoubtedly was, to draw your attention to one cloud, which though only the size of a man's hand at present might, if allowed to spread, assume dimensions great enough to swamp our whole association. I refer to the action at Thursday morning's session with regard to the matter of inspection, when it will be remembered one of the Toronto delegates, first premising that that city was not interested in the matter at all, proposed a committee of four to deal with the matter, consisting of three representatives of electric plant companies (two of which do not do wiring), and one alderman. I have no fault whatever to find with the gentlemen chosen, but I do object to the very class which of all others are interested, i. e., construction men, not being represented. This was pointed out clearly to the mover, and his courteous seconder even asked to add to the amendment such representative, only to be met with the curt rejoinder, "I persist in my motion." Now at the risk of appearing personal, of which I disclaim any intention, I consider the matter is of too great importance to the association to be "mealy mouthed," and therefore have to say (and I am not the only one), that for any member to carry such high handed proceedings, is a state of things the sooner remedied the better. We have bitter experience of West versus East in our own city without wishing to inaugurate it in our association, but I warn the members that if any clique attempts bull-dozing Quebec Province they will find that she is both able and willing to take care of her own interests, electrical and otherwise.

Whilst not altogether agreeing with the main motion I cannot but favorably contrast the fairness of its mover as compared with that of the mover of the amendment, in offering to withdraw his amendment provided a representative of a construction firm was added to the motion.

If the Toronto delegate's intention was to demonstrate that the association was only in the interests of electric plants, he is treading on still more dangerous ground, as the telephone and telegraph representatives will quickly prove to him, or if again, he intends to arrogate to himself the functions of a little pope he will find his following grow beautifully less, so far as this province is concerned, if he interferes in matters in which, admittedly, he has no interest whatever. I would like to ask you, sir, what is the total membership of the Electrical Association? What proportion of the Executive Committee are Ontario members and what Quebec? Apologizing for thus encroaching on your space.

MONTREALER.

Montreal, July 4th, 1898.

ELECTRIC HEATING.

The inventions that have recently been put on the market by the Dominion Electric Heating & Supply Company, Ltd., of Ottawa, mark a distinct advance in electrical heating apparatus. The appliances manufactured by this company relate not only to house and car heating, but to domestic cooking, laundry work, tailoring and clothing manufacturing, hat manufacturing, and other branches of heating where gas and other fuel have hitherto been in use. A representative of The Canadian Engineer called at their works in Sussex street, and saw water boiled in seven minutes in kettles of a size similar to American electric kettles that require 15 to 18 minutes to bring water to the boiling point. The company guarantee to boil water in seven minutes at a voltage of 110. Like efficiency is obtained in their other heating devices. This high efficiency is attained by a new composition which, paradoxical as it may seem, is at once a good radiator and a good insulator, and which moreover will last infinitely longer than the enamel plates and disks hitherto used in electric heating apparatus. In the heaters hitherto in use all depends on the durability of the enamel. Once that becomes cracked or broken the efficiency of the utensil is soon impaired, and finally destroyed. The conductivity of the ordinary enamel disks is from eight to ten as compared with from fifty to fifty-five of the Dominion Heating Company's discs, which can be heated to a degree that would ruin an enamel disc in a few minutes. A test of one of the Dominion Company's discs was made by a continuous use for over a year night and day at a high temperature, and at the end of this time there was no sign of oxidation in the resistance coil. The composition used by the company has a dark and roughened surface and can be applied in such thin coats that there is very little resistance to heat through, which is one of the secrets of its efficiency. Over 2,000 various heaters have been manufactured by this company, and time is rapidly proving their superiority. The catalogue issued by the company describes electric frying pans, sauce pans, pancake griddles, flexible heaters for water bags, tea kettle heaters, chafing dishes, electric tea and coffee pots, broilers or toasters, cake cookers, portable stoves, glue pots, immersion plates for heating baths or wash water, curling tong heaters, tea and coffee urns, bar water urns, milk heaters, plate warmers, foot warmers, flat iron heaters, goose irons, air heaters for bath and other isolated rooms, electric office heaters, library radiators, as well as car heaters, cooking stoves, etc.

Peter McGregor, inventor of this special composition, was born in Glasgow, Scotland, and began to study electrical depositions and japanning while employed in the Milton foundry in that city. He afterwards learned the pottery business and was employed in Moreland's Castle Espie Works, in the county of Down, Ireland. Coming to Canada in 1873 he started the Ottawa Pottery Works in the following year. In 1879 he was awarded the bronze medal presented by the Princess Louis for original designs in pottery.

FRASER VALLEY RECLAMATION.*

BY R. E. PALMER, A.M. CAN. SOC. C.E.

The freshets or floods of the Fraser River, British Columbia, occur as a rule between the latter end of May and the middle of July, caused principally by the melting of the snow upon the mountains. In the reclamation of portions of the delta lands of this valley, from these freshets, the most difficult part of the schemes at present adopted is the satisfactory design and building of the sluice boxes and flood gates. Up to the present time, that portion of the delta reclaimed lies in patches, each portion being protected by itself, and not connected with any other portion. Generally these patches or valleys front on the main river, and are surrounded on all sides, with the exception of the frontage, by high lands, which discharge all their drainage upon the flats. This water finds its way over these flats through sloughs and creeks which discharge into the main river, during the low or ordinary stage of the water, namely, from August to the end of April.

The system of reclamation adopted up to the present day has been that of the construction of dykes or embankments, of different dimensions, along the banks of the river, from high lands to high lands, and of the building in the creeks or sloughs, over which the dykes would pass, of flood gates, and sluice boxes as they are called, which are so constructed as to close during the high water, preventing the river water from backing up the sloughs and flooding the prairies. They are constructed also to open, so soon as the water in the river begins to fall lower than in the sloughs, and drain the prairies, the sloughs during the period when the gates are closed acting as reservoirs, to hold the ordinary drainage from the surrounding hills. In ordinary cases the sloughs have not enough capacity to hold the drainage during the time when the gates are closed, and pumping has to be resorted to, for about a month in the year.

One of the most difficult operations connected with these schemes is the proper designing and construction of these boxes. It is a very difficult matter to keep them tight, and the material in and surrounding these sloughs is such that when once the slightest leakage occurs, under pressure, it is a very short time until the whole box finds its way into the river or up the slough. Again the many and varied kind of sloughs and creeks, the different classes of material through which they pass, varying from gravel and sand to silt and clay, the fact that some discharge into the river where there is a regular rise and fall due to the tide, while others discharge at points where the tide does not reach—(the gates of the former having of necessity to close and open during each tide, while in the

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

latter they need only close during the freshet)—all tend to require very careful examination and much experience before deciding upon the proper design for the gates. In fact, almost every locality requires a gate of a design unique in itself, with some special features differing probably very materially from that required in a locality not half a mile distant. The boxes required for the sloughs located on the river above the effect of the tides are subjected to a very severe test and strain during high water. They are often subjected to a pressure of water due to a head of from 18 to 20 feet and lasting from a month to six weeks. On the other hand, those located on that part of the river affected by tidal waters are relieved twice every day during ebb tide.

The writer gives a description of two of these boxes built by him, one in March, April and May, and the other in August and September, 1896, all being under the same contract. They are built in two sloughs, discharging into the Fraser, through what is known as the Matsqui Prairie. They were designed in 1893 by Fred. J. L. Tytler, C.E., at present supervising engineer for reclaiming lands for the Provincial Government of British Columbia, and were built with several changes under contract by the writer. It may also be mentioned that in each of these sloughs prior to the construction of the ones described, there had been built three different and distinct boxes, each of which had succumbed to the effects of the freshets, and had been torn apart or scoured out, and carried by the flood for long distances over the prairies. One of the present boxes, the only one built at the time, was subjected to a very heavy freshet in July last, the water in the river reaching to a point only 2 feet 11 inches below that reached during the disastrous flood of 1894; but although the work was barely completed when the flood came, and had in consequence barely reached its true bearing, still there was no sign of leakage, or scour, or damage in any one particular. The lumber used in the boxes was all of rough sound cedar, with the exception of the clappers or doors, which were of dressed Douglas fir. The boxes are identical in design, each being 80 feet long by 26 feet wide by 5 feet 8 inches outside measurement, having four openings each 4 feet by 5 feet. They have also each an entrance apron 30 feet x 40 feet, and a discharge apron 60 feet x 40 feet, each contains about 90,000 feet B.M. All spikes were specified to be galvanized.

The most important part of the work is the method of setting the box, and the proper placing of the brush and clay and jackets, and this will be now described. At this point of the Fraser River, there is an ordinary rise and fall of tide, due to the backing up of the river, of about 4½ feet, while during the freshet no difference of rise and fall is perceptible. Both boxes being identical in design it is only necessary to describe the manner of placing one—the most difficult—and located in what is known as No. 3 slough. This slough is about 80 feet wide at the top, and from 25 to 30 feet deep, with water at the time of construction about 10 to 16 feet deep. It drains a large portion of the prairie, besides receiving a large creek from the surrounding hills, and as the weather was very wet at the time, it was necessary for it or the off-take ditch to carry away a large amount of water. The banks of the slough sloped at about ¾ to 1 and were interwoven with roots, and gave signs of sliding from adjacent springs and seepage of water. The method devised and afterwards adopted for placing the box was to build a temporary dam a short distance above the site of the box, another a short distance below the site, excavate an off-take ditch, and having pumped out the portion of the slough between the dams, to commence operations. The off-take ditch was excavated through fairly good clay, being about 12 feet wide at the bottom, with side slopes of about 1 to 1, and varying in depth from 4 to 14 feet. In constructing the upper dam a crib of logs was first built across, notched down and securely drift-bolted together, the logs on the upper side having a batter of about 6 inches to the foot. Along the upper side were driven sheet piles, consisting of 3 and 4 inches plank which penetrated from 4 to 8 feet into the bottom, but on account of the presence of many sunken logs and stumps, it was impossible to get all the plank down to a proper bearing, but they were intended merely to hold the brush and earth, afterwards conveyed in, from being swept down by the current so soon as it was deposited.

At first it was considered practicable to commence this sheet piling at one side, and continue along, finishing at the other, but it was found that the banks were of such a treacherous nature, that the increased current due to the narrowing of the channel, would scour away the banks more quickly than the sheet piles could be driven, and thus destroy the location of the box. It was then decided to commence at both ends, make them thoroughly secure, and work toward the centre. This was done, the sheet piling from each side being closely followed by laborers dumping earth to form an embankment on the upper side of the crib, keeping plenty of brush on the outside, to prevent the earth being scoured away by the current. After having proceeded thus toward the centre, and when the current became too strong, due to the narrow opening to hold the earth from being washed away, the gap in the sheet piling was closed, and the backing deposited as soon as possible. But the material in the bottom of the slough was of such a treacherous nature, that no sooner had the water on the upper side begun to rise on the piling than it broke through underneath, the water following the piles down, where it encountered a coarse, red sand, which was soon scoured out, and in a very short time an open channel was made underneath the piling. Sacks were immediately obtained and filled with earth (about 1,200 of them), and these dumped into the channel or hole with loose hay and earth, finally held the current until a large earth embankment was built across. No more trouble was afterwards encountered, although it was subjected at one time to a pressure due to a 27-foot head. The lower dam was built in much the same way, but with less difficulty, there being only a 4 foot tide to contend against. The specifications required all ooze, logs, sticks or perishable matter to be removed from the bottom of the slough, between the two dams, to a maximum depth of 6 feet below the bottom of the box, in order to secure a proper foundation on which to lay the brush and clay. Should the material below that be soft and mushy, then wild hay was to be tramped in below that again, until a firm bed was obtained. But it was to be left to the judgment of the engineer as to how deep up to the six feet the excavation was to be made.

