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IRON AND LIGNITE IN THE MATTAGAMI BASIN.

The route from the Grand Trunk Pacific railway to the iron and lignite areas of Northern Ontario is necessarily by canoe. The area may be reached from three different starting points on the Grand Trunk Pacific, as three large rivers, the Mattagami, the Ground Hog, and the Kapuskasing, converge to form the lower Mattagami, on the banks of which the principal deposits exist.

Tree Trunks and Limbs Buried in Lignite.

In the twentieth report of the Bureau of Mines of Ontario Mr. M. B. Baker describes these deposits.

Ever since the emergence of the Laurentian plateau from the Archean sea, a height of land appears to have been maintained between the Great Lakes and the basin of Hudson Bay. Within this basin a series of later sediments, including Paleozoic and Pleistocene accumulations, has been deposited. A similar but more extended series has been laid on the Great Lakes flank of this old barrier. The Hudson Bay basin therefore presents a well-marked geographical as well as geological basin, bounded by a distinct rim of pre-Cambrian crystalline and metamorphic rocks. This latter area presents a somewhat rough undulating surface, dotted by many small lakes, marshes, swamps and muskegs, and has a steep grade towards James Bay from all sides, as is clearly shown by the convergence of the many splendid rivers which flow down its slopes. The rapid descent is most pronounced where the pre-Cambrian approaches the margin of the Paleozoic sedimentary area. As a consequence, the "long portages" on all these rivers occur at these points. Once the sedimentary area is reached the flow is very rapid but gradual all the way to Hudson Bay, so that no portages are necessary for practically the whole journey.

The Laurentian plateau in northern Ontario is commonly styled a rocky country, but several seasons of field work in that part of the province have led to the conviction that the amount of rock exposed is very much less than is commonly supposed. In fact, except at rapids or falls, where rivers have cut rather deep gorges in the drift, there is scarcely an outcrop of rock to be seen in the country, so that it is essentially an agricultural one. The Paleozoic area has a flatness that is monotonous, and is perhaps too wet and flat to admit of sufficient drainage for agricultural purposes. Moreover, the upper portion of this area is sand and is quite unsuited for agriculture. The oldest formation seen in this area is the Laurentian. It consists almost entirely of typical pink granite gneiss, but varies in many places to a hornblende granite or mica granite. The rock for the most part is coarse grained, and consists chiefly of three minerals, quartz, orthoclase, and biotite mica, with various accessory minerals, the chief of which is microcline. All the feldspar is more or less decomposed, so that the weathered surface of the rock has a distinct kaolinic appearance. Practically the whole of the pre-Cambrian area north of the railway is this pink gneiss, of very uniform character throughout.

Cutting this in all directions is a series of diabase dikes. These dikes are the typical post-Middle Huronian diabase of the north country, and do not seem to differ in any way from the diabase of other portions of northern Ontario. They vary in width from mere stringers up to 250 feet. They are dark gray, medium to fine grained diabase, composed of laths of fresh labradorite feldspar, set in a ground mass of augite, which is partly in felt-like aggregates resembling uralite, and partly in larger well defined crystals and grains. A little original quartz is to be seen in thin sections, and often in the hand specimens, together with accessory pyrite

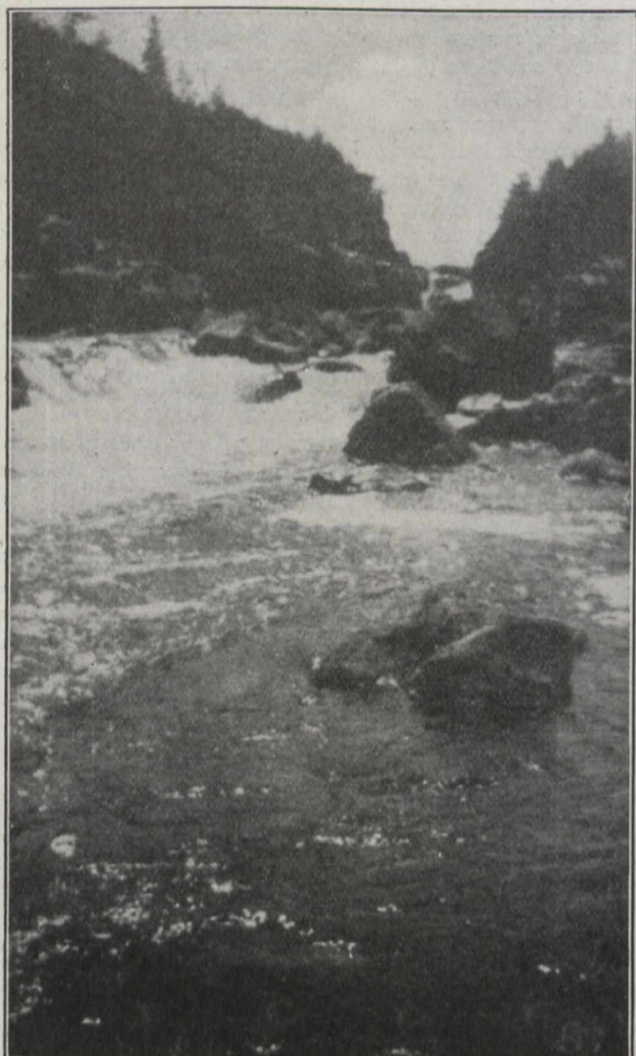
Ore Body Resting on Limestone.

and magnetite. At several places, calcite veins were found up to three inches in width cutting this diabase, but they did not show any of the silver, nickel or cobalt minerals so characteristic of similar occurrences in the Gowganda or Elk Lake areas.

Lignite.

Lignite has long been known to exist in the Moose River basin of northern Ontario, having been reported on almost every river of the James Bay water-shed. The economic possibilities of most of this lignite were investigated and reported upon for the Bureau of Mines in 1904, by J. M. Bell. New and rather extravagant reports, however, were circulated during the winter of 1909-1910 to the effect that real "coal" had been discovered in the vicinity of the Grand Trunk Pacific Railway on the Mattagami River. Several square miles of claims were staked out and recorded. A very brief examination served to convince the writer that the deposit had few economic possibilities.

Lignite or brown coal may be described as a fuel about half way in the state of carbonization between peat on the one hand and bituminous coal on the other. The term is a loose one, and includes materials of wide divergence in chemical composition, in texture, and even in mode of occurrence. The "braun kohl" of Saxony is so soft that it it dug from the field with spades, and piled in great stacks to dry, when it forms a valuable fuel. On the other hand, the lignites of the Western States and those of Western Canada are black, comparatively high carbonized, firm, even with conchoidal fracture, and require to be broken with a pick. The lignites of the Moose region are, considering their recent age, in a remarkably advanced state of carbonization. Some of them compare favorably with the lignites of Souris and Lethbridge, others are typically brown resembling the German variety. The lignites of northern Ontario are of interglacial age, occurring in stratified beds of clays, sands, etc. These coal measures occur extensively throughout the whole Moose Basin, but they do not always carry lignite, although in general they are more or less carbonaceous.



Foot of Smoky Falls, Lower Mattagami River..

The lignite of the Mattagami River outcrops at the east bank about one mile up-stream from Big Bend, or about eighty miles down stream from the railway. The outcrop cannot be seen except in the lowest water. It then shows in two narrow seams dipping into the east bank at an angle of about 50 deg., and striking W. 30 deg. S. The upper seam is six feet thick at the thickest place; lying below this is four feet of clay quite dark and lignite in places, followed by one foot of lignite, below which is a fat lead blue clay. This was bored into for sixteen feet without showing further lignite.

These lignites do not occur in beds associated with consolidated rocks, but in beds both overlaid and underlaid by clay and sand of inter-glacial age. All this series is absolutely free from boulders or other glacial material.

The lignite is in beds of quite irregular thickness; in places these are warped, shoved, ploughed, and crushed out of shape. The folds are often cut off by glaciation, at other times the beds are cut out entirely by glacial erosion.

Most of the lignite is laminated, showing stems, twigs, leaves and reed-like characters, but buried in this looser material are many sections of the limbs and trunks of trees (see Fig. 1). By digging up some of the lignite a few of the larger of these trees were secured, the largest one measuring seventeen inches in diameter. This would represent a rather substantial tree before compression. Scattered abundantly through the loose lignite are fragments of perfect charcoal, which have been preserved as fragments of charred wood, as if a fire, probably started by lightning, had passed over this area.

Analysis of Lignite.

	Fixed Carbon	Vol. Combust.	H_2O	Ash
Lethbridge, Alta.	54.93	26.87	12.08	6.12
Golden City, Colorado ..	45.57	37.15	13.43	3.85
Moose River, Ont.	44.03	41.39	11.74	2.84
Souris River, Man.	40.72	38.58	16.92	3.78
Big Bend, Mattagami River	40.31	39.24	11.45	9.00[1]
Big Bend, Mattagami River	40.53	46.44	11.22	1.81[2]
Blacksmith Rapid, Abitibi River	36.58	39.66	16.46	7.28
Big Bend, Mattagami River	26.25	40.43	72.27	21.05[3]

From the amount of carbonization that the lignite in general has undergone, as shown by the preceding analysis, it can be seen that this lignite is of rather low grade, but is sufficiently carbonized to produce a good fuel if briquetted.

Iron.

The iron ores on the Mattagami River were discovered by Dr. Robert Bell and later examined by J. M. Bell. Both

[1] Woody lignite, light yellow ash.

[2] Fragment of tree, jet-like.

[3] Mossy, loose, reedy; reddish ash.

these geologists appear to have seen only the deposits at the foot of the rapids, whereas deposits of equal size and possibly of equal richness occur at the head of the rapids, one mile and a half farther up stream. These deposits occur on both banks of the river. They extend across the bed of the river at both places, and they stretch along the shore for about eleven hundred feet in each case. They reach in places fifteen to eighteen feet above the level of the river, but their full thickness cannot be estimated, as they extend below water level in almost every case. Nor could it be ascertained how far they extend inland from the banks of the river, but from the fact that the ore-belt is eleven hundred feet wide, and extends across the full width of the river, a distance of a quarter of a mile, the conclusion was reached that it will extend inland for a similar distance at least. This opinion can only be verified by boring or mining, and as many claims are staked back from the river information from drill-holes, etc., should soon be forthcoming as to the continuance of the ore inland.

In some places the ore is a soft, often botryoidal, vuggy limonite, in radiating, lumpy masses. At other places it is a dense, hard hematite, or a compact limonite. Again it passes into coarse breccia, composed of fluted, water-worn fragments of the Corniferous limestone, and rounded boulders of siderite, the whole cemented by limonite; or at other places it is a quartz conglomerate composed of small water-, worn pebbles of quartz in a matrix of clay and limonite. Other phases show the ore as clay, impregnated by limonite, all stages of impregnation being found as shown by the following analyses:—

	Iron, per cent.
1. Clay of the country in general	2.46
2. Clay visibly reddened by the presence of iron oxide	6.30
3. Clay of ochreous color	11.38
4. Clay decidedly limonitic	28.25
5. Clay in appearance, but a low-grade limonite ore	33.19
6. Clay in appearance, but a good limonite ore	48.45

In the case of these clay-iron ores, the passage from one to another type is so gradual, and the clay characters are so well preserved, that there is no possible doubt of their forming one series. The deposits are of a mixed character, in some places the material being high enough in iron to constitute a good ore, but in other places the percentage of iron in the alluvial accumulations is quite low. The fact is well demonstrated by the following analyses of selected samples from the ore bodies:—

No.	Iron	S.	P.	Moisture	
1	52.45	0.14	0.08	1.16	Average of the best ore at the foot of the rapids on the north side.
2	52.10	0.11	0.14	0.94	Best ore below high water mark foot of the rapids on the north side.
3	41.68	0.15	0.12	1.7	Average ore from the foot of the rapids, south side.
4	37.35	0.16	0.13	1.56	Average of the best ore at the head of the rapids, south side.
5	36.68	0.60	0.09	1.42	Average of 850 feet of exposure at the head of the rapids, south side.

None of these would be a Bessemer ore, but some are well suited for open hearth treatment.

Regarding the origin of the ore, the writer is of opinion that it was derived from the oxidation of the Animikie siderite, found in place at the head of the rapids. This Animikie siderite is believed to exist at many places about the edge of the Paleozoic coastal plain. In reading the reports on the various rivers of this area one is impressed with the regularity with which iron-holding deposits occur about the edge of the basin, and it would appear that about the margin of the Paleozoic area, where the sediments are naturally thinnest, they are eroded in many places so as to actually expose the underlying siderite. The weathering of the siderite produced residual limonite and hematite, or supplied springs or other waters with a load of iron carbonate, to be carried to new resting-places, there to be oxidized and deposited as limonite, hematite or magnetite, the last of which was found in a few cases. Professor Van Hise, in his treatise on "Metamorphism,"* accounts for such deposits at follows:—

$4\ FeCO_3 + 2O + 3H_2O = 2\ Fe_2O_3 3H_2O$ (limonite) $+ 4CO_2$.
or $2\ FeCO_3 + O = Fe_2O_3$ (hematite) $+ 2CO_2$.
or $3\ FeCO_3 + O = Fe_3O_4$ (magnetite) $+ 3CO_2$.

It is possible that this Animikie siderite itself could easily become an ore. It is exceptionally high grade, as shown by the following complete analysis:—

SiO_2	Al_2O_3	FeO	Fe_2O^3	MnO	CaO
1.40	2.31	54.31	1.67	1.74	1.47
MgO	CO_2	Carbon	S	H_2O	Sp.G.
Trace	34.94	1.27	0.0	0.50	3.63

This analysis gives 43.27 per cent. iron, and by simply calcining the siderite over a Bunsen burner the carbon-dioxide was driven off, giving a product which analysed 63.74 per cent. iron. In many parts of Europe spathic iron ores, of much lower grade than this, are calcined; in some cases in open heaps, sometimes in continuous kilns, and sometimes in roasting furnaces, using gaseous fuels. It is possible, therefore, that with a high grade siderite, plenty of local fuel, for example lignite, or peat, or charcoal made from the birch forests of the north country, this siderite could be easily converted into a high grade ore, thereby reducing the freight rates to such a degree as would allow of the long haul necessary to bring them to the smelters. Without wishing to be too optimistic, it would appear to the writer that this is a phase of the question worthy of some consideration.

* Geo. Sur. Can.; 1875, p. 321.

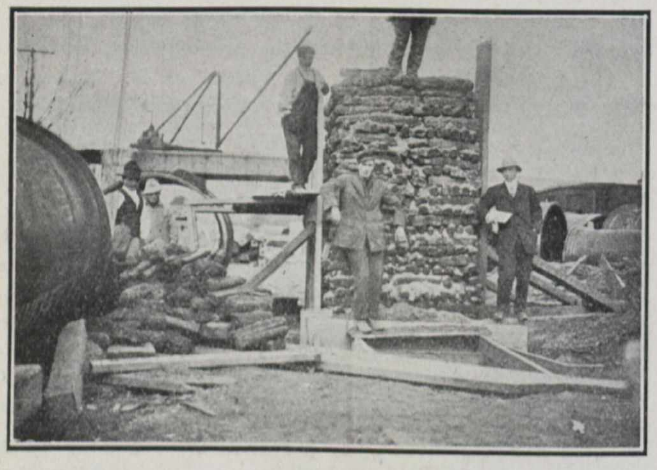
COBALT ORE SHIPMENTS.