After having pumped out the location—a centrifugal pump with a 4 inch discharge having been used with a maximum lift of about 15 feet—the bottom of the slough was carefully examined and the material tested. The first 2 feet or thereabouts consisted of ooze, slime, brush, logs, stumps and every imaginable kind of worthless matter. Beneath this for from 4 to 6 feet was a bed of silt, of a bluish color, containing minute particles of mica, and very gritty to the touch, but the particles of sand being fine. This when left in its natural bed, and not disturbed, is impervious to water, but once it is moved and displaced, and exposed to the action of water under pressure, it becomes a veritable quicksand. Beneath this was a bed of fairly coarse, red sand. After having made this examination, the cause of the former boxes having been scoured out was apparent to the writer. They had been constructed in the form of coffer-dams built by driving rows of sheet piles braced to ordinary piles, and filling the intervening space with earth or clay. These piles have penetrated this bluish silt, and were driven into the red sand. When the water acquired the necessary head on the outside, after the closing of the gates, it followed down the piles through the silt, into the sand and up again on the other side. The intervening earth was soon washed out, and with it the bottom of the piles, until a channel was formed underneath, and very little time elapsed before the whole structure was scoured out. After having been enlightened as to the nature of the bottom, it was decided to lay the foundation upon this bed of blush silt, without disturbing it more than necessary. This was done after all the decayed material—logs, ooze, etc.—had been removed from the bottom, and all roots, slides and loose material cleaned off the sides of the banks, and proper slopes of about 1½ to 1 excavated from them. The foundation under the box proper was built up of clay and brush, that under each apron of rip-rap. The specifications for the clay read as follows: "To be of first-class quality, and when kneaded stiff into a pyramid of an inch or so in height, and immersed in water, will remain intact for 24 hours without crumbling. The brush was to be of green bushy fir or cedar trees, of young growth, not more than 15 feet in length, when the stem is cut close to the head, which it shall be, or limbs similar in character." The separate limbs were afterwards practically excluded, and bush allowed much longer than specified, which served the purpose better. The first intention of the writer was to obtain the clay from a bed about a mile up the slough, above the site of the box; but after

the temporary dams had been built, a great quantity of rain fell, and as the off-take never was intended to carry off all the drainage, the water backed up, so that the clay could not be reached. Another bed of blue clay of excellent quality was then located on the river bank, about two miles below the mouth of the slough, and was conveyed by steamer and scows at a heavy expense.

The foundation was laid as follows: A bed of this clay was deposited on the bottom of the slough about 2 feet in thickness, and 80 feet in length, that is, under the site for the box proper. This was laid in layers a few inches in thickness, carefully spread and levelled, and well tramped and pounded down. On the top of this was laid a row of brush with butts to the end. These small trees were laid close together longitudinally, from one side of the slough to the other, and at one end of the foundation. The branches standing up were "necked" in order to let them lie close. After the first row was laid, another was placed on top partially covering the first layer, similar to shingling a roof, butts all lying out in the same way as number one row. Then another row was laid in a similar manner, until the layer of clay below (80 feet in length) was covered for about two-thirds the distance from one end, or between 50 or 60 feet. After this had been completed, a layer of clay was laid on top from 1½ to 2 feet in thickness, covering the whole foundation This was thoroughly compacted, and tramped down with horses and then levelled up. Upon the top of this clay was laid another layer of brush similar to the lower layer, but this time commencing at the opposite end of the foundation butts out, and extending for about two-thirds of the way towards the first end, and thus overlapping a portion of the first layer of brush, but care being taken that there was a good layer of clay between, so that the brush in no instance would be continuous through the entire length of the foundation. Upon the top of this was laid another layer of clay similar to the previous layer and so on, until the proper height was obtained to lay the box. When the foundation reached the required height, it was carefully levelled off and made ready for the box. The lower planks of the box floor (5 x 12 x 26 feet) were then laid close together, each one being levelled up and pounded down with a heavy pounder, until it lay on an even bed throughout, in contact with the clay. Upon the top of this floor was built the box as shown on the plan.

From the box to each bank of the slough was laid clay and brush in a similar manner to that in the foundation, care being taken that in no case should the brush extend in a continuous layer right through the embankment, or that it should touch the sides of the box. The clay was laid in thin layers and thoroughly tramped and pounded down, especially close to the box, and also carefully knitted into the banks on each side by key walls. A brush and clay embankment laid in this manner was carried up on each side and on the top of the box, until the top of the banks of the slough were reached, with the exception that, after the top of the box level was reached, the slopes on each end were carried up by driving split cedar pickets about 3 inches in diameter and 6 inches apart, 4 feet into the embankment—each row being 1 foot higher than the preceding one, and 1 foot nearer the centre of the box, thus making a slope of 1 to 1 at the ends. Behind, or inside each row of pickets, was laid "heading brush" or brush laid transversely with the box to keep the clay in place. From the top of the bank of the slough, a dyke of ordinary earth-work was built to the height of the river dyke, about two feet above maximum high water. The aprons were built as shown on the plan, the walls flaring out from the ends of the box to the end of the apron, and rip-rap being hand laid outside of the walls upon the floor, to load it down. From the rip-rap walls to the banks, the slopes were built of rough brush and ordinary earth, laid in a similar manner to the clay and brush.

The gates or clappers used on the box, are of the "top hung" pattern. A difference of opinion seems to exist among the engineers of this district, as to advantages derived from that style over the "side hung" gate. The trouble experienced with the gates on this box was as follows: when the freshet first begins to come, the river only rises a few inches in 24 hours, and, according to the state of the weather, may in its steady rise exceed 6 to 12 inches in one day. Consequently, the gates not being hung perpendicularly, but when closed have a batter of about 1 inch in 12—the water keeps running in underneath the clapper, filling the slough inside, as quickly or nearly so, as the river rises outside, and the clapper to all intents and purposes floats on the stream, there being practically no pressure against it, at least not enough to close it. Weights were attached to the bottom of the clapper which assisted materially in closing them. In the case where the water rises rapidly outside, as in tidal waters, no trouble is encountered, for once it begins to rise, a head very rapidly forms, and the gates will close with a sound as of the discharge of a cannon. Another disadvantage of the "top hung" gate is this: when the slough is discharging, the water inside as a rule is very slightly higher than the falling water outside. Also there are always more or less branches of fallen trees, sticks, pieces of logs, etc., being carried out through the boxes. These must necessarily pass underneath the slightly opened clappers, and in many cases are caught between the floor of the box and the bottom of the gate. Then when the tide changes, and the water turns to flow back into the slough, the debris prevents the particular gate from closing. Well designed grillages both above and below the gates ward off much of the debris, but notwithstanding this it is impossible to keep some branches, fence rails, etc., from passing through. In the "side-hung" gates, less trouble is encountered from this. Here the gates are hung in pairs, closing at the centre of the openings, the debris can then float upon the top of the water, and not being dragged along the bottom of the box, has only the two edges of the gates to encounter, and the gates being evenly balanced, will open enough to allow the debris to pass through. This difficulty of course is only encountered when the head on either side is small, and the gates in consequence are very slightly opened. In "side hung" gates there is a slight disadvantage in that it is very difficult to prevent the gates from sagging through length of time, which prevents them from closing tightly. They must be well designed with very heavy and strong hinges.

In many of these boxes on the Fraser, the gates are hung on the outside of the box, and have an advantage that they are more easily reached should anything prevent their closing during high water.

These gates cost practically $10,000 each.

SEWAGE DISPOSAL.

Editor CANADIAN ENGINEER

My attention has been drawn to a letter signed "Expert," which appears on pages 47 and 48 of The Canadian Engineer of June, 1898, containing mis-statements and inaccuracies with respect to the International system of sewage purification, which for ten years has been in this country so successfully used, and adopted in preference to all other methods, and is now being introduced into Canada and America by Mr. J. McDougall. It is evident that "Expert," who prefers to make his assertions anonymously, is not master of the subject on which he writes. His statement that the International Company has changed its filtering process from a continuous flow to an intermittent system, "thereby purifying the sewage by bacteria, which require atmospheric air regularly at short periods," is not correct, as the International Company has always recommended, and was the first to introduce, the now accepted principle that filter beds must be worked on an aerating system in order to ensure the best results. At the present time, by means of valuable patented improvements, we are able to aerate filters every few minutes, and at the same time filter at a much greater speed than any other process, and obtain a far higher degree of purity. "Expert" also makes some rash and totally incorrect statements as regards what he calls "Intricate sludge machinery." The sludge removal apparatus used in the International process is of the most simple and efficient kind, effecting great economy in the construction of sewage works, as its use does away with the necessity of large areas of tanks. The apparatus is used by the British Government, and at a great number of sewage works in this country, and its adoption is rapidly extending, which fact is proof of its success. "Expert" also says the precipitant Ferozone is a "heavy constant and useless expense," and that coal screenings are far superior to Polarite—(the filtering material of the International process). These assertions are so wholly incorrect that it is difficult to understand how "Expert" came to make them unless he wishes wilfully to mislead. As regards the cost of Ferozone,

with modern plant and machinery and with a dilute sewage such as met with in American and Canadian towns, chemicals may be dispensed with altogether, there being sufficient dissolved oxygen in a weak sewage to effect the necessary treatment in the sewage tanks, previous to the final purification through Polarite beds. "Expert" rashly says, "Coal screenings are far more efficient and lasting when used as a filtrate, standing ahead of every other material, except charcoal made from wood or town's garbage." The only advocates of charcoal made from town's garbage are those interested in what was known in England some years ago as the Jagger & Turley system of carbonized refuse, which was tried at a little place called Baildon, the results being given in a paper read by W. Naylor, Esq., F C S., chief engineer inspector, Ribble Conservancy Board, and published in The Journal of the Society of Chemical Industry, 30th April, 1894; the following is an extract, and will show the utter absurdity of attempting to deal with sewage by such a system:

"An impression has long been abroad among the local board 'Practical men' that coke is the proper thing through which to filter sewage. Reason and figures are of no avail with a sewerage chairman, who has set his mind on coke. It is an old established institution, handed down from father to son, and will die hard, but die it must, for (as shown by the Nelson figures, Nos. 32 and 33) it has no effect on dissolved organic matter at ordinary filter depths and rates of filtration. This coke, however, was pulled out and burnt during a recent coal famine, doing more good on that particular occasion than it ever did before. Its ghost, however, is now on exhibition at Baildon in the form of a 'Carbon' filter (so-called). Ash pit and privy refuse is here burnt, carbonized, it is claimed, and a filter made of the resulting ash. This forms a sand filter, but that is all, and if of sufficient area would perhaps in time form a nitrification bed. This is a process which at once appeals to the minds and pockets of local boards. No precipitants! No expensive filters! Refuse disposed of! No pollution! The impossibility, however, of its application on a large scale must be apparent at once to any but an outsider. The sewage treated at Baildon by this process is initially very weak. Its effect upon that is a mere screening effect, as shown by the results numbered 34 to 37."*

TABLE OF RESULTS.

No. of sample	Description of sample	Taken by	Date	Examined by	Part per 100 000 albumenoid ammonia.
32	Nelson effluent before coke beds	Author	8th Aug., '92	Author	2.0
33	do. after	"	"	"	2.0
34	Baildon raw sewage	"	17th Jan., '94	"	0.345
35	" tank effluent	"	"	"	0.330
36	" filter	"	"	"	0.150
37	" clear sewage	"	"	"	0.130

It is evident that your correspondent, who styles himself an "Expert," is woefully ignorant, not only of the science of sewage treatment, but of what has recently taken place as regards the system he indirectly advocates, viz., carbonized town garbage, which after trial had to be abandoned at the town of Alton, Hampshire, England. Is not "Expert" connected with this carbonized garbage process. Otherwise his unjustifiable attack on the successful International system cannot be understood. Polarite filters are vastly cheaper than any other form owing to the powerful purifying powers of Polarite, which enables a high rate of filtration to be maintained and an effluent of a much greater degree of purity obtained than by any other system. The best proof of this is the number of places at which Polarite filters are in operation. Her Majesty's Government would not use Polarite in England and send it to all parts of the world for purification purposes, could equal results be obtained by coal screenings, coke or similar substances, which when tried, even on a small and closely watched experimental scale, are found after a short time to choke up and become useless, even when worked at so slow a rate of filtration as to render them enormously costly and altogether prohibitive. Polarite filters on the contrary are most economical and their efficiency is shown by the following, which is the opinion of Major Tulloch, C.B., R.E., late engineer in chief to the local government board, on the Chorley Corporation Sewage Works, where the International Ferozone and Polarite process has been in most successful operation for several years:—

"I am highly pleased with what I have seen. The works are excellently managed and looked after, and reflect the greatest credit on the town council. The effluent from the depositing tanks is among the very best I have seen, almost perfectly clear, and with only a faint smell, while that from the filters is as clear as spring water and perfectly inodorous. These works I consider to be among the very best in the country. I know of none where better results are produced."

In view of the anonymous attack made on the International system by "Expert," I trust that your Canadian sense of fairness will ensure the fullest publicity to this letter, for the length of which I apologize, and remain, yours obediently,

FRANK CANDY,
General Manager.

109 Victoria Street, Westminster, London, England.
July 8th, 1898.

*Reprinted from the Journal of the Society of Chemical Industry of 30th April, 1894. Being a paper called "Comparative results of some modern systems of Sewage Treatment," by W. Naylor, F.C.S., Chief Engineering Inspector to the Ribble Conservancy.

GARBAGE DESTRUCTORS.

Editor CANADIAN ENGINEER:

Our attention has been drawn to a letter signed "Expert" in your June issue, and this gentleman mentions the name of our Mr. Warner and the Patent Refuse Destructor, which we manufacture, and we think it necessary to make some comment upon the matter. It is evident to us that this expert is a very dark horse, as in the first place he does not acknowledge his name, and in the second place, he does not know what he is talking about. If he would give his name, facts and figures it could be handled in a proper engineering manner, but, it may be as well to mention that we manufacture several kinds of destructors, both with forced draught, by steam and air blast and with chimney draught, that we are up to the most recent destructors as regards high temperature, cost of refuse treatment and the amount of steam produced, and as some proof of our statement we enclose a reprint from a recent English newspaper showing that after full investigation our patent destructor has been accepted at the city of Bath, the city of Sheffield, and the town of Plymouth. We have since been informed that the town of Hartlepool has passed our scheme for a destructor of 6 cells, and we are at the present time building destructors in different parts of the country and abroad, consisting of upwards of 150 cells; this, we think, is practical proof that our schemes are not so old-fashioned as made out by "Expert." We can say quite as much with regard to the treatment of sewage as we are at the present time supplying a large number of the most important schemes, and carried out under the most eminent engineers including J. Mansergh, Esq., of Westminster; W. Santo Crimp, Esq., T. de Courcy Meade, Esq., Mr. Leiley, Messrs. Pollard & Tingle, of Westminster, and many other borough engineers. In conclusion we can only say we think "Expert" will have to be a student for many years before he arrives at a possible chance of being a professional man, let alone an expert in matters he is talking about. Yours truly,

GODDARD, MASSEY & WARNER.

Nottingham, Eng., July 15th.

SANITARY PLUMBING.

Editor CANADIAN ENGINEER.

I have read with much pleasure W. M. Watson's article on the sanitary experiments at Cologne, and since reading it I have been able to prove the accuracy of the statement that sewage falling vertically through a soil pipe carries down with it several times its own volume of atmospheric air into the main sewer, which is a very important thing and tends to keep the sewers fresh and odorless. I have worked in three of the largest cities in England as a journeyman plumber, where interception traps on private drains or on drains serving rain water leaders were unknown. No more was sewer gas known to enter dwellings or pollute the streets in such quantities as to be injurious or noticeable. I have also worked in Toronto where traps are in general use for such purposes, and when doing repairing work I have found many chokes, and several buildings with the soil under the basement floors completely saturated with the liquid from excrement, which is a mishap that never occurred in any of the towns in which I worked in

England, where sound drains are used. The article has given valuable pointers to thinking plumbers and unbiased citizens who wish to secure the healthiest methods of erecting sanitary appliances. Truly yours, E. A.

Napanee, July 25th, 1898.

WILLIAM HENRY LYNCH.

William Henry Lynch was born at Danville, Que., July 25th, 1847. In his youth he worked as a telegraph operator and was afterwards manager of the old Danville school-slate quarry. When the quarry closed down though the lowering of prices, brought about by American competition, Mr. Lynch turned his attention to the dairy question. Under a strong conviction of the great future before the dairy interests of Canada, and the special suitability of the climate and soil of this country for this branch of agriculture Mr. Lynch began an agitation throughout the country for a reform in the methods then in vogue. From 1881 to 1889 he spent most of his time and money in efforts to arouse the attention of the farmers to the great opportunities before them in the manufacture of butter and cheese for export. He applied himself so intensely to this labor of love that he soon became one of the foremost authorities on dairying. His work attracted the attention of the late Prof. Arnold, of Rochester, who invited him there to carry on experiments in the treatment of milk and the manufacture of butter, and who returned the obligation by coming to Canada to testify to Mr. Lynch's great work in the interests of the Canadian farmer. During this time Mr. Lynch became the author of a book on "Scientific Butter Making," the value of which was manifest by its purchase by the Ontario Government for general distribution among the Ontario farmers. Among the direct results of this work was the establishment of a government creamery, and the incorporation of dairy work as a special department of the Agricultural College at Guelph. "Scientific Butter Making" was followed by "Butter and Cheese," of which 70,000 copies were issued in English and French. The edition was exhausted within a year, and this led to a larger work entitled "Scientific Dairy Practice," which is considered to-day the best hand-book ever issued on this subject, and of which 100,000 copies were printed. During these years Mr. Lynch delivered hundreds of public lectures to farmer's and dairymen's associations, besides addresses to various Boards of Trade throughout Canada. These were delivered without charge and in most cases without even compensation for his traveling expenses, his great work being carried on simply out of conviction of the importance of the subject to the country. That Mr. Lynch looked into the future with a prescient eye is very evident, when we consider the enormous development of the dairy exports of Canada. In 1886 the exports of Canadian cheese amounted to $6,754,620, and of butter $832,355. In 1897 the exports of Canadian cheese amounted to 164,220,699 lbs., valued at $14,676,239, and of butter to $2,089,173. To see what was being accomplished by other countries, Mr. Lynch made a tour at his own expense through Great Britain, Denmark, Norway, Sweden, Holland and Germany, and gave the results of his knowledge to the public in a series of interesting letters, written also without charge, to the leading Canadian papers. He had all along urged federal action by the Canadian Government to promote the export of dairy products, and closed his letters by a call to Canadian dairymen to meet in a convention at Ottawa. The immediate outcome of this convention was the appointment of a Dominion dairy commissioner, and the organization of the governmental machinery, under which our exports of dairy products have since increased with such remarkable strides. Mr. Lynch could have had the appointment of dairy commissioner, but it is in keeping with his character that he declined to reap to his own personal advantage where he had sown so generously. When it is known that he also declined a like appointment offered to him by a foreign government, simply because he did not wish to educate a foreign nation to compete with Canada, and when it is realized that his education of the Canadian farmers has meant millions of dollars in the pockets of the Canadian people, William Henry Lynch may well be enrolled among the Canadian patriots, whose names should pass into history. He was one of the founders of the Canadian Dairyman (the first paper in this country exclusively devoted to dairying), which was afterwards merged into the Rural Canadian. For some years past Mr. Lynch has devoted much attention to mining, being among the first to realize the importance of the developments in British Columbia. He made some suggestions for the improvement of the B.C. mining laws, which, had they been acted on, would have prevented some of the abuses that now exist there.

Mr. Lynch has now been entrusted by the Minister of the Interior with a commission to make a special study of the local condition of the Canadian Yukon district, particularly as to the mining regulations, and to report to Ottawa. Being an original thinker, as well as a man of high ideals, he is not likely to be tied down by precedent, and we may expect that his investigations will result in a code of mining regulations, which while conserving the public interests will give to the honest miner the fullest security, and make the Canadian Yukon a model mining region.

THE CANADIAN MUTUAL AID ASSOCIATION OF MECHANCIAL ENGINEERS OF THE PROVINCE OF QUEBEC.

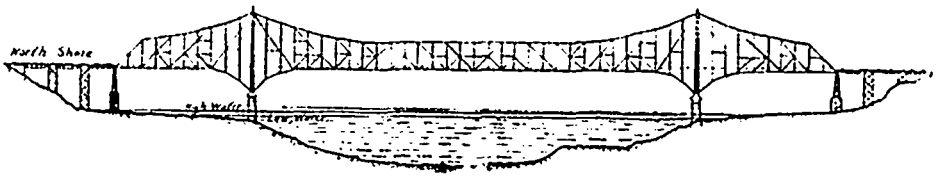
This association has sent out the following circular to manufacturers: "With a view to securing to manufacturers the advantage of obtaining experienced persons to take charge of steam plants, the mechanical engineers have formed an association which will accept as members only those who are licensed, and firemen who have a thorough knowledge. This association deserves much encouragement because it makes continually a special study of all questions relating to steam machinery, both as to economy and safety. It has also for its aim the mutual aid of its members in case of sickness, and differs from many other societies in that it does not interfere in any way with salaries. Having been founded as much in the interests of the proprietors of steam machinery as of the mechanical engineers themselves, they count on those interested in carrying out these two nobler aims. The president of the association will be most happy to reply to correspondence from engineers and firemen, and will furnish either by letter or personally any information having reference to steam machinery." The circular is signed by Ephrem F. Valiquet, 106 Bourget Street, the president of the association, and is dated from The Mechanical Engineers' Rooms, 392 Lagauchetiere Street, Montreal.

—Bond & Smith, architects, Temple Building, Toronto, are calling for tenders for the reconstruction of a residence on Lowther avenue, Toronto.

—An interesting test has just been completed by James Lang at the power house of the Toronto Railway Co with a view to getting at the actual results of a mechanical stoker as compared with hand firing. The test was made on an improved Jones underfeed mechanical stoker for three days, resulting in a saving of fuel of 15.2 per cent., or an increased evaporation for equal fuel of 17.93 per cent. Minute details of the test are being printed by the General Engineering Co., of Ontario, Canada Life building, Toronto, who will forward the report to those interested in the subject.

"STERLING" HACK SAWS.

THE PROPOSED QUEBEC BRIDGE.



Distance between base lines, 2,546.07 feet, from centre to centre of piers, 1,600 feet; between back walls, 3,300 feet; clearance for navigation, 150 feet above high water mark. E. A. Hoar, C. E., is the engineer in charge. Tenders will be called for till Sept. 1st.

FIRES OF THE MONTH.

July 2nd. The Ashbourne flour mill near Bullock's Corners, Wentworth county, Ont.; loss, $10,000; insurance, $8,000.——July 7th. Saw mill owned by Biecher Tingley, Moncton, N.B. ——July 8th. The Mastigouche Lumber Co.'s mills, St. Gabriel de Brandon, Que.; loss, $20,000; insurance, $9,000.——July 10th. Saw mill owned by Daniel Richards, Campbelltown, N. B.; loss, $10,000; insurance about $10,000.——July 11th. The Berlin Brush Co.; partially insured.——July 12th. C. Smith's foundry, Durham, Ont.; loss, $2,500; insurance, $800.——July 13th. The Maritime Sulphite Fibre Co.'s barking mill, Chatham, N. B.; loss, $1,000.——July 15th. The Sherbrooke Iron Works; slightly damaged.——July 17th. The Tilbury, Ont., electric light plant. ——July 20th. N. Cayonette's saw mill, Ste. Moise, Que.; total loss; G. Ross and his son, watchmen, were found burned to death.——July 22nd. The Macdonald Tinware Co.'s factory, Montreal; damages, $15,000.——July 26th. Steamer "D. L. Mather," owned by the Keewatin Lumber Co., burned at Winnipeg; loss, $8,000.—— July 27th. The Linotype Machine Co.'s works, Montreal; loss, $70,000, fully insured.——July 30th. Adam Haines' furniture factory and saw mill, Waterville, Que.; loss about $10,000.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

The ninth annual convention of the Canadian Association of Stationary Engineers will be held in Hamilton, Ont., Aug. 8th. The convention will open on Aug. 8th at 11 o'clock, when the Mayor of Hamilton will welcome the delegates to the city Committees will be appointed and the convention will then adjourn till 10 o'clock on the 9th, when a business session will be held, followed by an aquatic excursion in the afternoon. In the evening E. G. Barrow, C.E., city engineer of Hamilton, will read a paper on "Sewage Disposal," and J. S. Williams, analyst for J. Winer & Co., will read a paper on "Oils in the Engine Room." On Wednesday, Aug. 10th, business sessions will be held. In the evening the annual banquet will be held at the Waldorf.

GORDON J. HENDERSON.

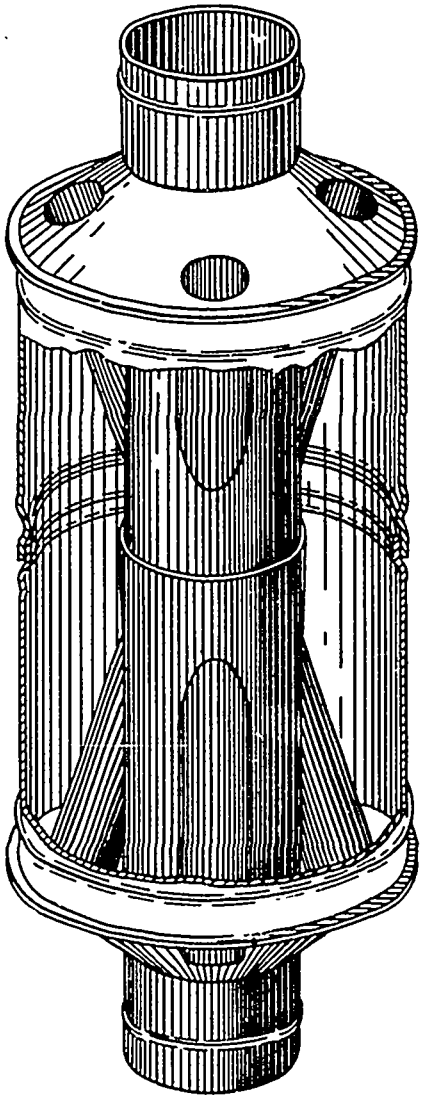
The manager of the Hamilton Electric Light and Power Co., ltd., Gordon J. Henderson, was born in Montreal in 1871, being the son of David H. Henderson, a well-known lumber and timber merchant of that place. Mr. Henderson was six years with his brother, C. W. Henderson, electrical contractor and general supplies, and has been connected with the present company for two years. He has been fortunate in putting this company on a paying basis, as it is a well-known fact that for six years previous to his being appointed manager, it had never paid any dividends. The revenue both from power and incandescent has very materially increased, and expenses all through show a marked decrease. We hope Mr. Henderson will long continue his present successful work. At the recent convention of the Canadian Electrical Association, Montreal, Mr. Henderson was elected a member of the Executive Committee.