The following are the shipments of Cobalt ore, in pounds, for the week ended September 29th:—La Rose, 279,380; Cobalt Lake, 183,450; McKinley-Darragh, 120,600; Drummond, 120,000; Cobalt Townsite, 65,100; Hudson Bay, 63,000; Chambers-Ferland, 63,900; Right of Way, 61,500; Coniagas, 58,500; Nipissing, 63,980; Kerr Lake, 60,930. Beaver, 60,785; total, 1,253,125 pounds, or 626.5 tons. The total shipments since January 1st are now 38,561,578 pounds or 19,780 tons.

In 1904 the camp produced 158 tons, valued at $316,-217; in 1905, 2,144 tons, valued at $1,437,196; in 1906, 5,129 tons, valued at $3,900,000; in 1907, 14,040 tons; in 1908, 25,700 tons; in 1909, 29,751 tons; in 1910, 34,041 tons.

REPORT ON DISTRIBUTED LOAD TEST ON 66-INCH CAST IRON PIPE.

It was thought advisable to make a load test on one of the cast iron pipes to be used in the syphon under the Don River, Toronto, in connection with the High Level Interceptor. The pipe tested weighed 9,038 lbs., measured 8 feet in length and 66 inches in inside diameter, and was made of 1.5-inch thickness of metal. This pipe being the last of the line, had a 3-inch flange in place of the bell of the standard pipe. The report of this test and the cuts are abstracted from the Report of the City Engineer of Toronto for 1910.



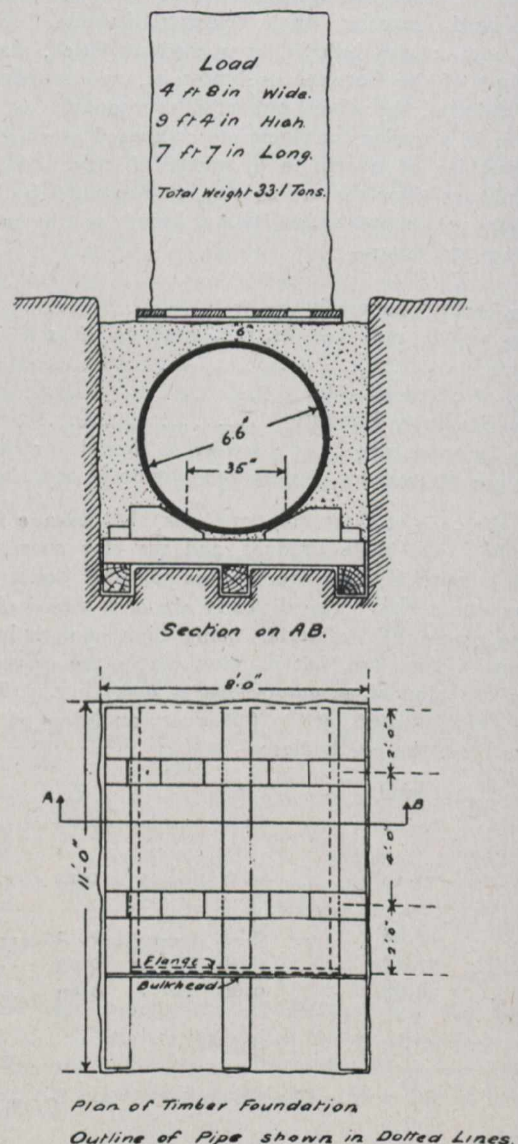
Testing Cast Iron Pipe.

A pit was excavated measuring 8 ft. × 11 ft. and 8 ft. deep. In this were laid three sills 10 in. × 10 in. × 11 ft. and on them two caps 8 × 10 × 8 ft., spaced four feet apart, centre to centre, and placed so as to lie 2 feet from each end of the pipe, this construction being similar to that adopted in the actual work on the syphon. On each cap two bearing blocks were fastened supporting the pipe at two points 35 inches apart horizontally. The pipe was lowered into place by jacking on the ends of a 10 in. × 10 in. timber placed through the pipe. The spigot end was placed tight against the end of the pit, and a bulkhead built around the flange end, so that when the back filling was completed access could be had to the inside of the pipe. The filling used was composed of the clayey sand being excavated from the river bed, was thoroughly wetted and tamped, and brought up to a height of 6 inches above the top of the pipe. On top of this a skeleton platform of 2-inch boards was laid to form a foundation for the pig iron, which material was to be used for the load.

The pile of iron was commenced on a base measuring 7 ft. 7 ins. by 4 ft. 8 ins. Two tiers, 4.1 tons, were laid before the gauges were set. These were three in number, two being used to measure contraction on the vertical diameter at the flange and spigot ends, and the third to measure expansion on the horizontal diameter midway between them. They were of simple construction; an oak rod ¾-in. square fitted with a metal bearing point at the bottom and having fixed at the top a rule inset in which was a graduated metal slide on which readings could readily be made to 1-64 of an inch. Depressions were made with a centre punch into which the gauges were set. The load was increased by increments of one ton (50 pigs approximately), and at each increment the gauges were read. The total load applied was 33.1 tons, and took approximately two days to place.

As may be seen by the accompanying tables and curves, the deformation occurred uniformly to the extent of approximately 1-64 of an inch per ton at the spigot end, one-half as much at the flange end, and one-half the difference midway between. The curves, plotted as they are to magnify any change in the rate of deformation, are practically straight lines. That for the spigot end, at which place only was the deformation for each reading appreciable, is the most uniform, the only inequality occurring where the load ceased to be applied continuously.

It had been the original intention to take readings as the load was decreased, but circumstances would not permit of this. Two readings were, however, obtained, one being made just after the load had been removed, and the other after the filling had been removed. The former showed that the pipe had returned from a total deflection of 25-64 of an inch at the spigot end to within 6-64 of an inch of its original diameter, and from a total deflection of 13-64 of an inch at the flange end to within 3-64 of an inch of its original diameter. The latter showed the pipe in its initial shape.



Method of Supporting and Loading 66-in. Cast Iron Pipe.

When the platform under the pig iron was taken up, it was noticed that very little settlement had taken place, showing that the load had been practically a uniformly distributed one.

The total load applied was 33.1 tons, which, if we take 7.6 as the length of the pipe and 5.62 ft. as the width, gives us a load of 618 lbs. per inch run of pipe. Now the maximum possible load to which the syphon pipes could be subjected would be due to the filling just east of the retaining wall where there is a depth of 22.5 ft. of earth over the pipe. Taking this as weighing 120 lbs. per cu. ft., we have for the 66-inch pipe 5.62 × 1-12 × 22.5 × 120 = 1,264 lbs. per inch run, which, although obtained by approximate methods, gives an idea of the relationship between the actual applied load and the possible maximum load. From Talbot's * formula; for a distributed vertical load—

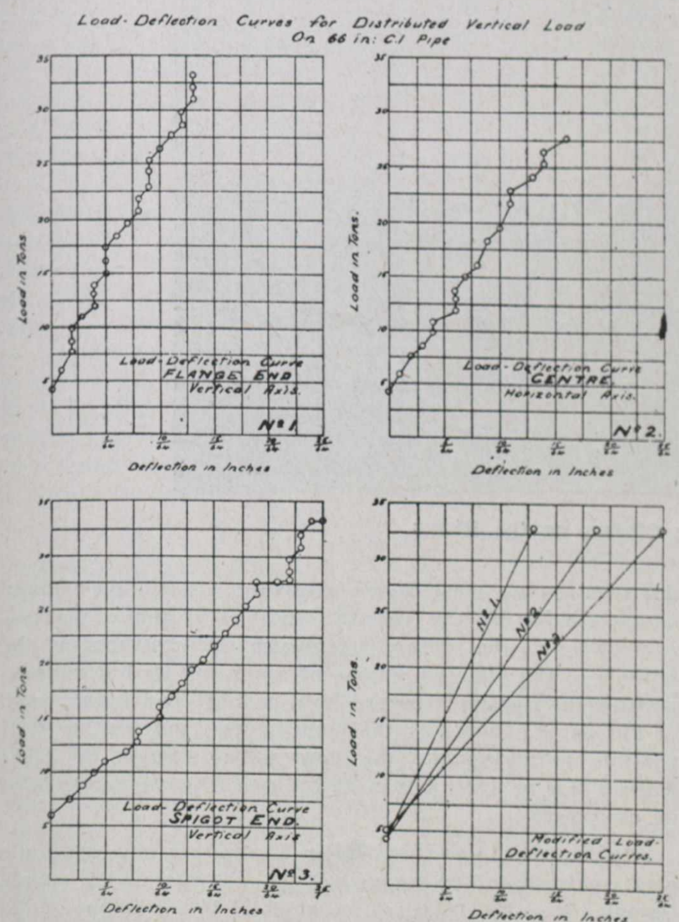
$$f = \frac{1}{16\frac{1}{6}} \cdot \frac{w.d.}{t^2}$$

where f—stress in remote fibre
w = applied load per in. run.
d = mean dia. of ring.
t = thickness metal in ring.

Considering the spigot end of the pipe and making the proper substitution, we have—

$$f = \frac{1}{16\frac{1}{6}} \cdot \frac{618 \times 819}{1.5 \times 1.5}$$

= 6953 lbs. per sq. in.



Load Deflection Curves on Pipe.

This under a load of 618 lbs. per inch run, which is about one-half the actual loading and using, as we may safely do, considering the quality of the casting, an ultimate strength of 30,000 lbs. per sq. in., we find that the pipe would stand with a factor of safety of 4.3 for the actual applied load, and 2.1 for the maximum possible load as described above.

We have also for a distributed vertical load,

$$E = \frac{w.d^3}{96.y.I}$$

where w—load applied per lin. in.
d = mean dia.
I = mom. of inertia of section.
y = deflection.

$$= \frac{618 \times 12 \times (67\frac{1}{2})^3 \times 64}{96 \times 25 \times 3^3\!/\!_8}$$

—18,020,000 lbs. per sq. in.

This result checks approximately the investigation and results of Mr. Talbot in his experiments above noted.

Owing, however, to the way in which the pipe was supported (described above), the conditions were more severe than those for which the above equation was intended, and would be accountable for the high value of the modulus of elasticity.

Table of Loading.

Load		Deflection			Remarks.
Pounds	Tons	Spigot End	Flange End	Centre Horizontal	
8,468	4.2	0	0	0	Gauges set at this initial load.
11,841	5.9	0	1-64	1-64	
14,986	7.5	2-64	2-64	2-64	
16,998	8.5	3-64	2-64	3-64	
19,526	9.7	4-64	2-64	4-64	
21,621	10.8	5-64	3-64	4-64	
23,838	11.9	7-64	4-64	6-64	
25,947	12.9	8-64	4-64	6-64	
27,315	13.6	8-64	4-64	6-64	
29,969	14.9	10-64	3-64	7-64	
32,126	16.0	10-64	5-64	8-64	
34,288	17.1	11-64	5-64	8-64	
36,531	18.2	12-64	6-64	9-64	
38,896	19.4	13-64	7-64	10-64	
41,177	20.5	14-64	8-64	10-64	
43,545	21.7	15-64	8-64	11-64	
45,857	22.9	16-64	9-64	11-64	
48,209	24.1	17-64	9-64	13-64	
50,469	25.2	18-64	9-64	14-64	
52,655	26.3	19-64	10-64	14-64	
54,867	27.4	19-64	10-64	15-64	
		21-64	11-64	16-64	At 5 p.m. November 2, 1910.
		22-64	12-64	16-64	At 9 a.m., November 3, 1910.
57,118	28.5	22-64	12-64	.....	Gauge on horizontal diameter broken.
59,395	29.6	22-64	12-64	.....	
61,707	30.8	23-64	13-64	.....	
63,922	31.9	23-64	13-64	.....	
66,265	33.1	24-64	13-64	.....	Total load.
		25-64	13-64	.....	Lapse of one day.
	31.1	24-64	12-64	.....	Two tiers removed.
		6-64	3-64	.....	No load.
		0	0	.....	Filling removed.

* Bulletin No. 22 of the University of Illinois.

HYDRAULIC POWER AND IRRIGATION IN FRANCE.

Up to the end of the last century small hydraulic plants and water mills, which were very numerous in France, employed only a small fraction of the total water power of the country. In 1890, according to the statistics of the department of agricultural hydraulics, these concerns numbered 69,620 for the whole of France, with a gross productivity of 1,028,807 horsepower, equivalent, because of the small yield of very imperfect appliances, to an effective horsepower of only one-third that amount. These matters were commented upon very fully by M. Reni Tavernier, Chief Engineer, Department of Public Works, France, in a report to the Geological Survey Department of the United States Government, from which the following discussion is taken:

The average productivity of each mill was 14 h.p. gross and 5 h.p. net. These small plants, when erected upon streams well supplied with water, generally used only a fractional part of the available power and water, and left the remainder available for other purposes, such as irrigation. But all times of the year, but also for using the average flow such as may be reckoned on more or less irregularly during only eight, six, or even fewer months of the year.

Hydraulic plants do not actually use up the water itself, which is always available for application to the soil after it has passed through the wheels. They do not interfere with the use of the water for irrigation below the point of exit. They prevent its use above that point. They consume the fall necessary to carry the water to the fields lying at altitudes between the upper and lower levels of the power plant. Hence the erection of one of these "complete" or integral power plants amounts simply to appropriating the impetus of the stream, which also constitutes, so to speak, the "energy" necessary for watering the soils that might benefit by irrigation. It may be more profitable for all parties—as we shall attempt to show later—to resort to the system of storing up this "energy" rather than to that of storing up water taken at the upper level of the fall. But before considering

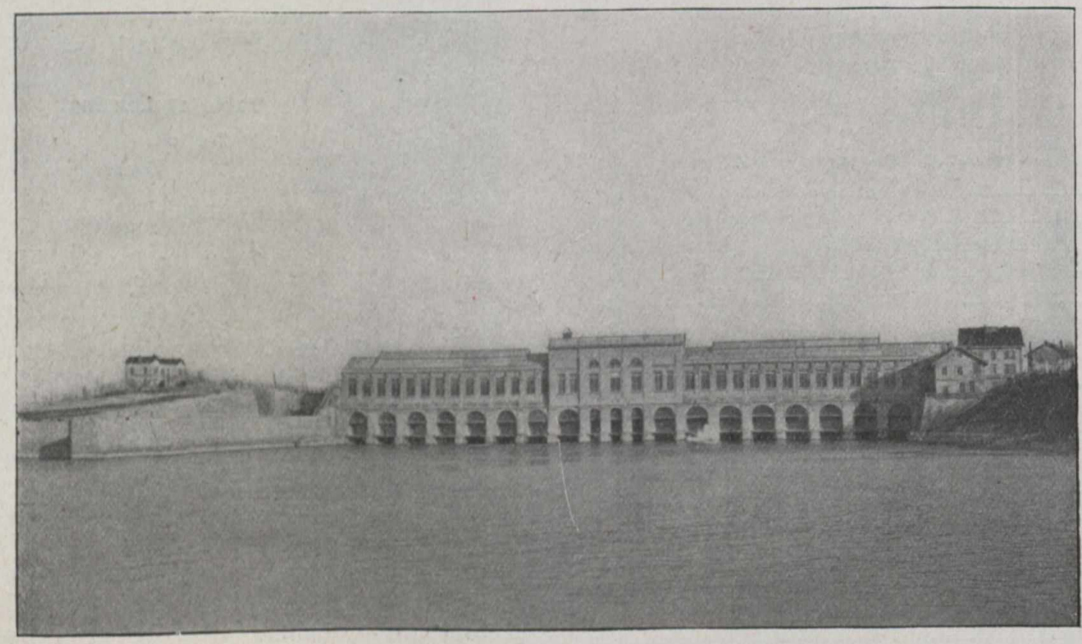


Fig. 1.—Lyons.—Generating Station on the Rhone.

this is not the case with large modern power installations, where a single plant gathers up several thousand horsepower. In the region of the French Alps alone—which to be sure, is the best provided with hydraulic power—there are 90 plants producing a total maximum of 325,000 h.p., an average of 3,600 h.p. for each concern.