THE CHILCOOT HOT AIR HEATING DRUM.

By W. M. WATSON.

The coal used in many sections of the country must be imported, which drains the country of its wealth and advances the price of fuel to such an amount that it is necessary to adopt any appliance that will extract an extra amount of heat from the fuel. The majority of hot air furnaces, heating and cooking stoves allow one to two-thirds of the heat from the fire to escape up the chimney unused. The inventor of the Chilcoot Hot Air Heating Drum has clearly shown how much of the formerly wasted heat can now be utilized and made to cause a healthy circulation of warm air in rooms that otherwise would be obliged to have either a hot air pipe or an extra stove to make them comfortable.

Single and double smoke drums have been long in general use and have radiated into rooms quantities of heat in proportion to the exposed surface of the smoke drum, to the distance the drum was placed away from the fire, also the temperature of the fire and the strength of the air draft passing through the fire. It must be borne in mind a coal fire allows its heat to be extracted from it by the iron and brick work that



surrounds the fire, while a fire made of wood is inclined to travel a long way beyond the seat of the fire if allowed to do so, and the smoke drums and pipes of a wood fire will radiate a large share of the heat made in the stove. But no coal fire can burn or be kept alive without some draught of air passing through it which causes the part of the heat of the fire to pass up through the smoke pipes to be discharged into the outside air, unless arrested and radiated into the living rooms by a smoke drum.

It is found that it takes about five times the quantity of heat to raise a volume of water or air ten degrees in temperature more than it does to raise it five degrees, and the difficulty of heating air or water becomes more as the temperature increases. By passing a thin stream of cold water or air over a hot plate at a reasonable rate, about twenty times the number of cubic feet would be heated to a given temperature in a stated time than if the whole quantity of water or air to be heated was collected into one large vessel, and a furnace placed in the centre or under it. Heating the water or air in a thin stream is called heating by circulation. Heating by bulk is called heating by radiation. The fuel that will heat to a temperature of 60 degrees will have to be increased in far greater proportions to raise the heat of the same rooms to 70 degrees. This shows the necessity of using the Chilcoot Hot Air Heating Drum, which combines the two systems of heating in one article. The outside casing or shell radiates quite as much heat as any of the drums formerly used. Then the air of the room is kept in a lively and healthy motion by rapidly passing through an inner drum connected by three collecting and distributing tubes acting similarly to tubes in hot air furnaces. The Chilcoot Hot Air Heater is really a secondary furnace

The patent rights of this valuable article are for sale by S J. Robertson, 62 Church Street, Toronto.

LITERARY NOTES.

A very interesting and attractive booklet, "Montreal Homes, Hints to Intending Builders," has been sent us by the author, Arthur J. Cooke, architect, Montreal. It contains a number of illustrations and many suggestions of great value to the intending house owner.

The annual reports of the several departments of the civic government of Halifax, N.S., for 1896-7 have reached us from the office of the city engineer, F. W. W. Doan. A great mass of information, much of it minute in detail, is given. The work of the year in all the departments of the city government is described. The city engineer thus sums up the difficulties of city improvement: "There is a great difference in foremen and the number who can be relied on for cheap work is limited. We are expected to employ men, simply because they are citizens of Halifax, whom no city contractor would have on his work. *Such a system is useless and extravagant, if the taxpayer* is to get one hundred cents for every dollar expended. The very men that claim that such men are not employed are the first to complain that there is nothing to show for the expenditure. The Works Department is not a Charity Board, and must be run on business principles. Good men can be obtained in Halifax and we should be permitted to select the best. The results during the last three years show what can be done by good men, and the standard set up should be maintained. The accounts of the Clerk of Works tell the story more forcibly than it can be expressed here."

Very few who are engaged actively in the mineral industry are able to find time to read up extensively in technical literature, however much they realize the importance of being fully and accurately informed on all that is going on about them in their own branch of industry. Such busy people will eagerly welcome "The Mineral Industry," each year as it appears from the press, for they find in it a maximum of the information that they need, at a minimum of expense both of money and time. An outline of the table of contents shows the broad field covered by volume VI. This volume contains a review of the production of abrasive materials and their uses, including carborundum, corundum, crushed steel, diatomaceous earth, emery, garnet, grindstones, pumice, quartz crystal, tripoli and whetstones. Special articles on Carborundum, by E. G. Acheson; The Garnet Industry of the United States, by F. C. Hooper, and the Volcanic Ash Deposits of Nebraska, by Erwin H. Barbour. The Mineral Industry, published by the Scientific Publishing Co., 253 Broadway, New York; price, $5.

The "Engineer's Hand Book," just published under the auspices of the Canadian Association of Stationary Engineers, is a handy pocket volume of 286 pages, and contains about 130 pages of tables and information for every day use by steam users, engineers and firemen. Besides a vast amount of data for engineers it contains a short history of the association and its aims. J. G. Robertson, the Executive secretary, assisted by J. J. York, O. E. Granberg, B. A. York and R. A. Ross, E.E., are named as the principal compilers, and well they have done their work It would be hard to find a book in which so much information is packed into so small a compass.

"Friction and Lubrication" is a pamphlet published by the Joseph Dixon Crucible Co., Jersey City, U. S., which describes the excellencies claimed for the preparations of graphite placed on the market by this company. There is also issued by the same company "Graphite as a Lubricant," which treats more extensively of the same subject.

The Ingersoll-Sergeant Drill Co. has issued a new catalogue, No. 32, which illustrates and describes the air compressors built by this company. Separate pamphlets are also issued to describe special installations. One of these describes the plant of the contractor of the Jerome Park Reservoir, New York, who has adopted a compressed air system. The work of excavation involves the removal of over 7,000,000 cubic yards of material, about half of which is rock. The field of operations covers an area of 1½ miles by ¾ of a mile. A compressed

air plant is located at a central point and pipe lines are laid to the points where the work is to be done. At these points are located hoists, pumps, drills and other conveniences for the work, all of which is described in a pamphlet sent out by the company. The Jas. Cooper Mfg. Co., ltd., Montreal, builds this machinery in Canada and Newfoundland.

We have received a very instructive book on "Water and Water Supplies," by John C. Thresh, D. Sc. (London), M.D. (Victoria), Ph. D. (Cambridge), Medical Health Officer to the Essex County Council, Lecturer on Public Health, King's College, London; Editor of the Journal of State Medicine, Hon. Sec. Incorporated Society of Medical Officers of Health, Fellow of the Institute of Chemistry, member of the Society of Public Analysts, etc., etc. The book contains 438 pages, besides a number of illustrations of machinery and appliances, which are of great value. It fully explains and carefully describes the properties and composition of waters, rain and rain water, surface water, subsoil water, natural spring water, deep well water, river water, quality of drinking water, etc. Impure water and its effect upon the health is discussed and the interpretation of water analysis and the pollution of drinking water. The self purification of rivers, the purification of water on a large scale, domestic purification and the softening of hard water are taken up. The quantity of water required for domestic and other purposes, how to select the source of supply wells and how to construct them, pumps of the best kind and pumping machinery, the storage of water, the distribution of water, the law relating to water supplies in Great Britain, are among the other subjects discussed, together with a vast amount of important information necessary for engineers and persons interested in towns or domestic water supplies.

Industrial Notes.

A new public hall will shortly be erected at Millerton, N.B.

The St. Vincent de Paul hospital at Brockville, Ont., will cost $4,000.

The Bushnell Oil Co., Sarnia, Ont., has bought the receiving tanks at Bothwell.

A new hotel to take the place of the burned Clifton House, Niagara Falls, Ont., will probably be erected at a cost of $500,000.

Jno. McGuirl, who was burnt out at Moosomin, Assa., with heavy loss some time ago, will rebuild his wood working factory.

The masons are making good progress with the new buildings of the Deseronto, Ont., Iron Company, and the walls are steadily rising. The carpenters are also at work.

The contract for alterations and additions to the Brantford, Ont, Box Company's works has been let to P. H. Secord. The work is to be completed by 15th September.

The Rathbun Company, Deseronto, Ont., has cleared the ground of the debris caused by the burning of their terra cotta works, preparatory to the erection of new buildings.

D. F. Maxwell, C.E., has been ordered by the St. John City Council to prepare plans for the proposed wharf extension, which are to be filed with the Dominion Government.

The Hamilton Bridge Works, Hamilton, Ont., is very busy and intends to increase its staff. It recently advertised on one day for a stationary engineer, two blacksmiths, four machinists, two punchers and two air riveters.

A. Kellar, Detroit, Mich., wants a free site and a loan of $5,000, in consideration of which he will move the business of the Michigan Heater Co., of Detroit, to Winnipeg. The company is engaged in the manufacture of stoves and furnaces.

J. H. Connor & Son have just completed a new washing machine factory in Jane street, Ottawa. It is three stories high and is operated by two electric motors. The productions of the new factory will be washers and wringers. The damage reported in the firm's late fire was greatly exaggerated, the actual loss being only about $600.

The contract between F. Thompson & Company and Lennoxville, Que., for the building of a system of waterworks for the village of Lennoxville, was signed July 27th, and work was commenced upon the undertaking the next day.

Thos. H. Murphy has purchased from the St. Clair Tunnel Co. all the air locks, rams and fittings used in the construction of the tunnel under the St. Clair. The plant will be used in the contract for the construction of the drainage tunnel in Chicago.

B. D. Hanna, of the Dauphin Railway, has secured some samples of red oxide which were found by a Dauphin man about twenty miles south of Birch Island, in Lake Winnipegosis, Manitoba. If the quality is good the deposits will be of immense value, as there are great quantities of it.

The Shawinigan Water and Power Co. is offering special inducements to manufacturers to locate on the St. Maurice River, Que. Large limits of power may be secured, as this is one of the largest powers in Canada. Information may be had from the company, 1724 Notre Dame Street, Montreal.

Engineer Hibbard, who took soundings for a new bridge at Arnprior, Ont., has sent a report to the town council recommending a two-span bridge with one pier, along with the usual abutments. The cost is estimated to be in the neighborhood of $10,000.

A. Rosseau & Co., Montreal, have been awarded the contract by the city of Quebec for the bridge to replace Bickell's bridge, together with the dam, for the sum of $23,000. The dam or lock is intended to keep the water at a uniform height of twelve feet at low tide around the Victoria Park.

The necessary stock has been subscribed for the proposed scissors factory in Brantford, Ont., occupying a portion of the old Waterous building. The provisional directors are: J. F. Watt, W. R. Turnbull, R. W. Robertson, George Heyd and W. F. Cockshutt.

The annual report of the city engineer of Halifax, N.S., shows that the city water mains have been carefully cleaned during the year, the Kennedy-Keating scraper being used. The engineer also comments on the fact that no progress has been made in the proposed garbage disposal works during the year.

Rhodes, Curry Co., Amherst, N. S., have been awarded the contract for building the Intercolonial Railway pier and sheds in Halifax. The pier will be 600 feet long by 160 feet wide. The plans are completed for the elevator and Hon. W. S. Fielding is said to have promised that the elevator will be open by Dec. 1st.

The committee considering the sewage question in London, Ont., has reported to the city council in favor of the system of the International Sewage Purification Company, Detroit. The plant is to cost $41,300 and the annual expense of operations to be $2,800. Willis Chipman, C.E., is to make a report on the proposed plant.

Mrs. E. J. Sanford, Knoxville, Tennessee, daughter-in-law of Hon. W. E. Sanford, Hamilton, Ont., has given C. Mills, architect, Hamilton, instructions to prepare plans and specifications of a memorial cottage to be erected on the grounds of the Consumptive Sanitarium Association at Gravenhurst, Muskoka.

A license to manufacture in Canada has been granted to the Galena Oil Co., Toronto.

The new iron tank erected by the Edwardsburg, Ont., Starch Co., is nearing completion. It is to contain the water supply of the village, and is forty feet in height, and holds something like 90,000 gallons of water, standing on four legs which are strongly braced. These are sixty-five feet in height, a total height of 105 feet. Two filters are now being installed by the Caledonia Iron Works, Montreal.

The Department of Trade and Commerce has issued a circular calling the attention of manufacturers and others in Canada to the industrial and arts exhibition to be held at Grahamstown, South Africa, from 15th December this year to the 21st January next. Parties wishing to exhibit are asked to make application for space as early as possible, and are notified that arrangements will probably be made for the free transportation of goods to Cape Town. In all likelihood the Government will despatch a vessel direct from Canada to the Cape for the transportation of exhibits, if sufficient are forthcoming to guarantee a full cargo. Parliament, last session, voted an appropriation of $5,000, which can be devoted to this purpose.

Wray & Hawkshaw, Lucan, Ont., have decided to rebuild their flour mill recently destroyed by fire.

The Davis Dry Dock Co., Kingston, Ont., has supplied a compound engine to F. W. Fearman, Hamilton, Ont.

The contract for heating and ventilating the new St. Thomas schools has been given to the Pease Furnace Co., of Toronto.

The Pennsylvania Sanitation Co., Philadelphia, has offered to install a sewerage treatment system in London, Ont., which would treat one million gallons daily at a cost of $1,000 per annum. The bacteria method of purification would be employed.

Dr. Bryce, Toronto, secretary of the Ontario Board of Health, spoke to the town council on a system of sewage for Galt, Ont., recently. Dr. Bryce's address was of considerable length and he urged the people of Galt very strongly to establish a sewage farm at once.

A boiler in Chas. Betts' stave mill, Sycamore (near Coatsworth), Ont., exploded July 15th, instantly killing Jas. Pain, a mill hand, John Rambo, fireman, and fatally injuring Chas. Betts, owner of the mill. The Ontario Government has ordered an investigation to be held.

E. J. Rainboth, C. E., E. S. Leetham, R. G. Code, Ottawa; G. C. Rainboth, Aylmer, Ont; A. J. Rainboth, Hull, Que., have been incorporated as the Ottawa Suburban Waterworks Company, Limited, to supply gas and water to the villages of Hintonborough and Ottawa East. The capital of the company is $10,000.

On July 12th the Bushnell Oil Co., Ltd., Sarnia, Ont., bought the Petrolia Oil Co., Ltd., Petrolia, Ont., for $4,000, and the Petrolia Crude Oil and Tanking Co., for $17,000, and on the 14th the same company bought the Petrolia Oil Co., Ltd., Sarnia, Ont., for $4,000, and the works of J. R. Minhinnick, London, Ont., for $4,000.

W. H. Croker has completed plans for a large addition to the Tudhope Carriage Company's Works, Orillia, Ont. It will be a four-story building, 50x120 feet. The new building will be used for a warehouse, and will have a floor space of 6,400 square feet. an addition 24x100 feet is also to be made to the woodworking department.

The following contracts have been entered into for the Charlottetown, P. E. I., sewage works: Vitrified pipe, Dodd & Rogers; hard stone, George Battye, Wallace, N. S.; grey stone, John F. Robertson; Portland cement, Dodd & Rogers; brick, Carvel Bros.; pumping engine, the Geo. F. Blake Mfg. Co.; boiler, etc., T. A. McLean.

The new steel bridge over the west branch of the Winnipeg river, Rat Portage, Ont., is now completed, except the approaches, which are to be of earth filling. The construction has been in the hands of T. Jevons, of the Peterborough Bridge Co. It is one of the largest highway bridges in Ontario, the main span being 222 feet in length.

The following tenders were received by the town of Listowell, Ont., for putting in waterworks plant: Clark & Connelly, Toronto, $13,647; McQuillan & Co., Montreal, $14,225; Hill & Gowanlock, $14,899; J. H. McNight, Toronto, $15,173; S. H. Craig, $16,800; J. M. Wallace (piping and trenching only), $6,795. Clark & Connelly were awarded the contract. The firm is installing a waterworks system in Mount Forest, Ont.

The 1898 catalogue of the Sun Bicycle Works shows that the proprietors, G. T. Pendrith & Co., 81 Adelaide street west, Toronto, are steadily gaining popularity with their wheels. "The Sun" wheel and the "Lakeside" are the two special makes of this firm. The latter for a cheap wheel is excellent value, and a Montreal purchaser of one of them informed the writer that her wheel, which cost $55, would pass for an $85 wheel anywhere.

At a special meeting of the Lachine Council, held July 13th, a by-law was adopted granting a bonus of $15,000 to Geo. Barrington & Sons, trunk manufacturers, Montreal, for which the firm will establish their factories in Lachine, Que. The conditions under which the bonus is granted include that the buildings and machinery to be erected to have a value of not less than $25,000, the erection of two factories, the permanent employment of 80 hands, the payment of $25,000 annually in salaries, proper insurance against fire, etc. The bonus will be paid when the factories are in full operation.

The rebuilding of the Truro, N S., condensed milk and canning factory is progressing rapidly. The new buildings are to be roofed entirely with iron and the contract has been let to an Eastern firm. Roofs of this class are rather uncommon in Nova Scotia.

Incorporation has been applied for by the London Cold Storage and Warehousing Company, Limited, to build and operate a storage warehouse and ice factory in London, Ont. The incorporators are T. H. Smallman, John Labatt, M. D. Fraser, etc., all of London, Ont. The proposed capital is $75,000.

Railway Matters.

The G. T. R. will construct 250 refrigerator cars for the general service of the system.

A. H. Harris has resigned the position he occupied on the Intercolonial system of railways as traffic manager, and the office itself has been abolished.

Hawkesbury, Ont., has voted a bonus of $7,500 to the Canada Atlantic Railway, to build a siding to accommodate the proposed Riordon pulp mills in that town.

The C. P. R. has under consideration the construction of a branch line of the road to Brantford, Ont. Woodstock being the point at which the connection with the main line will be made.

Neil Keith, railway contractor, is building the C. P. R. branch from Killarney to Hartney, Manitoba. It is understood that Mr. Keith will also build a branch line from Reston to Moose Mountain.

The surveying of a route for the proposed railroad from Amherst, N. S., to the North Shore via Truemanville and Chapman settlement, has been decided upon by the Amherst and Eastern Railway Co.

The Master-in-Ordinary at Osgoode Hall, Toronto, has accepted the tender of Geo. M. Neelon, St. Catherines, Ont., for the purchase of the St. Catherines & Niagara Central Railroad. The bid was $35,000.

The Grand Trunk Railway is renewing the bridges between Island Pond and Montreal. The iron bridge over the Magog and the bridges at Massawippi, Lennoxville, Brompton and Richmond are among the number.

The G. T. R. celebrated the semi-centenary of its Portland line, July 4th. During this time the lines have been extended from 292 miles to 4,186 miles. Fifty years ago the passengers carried numbered 686,924, and in 1897 there were over 8,000,000.

O'Brien & McDonald, Renfrew, Ont., railway contractors, have a contract in Nova Scotia, to build a railway across Hants County between Windsor and Truro. The work which O'Brien & McDonald have consists of twenty miles of grading and sixty miles of ballasting and track laying.

The suggestion that railway employees should be subjected to a severe physical examination and course of technical instructions before being allowed to assist in the operating of trains and switch yards, has been made by the Association of Railway Surgeons in session at Toronto. The association elected as president for the ensuing year, Dr. Bruce L. Riordan, the G. T. R. surgeon at Toronto.

The contract between the city of Quebec and the Great Northern Railway Company has been signed by Mayor Parent and the Hon. P. Garneau, president of the railway company. By this agreement the city invests $200,000 in the stock of the Great Northern and the latter is to give Quebec railway connection with the Booth system, thus making Quebec an exporting port for the Parry Sound traffic.

H. D. Lumsden, C. E., of the Canadian Pacific Railway, who has been engaged at the head of several surveying parties, whose object was to secure a good route for the railway that company contemplates building from a point north of Toronto to Sudbury, Ont., states that a first-class line has been secured, and one where few engineering difficulties are met with. It is pretty well understood that the C. P. R. will enter upon the construction of the road without delay.

The Canadian Pacific will probably extend its Point Fortune branch of the Montreal and Ottawa to Hawkesbury, Ont.

A building 50 feet wide by 100 feet long will shortly be built on the G. T. R. car shops property, London, Ont. It will be for the stores department, and will cost about $5,000 or $6,000.

The Pullman Car Company has completed twenty first-class cars for the Grand Trunk, an order which represents over $100,000. The cars are all of the latest design, and will be a great addition to the Grand Trunk's rolling stock.

The Ontario Public Works Department has received information that the Pembroke Southern Railway, running from Pembroke to Golden Lake, on the Ottawa, Arnprior & Parry Sound Railway, a distance of about 20 miles, will soon be completed. The new line, which crosses the townships of Pembroke, Alice, and Wilberforce, and, after spanning the Bonnecheres river, connects with the O. A. and P. S. Railway, in the township of South Algoma, will, when completed, give Pembroke a competing line with the C. P. R., and will open up a very fair agricultural country. The railway is being constructed by Contractor Poulin, formerly chief engineer for the Parry Sound Colonization Railway.

W. D. Reid, son of R. G. Reid, the Newfoundland railway contractor, when in Montreal recently, stated that they had run a train through from St. John's to Port aux Basque, the terminus on the west coast, in twenty-four hours, the distance being 550 miles. The trial trip was made, however, under most favorable auspices, and the whole distance from east to west was run on schedule time. It is Mr. Reid's intention to establish hotels at different points on the system, so that when the expected influx of tourists, business people and sportsmen sets in, they may be comfortably provided for at whatever section of country they see fit to visit. At present Mr. Reid's steamer, the Bruce, makes two trips a week between Placentia and North Sydney, but with the railway to Port aux Basque the boat will run to that port three times a week, the distance across being made in six hours, and giving Newfoundland a tri-weekly mail to and from the Dominion of Canada. The establishing of separate steamship lines connecting the settlements along Placentia, Trinity and other bays, on south, east and west coasts, with his railway system, is also another important feature in Mr. Reid's vast enterprise in Newfoundland. Plans for seven of these steamers are now being prepared, six for the trade just mentioned, while the other is intended for the Labrador traffic. These vessels will be about 250 tons register, and besides being good freight carriers, will possess superior accommodation for about twenty first-class and from fifty to sixty second-class passengers. They are to be built on the other side of the Atlantic, and while some of them will be placed on their respective routes next spring, the remainder will commence the service a year later.

Marine News.

The steamer "D. L. Mather" was burned to the water's edge at Rat Portage, July 26th. It was insured for $8,000.

The Standard Oil Co. is negotiating with the Canadian Locomotive and Engine Works Co., Kingston, Ont., for the building of a number of steel tank barges to carry oil from the refineries to the distributing points.

The launch of the Dominion Atlantic Railway Company's steamer "Prince Arthur" took place at Hull, England, July 19th. W. R. Campbell, the general manager of the company, was present.

The Richelieu & Ontario Navigation Company will, it is understood, have another boat built at the Bertram yards as soon as the "Toronto" is launched. It will be called the "Kingston," and will be constructed on the same model as the "Toronto," and will cost $250,000.

Lieut. Porter, of the U. S. Cruiser "Yale," has been appointed to command the Rita when she is turned into a transport. He was the officer who commanded the prize crew when she was first captured. Mr. Porter is a son of the Rev. W. H. Porter, Brantford, Ont.

Petersen, Tait & Co. have been notified by the Canadian Government that the fast mail contract must be considered at an end. Petersen's firm will forfeit its deposit of £10,000.

An Ontario charter has been granted to W. J. Brown, Mrs. A. A. Brown, and John McLean, manufacturer, Detroit, U.S.; and T. Mulvey, and J. L. Galloway, Toronto, Ont., as the Georgian Bay Navigation Company, limited, with a capital of $20,000.

T. Eaton's steam yacht the "Wanda" was built from the designs by E. Redway, marine engineer for the Polson Iron Works, Toronto. The dimensions are: Length over all, 55 feet; beam, 3 feet 2 inches; draught, 3 feet 8 inches; displacement, 9 tons; triple expansion engines, 5½, 8½, and 14 inches, with 8 inch stroke; boiler, improved Yarrow carrying 200 lbs. pressure; indicated horse-power, 100; estimated speed, 16 miles per hour. The yacht cost $6,000.

Canadian Pacific Navigation Company are arranging for the building of a fast steamer for the route between Victoria and Vancouver, to give a daylight service. The plans are out, but at present the shipbuilding firms of England and Scotland have too much work on hand to undertake the contract, so it may be a considerable time before the work is begun. The new vessel will, it is said, be much larger than the "Charmer," and faster than any steamer now in service on the Pacific coast.