A feature of the progress made during ten years in the method of utilizing large waterpower plants is indicated by the large power-distributing enterprises. Such enterprises, employing the technical inventions that continue to extend the practical limits of long distance transmission, have sprung up in various parts of France in which water powers are located. The experience acquired in the past in the exploitation of railroads must be applied to the better organization of the public services for power distribution.

The new tendency is to build, at the very start, a series of canals that will divert the entire low-water flow of the streams. Many of the large plants are fitted up not only for operating with the minimum flow that can be counted on at this question we must clearly grasp the dissimilar economic characteristics of the various types of hydraulic plants—characteristics that depend upon such circumstances as the altitude of the fall, the volume of water and its fluctuations, whether the stream is tapped by a channel at a higher level or the water dammed at the point of use, and whether it is possible to accumulate the flow and to regulate the plant without loss of water but in accordance with the demands of its customers.

In France the productivity in horsepower of a hydraulic plant is calculated by means of the following very simple formula: $P = H \times Q \times 10$, in which H is the height of the fall in meters and Q the discharge in cubic meters per second. This gives us the gross productivity in horsepower, each of 100 kilogram-meters a per second, which corresponds at the turbine axle—assuming a net yield of 75 per cent—to a horsepower of 75 kilogram-meters per second.

But the industrial value of a power plant is not measured solely by its power thus calculated. In the first place, the formula is inapplicable to a plant using, in addition to a permanent minimum flow of water, a certain average intermittent volume. An irregular power is manifestly not equivalent to a uniform power, when the irregularity is independent of the requirements of consumption and is governed solely by the fluctuations in the condition of the steam.

On the other hand, if a plant is equipped with facilities for storing up the natural flow of the stream for a time at a higher level in order to make use of it at the periods of maximum consumption, irregularity in the production of energy becomes subject to control and constitutes a source of large additional gain. It should be remarked, moreover, that these profit-creating reservoirs are much more effective and economical with high than with low head plants. Compare, in this respect, two hydraulic plants of 10,000 horsepower each, one receiving a flow of 71 cubic feet (2 cubic meters) per second, with a fall of 1,640 feet (500 meters), and the other a flow of 7,100 cubic feet (200 cubic meters) per second, with a fall of 16.4 feet (5 meters). A reservoir of 2,542,600 cubic feet or about 58 acre-feet (72,000 cubic meters) would suffice, in the first case, to store up the total discharge of ten hours, enabling that plant to vary its production sufficiently to provide for the widest fluctuations in the daily demand. In the second case a reservoir 100 times as large—that is, with a capacity of 254,260,000 cubic feet or about 5,800 acre-feet (7,200,000 cubic meters)—would be needed to obtain the same results. High falls admit much more readily than low ones of being so equipped as to produce power at the precise time of day when it is wanted. But they play an even more important part. Imagine a poorly-fed basin in a mountainous region receiving during the year by irregular discharges a total volume equalling a regular and uninterrupted flow of 3.5 cubic feet (100 litres) per second. With a reservoir having a capacity of 83,794,000 cubic feet the water could be stored during nine months in order to let it flow during the remaining three months. If the height of the fall is 1,640 feet the creation of this reservoir would mean substituting for an average force of 500 h.p., that is altogether useless because of irregularity of the flow, an additional force of 2,000 h.p. that is extremely valuable because it may be used at the very season when it is needed.

In short, it will be readily seen that the industrial value of a large hydraulic plant does not depend solely on the maximum amount of power that may be produced, but differs considerably as the power is produced permanently and regularly or intermittently, and also according to the extent and nature of the irregularity.

The hydro-electric power supplied by such plants will be in demand by many kinds of consumers with exceedingly varied needs. For illumination the motive power is needed at certain definite times and during a limited period of two or three hours on an average day.

The power needed by motors used in manufacturing concerns is required for periods as long as the workday of the laborers. The demands for traction depend on the time-tables of the railway companies or of the street car companies. All these enterprises, which are rather irregular and capricious in the need of power, nevertheless require that power at certain very specific times. It is natural that the price which must be paid should be proportionate to the specific demands, and this, as a matter of fact, is the practice in France, as is shown by the following table of rates customary in France:—

Cost Per Kilowatt-hour.

For illumination	50 to 80 centimes	(10–16 cents).
For small quantities of 20 to 50 horsepower	9 to 20 centimes	(2–4 cents).
For larger amount of power transmitted some distance	4 to 6 centimes	(8–12 mills).
For power furnished at the business place itself	1 to 3 centimes	(2–6 mills).

The organization of large corporations for the public sale and distribution of power furnished by hydraulic plants is sufficiently advanced in certain parts of France, such as the southeastern region, to indicate the essential tendency of such concerns, which is to bring together into a systematic unit, by means of electrical connection, all the power-producing plants and all the consumers of power in a given section of the country.

Fig. 2.—Lyons.—Interior of Generating Station on the Rhone.

Use of Hydraulic Plants in the Development of Irrigation.

Pending the discovery of new methods of bringing water for purposes of irrigation to the places where it is needed, it would be absurd to condemn the old methods and to insist unduly upon the general application of the methods about to be described. Many isolated and independent irrigation enterprises will undoubtedly continue to be justified; but, while the industrial utilization of streams is made on a large scale, as on Durance River and its tributaries, it is questionable whether the separateness of irrigation enterprises does not constitute a source of weakness and a hindrance, and whether a possible antagonism of interests in the future might not be avoided by bringing together several systems for utilizing the streams.

From purely mechanical considerations, it may at first seem surprising that there should be an advantage in employing expensive mechanical devices, such as turbines and dynamos, whose use results in considerable loss of energy, rather than in continuing the exclusive use of gravitation. But a little reflection suffices to justify this conclusion as to the relative merits of the two systems.

By the use of separate pumps, each of which raises to necessary level the water needed for irrigating at that particular level, the greater part of the loss of energy may be avoided. Moreover, very considerable losses of water caused by the long main channels may be avoided by a series of separate pumping stations. Finally, whether it is utilized or not, the maximum volume of water flowing into a large irrigation trench should always be available. Under the system of pumping stations the quantity of water brought to a given level corresponds exactly to the requirements of the consumers. Without doubt, in the gravity system of conducting the water the total waste of water or of power does not greatly exceed the mechanical loss due to electric transformation and to the transmission of power made necessary by the pumping process.

The following figures will give some idea of the height to which water may be pumped without greater losses than those usually incurred in agriculture:

Watering 2.471 acres (1 hectare) of land with a volume of water equalling a continuous discharge of 0.035 cubic foot (1 liter) per second for six months will mean, if the water is raised 39.37 inches (1 meter) a power in pumped water of $\frac{1}{150}$ horsepower throughout the year, or of 42.98 kilowatt-hours. If the total yield of the pumping station is 60 per cent., including dynamo, pump, and pipes, the annual consumption of power will be 71.6 kilowatt-hours, and the cost, at a rate

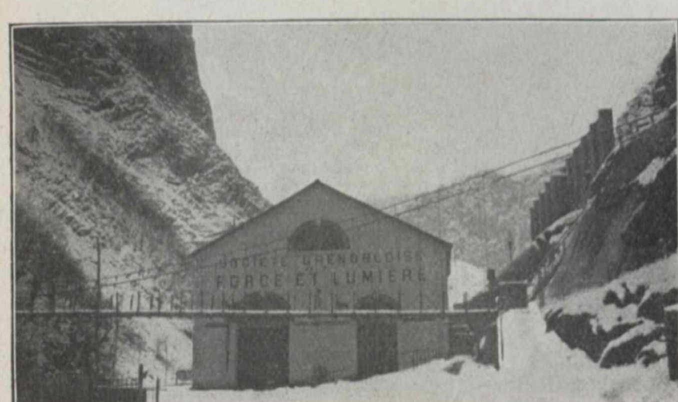


Fig. 3.—Avignonet Generating Station.

of 1/5 cent (1 centime) per kilowatt-hour will be 14 cents (71.6 centimes). If the price per kilowatt-hour is X centimes and the elevation N meters, the annual expenses for pumping the water necessary to irrigate a hectare, according to the formula 0.716 XN, will be as follows:

Cost, in Francs, of Pumping Water Necessary for Irrigating 1 Hectare (1 Liter per Second).

Height (meters).	Cost when price of kilowatt-hour, in francs, is— 0.01	0.02	0.03	0.04	0.05
10	7.16	14.32	21.48	28.64	35.80
20	14.32	28.64	42.96	57.28	71.70
30	21.48	42.96	64.44	85.92	107.40
40	28.64	57.28	85.92	114.56	143.20
50	35.80	71.60	107.40	143.20	179.00

These figures may be compared with the cost per liter per second diverted by some of the great irrigation canals in southeastern France:

Cost per Liter per Second (Equivalent to Watering 1 Hectare) of Water from Canals in Southeastern France.

Canal.	Capital value of first plant. Francs.	Annual interest at 5 per cent. Francs.
Marseille	5,000	250
Verdon	3,500	175
Manosque	2,000	100
The Bourne	1,600	80
Pierrelatte	1,150	57.59

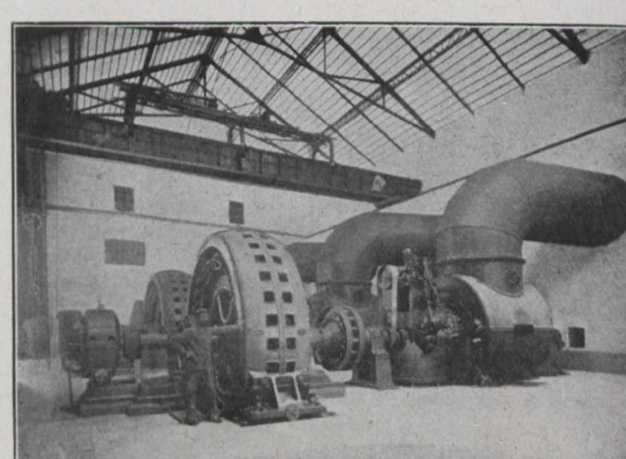


Fig. 4.—Interior of Avignonet Station.

However cheap a kilowatt-hour may be, the areas devoted to extensive farming will be unable to stand a charge of more than $3.25 to $4.00 per acre (40–50 francs per hectare), and hence cannot buy the water if it must be carried to too high an altitude, but this will not be true of truck farming in the neighborhood of cities. In many places it will be profitable to supply both the city and its environs by having the same plant provide drinking water, and thus obtaining the larger receipts which this involves. Underground waters, as well as surface waters, accumulated in reservoirs will then be supplied to the soils which make the best use of them.

THE STRENGTH OF EYEBOLTS.

Data of tests on eyebolts used in the lifting of heavy machine and generator parts, carried out at the testing laboratory of the General Electric Co., Schenectady, N.Y., were published in American Machinist, May 18, 1911. The eyebolts were forged from double refined iron having a tensile strength of 48,000 lb. per sq. in., and an elastic limit of 28,000 lb. per sq. in. The smallest size tested had an inside eye diameter of 3 in., the diameters of the stock in the shank and eye were respectively 1.65 in. and 1.25 in., and the load at which the eye began to deform was 30,000 lb. In the largest size the inside eye diameter was 6 in., the stock in shank and eye, 2.2 in. and 1.92 in. in diameter, respectively, and the deforming load 44,000 lb.

The following reliable formula for the strength of lifting rings was given in the June, 1910, issue of this journal (p. 444): $W = md^3 \div D_1$, in which W = load in pounds at which deformation commences, d = diameter of stock in the ring, D_1 = mean diameter of ring (= internal diameter D + d), both in inches, and m = a coefficient depending on the material used. Now, an eyebolt is a ring stiffened in its lower half by the addition of a threaded shank, and W will be greater than the value given by the ring formula. The effect of adding a shank is equivalent to that of reducing the mean diameter of the eye by some function of the shank diameter, and the formula thus altered reads $W = md^3 \div [D_1 - f(D_2)]$, in which D_2 is the shank diameter. Calculations made using the data of the eight eyebolts tested by the General Electric Co. yield the following formula which gives results within 6 per cent. of the experimentally obtained values of W:

$$W = 33{,}000d^3 \div (D_1 - 1.2D_2),$$

or, letting Y = elastic limit of the metal (in this case 28,000 lb.),

$$W = 1.18Yd^3 \div (D_1 - 1.2D_2).$$

Examples.—Eyebolt for lifting 60,000 lb.; inside eye diameter D = 6 in.; elastic limit of metal, 30,000 lb. per sq. in. Allowing a stress of 10,000 lb. per sq. in. in the bolt shank would give a sectional area of 2.78 sq. in. at the root of the thread; the nearest U. S. standard size of bolt has an outside diameter of 3.25 in., which is taken as the value of D_2. Allowing a safety factor against deformation of 3, W = 180,000. Substituting the values given in the formula and solving the value of d is found to be 2.95 in. The same assumptions for an eyebolt for lifting 20,000 lb., with D = 3 in., give $D_2 = 1.875$ in. and d = 1.6 in.

Mr. Axel Pedersen, in the article referred to, gives charts and formulas for the solution of such problems, based on Bach's general theory of eccentrically loaded curved beams. From these the value of d for the 60,000-lb. eyebolt is found to be 2.88 in. as against 2.95 in. above given, and 1.58 in. for the 20,000-lb. eyebolt as against 1.6 in.

THE QUEEN STREET VIADUCT.

A piece of work of general interest to the engineering public which has recently been completed is the grade separation approaching the Don River at Queen Street East in the City or Toronto. This work has presented a number of engineering problems which have been admirably executed by the F. N. McGuigan Construction Company. This firm received the contract and signed the same on September 19,

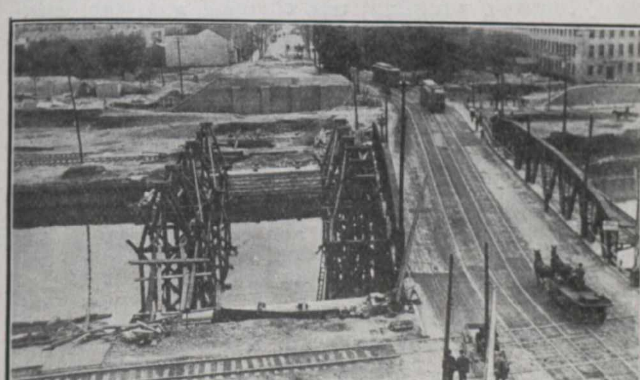


Fig. 1.—Showing Temporary Diversion.

1910. Work on the test pits for foundations was begun on the 22nd of the same month. This promptness in beginning work has characterized the whole undertaking.

In order that the car line traffic should not be disturbed, the old Queen Street bridge over the river at this point was shifted to the south one Sunday night. The bridge was moved on the 19th of November. At the same time the steam railway station at this point was also moved. Part of this undertaking was the moving of a large number of cables which had to be taken up and shifted without breaking or tangling the wires. (Fig. 1 illustrates the changes thus caused.)

The old bed of the Don was shifted to the east, 55 piles being driven in to begin the foundation. This part of the work was completed in the spring.

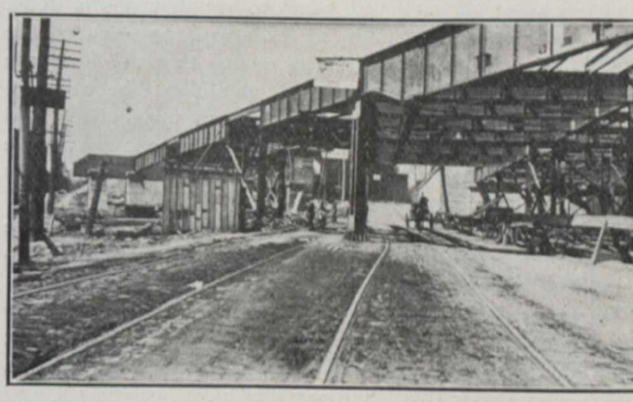


Fig 2. Showing Method of Erecting Steel Viaduct.

The concrete work on the abutments was begun in January, 1911, all of the work being done under housing to protect the concrete from the frost while setting. A curious point in connection with this foundation work was the fact that a number of old filled-up sewers were cut into and also an old macadam roadway was encountered. There was absolutely no record of any of the sewers nor of the old roadway, which must have been one of the first built in the vicinity of Old York.

About the middle of March the work was in readiness for the laying of the steel, but, owing to delay in delivery, this part of the work was held up. If it had not been for this delay, there is no doubt that a record in construction would have been made. The steel work over the river consists of one through 6-panel span, 129 feet long. The approaches are all tower and girder construction over the C.N.R., C.P.R., and G.T.R. Railways on the west, and the C.P.R. and Industrial on the east side. The spans of the girders of this portion of the work are 71 feet long. (Fig. 2 illustrates part of this girder work.)

The flooring is made up of 6-inch reinforced concrete. Sidewalks are provided by bracket supports at the side of the structure, being 12 feet wide and 4 inches thick. The roadway is made of preserved wood blocks resting on ½-inch sand cushion with waterproofing over the concrete. In connection with the reinforcing work twisted bar was used throughout. All pipe and wire work is carried underneath the sidewalk. In the erection of the steel a stiff-legged derrick was used, being constructed in such a manner that it travelled up the bridge as the work advanced.

The construction plant consisted of a 5,000 lb. steam hammer for the pile-driving with the necessary hoisting engines; two 20-ton stiff-legged derricks, one for loading and handling, and one for travelling work as mentioned before. The compressed air was furnished from a 9 by 12 Chicago air compressor with 6-in. lines for the riveted work.

THE CARE OF LABORERS IN CAMP.*

By Daniel J. Hauer.

When men are worked hard they must be paid promptly according to agreement, and some thought and study should also be devoted to their mental and physical welfare. In city work this is provided for, but on jobs outside of towns and cities contractors must care for their men well, if they expect to hold them on the job and obtain efficient work.

Comfortable houses should be furnished and someone should be detailed to keep them clean, and it should be the business of some officer of the camp to see that this is done. It may not be possible to make up beds and carry water, but supervision can be given the camp to see that the beds are kept clean and free from vermin. It should not be expected of a man who works hard all day to clean up a shack and sweep around the doorway, after he has come to camp in the evening. Fuel should be furnished him at a low cost for cooking and heating purposes.

These items will not cost much during a year, but the money so spent will yield a large per cent. of profit in satisfied employes giving their best endeavors to their work.

Every camp should have a night watchman. He not only looks after the property of the contractor, but he sees that the men are protected. This is necessary as there have been occasions where men just after pay day have been "held up" in large numbers in a camp and robbed of their wages.

Men feel much safer sleeping in camp where a watchman is employed. A night watchman will also see that men are awakened in the morning, first the cook and his assistants, then the superintendent and stable men and then the other employes.

Good order and cleanliness should prevail in camp. For this purpose the night watchman can be made a sort of health and police officer. At times he can be made through the proper officials, a constable or deputy sheriff, which will be a great help.

He can see that the buildings and grounds are kept tidy and in a healthy condition, and that all boisterous and rowdy men are not allowed a free hand, so as not to molest those who wish to rest at night, or are peacefully inclined.

It is better to get rid of a few rowdies than lose a large number of self-respecting and hard working men. There should always be an hour set for men to cease their noise in camp, so that sufficient sleep can be obtained by all. Those men who do not wish to retire at that time must be made to keep quiet, or if they wish amusement until late in the night, go outside the camp for it.

Liquor should not be allowed to be brought openly into a camp, as it has a demoralizing effect. When men are solicited to come to your camp, either personally or through labor agents, be certain that all details are pictured to the prospective workmen as they really exist. Tell them of the wages and pay days, of the living expenses, the hours of work, should they ask regarding these subjects, just as they are, so that the dissatisfied ones can drop out before they start.

One man grumbling later means a large number dissatisfied. Above all things do not use whisky to entice a man to take employment with you. The contracting business and whisky do not mix well. Make only such promises as can be kept.

Broken promises mean that men will quickly leave you. It is a fact, that few seem to realize, that as laborers only too often break their promises, they are quick to criticize others, who may not do as they promise. One good rule is not to make promises, then you will have none to keep. To make men feel that their comfort is being considered, do not make them work over ten hours a day, unless unforseen difficulties arise or the work has to be pushed, in which case overtime should be paid. Above all things, so arrange the working hours, that the men will start to work in daylight and stop work before it is dark. Place yourself in a laborer's place and see how you would feel not to have any hours in daylight that you could call your own. To do this it may be necessary to change the time, but it is a common occurrence that camp time is different from standard time.

The feeding of men must be done with care. Men must be well fed to work well. The day for a fare of "salt horse," black bread and coffee is past. A good variety of well prepared food should be furnished and frequent changes should be made. Deserts and other tasty things should be served, and everything should be neat and clean. Men working in cold climates should be given plenty of meat and sweets to eat, while in a hot country plenty of fresh vegetables and fruits should be used. Good cooks should be employed, as they are the most economical in the end. Badly prepared food means waste. If the feeding of men is let out by contract the contractor should give some supervision to it.

Always have a pleasant greeting for every person in your employ. A few minutes of pleasant chat to a gang of men now and then means little lost time to a contractor, but is significant to his men, and thus a gain. Men wish to feel that they know their employer and much good can be accomplished in this manner. Do not become familiar or hail-fellow-well-met with them, as this does away with all esprit de corps. Upon every occasion possible commend good honest work. When fault is to be found, have the matter disposed of quickly. Do not be a continual fault finder. This may make men afraid of you, but it does not get good faithful work.

The welfare of men must also be looked after. Wherever possible amusements and diversion should be furnished them. A few musical instruments, such as a banjo, guitar, accordian and such like instruments kept in camp for the use of the men, will be found a source of much pleasure to them and the cost will be nominal.

During the winter evenings games of checkers, dominoes, cards and similar diversions will be found of much benefit to the men. In summer, quoits, baseballs for throwing and catching, weight lifting, single stick play and numerous other sports will be found attractive to the men.

At times various athletic sports can be indulged in. Jumping, running, wrestling, tree climbing and other exercises, will be both interesting and amusing. Many who have not tried to interest their men with such sports may think that they will not enjoy them, and some will say they get exercise enough from their work, but the writer knows from experience that hard working men enjoy such things and are better satisfied with both their work and surroundings. The truth is, that men accustomed to hard physical work find that these various athletic games and exercises help to rest them by bringing into play muscles that are not used at work. On holidays men work with greater zest by being furnished with a finer meal than usual, or other special attention paid them. In the South, where negro labor is worked extensively, a dancing platform will afford the men much pleasure, and on certain nights in the week, especially Saturday, will be used extensively. Less liquor will also be drunk when men's surplus energies are used up in such harmless ways.

Any contractor knows that the less liquor his men drink the greater is the amount of the work he obtains. In fact, liquor is a great disorganizer, and men who drink excessively are not competent to handle and care for machinery, nor are they capable of doing a fair day's work.

*From "The Contractor."

Papers and books can be furnished the men at a small cost. Engineering papers are always read in camp and a daily paper is much appreciated. A few books give much pleasure. On short jobs extensive preparations cannot be made for a reading and writing room, but on jobs lasting some years there is no reason why such accommodations should not be furnished. The government has done considerable work of this kind at Panama, and some contractors, who have extensive work covering long periods of time, have gone so far as to establish banks for the convenience of their men. Also music halls, where theatrical companies and others give performances, have been established and proved paying investments. This brings us to another feature of the care of men.

Anyone suffering from physical ailment or weakness is not competent to work and nearly every contractor employing large numbers of laborers always have men on the sick list.

At times those disabled become so numerous that he is seriously handicapped. Outside of the sentiment in this matter there is the hard business reason that men becoming sick and injured should be dealt with from a practical standpoint. Upon one occasion the writer heard a contractor say that he had thirty men suffering with malaria fever, and as he was working about one hundred men on his contract, to have about one-third of his force on the sick list was a serious problem.

Obviously the best way to prevent such things would be to have a doctor on the work continuously. This may be both feasible and practical on such a job as a subaqueous tunnel, where the cost of not only a corps of doctors, but also a hospital may be figured in the price of the job, or even on an extensive and long job, but for most work this is not possible.

First, it would be entirely too expensive, and in the second place most construction work is done in out of the way places and in undeveloped country where doctors are scarce. But it is possible to arrange for the attendance of a doctor two or three times a week at a camp.

In some sections of the country this is customary. The expense of the doctor is borne by the men themselves, a small fee being deducted from the men's wages each month and turned over to the camp doctor, the contractor taking a small per cent. for keeping the accounts and guaranteeing the money. This fee also covers the cost of such medicine, that a country doctor is accustomed to carry with him in his medicine case. Now and then, when the work is extensive and the number of men being employed is sufficient, a doctor will temporarily give up other practice and devote all his time to the several camps that are maintained on the work.

Such arrangements are good, and much sickness of a serious nature is thus prevented, but as the doctor usually visits the camps during the day, when the men are at their work, he is only able to treat and give attention to those who are so ill that it is not possible for them to be with their gangs. Thus many who are ailing are ultimately laid up and put under the doctor's care, when a few doses of medicine promptly given would keep them from stopping work. Then, too, there are men who are injured in various ways on the work, or in quarrels and fights. These things frequently happen when the camp physician is not within easy reach, and at times a man is so severely injured that unless he has prompt aid he may die from his wounds.

For these purposes a medicine chest or a miniature drug store should be kept in camp. Bandages, restoratives, and other things for first aid to the injured should be kept on hand, so as to care for the injured until a physician arrives. A chest with things for first aid can be purchased, but the author has been accustomed to provide medicine to treat minor diseases and slight ailments.

Contractors should not oppose labor laws unless they are drastic in their action. However, the various contractor's societies should see that such laws, when they are being enacted, are made equitable. A law compelling only eight hours of labor on contract work does not injure contractors unless it affects old contracts. On new work the extra cost can be figured in the price. This is the same case with workmen's liability and compensation acts.

Eight hour labor laws allow a day to be divided into three shifts and men can be made to do more efficient work in a short day than in a long one. Over-time is thus saved, and the forces can be better organized. Men are also given some time for recreation, and in cities where such laws are especially applicable this means better work from the men.

Laws to protect workmen's lives are also a good thing for contractors as the proper safeguards are thrown around machinery and the work, thus saving money to contractors. Contractors should not only see that such laws are properly drawn, but should also be active in obtaining legislation to protect themselves from abuses from workmen and owners.

All men are working for wages, so that this is an important matter to them. It is likewise of importance to contractors and one of the uncertain factors of contracting. In past days it has been too prevalent a thing to cheat men of their wages, but contractors have learned that this does not pay, and to-day men are being treated more fairly.

A system of time-keeping and paying men should be used that prevents men from robbing their employer, by means of raising wages, and by dummies on the pay roll, and one that also guarantees to all workmen his full pay for the time employed. Mistakes are a bad thing in a pay roll, but if they are made they should be rectified promptly.

Estimating labor efficiency is and probably always will be one of the large problems contractors have to face, particularly when undertaking jobs of any size. Many things affect the efficiency of men. In a vast construction undertaking this alone may mean decreased efficiency from workmen. High wages also mean less work from men.

One large company employing many men in a community with incompetent management and a loose system of handling men may mean to affect the efficiency of workmen in that line in the entire community. The writer has known this state of affairs to exist.

Labor unions likewise affect the efficiency of men. The attempt to set a common wage means to add to the cost of work done by the laggards, and has a tendency to make good men do only as much work as the poor ones. Labor unions do not limit the amount of work that a man can do in a day, yet it is a fact that in the same line of business in different sections of the country the amount of work done by union men varies exceedingly.

The weather likewise affects the efficiency of men. Numerous other conditions also play a part in this. Thus contractors, in order to keep the efficiency of their men up to a standard, must employ all means possible and study closely the management of men.

THE METRIC SYSTEM.

The Decimal Association announces that a weights and measures law, rendering the use of the metric system compulsory in Bosnia-Herzegovina will come into force on the 1st September, 1912.

No country which has reformed its weights and measures has ever adopted the British system, nor has any country which has introduced the metric system ever expressed the slightest intention of abandoning it.

SPECIFICATIONS FOR CONCRETE ROADS.

These specifications are abstracted from an article on concrete roads in Wayne County, Michigan, appearing in a recent issue of "Concrete."

The specifications for concrete roads are written for contract work, merely because the law requires that the commissioners advertise for bids. This is a mere formality in view of the now settled policy of the commissioners to build all roads themselves. Therefore the specifications are printed here only in their essential parts, as follows:—

Open Ditching.—An open ditch must be dug alongside of said road opposite the street railway track and beyond the gravel shoulder, location and dimensions of said ditch being shown on plans. This work may be done either before or after the roadway proper; but if done before, the ditch must be kept free and clear from rubbish and refuse during the construction of the roadway proper and left in as good condition in every way as it would have been if done after the concreting and shoulders.

Grading.—The contractor shall do all the excavating and filling necessary to bring the subgrade to the required elevation shown on plans and designated by grade stakes. After the subgrade has been prepared, and before any materials are drawn thereon, it shall be thoroughly compacted and rolled with a steam roller weighing at least ten tons, until pronounced satisfactory by the engineer. At such places as it is found necessary to do any considerable amount of filling to provide sufficient subgrade, the filling shall be done in 3-in. layers, thoroughly wet, and compacted while being built, and built as far in advance of the concreting as possible to prevent settling after the concrete is laid.