Last fall the United States government put surveyors on the route of the proposed Michigan-Erie canal, and the chief of the party has just made his report, and he says the canal would not be a difficult work to construct. The line would be from Benlow harbor on Lake Michigan to the Maumie River at Toledo. That would reduce the distance from Chicago to Toledo to 101 miles, a saving of over 900 miles over the present route from Chicago to the mouth of the Detroit River by way of Lake Michigan, Straits of Mackinac and Lakes Huron and St. Clair, and a canal to pass vessels of the heaviest tonnage of the lakes would cost about $40,000,000.

As soon as the proposed Montreal harbor improvements are commenced the Richelieu & Ontario Navigation Company's boats will have to take up new quarters. General Manager Gildersleeve has already made the necessary arrangements. The Quebec steamers are to lie where the "Laprairie" berths now, at the front slip below Jacques Cartier wharf, while the "Laprairie," "Cultivateur," "Three Rivers," "Terrebonne," "Berthier," and "Chambly" will rendezvous at the Victoria pier, or in adjacent slips. New sheds will have to be erected for freight.

Electric Flashes.

Street railway construction is being rushed in St. John's, Nfld., under Engineer Massey.

Galt, Ontario, will shortly vote on a by-law to provide for taking over the town's gas and electric lighing plant.

The Napanee Electric Light & Water Co. has ordered from the Royal Electric Co. a 35-k.w. two-phase generator and 500 light capacity in transformers.

The by-law to raise $19,500 for waterworks and electric light purposes in Listowell, Ont., was defeated, July 6th, by a majority of 71 votes, on a total vote of 427.

English capitalists have secured a controlling interest in the New Westminster and Burrard Inlet Telephone Company. The lines of this company extend over a considerable area.

The proposed Lanark-Perth electric railway is being revived. The subscribed capital is now said to be sufficient to build the road, and the company undertakes to complete it by April 1st next.

The town of Thorold, Ont., will receive tenders to Aug. 17th for an incandescent lighting plant of 1,500—2,000 lights, alternating current, according to specifications prepared by R. J. Parke, consulting engineer.

The desire for cheaper telephone service has induced the organization of a company in London, Ont., to rival the Bell Co., and give a house service at $18 and office for $25. Several strong local capitalists are interested, including Col. Leys, John Labatt and John Milne.

The Electric Street Railway, Cornwall, Ont., is building a deep water wharf at St. Lawrence Park.

The Jenckes Machine Co., Sherbrooke, Que., has the contract for installing the lighting plant at Granby, Que.

David Spiers, Galt, Ont., has bought a water power, and may install a power plant if satisfactory arrangements can be made.

The Ottawa Electric Railway is putting its employees on a ten-hour day instead of the eleven hours which had caused some friction.

The West Kootenay Power and Light Co. is now delivering 1,000 h.p. in Rossland, B. C., from its generators at Bonnington Falls, B. C., 30 miles away.

Mrs. Wm. S. Dockrill, Montreal, has ceased to do business alone under the name of W. S. Dockrill & Co., and has formed a partnership under the same name, as electrical engineers with Ernest W. Sayer.

McCurdy & Co., of Antigonish, N. S., are enlarging their electrical plant and have a contract to light the streets of the town. A 60-h.p. engine and boiler have been ordered from the Robb Engineering Co., Amherst, N. S.

McCurdy & Co, Antigonish, N. S., are enlarging their electric light plant and have a contract to light the streets of the town. A 60-h.p. engine and boiler has been ordered from the Robb Engineering Company, Amherst, N. S.

At a meeting of the special committee of the Hamilton city council, on civic electric lighting, it was decided to recommend the council to engage Roderick J Parke, Montreal, consulting electrical engineer, to report on the cost of establishing and operating a civic electric light plant. The council, however, overruled the committee and engaged Percy Domville.

The Niagara Falls Park & River Railway Co., are now running cars every five minutes over the upper steel arch bridge. The first car was run over, July 1st, with Supt. Rothery at the motor. Manager Phillips of the N. F. P. & R. R., and Supt. Dill, of the new bridge, were on board.

The Crow's Nest Pass Coal Company, ltd., Fernie, B. C., has placed an order with the Royal Electric Co. for 2 25-k.w. direct current generators wound for 250 volts, from which is to be operated a trolley-car equipment for drawing coke to the smelters and also mining, hoisting and lighting apparatus.

The London, Ont., Electric Co. is now installing two 100-k.w. direct current power generators, and a 300 k.w. alternator of the revolving field type, from the Canadian General Electric Co. The power generators will be operated by two engines of 250-h.p. each, made by E. Leonard & Sons, of London.

Edward Slade, electrical contractor, Quebec, is putting in a dynamo, and the necessary wiring for the electric lighting of Capt. Boldue's new steel boat the "Orleans," plying between Quebec and Ste. Petronille. Mr. Slade has got the contract for wiring the SS. "Champion," and also the Beaufort Asylum, 600 lights.

C. E. Shedrick, who manufactures in Canada the apparatus of the Whitney Electrical Co., will again occupy a portion of the Sherbrooke, Que., Gas & Water Co.'s building recently destroyed by fire as soon as it is ready for him. The business, which has been rapidly increasing in volume, will not be injured by the fire to any great extent.

R. A. Bayley, sec.-treas. of the People's Telephone Co., of London, Ont., has written to the Mayor of Hamilton, Ont., requesting that that city do not grant a franchise to any parties for a telephone company without communicating with it. This is in connection with the movement to establish local telephone companies in each town in Ontario in opposition to the Bell monopoly.

H Alabaster, Gatehouse & Co., publishers, 4 Ludgate Hill, London, E. C., announce that the 1899 edition of the "Universal Electrical Directory" is in course of preparation for its 18th annual issue in January next. Manufacturers and others interested would do well to send in their names at once so as to be included in the forthcoming edition. No charge for such insertion is made.

Some Galt, Ont., people have formed a scheme for the construction of an electric road from New Hamburg to Galt through Haysville, New Dundee, Roseville and Blair.

Paris, Ont., wants to secure C. P. R. connection by building an electric line from Paris to Ayr, Ont. The promoters are asking for no bonus, but simply for the right of way through the municipalities, a distance of seven miles.

A scheme is on foot to connect Brantford, Ont., and Port Dover electrically, a new line being built from Port Dover to Waterford, and the T. H. & B. tracks being used from there to Brantford. The proposed line is to be known as the Brantford & Port Dover Railway.

The poles for the Cataract Power Co. are now all up between Hamilton and Decew's Falls. Four heavy copper wires are strung from Hamilton to Stoney Creek, about one-quarter of the total distance, and the balance will be strung at the rate of two miles a day. The insulators are being tested at an average of 600 per day, and are tested up to 70,000 volts.

Ontario charters of incorporation have been granted to the following companies: "The People's Telephone Company, of St. Thomas, ltd.," with a capital of $60,000, and the following projectors, A. E. Wallace, E. A. Smith, F. M. Griffin, S. Chant, W. H. Murch, D. McLarty, T. W. Duncome, J. Campbell and A. McCrimmon, of St. Thomas, and H. C. Walters and R. H. Evans, of Detroit, and also to the "Electric Cloth Cutter Company of Toronto, ltd.," with a capital stock of $40,000.

Notices are being sent out to the creditors of the Hamilton Electric Light & Power Company, asking them to send in their accounts for settlement, in view of the taking over of the company's business by the Cataract Power Company. This is understood to refer to a bargain by which the Cataract Power Company undertakes to supply power for fifteen years, and will share in the expected increased profits, but the Hamilton Electric Light & Power Company will not be absorbed, but will continue in existence. It is said the bargain also permits the Cataract Power Company to supply power to the city if the latter goes into the electric lighting business.

The Canadian General Electric Company is manufacturing an incandescent lamp called a "night lamp." It has a device by which it can be changed from 16 c.p. to 1 c.p. The transformation from 16 to 1, or from 1 to 16 c.p., is effected by turning a small screw on the side of the lamp. The current consumed by the lamp when burning at one candle power is less than half of that which it requires at 16 candle power. In appearance, the night lamp resembles the ordinary 16 candle lamp with its bulb frosted. The peculiar construction of this lamp which gives it its double nature, consists in dividing the carbon filament into two sections, one of which is switched into circuit when 16 candles are desired, and both sections—one in line with the other—when only one candle is desired. The additional resistance causes the filament to give out less light.

Henry Symons, Q.C., has just returned from England, where he had estimates prepared for the construction of the proposed works of the Welland Power & Supply Canal Company. This project involves the construction of a canal from the Welland River to the brow of the Mountain at Thorold, a distance of 8 miles, the construction at Thorold of a power house, and from Thorold to Lake Ontario, a raceway by which to carry water into the lake. In addition to these different works, estimates were obtained for the construction of a transmission line from Thorold to Toronto by way of Burlington Beach. The estimates obtained by Mr. Symons were prepared by Dr. Hopkinson, F.R.S., one of the leading electricians of Great Britain; Sir Douglas Fox, Edmund Wragge, late of Toronto, and W C Unwin The estimate for the machinery to generate 100,000 horse power is £125,000, for transmission line to Toronto at a voltage of 10,000 and delivery of 50,000 horse-power, £801,600; for excavation and other work connected with the undertaking, £1,525,062 The total estimate therefore amounts to £2,452,162, or roughly speaking, $12,000,000. If the amount to be delivered in Toronto is reduced to 20,000 horse-power, the project would cost $1,000,000 less. S. Pearson & Son, contractors, state that if the contract could be secured from the cities of Toronto and Hamilton for a considerable quantity of power, for a definite term, there would be little difficulty in raising money for the project by bonds and shares in Great Britain.

Mining Matters.

Mica of very fine quality has been discovered near Arkell, Ont.

A steam plant is being installed on the Atlantic Cable mine, Rossland, B.C., owned by William Caldwell, Toronto.

Rich quartz is reported from the township of Dysart, Haliburton, Ont. It is also stated that beds of sand containing gold exist in the same locality.

Efforts are being made to develop natural gas extensively at Humberstone, Ont, with a view of inducing manufacturers to locate in that neighborhood.

The Summer Mining School maintained at Rat Portage, Ont., by the Ontario Government is conducted this year by J. Watson Bain, B.A., Sc., of the School of Practical Science, Toronto.

The War Eagle mine of Rossland has let a contract to the Wellman & Sevver Co., Cleveland, Ohio, for the construction of a large steel gallows, frame and hoisting apparatus, at a cost of $20,000.

The Donnelly Bros., Kingston, Ont., have purchased all the plant of the Frontenac Oil Company at Fredericksburg. The plant consists of steam engine and boiler, 15,000 feet of 8-inch pipe, drill, derrick and tools.

The Kaladar and Anglesea Gold Mining Company will at once begin the erection of a separating plant on its property at Bridgewater, Ont. The work will be performed under the direction of Dr. Eames, the company's assayist.

A company has been formed in Vancouver, Ont., to dredge for gold in the rivers of the Yukon district. A special pneumatic caisson and air-lock elevator will be used, which it is claimed will make the work of dredging to bed rock easy. H. Abbot, R. G. Tatlow, J. W. Campion, S. O. Richards and Major C. C. Bennet, Vancouver, are interested in the company.

The Harris Sulphur and Copper Company, Glasgow, Scotland, has secured options on several copper mines in Newfoundland, which were secured by an expert sent out to examine them. These properties include the Colchester, Robert's Arm and Sunday Cove mines, all situated on North Dame Bay, as well as a lease of the Silver Cliff mine on Placentia Bay.

R. Prefontaine, M.P., J. R. Fair, Montreal; C. A. Chenevert, Berthierville; A. Brosnan, J. U. Gregory, Quebec; C. King, Sherbrooke; L. F. Morrison, Saint Hyacinthe; C. Nelson, Montreal, and W. de F. Nelson, Saint Paul, U.S.A., have secured a Quebec charter as the Eastern Townships Chrome Iron, Mining and Milling Company, Ltd. Capital, $50,000; headquarters, Montreal.

Archibald Blue, Director of the Bureau of Mines, has received a letter from Prof. W. L. Goodwin, Principal of the Kingston School of Mines, stating that the summer mining at Parry Sound had proven a great success. In all 51 students had attended, and the daily average attendance had been 20. The school at Mattawa had been, he said, even more successful. There 72 students had come, and the average attendance had been 45, and there was no indication of a falling off. The bureau has divided their summer school between the School of Science and the Kingston school, the former taking the district west of Michipicoten and the latter Michipicoten and the territory east.

The officers of the Toronto Smelting Company, Limited, Madoc, Ont., are James Kendry, M.P., Peterboro, president, J. B Hay, Toronto, 1st vice-president, F C. Flannery, Toronto, sec.-treas., and W. A. Hungerford, M E., Belleville, general manager. Two smelters of five and fifteen tons capacity respectively have been put in for the smelting of ore and the manufacture of mineral wool. Mr. Burton of St. Louis, Mo., has charge of the smelters; Mr. Norman, a gold medalist graduate of the school of mines for the State of Missouri, is in charge of the assay department, and George Lee, of Staffordshire, England, superintends the roasting of arsenical ores.

As showing the extent of the work going on in Rossland at present a western contemporary states, when speaking of the recent driving of a tunnel between the Le Roi and the Black Bear mines. "Only a very few feet of work would be necessary to drive a shaft from the Le Roi's workings to those of the Centre Star, and if this is ever done it would give a continuous underground passage from the Black Bear through the Le Roi into the Centre Star, thence into the Iron Mask and from there to the War Eagle, for the workings of the latter mines are already connected. From the War Eagle it would require only a few feet of work to connect with the Poorman, and as the latter already opens into the Josie, it would thus extend the chain of connecting properties through to the latter mine. The horizontal workings thus connected would measure about three miles in length."

The Cumberland Railway and Coal Co has a contract for 50,000 tons of coal for the I.C.R.

The Grand Calumet Mining Co., Calumet, Que., has made a trial shipment of 250 tons of ore to Belgium.

J. E. Hardman, B.Sc., of Montreal, spent some time in the Whycocomagh district of Cape Breton recently, in the interest of Canadian capitalists.

Wallace Bell, well sinker, St. Lawrence street, Montreal, has gone to Newfoundland, where he will help in developing the newly discovered oil regions in the island.

F. H. Drew, Michipicoten, Ont., reports the discovery near Lake Wawa of a vein of copper-bearing ore very much like that in the famous Calumet and Hecla mine, Michigan.

Gold is reported from Chelsea, Molega, Lunenburg county, N.S., and prospectors are said to have cut a large and rich looking lead there, which shows gold very plainly in the outcrop.

The Boston Company developing the oil wells of Lake Ainslie, Cape Breton, are progressing favorably with the work. They have lately received 16,000 feet of wall casing which will be utilized in the work.

W. J. Hopgood, Spring Garden Road, Halifax, N.S., has chartered a small schooner which will carry provisions, implements and mining men necessary to prospect for some time on the coast of Labrador, where traces of gold have been reported.

The Ingersoll-Sergeant Drill Co., New York, has just issued a new air compressor catalogue, No. 32, which illustrates and describes the compressors which are making such a name for themselves on the Canadian market, for which they are manufactured by the Jas. Cooper Mfg. Co., Ltd., Montreal.

The old Bruce Mines, near Thessalon, have been taken over by Lord Douglas, of Hawick, on an option, writes an associate of this gentleman, to the Bureau of Mines. For some time past Lord Douglas has had experts at work on the mine, and their reports have been very encouraging.

E. R Faribault, of the Geological Survey, Ottawa, is at present at work in Nova Scotia. He will survey Renfrew, South Uniacke, and Mount Uniacke. After these districts are covered, he will remove to Halifax and from there go over Cow Bay, Montague, Lake Catcha and possibly Lawrencetown and Tangier.

A deposit of manganese has been located at New Ross, Lunenburg Co., by Charles Keddy and W Rafuse, on the property of Peter Benjamin of the above place. It is said that several barrels of the outcrop were sent to New York to be tested, and the reports received are said to give ore values of from $15 to $60 per ton.

The Government has refused to prohibit the exportation of natural gas from Ontario, as requested a few weeks ago by the largest deputation that ever visited Ottawa. The people of Essex asked, failing total prohibition, for a heavy export duty. This, too, has been refused. Permission has been given the American concern—the Interior Construction and Improvement Company—to lay two new conduits from the town of Sandwich to Detroit, and to convey across the border up to three billion feet of gas per annum. This is accompanied by some conditions which may not be enforcible. At the end of three years the company which is now reaching out into Ohio, is to confine its operations to Detroit. It is provided that natural gas must at all times be sold in Canada at ten per cent. lower than the lowest price at which it is sold at any other point, and that the selling price in Canada at any well, or on the highway nearest the well, shall not exceed five cents per thousand feet. The company is forbidden to use artificial means for drawing gas from the wells.

From Sault Ste. Marie Prof. A. P. Coleman, of the Provincial Crown Lands Department, writes his chief, Director Blue, of the Bureau of Mines, as follows: "We have just returned from a ten days' trip down the St. Mary's River, and along the north shore of Lake Huron as far as Thessalon. We visited Garden River, Echo Lake, Bruce Mines and Thessalon, making a survey of the shores and pushing a few miles inland at each place. The more important mines along the shore and inland have been visited, with the exception of the placers near Thessalon, where we found no work is at present going on. We hope to see them later in the summer. The most interesting point was, of course, Bruce Mines. We found the Cleveland Company at work with more than forty men at the quarry of 'trap' or diabase, for the boulevards of that city. Mr. Spence, who is managing the operations at the quarry, says that these roads cost at present $2 per square yard, and that the surface, when complete, is far better than asphalt, not having the slippery character of the latter in rainy weather, and being far more durable. This pavement might be introduced into Toronto for good residence streets."

Considerable interest has been aroused in England over the discovery of corundum in the township of Carlow, Hastings county. Ontario corundum, it will be remembered, is a valuable substitute in the manufacture of abrasive wheels, and is also one of the chief bases of aluminium. In an editorial the London (Eng.) Mining Journal discusses at length the discovery of the mineral in Hastings and speaks about its possibilities as a commercial product. The Journal notes the fact that the deposits have been traced through over seven different townships over an area of about 100 square miles, and goes on to give in detail the circumstances surrounding the discovery of the deposits and its exploration by private parties and agents of the Ontario Government. The Journal then proceeds to say that in the United States and in Europe aluminium is produced chiefly from kaolin and cryolite, which contain a smaller percentage of the finished metal than does corundum. The only known valuable cryolite mine is in Greenland, where mining operations are conducted with much difficulty In Ontario these corundum deposits are easy of access and may be worked continuously all the year round As an abrasive material this corundum has already been favorably reported upon by American experts who have examined samples. If it turns out, as seems probable, that the corundum can be smelted economically for the production of aluminium this will give it a value second to none in the mineral resources in Ontario. The tests which have so far been made are merely sufficient to show that successful concentration of the ore is feasible on a large scale. The Mining Journal gives prominence to its editorial and seems to consider the possibilities of the Hastings deposits to be good

Personal

T. J Sabin, contractor, Peterboro, Ont., was drowned in Little Lake, Ont., while fishing

R. Cullen, snperintendent of the sulphite plant in the Riordon Paper Mills, Merritton, Ont., has gone to Hawkesbury, Ont., to superintend the mills to be established there.

Grant Hall, mechanical foreman of the Intercolonial Railway, Moncton, N.B., received notice of dismissal, to take effect on Aug 31. His place is to be taken by Fred G. Hunter

Edward Butler, Government electrician for the Lachine Canal, Montreal, died recently after a three weeks' illness. He was forty-two years old, and leaves a widow and eight children to mourn his death.

Mr. Spencer, formerly an engineer in the employ of the Peninsular and Oriental Steamship Co., running between Bombay and Hong Kong, has located in Galt, and is now employed by the Goldie-McCulloch Co.

James Green, a well-known G T.R engineer, died at Stratford July 13th, aged forty-four years About twenty-three years ago he entered the employ of the G T R, and had ever been a faithful and attentive employee.

John Patton, foreman pattern maker in the Truro Foundry and Machine Co 's works, and one of the oldest employees of the company, lost four fingers from his right hand, owing to it coming in contact with a saw a short time ago.

Andrew Harrison, an employee of the Canada Sugar Refinery &o., Montreal, was killed a short time ago by coming in contact with the transmission wires of the Lachine Rapids Hydraulic and Land Co. while holding on to part of an iron bridge.

Henry Szlapka, engineer and manager of the Hamilton Bridge Works Co., Ltd., Hamilton, Ont., was very successful in the discharge of his duties when on the staff of the New Jersey Steel and Iron Co., Trenton, N J, where he had charge of the designing department.

Joseph Taylor, formerly secretary of the Michigan Peninsula Car Works, and identified for years with some of the most prominent business interests of Detroit, died July 19th at his summer residence, Taylor Point, Sandwich, Ont. Mr. Taylor was 58 years of age, and was born in England, but had spent the greater part of his life in Detroit. He was formerly for ten years chief assistant to the general manager of the Great Western Railroad.

T. B. Speight, of Speight & Van Nostrand, has been commissioned by the Government to run an exploration line due north from the head waters of Goulais River, following the 84th meridian, to the C.P.R. Railway, a distance of 90 miles This is a district that is almost wholly unknown. Mr. Speight will be accompanied by a woodranger and a geologist, W. A. Charlton, who will explore the country for a distance of ten miles on either side of the line, and report upon the timber and mineral resources and the agricultural possibilities of the district.

Joseph Middlemas, engineer at the Deaf and Dumb Institute, Belleville, Ont., has been relieved of his duties.

Jos. McGregor, Nanaimo, B C., has been appointed provincial inspector of metallurgical mines for British Columbia.

George Todd died in Fredericton, N.B., on the 12th ult., at the age of 86 years. He was the originator and manager of Todd's foundry, Woodstock, N.B.

J. N. Young, general manager of the Dominion Construction Company, has removed from Hamilton to Chicago, after a residence in the former city of about nine years.

Leopold Meyer, mining engineer, of California, has moved to Ottawa, Ont, with his family, to live. He has been appointed manager of the Grand Calumet mine, Pontiac county, Que.

Thos. McFarlane, lately chief clerk in the office of the superintendent of motive power of the Grand Trunk Railway, Montreal, died in Brockville, Ont., a short time ago, at his father's home.

Wm. Tye, C.E., formerly of Haysville, Ont., has been appointed chief engineer of the Robson and Boundary Creek Railway at $5,000 a year, and a good bonus if he succeeds in getting it finished on time.

D. McLennan, of the Auditor-General's office, has been appointed astronomical computer to W F. King, chief astronomer of the Department of the Interior. Mr. McLennan is a graduate of Toronto University.

W. J. Weller has been appointed superintendent of bridges and buildings of the Crow's Nest Pass branch of the Canadian Pacific Railway, with headquarters at Lethbridge, Alberta, in place of R. Balfour, resigned.

W. F. Robertson, New York, who has succeeded W. A. Carlyle as British Columbia mineralogist, is a graduate of McGill University, and is very highly recommended by Dr. Dawson, head of the Dominion Geological Survey.

Henry Tandy, of Dunkirk, N.Y., has been appointed superintendent of the Canadian Locomotive and Engine Company, Kingston, Ont., in place of F. J. Leigh. Mr. Tandy was previously connected with the works in Kingston, and is a capable manager.

Thomas A. Harvey, formerly with Moore & Henry, London, Ont., who has recently graduated with the degree of civil engineer from the Rennsselaer Polytechnic Institute, Troy, N Y, has taken a position in the bridge and construction department of the Pennsylvania Steel Company, Harrisburg, Pa.

J. Murphy, engineer for the Cornwall Electric Street Railway, who has taken a good position in Montreal, was presented by the employees of the railway with a beautiful smoking set as a token of their esteem. The present was accompanied by an appropriate address, which was read by Mr. Taylor, superintendent of the company.

Among the Royal Military College graduates who have recently received good appointments are: Capt. A. H. Van Straubenzie, R.E., who has been appointed to the command of the "M" submarine mining company at Chatham. He is a son of Lieut.-Colonel Van Straubenzie, late D.O C., Kingston. Lieut A Adams, R E., third-class, first grade superior revenue establishment of Burmah State railways traffic department, has been promoted to second class fourth grade of that establishment. He is a son of Mr. Adams, architect, late of the Kingston penitentiary staff. Captain A. C. Joly de Lotbiniere, C.E., has been appointed assistant instructor, School of Military Engineering, Chatham.

We regret to record the death, in Montreal last month, of Thomas Hartnell Spurrier. Mr. Spurrier was born in Shepherd's Bush, London, England, thirty-seven years ago, and was educated at Spurgeon's College and afterwards at Regent's Park College. His parents intended him for the ministry, but Mr Spurrier preferred literary and artistic work, and was engaged in painting and newspaper work before coming to Canada He settled in Montreal five years ago and was engaged by McGill Medical College to do the anatomical painting of that institution He also contributed some spirited cartoons and sketches for the daily press as well as for THE CANADIAN ENGINEER. He was very popular among the engineers, his sketches of the annual conventions having been much appreciated A few weeks before his death he had finished the compilation of a book on the "Yukon Region of Canada," which is shortly to be published by a London House. Mr. Spurrier was an agreeable companion and conscientious worker and will be mourned by many friends as well as his family. He leaves a wife and three young children. He had just brought his two eldest children through a severe attack of typhoid fever, which he himself took with fatal result as they were recovering.