Concrete.—Concrete shall be laid 7 in. deep and 15 ft. wide and consist of one part of cement, 1½ parts of sand, and three parts of pebbles, evenly and thoroughly mixed; parts of cement, sand and pebbles to be determined by measurement.

Mixing.—All concrete shall be mixed in mechanical batch mixers, which the contractor shall furnish, of type to be approved by the Board; and measurements of all material shall be taken in manner to be approved by the engineer.

Placing the Concrete in Position.—Before placing the concrete, 2-in. by 7-in. plank shall be placed on edge and staked in line with the outer edge of the pavement, the upper edge of said plank to conform to the finished grade of concrete. The workmen shall place the concrete in position in the pavements where directed, and it shall be well tamped. Extra precautions shall be taken to insure proper tamping, and proper consistency at the expansion joints hereinafter provided for.

Finishing the Surface.—The contractor shall employ at least two men whose special duty it shall be to use a strike board having a curvature corresponding to the crown of the road, so that the top can be properly stroked off. The men employed in finishing the concrete must be at least one full section behind the mixer, and the surface must be finished smooth; i.e., there must be no depressions or elevations on the surface. At night, and at any other time when the work is discontinued for a time, all the work must be completed up to an expansion joint, hereinafter provided for. In other words, no section of pavement shall be allowed to be left unfinished for a longer period of time than 20 minutes, if work thereon has been started.

In the work of placing the concrete in position, and in finishing the subgrade, and in all other work under the contract, all foot and other traffic, both of employees and others, must be kept off the top of the concrete until it has thoroughly set; and the contractor must provide such bridges and other devices as may be necessary effectually to carry out the provisions of this paragraph.

Protection of Concrete After Laying.—After the concrete is laid, and until it has thoroughly set, it shall be protected from the sun by a canvas covering. When in the judgment of the engineer the concrete is sufficiently hard to warrant, this covering shall be removed, and the concrete covered with a layer of sand or gravel, 1 in. in depth, and sprinkled several times daily so as to be kept damp continuously to prevent the surface of the concrete from drying out while setting, which covering and sprinkling shall be done for a period of seven days, and then the covering removed and taken away from the road or otherwise disposed of in manner to be approved by the engineer.

Expansion Joints.—To allow for expansion the pavement shall be built in sections 25 ft. in length, and at each end of each section a soft steel plate 3/16 in. thick and 3 in. deep shall be embedded in the concrete and fastened to the section by projections from the steel or in some other manner satisfactory to the Board. It is hereby expressly stipulated that the joints furnished by the R. D. Baker Company, Detroit, will be satisfactory. The sections shall be separated a distance of ⅛ in, and this space filled with a suitable filler of pitch, asphalt or still wax.

Shoulders.—After the pavement is laid, gravel shoulders must be built on each side thereof, of sufficient width to bring the total width of the road from berm to berm up to 24 ft., as shown on plans. These shoulders must be built in layers not exceeding 3 in. in depth, and each layer must be packed before the next layer is placed. The top must be 6 in. deep, built of gravel containing 65 per cent. pebbles and 35 per cent. sand. Where necessary, the earth must be excavated to permit building of gravel top shoulders, which must conform to cross-section when completed.

When completed, the shoulders must be rolled as directed by the Board with a roller to be approved by the Board; but such rolling will not be permitted until the concrete has thoroughly hardened, and in any event not until at least three weeks have elapsed after the laying of the concrete opposite.

Material on Road.—Material delivered on the road in connection with the work must be compactly piled in such manner as to cause the least inconvenience to the public and the adjacent property owners. Private drives and road crossings must be kept open as far as practicable, and planked.

Surplus Earth.—All earth not used for filling or shoulders or otherwise in connection with the work, must be disposed of by the contractor in manner to be approved by the engineer at some point not further distant from point of origin than 1,000 feet.

Obstructing Travel.—Travel upon the road, and upon intersecting roads and alleys shall not be inconvenienced or hindered needlessly; nor shall any portion of the roadway be opened up, nor shall the same be wholly obstructed except as directed by the engineer; in which case the contractor shall cause plain and properly worded signs, "Road Closed, By Order of the Board of County Road Commissioners," announcing such fact, to be placed with proper barricades, and with other signs by day and lighted green lanterns at night, plainly indicating the nearest route around the obstructed portion, and upon intersecting roads, so that travel can pass around same in the shortest and easiest way.

The Canadian Engineer

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The Canadian Engineer absorbed The Canadian Cement and Concrete Review in 1910.

NOTICE TO ADVERTISERS.

Changes of advertisement copy should reach the Head Office two weeks before the date of publication, except in cases where proofs are to be submitted, for which the necessary extra time should be allowed.

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CONTENTS OF THIS ISSUE.

THE NEW CHAIRMAN OF THE TRANSCONTINENTAL COMMISSION.

We note that Mr. R. W. Leonard, of St. Catharines, has been appointed chairman of the National Transcontinental Railway Commission, to succeed the Hon. Mr. Parent. This is an appointment which will receive unanimous endorsation by the public.

Mr. Leonard's career has been one of exceptional interest. His initial technical training began in the Royal Military College at Kingston. In his early work he made a marked success in railroad construction in the Maritime Provinces, and later in Ontario. The Kakebeka Falls power development was under his charge as construction engineer. Later, Cobalt gave Mr. Leonard his opportunity, and his success with the Coniagas mine stands as a monument to his work as an experienced calculating financier. The Coniagas smelter at Thorold is another success achieved. Mr. Leonard, while he has made money, a great deal of it, in fact, he made it cleanly and in the engineering profession.

His appointment to this position means that the Transcontinental will have a man at the helm well versed in the technical aspects of the work, an aggressive, keen and successful engineer, who will be able to hurry on this work to completion.

There is only one regret to be expressed in this appointment. About a year ago Mr. Leonard was appointed to the Board of Governors of the University of Toronto, and on that Board he stood as the special advocate of Applied Science and Engineering as against the purely cultural tendencies of the other members of the Board. No doubt this new appointment will mean that he will not be able to devote any time to the Board of Governors, with the natural result that the interests of Engineering in the University of Toronto will suffer.

THE INTERNATIONAL DEEP WATERWAYS COMMISSION.

The reorganization of the Canadian Section of the International Deep Waterways Commission is being agitated, and there appears to be good grounds for change.

The work of this Commission is of the most important character, dealing as it does with International questions relating to the water boundary between the United States and Canada, and to the protection of the rights of people on either side of the boundary line. It is of particular interest to Ontario, as the interests of the Province have already been sacrificed in the work of the first Commission.

The United States recognized the importance of this Commission, and in making the appointment to their section they placed on it the best men it was possible to obtain. As a result, the American Section completely dominated the work of the Commission to the sacrifice of the Canadian interests.

Sir George Gibbons, as the chairman of the old Commission, was renominated for the position about four weeks before the general election. This appointment, made during the dying days of the old Government, will hardly be allowed to stand. It is to be hoped that it will not, for it is appointments such as these which allow Canada's position to be jeopardized in dealings with the United States.

If this Commission is to be reorganized, the appointment should be removed from the realm of political preferment, and men chosen who will stand for the best interests of the Dominion—men big enough to handle the difficult situation which will arise with dignity and justice to us.

As has been noted, Ontario's interests were sacrificed in the first International Deep Waterways Treaty in the matter of the adjustment of the amounts of power to be developed at Niagara Falls, on the Canadian and the American sides. Ontario's peculiar geographical position should have procured for her a much larger percentage of the developable power than she secured. Sir George Gibbons and his associates sacrificed the interests of the Dominion here, and it cannot be expected that they will do differently in the future.

Ontario's position in the work of the International Deep Waterways Commission is of tremendous importance, since the situation at Niagara Falls will require considerable attention from the Commission. The success of the Hydro-Electric Commission to a great extent depends on the interests of the Province being safeguarded in dealings with the United States.

For that reason, it appears to us that Ontario should have the privilege of appointing at least two members of the Commission if this reorganization takes place.

It has always been a matter of regret that the Government has never seen fit to appoint an engineer to this Commission. The work of the Commission, dealing as it does with the different power situations throughout the Dominion, is of such a nature that engineering knowledge would have been invaluable in dealing with the complex problems coming before it for adjustment. Now appears to be the opportunity of the new Government to show the same regard for efficiency as appeared in the matter of the Transcontinental Commission, by appointing men with large vision and technical ability, who will be able to handle the problems coming up for solution—men who will not allow Canadian interests to be sacrificed as has been done in the past.

THE CANADIAN SOCIETY OF SANITARY ENGINEERS.

The Plumbers' and Steamfitters' Union is again asking for a charter with the euphonious title, "The Canadian Society of Sanitary Engineers." They have been working along this line for over a year, and a committee from their ranks now approach the Provincial Government. Inquiry from Hon. Mr. Hanna elicited the information that they were about to be granted their request. However, the matter has been held open until the Canadian Society of Civil Engineers have had an opportunity to be heard.

It is hard to believe that an intelligent body of men, such as the Plumbers' Union, would make such an absurd request. One can hardly understand where any benefit would accrue to them if their application was granted. The term "Sanitary Engineer" in this case is a misnomer. The term "Sanitary Engineer" applies strictly to a small branch of the Civil Engineering profession, practically all the members of whom belong to the Canadian Society of Civil Engineers. With the thought of the plumber qualifying as a sanitary engineer, one brings to mind the old quotation, "A rose by any other name." The plumbers certainly should feel their dignity enhanced if their application is granted. Bill Dobbs, the plumber, will become Mr. William Dobbs, The Sanitary Engineer.

It is to be hoped that the Provincial Government will not allow this incongruity to pass, either in its present or in changed form. A committee representing the claim of the Canadian Society of Civil Engineers, and composed of Mr. C. H. Rust, president of the Society; Mr. J. Galbraith, past president; Mr. H. E. T. Haultain, chairman of the Toronto branch, and Mr. E. A. James, secretary of the Toronto branch, met the Hon. Mr. Hanna on Tuesday, October 24th, to discuss the matter, and presented their reasons why this body should not be allowed a charter under the name of Canadian Society of Sanitary Engineers. At the time of going to press we have not ascertained whether their claims have been recognized.

TORONTO UNIVERSITY ATHLETIC FIELD BLEACHERS.

A letter to the Editor from Mr. Graham Campbell, Superintendent University of Toronto, will be found in the columns of the Engineer after editorial comment. We are pleased to draw attention to this letter. Last week it was noted in the Engineer that the bleachers at the University Athletic Stadium had swayed considerably under the movements of the crowd. In drawing attention to this fact it was not with the thought of criticizing the design of the structure, which we are satisfied is of the best, but rather with the idea of preventing a recurrence of the surging songs, sung by the student body at that time. No engineering structure can withstand the tremendous stresses induced by a body of men moving in unison. We understand from Mr. Campbell that the Athletic Association have taken measures to prevent such an occurrence again.

The University authorities called in Mr. A. H. Harkness to investigate the strength of the structure, and we publish his report after Mr. Campbell's letter. In his report Mr. Harkness notes that the structure is amply strong to withstand any loading placed upon it. This, along with the assurance of the University authorities, that the loading will hereafter be confined to the ordinary conditions, gives us confidence that the bleachers are quite safe, and will no doubt reassure the public.

The authorities of the University are to be congratulated on the prompt action taken in this matter, and their attitude throughout is one which inspires confidence.

EDITORIAL COMMENT.

The collapse of a scaffold at Saskatoon again brings to notice the reckless methods adopted in construction work, and demonstrates the need for a closer supervision on the part of the local authorities.

* * * *

In Preston the town council supervises the erection of buildings on residential streets for the purpose of excluding eyesores and protecting owners who have invested in and built up attractive properties. Preston has taken a step in the right direction.

* * * *

Railway men have been growing quite concerned about this matter of tie supply. Year by year ties are becoming more costly, and something will have to be done before the price becomes prohibitive. A great fortune awaits the man who will find a substitute, combining cheapness and durability, for the present wooden ties, the supply of which will not last many more years at the present rate of consumption.

* * * *

The remarks of Mr. Fellowes, Waterworks Engineer, to the Press concerning the diving of Capt. Mitford, who will investigate the intake pipe for the water supply of Toronto, are, to say the least, in very bad taste if he is correctly reported. Too many of the officials in the city of Toronto are prone to give newspaper interviews when it serves their purpose so to do. The time to criticize Capt. Mitford's work will be when his report has been made.

LETTER TO THE EDITOR.

We have received the following letter from Mr. Graham Campbell, Superintendent University of Toronto, with an accompanying report from Mr. A. H. Harkness, Consulting Engineer, both of which we are pleased to publish:—

Sir,—In your issue of October 19th I notice a paragraph in your editorial comment relating to the safety of the new Bleachers constructed in the Athletic Stadium for the University of Toronto Athletic Association.

I feel that your information can hardly have been obtained from a reliable source, as an independent inspection assures me that there is no possibility of the danger mentioned. I enclose a copy of a report made on this structure by Mr. A. H. Harkness, Consulting Engineer. The report of an engineer with the standing of Mr. Harkness is, I think, full assurance that the safety of the public has been carefully considered in the design and erection of this stand.

Might I ask that this letter and report appear in your next issue of the Canadian Engineer. Yours faithfully,

GRAHAM CAMPBELL,
Superintendent, University of Toronto, Toronto.

Mr. Campbell, Superintendent,
University of Toronto,
Toronto, Ont.

Dear Sir,—I have checked up the design of the grand stand (bleachers) in the athletic field of the university, as shown on the drawings submitted by you, and have carefully looked over the structure itself.

I find the stand to be safe for any load of people that could get on it.

It is securely braced so that it is safe to withstand the surge of a crowd of people moving in unison.

There is no indication of any movement or loosening of joints in the building from previous loadings.

I am returning, under separate cover, the drawing and calculations submitted. Yours truly,

A. H. HARKNESS,
Consulting Engineer.

A DIFFICULT PIECE OF WORK.

The Dominion Government have undertaken the task of protecting shipowners using the Annapolis River, N.S., from damage caused by ice and tide. A number of piers have been erected in mid-stream to form a barrier to the ice, which is expected to freeze in a solid sheet above the piers, instead of breaking up into cakes and racing up and down with the current, to the detriment of shipping at the wharves.

Three piers were placed in position last year, but this work proved an easy task as they stood in shallow and comparatively still water; the mid-stream piers, however, had to be located in forty feet of water at low tide, which runs at the rate of six miles per hour.

Mr. E. R. Reid, contractor, St. John, N.B., secured the work relative to the mid-stream pier cribs. These cribs are built of heavy creosoted timber, 12 x 12 inches, 39 x 28 feet on the bottom and forty feet deep.

The piers were built on Annapolis side of river and when complete and ready for setting, fastened to heavy scows, one on each side, and at high water "slack" were towed across the river with a tug-boat and a steel wire fall (four-fold purchase) connected to the Grenville side up-stream moorings and carried to a steam winch on a scow alongside the pier. The scows were for assistance also in keeping the pier on an even keel.

The ends of the piers were square face construction, and in building bridle wires "bottom, centre and top" on each side of each end were put in. These bridle wires were gauged to draw with equal strain, and came together about forty feet from the face of the pier and were shackled together there; into this shackle was connected the block on one end of the steel wire fall, the other end of fall being connected to the main moorings. In this way, with moorings on each side of river the contractor was able to gradually let out on either of the moorings and secure desired position both as to line across river and angle-wise.

The system of bridle wires used tended to keep the pier on fairly even keel, which was one of the greatest difficulties owing to the enormous run of tide.

In setting this pier between fifteen and sixteen tons of wire cable in sizes of from ⅞-inch to 1½-inch diameter, were used, practically all of which will be recovered, though somewhat damaged. About 1½ tons of heavy steel blocks were also required.

The main mooring cables were from 1,200 to 1,500 feet long and held the pier in river, through an entire ebb tide (six hours) before it could be allowed to take bottom and ballasted.

The engineer in charge of this work for the Government is Mr. C. E. W. Dodwell, of Halifax, and the contractor Mr. E. R. Reid, of St. John, N.B.

RAILLESS TRAMS A SUCCESS.

Success has attended the introduction and working of the railless trolley tramcar system as inaugurated in Bradford in June last. This will, there is no doubt, be welcomed by Municipal Authorities who own tramways, for the adoption of the system will enable them to meet the demands for extensions to parts of their districts which are not populous enough to justify the expenditure on an ordinary tramway. It also means that before many years are passed rural highways not hitherto believed possible to be served by electrically propelled vehicles will be invaded by trackless trams. In the installation which has been carried on at Bradford, from an engineering and operating point of view the system, according to the Tramways Manager, has been an unqualified success, and no difficulties of any sort, he reports, have cropped up, such as might reasonably have been expected in connection with an experimental installation. The Bradford Corporation, it is to be noted, are so satisfied with the results that they have decided to equip an additional nine miles of highways with the trackless tramway system.

Metallurgical Comment

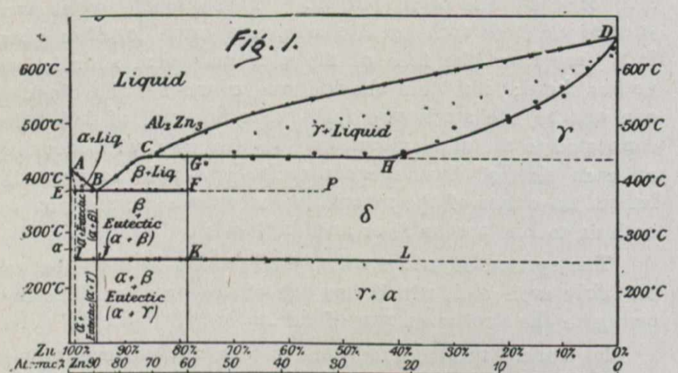
T. R. LOUDON, B.A. Sc.

Correspondence and Discussion Invited

THE ALLOYS OF ALUMINIUM AND ZINC.

Although this series of alloys has been investigated by many others, the paper presented by W. Rosenhain and Sydney L. Archbutt, before the Institute of Metals, contains very valuable information. The following summary gives an idea of the results of the investigation:—

The results of the thermal and microscopic investigation of the alloys of aluminium and zinc are embodied in the equilibrium diagram given in Fig. 1. This diagram differs



from that given by Shepherd and others in showing two horizontal lines of heat evolutions, lying at 443 deg. and 256 deg. Cent. respectively, the former cutting the liquidus curve at a concentration close to 85 per cent. of aluminium, where a small break occurs in the liquidus. The eutectic line has been shown to end in alloys which have attained equilibrium, at a concentration near 78 per cent. of aluminium, while the maximum of the heat evolutions at 256 deg. Cent. has also been shown to lie near this concentration. These facts, together with microscopic data, lead to the conclusion that the heat evolutions at 443 deg. Cent. represent the formation of the definite compound Al_2Zn_3 (called β in the paper), while the heat evolutions at 256 deg. Cent. represent the decomposition of this substance. The β compound is incapable of dissolving zinc, but forms an unbroken series of solid solutions with aluminium. The exact position of the solidus curves has been determined by quenching experiments, and has been found to accord with the equilibrium diagram as given above.

The researches described in this paper have been carried out in the National Physical Laboratory (metallurgy department).

G. E. Pellisier, in the Electric Railway Journal, advances a new theory on the causes of rail corrugation as follows:—

That corrugations are directly due to non-uniformity of pressure between the tread of the carwheel and the surface of the rail, and between the flange of the wheel and the side of the rail head, and they occur only when the pressure at the point of maximum intensity of pressure exceeds the elastic limit of steel at that point; that any condition or set of conditions which produce this non-uniformity of pressure will cause corrugations if the maximum intensity of pressure exceeds the elastic limit of the rail material; that comparatively few combinations of circumstances cause the maximum intensity of pressure to exceed the cubical elastic limit of steel; than any conditions which cause the position of a point of maximum intensity of pressure to move away from the approximate centre of the rail head to the edge where any particles are not restrained, but free to move in one or more directions, reduce the elastic limit to its linear value, which is not more than one-third of its cubical value, according to good authorities; that the shape of the rail head, wheel tread and wheel flange, and the position of the one relative to the other under traffic, has great influence on the position of point of maximum intensity of pressure, and thus is responsible for most of the corrugations; that by so designing the rail head, wheel tread and wheel flange and so laying the rails that the maximum intensity of pressure will occur near the centre of the tread surface of the rail and as far as possible from the corner or edge of the side of rail, most of the corrugations can be eliminated; that corrugations produced by pressures exceeding the cubical elastic limit of steel (such as might occur with quick braking of heavy, fast trains) can be eliminated only by raising the elastic limit of the steel, increasing the area of contact between the wheel and rail, or by making the acceleration (positive or negative) so uniform that a uniform cold flowing of the metal will follow.

ELECTROLYTIC CORROSION OF IRON BY DIRECT CURRENT.

In the October number of The Journal of the Franklin Institute an account is given by J. L. R. Hayden of some experiments carried on in the Research Department of the General Electric Company to determine the influence of electric current on the corrosion of iron, the experiments being directed toward electric railway rails.

To investigate the electrolytic corrosion which may be expected in iron in the ground, some tests were made with dirt solution as electrolyte, but the tests were not conclusive, and had to be postponed for lack of time.

The investigation is very far from complete, and no too much reliance must be placed on the numerical values, for instance the effect of chlorides or sulphates on nitrates and bichromates, etc., as they are based on a small number of tests only, and a number of conditions, which are of influence, have not yet been studied, as the concentration of the electrolyte, the current density, the effect of circulation (which is possible in the solution of the electrolyte, but would be practically absent in the soil), the temperature, etc. However, some general conclusions appear warranted:—

(1.) No conclusion can be drawn on the electrolytic corrosion of iron from the amount of current which passes from the iron as anode, since iron may assume a passive state, in which electrolytic corrosion is entirely absent, or an active state, in which the corrosion follows Faraday's law.

(2.) The conditions which lead to the active or to the passive state are not yet fully understood, but sometimes, under apparently identical conditions, either state may occur.

(3.) Alkaline reaction of the electrolyte, the presence of nitrates, and, more still, bichromates, tend to produce the passive state; sulphates, and especially chlorides, even in small quantities, produce the active state of electrolytic corrosion.

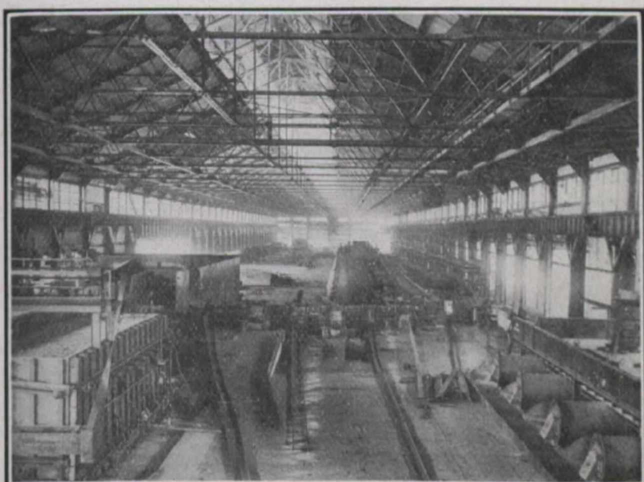
(4.) High current density, even if only momentary, tends to produce the passive state, absence of current the active state.

(5.) In the active state the products of corrosion are initially ferrous compounds, in the passive state ferric compounds, and the passive state occurs in such electrolytes in which ferrous compounds cannot exist or are chemically unstable.

(6.) In the passive state the potential difference at the electrodes is much higher than in the active state.

NEW MERCHANT MILL OF LACKAWANNA STEEL COMPANY.

As recently announced in The Canadian Engineer, the new merchant mill for the production of bars, wire rods and other merchant shapes, which was begun about a year ago at the Buffalo plant of the Lackawanna Steel Company has just been completed and was placed in operation. This mill, which is to be known as number 9, is designed to roll rounds from ¼-inch up to ⅞-inch in diameter and equivalent sections of squares, flats, ovals and shapes, and will have a capacity of 10,000 to 12,000 tons per month. The mill is located parallel to the present merchant mill in a steel building 105 feet wide by 1,050 feet long.



General View of No. 9 Mill, Lackawanna Steel Company, Buffalo, New York.

The mill, which was furnished by the Morgan Construction Company, of Worcester, Mass., consists of one 6-stand 12-inch continuous roughing train and four 2-stand 10-inch finishing trains.

The billets which are 30 feet in length and 1¾-inch, 2-inch or 2½-inch square are brought from the billet mill on cars and delivered to the billet storage, which occupies a space of 105 feet wide by 156 feet long in the south end of mill building, and is commanded by a 15-ton electric overhead crane.

From storage, the billets are handled by crane, weighed and introduced into furnace by means of a Morgan conveyer of the usual type. The heating furnace is of the suspended roof continuous type, having a hearth 30 feet by 25 feet. The furnace is gas fired, gas being furnished by four 10-foot Morgan gas producers. After heating the billets are delivered to the first stand of the continuous roughing mill and a power-driven toggle shear located between the furnace and the roughing mill shears the billets to proper length. This shear is arranged to operate independently on two separate lines of billets, cutting the billets as they are passing through the rolls. From the continuous roughing mill the bar passes to the 10-inch finishing mills.

After passing through the finishing stands the bar is delivered to a double cooling bed 360 feet long. This cooling bed, which is of the Morgan inclined escapement type is designed to handle sections from ¼-inch rounds up to 3-inch wide flats. For preparing this material for shipment there are two bar shears and two back shear tables 75 feet long, complete with bundling pockets and 30-ton scales. The back shear tables are each equipped with gauges and electrically operated push-offs.

There are also four pouring type automatic reels for coiling wire, rods, nut flats and other sections. The reels mechanically discharge the coils on to a conveyer which delivers them to a hook carrier, which automatically takes the coils from the first conveyer and delivers them to any point on the loading dock.

Including the crane at billet storage there are three 15-ton electric overhead travelling cranes. The crane runway extends the full length of mill.

The continuous mill is driven by a heavy duty tandem Corliss engine, and the finishing mill by a heavy duty horizontal cross compound Corliss engine. Both engines are connected with a 72-inch Type "A" Helander barometric condenser.

In addition to constructing the new mill, the old merchant mill has been extended 350 feet on the north, and to provide additional room for finishing and shipping. An electrically operated stock transfer car 90 feet long has been installed to deliver material from one mill to the other, thus saving the switching of cars in cases where material from both mills is to be loaded out in the same car.

GALVANIZING WIRE IN ZINC-DUST.*

By Alfred Sang.

Ever since I presented before the American Electrochemical Society my first paper on galvanizing steel wire by heating it electrically in zinc oxide or zinc dust, I have realized that a perfectly clear conception of the forces at work was essential for successfully operating the process. Once the nature of zinc dust was well understood and the action which different temperatures may have on it was clearly demonstrated, the application of the process was found to be, after all, not nearly as complicated as might have been feared, in fact it was less complicated than the other two processes in general use.

It must be recalled that zinc dust does not melt when heated to the temperature of fusion of zinc, but at higher temperatures reducing agents will "precipitate" the metal, as it were, and it can also be squeezed out under mechanical pressure. This property of resisting fusion is supposed and is probably due to the surface of each particle being formed of zinc oxide or zinc carbonate.

If zinc dust is heated evenly, the temperature is found to rise steadily until around 390° C. when the rise becomes much more rapid, attaining its maximum rate at about 420°, then falling gradually until in the neighborhood of 470° it again becomes normal. When the dust is cooled down an opposite effect is noted between 450° and 260°. If the operations of alternately heating and cooling the same dust are repeated, the exothermic and endothermic effects are manifested each time between the same temperatures, with their apices at about 420° on the rise and about 350° on the fall.

We cannot help but notice that the exothermic effect on the rise occurs at the melting point of zinc metal, but when zinc is melted the effect is the very reverse, heat being absorbed at the moment of fusion to the extent of 28 calories per kilogram.

*Abstracted from a paper given before the Am. Electrochemical Soc.

We are therefore in presence of an anomalous critical point, and I will now consider separately the operations of galvanizing in zinc dust below and above that critical point.

If a clean piece of steel wire is immersed in zinc dust which is heated to a temperature below 420°, or at what is known as "sherardizing temperatures," a slow cementation takes place and zinc is absorbed from the very moment that the wire reaches the temperature of the dust; there is at the same time a slow sublimation of zinc at the surface increasing with time but sufficient for all practical purposes after a few hours of treatment; in the presence of reducing gases the time of treatment can be considerably lessened but the penetration of zinc is of course less. This process is sherardizing, unsurpassed for many purposes, unsuitable for many others. There are two varieties of sherardized coatings: the gray, porous and brittle variety, mostly composed of zinc carbonate which darkens with age; other variety has a high metallic luster and is compact and of a finely crystalline structure. If this were the class of sherardizing produced by all existing plants, there would not be much hot-galvanized work produced outside of wire and sheets.

When we work with the dust at a temperature above the critical 420°, results are entirely different; galvanizing is instantaneous, taking place the very instant that the wire reaches the temperature of the dust. There is very little penetration of zinc in the iron; there may be vaporization and condensation of zinc as in sherardizing, although I doubt it. A wire heated to 800 or 900° in a non-oxidizing flame and quickly thrust into cold zinc dust will condense around itself a considerable thickness of zinc. The best working temperature ranges between 500 and 600° C. The galvanizing is bright and more pleasing in appearance than that obtained by any other means.

The furnace used merely consists of a zinc-dust trough between two sand troughs provided with a set of cast-iron cover-plates over the zinc trough and power-driven rolls. As high a speed as 850 feet per minute can be used for securing good merchant galvanizing. It is found preferable to run at 35 feet only, running a large number of strands and attaching the coils end to end.

The process is economical as regards current consumption which, outside of zinc and labor with a very small amount of power for driving the rolls, represents the bulk of direct cost. Figures are readily arrived at, for as soon as the dust has attained a fairly constant temperature, as it very rapidly does, the consumption of electricity in watt-hours is represented by the formula

$$\text{Watt-hours} = \frac{w \times s \times t \times 7}{6}$$

where

w = weight of wire treated.....say 1,000 kilograms.
s = specific heat of steel.......say 0.18 at 550°.
t = temperature to be maint'd..say 550° C.
w s t = calories needed, which, multiplied by the ratio 7/6, gives the watt-hours.