METAL IMPORTS FROM GREAT BRITAIN.

The following are the sterling values of the imports of interest to the metal trade from Great Britain during June and the six months ending June, 1897, 1898:—

	Month of June.		Six months ending June.	
	1897	1898.	1897.	1898.
Hardware and cutlery	£6,283	£1,675	£31,930	£11,918
Pig iron	1,847	384	2,865	6, 7
Bar, etc.	808	1,627	5,013	6,737
Railroad	..	7,845	20,286	14,817
Hoops sheets, etc	6,245	5,034	22,690	16,626
Galvanized sheets	3,377	3,187	19,375	24,167
Tin plates	7 981	11,507	88 953	73,475
Cast, wrought, etc., iron	2,369	2,684	17,334	16,342
Old (for re-manufacture)	925	1,571	1,497	3,075
Steel	4,958	3,559	23,438	27,857
Lead	2,806	4,240	7,260	12,290
Tin, unwrought	909	1,698	9,834	10,785
Alkali	3,638	4,273	15,360	21,010
Cement	1,777	1,700	6,555	10,052

FIRE-PROOF BUILDINGS.

BY FRANCIS C. MOORE.

I think it advisable, in an article of this kind, to state, as premises, certain propositions which might be treated as deductions. Some of them are self-evident, and ought to appeal to any practical mind as being truths, rather illustrated than demonstrated by the experience of the past few years. In accordance with this line of treatment, I desire to state by way of premise:

It may be claimed that no construction is "fire-proof," and that even iron and masonry could with propriety be designated as "slow burning." The iron or steel used in a modern building has, in its time, been smelted in a furnace which presented no greater capacity for running metal into pigs than some of our modern buildings, whose interior openings from cellar to roof correspond to the chimney of a furnace, and the front door to its tuyere. If a pyrometer could be adjusted during the progress of a fire it would be found to rise quite as high as in any forge.

Glass windows will not prevent the entrance of flame or heat from a fire in an exposed building. It may seem strange that so obvious a proposition should be thought worth stating, and yet to-day more than 75 per cent. of the "fire-proof" structures of the country have window openings to the extent of from 30 per cent. to 70 per cent. of the superficial area of each enclosing wall without "fire-proof" shutters. Heat from a building across a wide street finds ready entrance through windows, and the several "fire-proof" floors serve only to hold ignitible merchandise in the most favorable form of distribution for ignition and combustion, like a great gridiron, to the full force of a neighboring fire. A recent article on the Pittsburgh fire in The Engineering News aptly expresses this in the following words: "There seems to be some irony in calling buildings 'fire-proof' which opposed hardly anything to a fire from across the street more sturdy than plate glass!"

Openings through floors for stairways or elevators, gas, water, steam pipes, and electric wires, from floor to floor of "fire-proof" buildings tend to the spread of flame like so many flues and should be fire-stopped at each story. This fault is more generally overlooked than any other. Ducts for piping, wiring, etc., should never be of wood.

In view of the fact that it is necessary to cover iron with non-combustible, non-conducting material to prevent its exposure to fire and consequent expansion, and in view of the fact that all ironwork, except cast iron, will rust to the point of danger, it is best to use cast iron for all vertical supports, columns, pillars, etc. It is not advisable, of course, to have floor beams of cast iron (except in the form of Hodgkinson beams thoroughly tested). If a floor beam should give way, however, it might not necessarily wreck the building, whereas if a vital column should give way a collapse of the entire structure might result.

At a convention held some years ago in New York, at which were present a greater number of experts in iron than probably ever met before or since in one room, there was not one who contended that cast iron would rust beyond the harmless incrustation of the thickness of a knife blade, whereas there was not one who did not believe wrought iron would rust to the point of danger; and there was not one who claimed to know whether steel would or not, each admitting that steel had not been sufficiently tested as to rust to warrant a reliable opinion. If it could be relied upon as rust-proof, it would be superior to all other material for "fire-proof" buildings because of its great strength in proportion to weight. The use of steel in construction is growing, because it is cheaper than wrought iron, as lighter weights are used for the same strength, but while supposed to be superior to wrought iron, some of the prevailing impressions with regard to it are erroneous. Defects not possible of detection by tests are liable to exist in its structure. Among the first steel beams brought to the city of New York there were instances in which they were actually broken in two by falling from the level of trucks to the pavement, probably due to their having been rolled when too cold, as steel when rolled below a certain temperature becomes brittle. Better beams are now made. In my opinion, cast iron columns are superior to steel and more reliable. It is not generally known that American cast iron is vastly superior to English cast iron, and will stand a greater strain without breaking. Cast iron, moreover, will not expand under heat to the same extent as wrought iron and steel, which is another fact in its favor.

No bearing column should be placed in such a position that it cannot be uncovered and exposed for examination without danger to the structure. One of the ablest architects in New York makes it a rule to so "fire-proof" his columns that they can be examined at any time by removing the "fire-proofing" to determine whether rust has invaded their capacity to carry their loads. In my judgment, examinations should be made, from time to time, in this way, of all wrought-iron or steel columns, as it may happen that a leaky steam or water pipe has worked serious harm. Such a discovery was accidentally made recently in an important New York building. Numerous newspaper paragraphs appear, from time to time, which claim that metal stripped of its covering of cement has been found exempt from rust, with the paint intact, etc., and the fact is cited as evidence that cement is a preservative of iron and that the danger of rust is over-estimated. It is probable that cement will protect paint for a long time, and, of course, paint, if properly put on, will protect iron while the oil in it lasts. Painting, by the way, should be done with the best quality of linseed oil and without the use of turpentine, benzine, or dryers. It should be thoroughly applied in three coats, with about a gallon to 400 square feet, and the iron should be first thoroughly cleaned of rust and dirt, by picking or other process. Paint is rarely properly applied, however, and even when of the best quality, is a preservative of the metal, as already stated, only so long as the oil in it lasts.

Those who claim to have evidence of the exemption of iron from rust rely, I think it will be found, upon iron which has been under exceptionally favorable conditions, free from dampness, the action of gases, etc., overlooking the fact that a leaking water pipe or steam pipe, or the escape of gases from boiler furnaces will attack iron and gradually but surely consume it. A notable instance of this is the case of the plate girder of the Washington bridge over the Boston and Albany Railroad in Boston, where a quarter-inch plate girder was recently found to be entirely consumed in places from the operation of gases from the locomotives passing below.

It is quite common to have advocates of wrought iron cite railroad bridges and the elevated railroad structures of New York as proof of their claims, but if they will take the trouble to examine these structures, they will discover that in spite of the fact that they are exposed to view, that they can be painted frequently, the evidences of rust are unmistakable, especially about the rivets; and one can well imagine what would be the result in the case of riveted iron members in the skeleton structure of a building where such ironwork is entirely concealed from view, periodical inspections being impossible. Rust is especially liable to be found in the cellars and basements of buildings. The wrought-iron friction brakes of freight elevators in the cellars of stores, for example, are frequently found so consumed with rust as to be easily rubbed to pieces in the hand. Steel rivets are dangerous and they should never be used, unless of a very superior quality, so soft that hammering will not crystallize the material, and yet with sufficient tensile strength

*Extracted from the publications of the British Fire Prevention Committee.

to insure perfect holding qualities. This is difficult to secure. Their use in columns for buildings is objectionable, as they rust badly under certain conditions; columns, therefore, should be without rivets, and the beam-bearing bracket shelf on cast iron columns should be cast in one piece with the column. It is generally supposed, and frequently stated, that there is a great difference between the expansion of iron and masonry by heat. This is not the case. For example, the length of a bar which at 32 degs. is represented by 1, at 212 degs. would be represented as follows:

Cast-iron	1.0011
Wrought iron	1.0012
Cement	1.0014
Granite	1.0007
Marble	1.0011
Sandstone	1.0017
Brick	1.0005½
Fire-brick	1.0005

In the "fire proof" building of the Western Union Telegraph Company, in New York, some years ago, a heavy brick pier, 7 or 8 feet in diameter, adjoined the wall of the boiler furnaces. The difference in expansion in the brickwork next to this furnace wall as compared with that of the remaining brickwork of the pier was so great as to produce a crushing of the material from top to bottom of the pier for a depth of several inches, and it was found necessary to change the furnace wall and leave an air space between it and the pier.

While the difference in expansion between masonry and iron incorporated with it is less per running foot than is generally supposed, and while the difference in expansion between a cubic foot of iron and that of a cubic foot of masonry would hardly be noticeable, especially if the iron were covered on all four sides, yet in stretches of 50 feet or more, as in the case of iron I-beams and girders, the cumulative effect of expansion in uncovered iron might be a serious matter—quite sufficient with the rises of temperature due to a burning building to push out the bearing walls and wreck the building. Especially is this true of temperatures higher than 500 degs. It is unnecessary to suggest that metal differs from masonry in the important respect that heat does not travel throughout the entire length of the latter, while it does in the case of metal. In other words, while the difference between the expansion of a lineal foot of iron as compared with a lineal foot of masonry, marble, brick, etc., is very slight, the difference in conductivity is very great. The conducting power of silver, for example, being represented by 1, copper would be .845, cast iron .359, gold .981, marble .024, and brick .01—an important fact to be considered in the construction of buildings. Brickwork raised to a white heat would not raise the temperature of other masonry in the same wall a few feet away, but one end of an iron I-beam could not be raised to a white heat without raising the temperature of the beam for its entire length.

Where iron beams and girders are inserted in walls without sufficient space left for their expansion under heat they are almost certain to overthrow the bearing walls by their expansion thrust. A large warehouse in Vienna in which such provision had been contemplated by the architect was totally destroyed, with its contents, by reason of the fact that an officious subordinate, discovering the space in the wall purposely left at the end of each beam, deliberately poured liquid cement therein, which, having set, effectually thwarted the well-meant intention of the architect, and resulted in the destruction of the building. The expansion thrust of iron beams may be computed upon the following factor of expansion: Rolled iron of a length of 1,562 feet will expand one-eighth of an inch for every degree of temperature. The heat of a burning building as already stated is enormous—sufficient to fuse most known materials; it may safely be estimated to be at least 1,000 degs.; therefore a length of rolled iron of 1,562 feet at 1,000 degs. of temperature would expand about 125 inches and a 50 foot length of iron girder would expand between 4 and 5 inches, showing that there should be a play at each end of at least 2 inches if the iron is not fire-proofed. Inasmuch as in iron construction the iron beams and girders are usually anchored to the walls to steady them, space should be left and the tie to the anchor should be by a movable hinge joint, which would be of the same strength with an inflexible anchor for all tying purposes, but would yield under the thrust pressure like an elbow and allow play of the beam, or stiff anchors should have elongated holes to allow expansion when beams are of great length. Girders are seldom over 25 feet long, but if bolted together, as is frequently the case, they may be 120 feet or more long, and a line of columns from cellar to roof of a building may easily have one continuous iron structure of two hundred or more feet. It should be remembered, however, that this danger from the expansion of iron may be almost wholly counteracted by protecting it from exposure to fire through the use of non-conducting material. It is more important to protect girders than beams.

The mistaken pride with which the owners of some buildings point to exposed iron beams in ceilings as evidence that the floors are "fire-proof," actually justifying the supposition that they are left exposed for such display, would be ludicrous if it were not serious. In buildings occupied for offices or dwellings, where there is not sufficient combustible material to endanger the beams, it is not so objectionable; but in warehouses and stores, filled with merchandise, such construction is dangerous; and if one of the upper floors should give way it would come hammering down to carry all below and thoroughly wreck the structure. In this connection it is well to say that combustible merchandise should never be stored 100 feet above the street grade even in a "fire-proof" building, since the average fire department cannot reach it at that height.

The roof, that portion of a building which ought to be most carefully watched during construction, is often the most neglected, woodwork entering into the composition, as in the case of the Horne building, at Pittsburgh, where the cornice was supported on wooden outriggers.

Partitions.—These should not be erected upon wooden sills, as is sometimes the case—only, however, with ignorant and inexperienced architects, who suppose that it is necessary to use wood in order to nail baseboards and other trim at the bottom of the partition. Porous terra-cotta will hold nails and should be used in preference to wood, which, as soon as it burns out, will let down the entire partition.

(To be continued).

—At a meeting of the Board of Governors of McGill University, held July 28, Ernest Rutherford, M.A., B.Sc., Trinity College, Cambridge, was appointed W. C. McDonald Professor of Physics, and Dr. James Wallace Walker, of University College, London, was appointed W. C. McDonald Professor of Organic Chemistry. Both the new professors have had most successful careers hitherto, and we hope they will add to their laurels while at McGill.