Figuring 75 per cent. efficiency for the dynamo or transformer supplying the current, the above formula gives 154 kilowatt-hours per long ton of wire of any diameter.

While the wire is softened by the process, a full annealing can only be secured by using a higher temperature, the consumption of electrical energy being then increased from 40 to 50 per cent. and the sand trough through which the wire passes after leaving the zinc dust must be appreciably lengthened. If a slight scale is to be removed, the high temperature must be used in connection with a reducing agent. Sand must be used with the zinc dust to prevent caking and cavitation in the path of the wire. Aluminium contact rolls and special mercury contacts are the only ones suitable for this kind of plant.

The wire can be brought out into the air immediately after coating, but it is preferable to let it cool by passing it through sand which brightens it at the same time.

The instantaneous galvanizing of steel in zinc dust above 420° is readily explained by completing the theory which I developed as far back as 1907; I will now state it in its complete form.

Zinc dust is produced by the sudden cooling of the vapor of zinc and the transition from the gaseous to the solid state is so rapid that, for all practical purposes, the liquid state is skipped. The setting of the zinc, brought about by sudden chilling, prevents regular arrangement of the molecules along determined stereochemical lines; it forbids the formation of crystals for which time is required. The heat of solution of matter in an amorphous state is always higher than when in a crystalline state; the same is true of a strained condition which likewise presents an amorphous appearance. At the time of formation, considerable heat is retained which would have been radiated by slow cooling. The condition is one of physical instability resulting in readier and, oftentimes, explosive decomposition.

The physical instability of zinc dust may be explained thus: In the prolongs of zinc furnaces the uncondensed vapor is suddenly chilled and collects in minute drops which are instantly congealed at the surface and oxidized, forming a rigid spherical skin or crust. Within this crust the liquid zinc cools and contracts more slowly but the rigidity of the crust does not permit the drawing in of the surface to form the facets of a crystal and compensate this internal contraction. Thus, voids must exist within the crust and we may presume a structure which might be described as "piped radially" or as negatively crystalline.

Below the melting point of zinc this condition persists but affinities and thermal inducements find a readier response from zinc dust than from any other form of zinc, both by reason of the enormous amount of free surface and because of this unstable condition.

At about 415°, which is the melting point of zinc, the strain within the zinc dust particle is totally or almost totally relieved as indicated by the loss of heat, although some of the latent heat must be retained for fusion.

At high temperatures zinc dust is pasty, because formed of innumerable little bags of melted zinc, but these will not coalesce on account of their small size and closely packed condition, unless considerable pressure is used. These minute bladders might be compared to soft-shell turtle's eggs; they form a plastic and cellular mass.

If, however, a reducing agent, say a drop of coal tar, is introduced, reduction of the skin takes place and we get a small mass of more or less spongy metallic zinc. If a metal which is electronegative to zinc, such as iron, is put into contact with these bags of zinc, reduction and an exchange of metals take place, the bag is punctured at the point of contact and the zinc spreads itself on the iron.

Hence it is that wire can be galvanized in this manner by means of a plant closely resembling a hot galvanizing plant, for the process is, in fact, one of hot galvanizing.

NEWS ITEMS.

In view of the protracted strike of the coal miners in the southern portion of British Columbia, there are grave apprehensions of a coal famine during the winter in those western provinces which draw their supplies of fuel from the mines affected by the strike.

* * * *

The Ovifaker Iron; a Natural Carbon Steel. C. Benedicks. (Metallurgie, viii, 65.)—On examining the specimens of the natural mass of iron discovered at Ovifaker by

Nordenskiöld under the microscope, the results show that the mass is a natural steel containing high sulphur. The structure differs from that of meteoric iron, and shows the presence of finely divided pearlite, indicating very rapid cooling below 700 deg. C. A new constituent was observed, which the author terms "oxide-pearlite," in which the cementite lamellæ appear to penetrate into the oxide; this oxide-pearlite was probably formed by a secondary oxidation of the ferrite lamellæ in pearlite. This confirms the view that the mass has been produced by the reduction of the iron compound in molten basalt by a highly carbonaceous material.

* * * *

Iron and Steel Institute.—The fall meeting, which was to have been held at Turin, Italy, October 5, was held instead in London, owing to circumstances which had unexpectedly arisen. The following is the list of papers submitted, a selection of which was read and discussed:—

1. "Reports on the Iron Ore Resources of Italy." (a) Sardinia, by Ing. L. Testa. (b) Brembana Valley, by Cav. G. Calvi. (c) Central Italy, by Ing. A. Ciampi. (d) Southern Italy and the Island Dependencies, by Prof. G. la Valle.

2. "Temperature Influences on Carbon and Iron." By E. Adamson, Sheffield.

3. "Mechanical Influence of Carbon on Alloys of Iron and Manganese." By Prof. J. O. Arnold and F. K. Knowles, Sheffield.

4. "Autogenous Welding of Metals." By Dr. Francesco Carnevali, Turin.

5. "Application of Electric Energy to the Manufacture of Iron and Steel in Italy." By Cav. Ing. Remo Catani, Rome.

6. "Present State of the Metallurgical Industry of Italy." By Signor Comm. Luigi Dompé and Cav. Francesco Saverio Pucci, Milan.

7. "Origin of the Iron Ores of Swedish Lapland." By L. L. Fermor, Calcutta, India.

8. "New Industrial Processes for the Cementation of Steel." By Cav. Prof. Dr. Federico Giolitti, Turin.

9. "Cementation with Gas under Pressure." By Prof. Dr. F. Giolitti and Dr. Francesco Carnevali, Turin.

10. "Transformation of Steel within the Limits of Temperature Employed for Heat Treatment." By L. Grenet, Argenteuil, France.

11. "Reseaches on the Nature of the Phosphates contained in Basic Slag derived from the Thomas Gilchrist Dephosphorisation process." By Victor Adolphe-Kroll, Luxenbourg, Germany.

HAND-MIXING OF CONCRETE.

Although upon all extensive operations concrete is now mixed by a machine, says Sanford E. Thompson, hand mixing is necessary, and may be even economical under certain conditions: (1) Where the quantity of concrete is so small as to prohibit the expense of purchasing or renting a mixer, (2) where concrete is laid in so thin a layer or at so many different places that the cost of the frequent moving of a mixer counterbalances the saving otherwise realized, and (3) in beginning large jobs before the machinery has arrived or where the work is slow at the start. The cost by hand mixing, therefore, should be estimated not only when it is obviously the only method to use, but also to determine whether hand work may not be the cheaper.

Notwithstanding that comparative tests have usually shown machinery-mixed concrete to be the stronger, with careful superintendence, hand mixing will give first-class results. Concrete of wet consistency, soft enough to flow sluggishly, such as is used in building construction, is less easily worked by hand than a mixture of stiffer plastic consistency.

The cost of mixing by hand varies with local conditions, but when, as is usually the case on any particular job, the local characteristics are known, it is possible to estimate the cost very closely instead of making it a matter of mere guess. To be sure, the experienced engineer or contractor may guess quite accurately, but almost anyone will fall down once in a while and make a mistake which may amount to a large percentage of the cost, enough to make a difference between profit and loss, when conditions are different from those with which he is familiar. With the proper data at hand it is just as easy and takes no more time to estimate accurately than to study the problem carefully enough to hazard a guess which will include all the variables.

The strength of hand-mixed concrete is but little affected by the system employed in mixing the materials, provided they are turned in a proper manner and a sufficient number of times to incorporate them thoroughly. Some engineers prefer to make the cement and sand into a mortar, while others do not add the water until the final turning. Excellent work is produced by both methods, but the latter is slightly more economical because shoveling the mortar on to the stone involves more labor than handling the dry mixed cement and sand. For example, comparative tests show that it costs less to mix the cement and sand dry, shovel the mixture on to the stone, and turn three times than to make a mortar, shovel it on to the stone, and turn only twice. Still other methods are sometmes employed, so that they all may be summarized as follows:—

(1) Cement and sand mixed dry and shoveled on to the stone or gravel, levelled off, and wet as the mass is turned.

(2) Cement and sand mixed dry, and the stone or gravel dumped on top of it, levelled off, and wet as the mass is turned.

(3) Cement and sand mixed with water into a mortar which is shoveled on to the gravel or stone, and the mass turned with shovels.

(4) Cement and sand mixed with water into a mortar, the gravel or stone spread on top of it, and the mass turned with shovels.

(5) Gravel or stone, sand and cement, spread in successive layers, mixed slightly and shoveled into a circle or crater, water poured into the center, and the mass mixed with shovels and hoes.

The last method is applicable only where a small amount of concrete is to be mixed on the ground with no mixing platform or mortar box.

Mixing of the sand and cement must be done just before they are needed. If mixed more than half an hour in advance, the natural moisture, which all sands contain, will make the cement set and cake.

NEW TYPE LOCOMOTIVE.

The London and Northwestern Railway, in conjunction with the Great Central Railway, is experimenting with three electric locomotives, generating their own power. Designs for three of these engines are being prepared.

Electricity will be generated by a dynamo driven by a petrol engine. Experiments have previously been made with electric locomotives in which the dynamos driven by a steam turbine, but the type proved unsatisfactory in the matter of economy of working. By replacing the turbine with a petrol engine, a great deal of weight and space will be saved.

A CONCRETE PLANT LAYOUT AND METHODS OF HANDLING MATERIALS ON A TEN-STORY REINFORCED CONCRETE WAREHOUSE JOB.

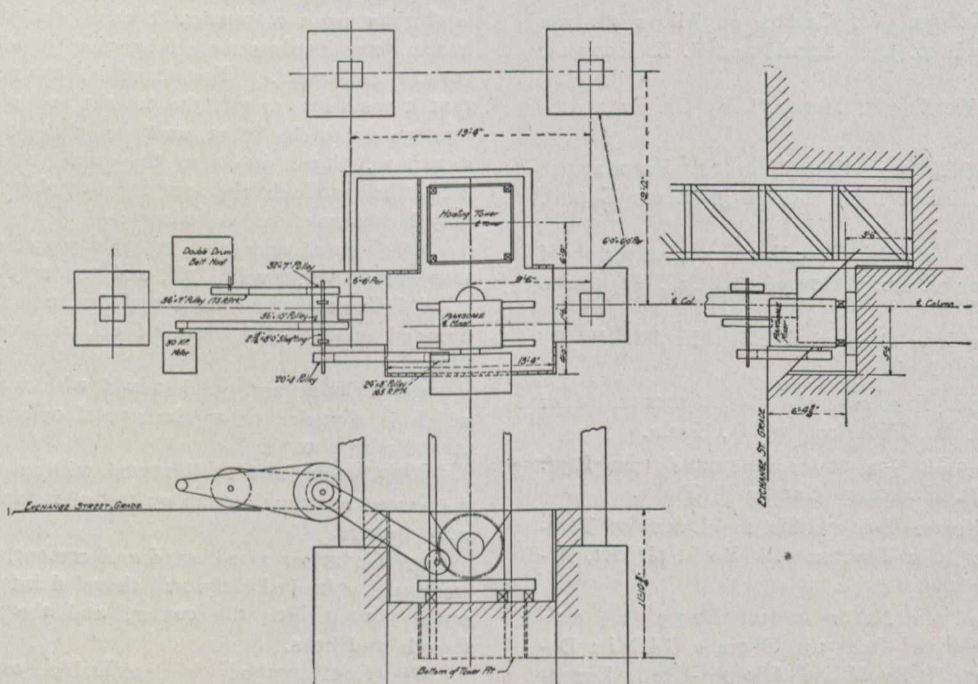
The concrete plant layout and the methods used in unloading, dumping and transporting the raw material to the mixers and hoisting towers, by the Aberthaw Construction Co., of Boston, in erecting the large ten-story reinforced concrete warehouse of the Larkin Company at Buffalo, N.Y., are well worth attention. The Larkin warehouse will contain 613,000 sq. ft. of floor space, or over fourteen acres, and the consulting engineers are Lockwood, Greene & Co., of Boston and Chicago.

There are two distinct mixers and hoisting towers located at thirds of the building's length. In back of these and across the road kept open to traffic, are the cement sheds and stone bins, all of which are connected to the mixing plant by industrial tracks so arranged that the raw material can be brought from any point to either of the Ransome mixers. The aggregates are received on the Erie Railroad tracks alongside of these buildings.

show as good results as average sand with crushed stone, and even better in most instances.

The location of the two cement sheds of capacities of 4½ and 5¾ cars each, was arranged so that the railroad cars could be placed on one side of the sheds and the industrial tracks serve the shed both between the standard gauge cars and on the street side of the shed. However, all the cement is not unloaded at the sheds, as it is tested at the works of the Crescent Cement Co., Wampum, Pa., by the Pittsburg Testing Laboratory, and seven-day reports are usually in hand before the cars arrive at the job. In this way the cement can be used direct from the railroad cars, a special industrial track being provided from the back of the cars direct to the mixer platform, so that two men can usually take care of all the cement which is being introduced into the mixer. The batches at the present time are running in the neighborhood of forty-two to the hour; it is expected, however, that when the plant is running smoothly and the men are all broken in to the work the contractors expect to be able to get as high as sixty per hour from each of the two Ransome mixers.

The unloading gravel plant is of the continuous chain and malleable iron bucket type. It is inexpensive so far as



Concrete Plant Layout for Larkin Co., Buffalo.

One advantage of the two towers is that they can be worked independently of one another, being used simultaneously on the different levels to which the forms have been erected, and that one may be used for placing concrete in the ground floor columns while the other is working on the fourth floor.

The warehouse is surrounded by streets on three sides so that the streets cannot be blocked, and as the railroad tracks are on the opposite side of the street it was necessary to locate the raw material bins and cement sheds away from the mixers. The Erie Co., who serve this switch, raised no objection to putting pockets underneath the railroad tracks, thus enabling unloading direct from bottom dump equipment.

The gravel dredged from the Niagara river in the neighborhood of Strawberry Island, has in it sand and stone in approximately the proportion needed for good concrete work, the sand being slightly in excess, but being of such good quality that tests made with concrete using this aggregate

the machinery is concerned, the chief expense occurring in the building of the two fifty-ton stone bins. These stone bins are of standard construction and are so made that they can be taken down without the drawing of any nails. They are so bolted together that they can be removed from one job to the other and re-erected with minimum expense.

The loading device which commands these towers contains a heavy shoe, and a little difficulty is found in getting the gravel to flow from the bottom dump of the cars into the shoe. It is found necessary, however, to have at least two men shovel out the ends of the cars while one man stops blockades, and a third sees that the plant works quickly and that the buckets are kept filled.

The shifting of the cars is accomplished so far as possible by the railroad company's locomotive. When this is not available, however, the contractors have provided a nigger-head, a geared machine running two nigger-heads, one slow and one medium speed. This is motor driven and can be started and stopped by the man who tends the placing of the cars. A rope haul moves the cars to position and moves the empties out onto the second track which is usually kept clear by the railroad so that the empties may be taken away. At the present time as many as twenty cars per day have been handled by the two plants, and it is not expected that the average will be as much as this, but it shows that the plants are large enough to amply take care of the work in hand. Five horse power motors situated on top of the bins drive these plants.

The usual complement of men for using each of the bins for unloading is five, it being found that these five men can care for about a car an hour, according to how the cars are placed on the tracks, the greatest difficulty being, not the unloading so much, but the placing of the cars by the railroad and the insuring of a steady supply of gravel having in mind the fact that this gravel must be interspersed by cement cars so as to supply both cement and gravel for the work.

Alternating current is supplied from the power house of the Larkin Co. The Ransome mixers themselves and the hoists, which convey the concrete to the upper stories are driven by thirty horse power motors. These are belted and are group driven, being the double drum belt hoists.

At each mixer two men are steadily employed, one taking care of the charging, adding water, etc., and another cutting the ties of the cement and adding the bags of cement to the batches. The men who push the industrial cars from the bins also load from the Ransome gate in the bins. This loading is very readily accomplished, the round gravel running from the bins much more easily than would be the case if crushed stone aggregate were used. Four men with two cars keep the mixer busily working without additional help.

The discharging of the bucket at the top is usually accomplished without the intervention of any bin, it being arranged that a car is always at the top of the tower to receive the loaded bucket as it reaches the dumping point. While columns are being poured, however, it has been found best to distribute by barrows, the reason being that the concrete is placed around structural steel columns which continue up through the lower stories of the building where the loads are very heavy and does not allow of proper placing when an industrial car containing some eighteen cubic feet is dumped at one time.

SEWER GAS AND CONCRETE.

In a report by Messrs. Metcalf & Eddy, consulting engineers, of Boston, Mass., which deals with plans proposed by Mr. William F. Williams, city engineer of New Bedford, Mass., for the construction of intercepting sewers and disposal by dilution in Buzzards Bay, the question of the effect of sewer gas on concrete is discussed. Concrete, the report states, is known to be affected under some conditions by gases generated from sewage chiefly, it is believed, hydrogen sulphide. Where the sewage is admixed with salt water the amount of sulphur compounds from which hydrogen-sulphide gas may be formed is increased. A portion of the intercepting sewer proposed for New Bedford will at times contain a mixture of sewage and salt water; the velocity of flow in this portion of the line will often be low enough to cause a precipitation of solids in the sewer. These will decompose more or less rapidly, and it is quite possible that under these conditions some hydrogen sulphide will be generated and may be liberated from the sewage. In view of these conditions Messrs. Metcalf & Eddy advise lining the invert and arch with a single course of hard burnt brick, or constructing the sewer entirely of brick, as economy shall dictate, in the section which may contain salt water. In this way, it is stated, the danger of injury from the action of gases will diminish, and it will be easier to repair any damage which may be done and which will probably be largely confined to the joints than if concrete were used. The use of brick lining, however, is not believed to be imperative; if it should be decided to build a sewer wholly of concrete the sections should be increased by a thickness of from 1 to 2 in. on account of this possible corrosive action. The concrete should be proportioned 1 part Portland cement, 2 parts sand and 4 parts broken stone instead of 1:2½:4½ of thereabouts which it is proposed to use for the remainder of the sewer system to which salt water must not be admitted.

ROPE VALUES.

The apparent value of rope is in the price per pound, the real value is in the strength and length. Unfortunately these have no relation, which is self evident to the purchaser. He must independently compare them if he would determine just how much he is getting for his money. When he does he will find that the best rope proves to be the cheapest. The following results of a recent reliable test show this conclusively. The coils of rope of the same size (one-half-inch diameter) were purchased in the same store, one, here designated as "A" was of the highest grade manila, the other designated "B" was of an inferior grade, but called "manila," although selling for three cents less per pound. They were weighed, measured and tested for strength on a reliable testing machine with the following result:—

	"A"	"B"
Length of rope in coil	1,250 ft.	1,070 ft.
Weight of coil with lashings	97 lbs.	97 lbs.
Weight of lashings	1 lb.	3 lbs.
Price per pound	12 cts.	9 cts.
Comparative price per 100 ft.......	93 cts.	82 cts.
Breaking strength	2,907 lbs.	1,450 lbs.
Comparative value ("A" worth 12c.)	12 cts.	5⅔ cts.

These figures are well worth the careful study of anyone who buys even one dollar's worth of rope.

It will be seen that although the two ropes in the illustration were the same size and the coils weighed the same, coil "A" contained nearly two hundred feet more rope than "B." It will also be seen that while rope like "B" can be bought at three cents per pound less than "A" the actual cost of 100 ft. is only eleven cents less.

The difference is better shown when we consider the most important quality of these ropes—the strength.

The figures indicate that "B," although much heavier, was less than one-half as strong. Assuming the value of "A" to be 12 cents per pound, a simple calculation shows that, taking into consideration weight and strength, the comparative value of "B" is only 5⅔ cents per pound. Or, to return to the original proposition, when high grade rope like "A" can be bought for 12 cents per pound, every penny above 5⅔ cents per pound paid for rope like "B" is absolutely. wasted. Of course the same proportion holds good with the price of "A" higher or lower.

Actual figures might vary in other cases, but the results are typical of those always obtained in buying low-grade rope.

ENGINEERS' LIBRARY

Any book reviewed in these columns may be obtained through the Book Department of The Canadian Engineer.

BOOK REVIEWS.

The Design and Construction of Dams. Including Masonry, Earth, Rock-Fill, Timber and Steel Structures; also the Principal Types of Movable Dams. By Edward Wegmann. Sixth Edition, revised and enlarged. Published by John Wiley & Sons, New York. Renouf Publishing Company, of Montreal, Canadian Agents. Cloth; 9¼ × 12 inches; pp. 529; 157 plates; 198 text figures and 24 tables. Price, $6 net.

This book, which has now reached the sixth edition, is one of those standard treatises without which no engineer's library is complete. It is a book along side of which all other books on the subject are compared.

A general revision of the fifth edition has been carried out, bringing the treatise up to date by the addition of descriptions of many new dams and extending and correcting the descriptions of those under construction at the time of publishing the fifth edition.

Two new chapters have been added; one on "Overflow Weirs," and the other on "Coffer-dams." The chapter on "Overflow Weirs" deals in a descriptive way, with the Indian and United States Reclamation Service types of design. The chapter on "Coffer-dams" describes the different types of these structures, with descriptions of dams actually built, including such recent work as the pneumatic caisson coffer-dam at Hauser Lake.

The chapter on "Recent Dams" is a resumé of descriptions of many of the large dams recently built. Among these might be noted the Cataract dam in New South Wales, the Roosevelt dam in Arizona, the Gatun dam, and several moveable dams of the latest types.

In the Appendix, the different investigations into the actual distribution of stresses in a masonry dam are noted, and a bibliography attached.

The Theory of Structures. By Charles M. Spofford, S.B. Published by McGraw-Hill Book Company, New York, 1911; Cloth; 6½ × 9½ in.; 412 pp., including index. Many illustrations and tables. Price, $4.

This book deals with the fundamental theories upon which the design of all engineering structures is based. It does not take up the design of the complete finished structures but gives a very complete analysis of manner of obtaining stresses, and designing the different elements, such as beams, columns, trusses, etc.

The author only takes up the design of statically determinate structures, leaving the indeterminate cases for another volume. However, he devotes one chapter to the arch, giving the commonly accepted methods of solution.

One pleasing feature of the book is the early introduction of the influence line with its use in deriving and illustrating analytical methods. There is also a chapter on deflections, which is a decided addition to a book of this type.

To our mind this is one of the best books of recent years on the subject of Theory of Structures. The analytical methods and mathematical explanations used are clear with no unnecessary verbiage. The illustrations, cuts and tables are exceptionally good.

The author has taken the most recent developments in connection with different elements of design. For instance, in connection with column design, he incorporates the latest practice and results as exemplified from the results of full size column tests made by the Phoenix Bridge Company.

We have no hesitation in recommending this book to all engineers interested in the design of structures. It is a book that will amply repay attention both to the student and designer.

Pumping Machinery.—A treatise on the history, design, construction and operation of various forms of pumps, by Arthur M. Greene, jr., Professor of Mechanical Engineering, Russell Sage Foundation, Rensselaer Polytechnic Institute. John Wiley & Sons, New York; Chapman & Hall, Ltd., London. Cloth; 6×9 ins. 703 pages. $4 net.

The author of this book has extended a course of lectures given by him at one time, to the students of an engineering school, and it is intended primarily for use as a text-book. As such it is rather bulky and contains much that would no doubt have to be omitted in a course on the subject. The first two rather lengthy chapters are devoted entirely to the history of pumping machinery, which it is well to have recorded but will only be used by the comparatively few whose special work lies along this line. The chapter on forms of pumps are compilations from trade catalogues, where the same information could be easily obtained and to better advantage as practice is constantly changing.

Considerable space is devoted to the theoretical side of the design of pumps which will be of use to only those few concerned with pump construction. Several chapters are taken up with details of steam and water ends, design of parts, injectors, pulsometers, air lift and pneumatic pumps, mine pumps and special pumping machinery. One chapter takes up the history of pumps.

It would have been much better if a large part of the descriptive material had been left out and more of the questions taken up which would be of more general use to a larger number of the practising engineers, such as typical layouts, selection of form of pumps to suit various conditions, costs, efficiencies, etc. The book will serve as a text-book for students much better than as a reference book for the older members of the profession.—H. J. C.

Reinforced Concrete. Mechanics and Elementary Design, by John P. Brooks. Published by McGraw-Hill Book Company, New York, 1911. Cloth, 6½ × 9½ in., 220 pp., including index. Many cuts and tables. Price, $2.

This book, just published, is intended for the student, to supplement the usual college work in Mechanics and Masonry design. But it will also appeal to the engineer who desires a compact, little volume containing the essentials of reinforced concrete design. The book is written in a very logical manner; the chapters in the order given are as follows: Historical, Sketch, The Component Parts, Tests of Reinforced Concrete, Analysis of Stresses, and Elementary Design.

One good feature of the book is the fact that much of the matter usually found in volumes of this kind, such as quotations of tests, and details of construction is omitted, the reader being referred to the sources of information for this material. The chapter on Elementary Design is one that will appeal to the man using reinforced concrete for the first time. The work there is well arranged and takes up the separate design of tee-beams, retaining walls, cantilever and counterfort types, and the arch.

The book will no doubt be well received by students and engineers, as it forms a very concise little treatise on the subject.

Straight Line Engineering Diagrams. By Manifold & Poole. Published by the Technical Publishing Company, San Francisco, 1911. Cloth; 4½ × 7½; pp. 96; 44 diagrams and 5 half-tone illustrations. Price, $3.

This book consists of 44 diagrams, which furnish a simple and convenient method for obtaining results with certain involved engineering calculations. The diagrams are isoplethe charts, in which the result required is obtained by laying down a straight edge, and adjusting over two of the scales of which the quantities are known and reading off the desired result from a third or fourth scale. For this purpose a strip of transparent celluloid is furnished with a straight line cut on it. The diagrams take up the bearing power of piles; masonry arches; reinforced concrete; strength of beams; electric wiring; pole line construction; power transmission lines, steam engines and hoists; flow of water in pipes, channels, canals, flumes, etc.; steel and wood stave pipe lines; water measurements; stadia measurements; shafting, belting, gearing, etc. This book is of convenient size for pocket use, and will form a handy little volume for the engineer who desires a rapid and approximate method of arriving at results for many of his computations.

"Tests of Nickel-Steel Riveted Joints," by Arthur N. Talbot and Herbert F. Moore has just been issued as Bulletin No. 49 of the Engineering Experiment Station of the University of Illinois.

The use of nickel-steel in the construction of bridges of great span is one of the interesting recent developments in the field of engineering. For many years, it has been known that an alloy of nickel with steel possessed great strength and toughness, and hence nickel-steel has been extensively used as armor for battleships, and in other structures where the necessity for great strength was paramount.

To the casual observer, a steel bridge seems to be a rigid structure, but the engineer knows that microscopic movements of parts are constantly taking place as the bridge is exposed to wind, to heat and cold, or to the moving load of a passing train. There is no doubt that the use of nickel-steel would make possible the reduction of the weight of steel required to build a bridge, but the action of the riveted joints of the bridge, if nickel-steel were used, has not been known.

In considering designs for a new bridge over the St. Lawrence River, near Quebec, Canada, which is to replace the bridge that collapsed during erection, the Board of Engineers of the Quebec Bridge, appointed by the Canadian Government, requested the Laboratory of Applied Mechanics of the University of Illinois to undertake a series of tests of nickel-steel riveted joints.

Bulletin No. 49 describes these tests, and also a series of tests on chrome-nickel-steel riveted joints made for the Pennsylvania Steel Company. It was found that the rivets of the nickel-steel riveted joints began to slip under loads just as low as did joints with ordinary steel rivets and plates, but that the nickel-steel joints carried higher loads before final tearing apart of the plates or shearing of the rivets. Tests were made in which the riveted joints were loaded in one direction, then in the other, and it was found that under such loading, the slip of rivets was much greater than under steady load.

Copies of Bulletin No. 49 may be obtained gratis upon application to W. F. M. Goss, Director of the Engineering Experiment Station, University of Illinois, Urbana, Illinois.

Aids in the Structural Design, by C. R. Young, B.A.Sc., Lecturer in Structural Engineering, University of Toronto. Published by The Engineering Society of the University of Toronto, 1911; paper, 6 x 9; 12 pages; 7 plates; 2 tables; price, 50c.

This little pamphlet has been issued by Mr. C. R. Young, to be used in conjunction with his lectures on Structural Design in the Faculty of Applied Science, of the University of Toronto. It contains plates giving the various standards for rivets and riveting, the convenient gauges of angles of moderate thicknesses and the essentials of the lacing standards of the American Bridge Company.

Plate 4 gives a moment table of a series of 40-ton double truck electric railway cars in train, under the Dominion Government specification, 1908, and the specifications of the Ontario Railway and Municipal Board, 1910.

Tables 1 and 2 give the permissible compressive stresses on medium steel columns having slenderness ratios of from 28 to 150.

This little pamphlet is a most valuable one to the engineer and student, dealing with the design of structures.

The Road Board. Published by Waterlow & Sons, Ltd., London Wall, London, Eng. Price, 1s. 6d.

This little pamphlet bearing the title "Trials of Road Materials by the Kent County Council, Under Arrangements with the Road Board, on the New Eltham-Sidcup Road," has been recently published through Messrs. Waterlow & Sons, by the Road Board, giving particulars of the various materials selected for experimental lengths of roadways laid down by the Kent County Council.

Col. R. E. Crompton, the consulting engineer to the Board makes a preliminary statement in which he says that the object of the Road Board has in view is to secure a service test under uniform conditions of a number of trial lengths or roadway laid down under the general direction and supervision of the Advisory Engineering Committee of the Board, so that a record of comparative results can be obtained in a better and more reliable manner than is generally obtainable in the case of road services laid down in the ordinary course of road maintenance in different parts of the country.

The pamphlet includes a copy of the specifications under which the work is to be carried out. It is provided that the various contractors shall be responsible for the maintenance of their work from the date of the commencing of the laying of the materials until the county surveyor of Kent gives notice that the same requires reconstruction.

This little volume is a valuable one and future conditions of the work will be looked forward to with interest by engineers interested in construction and maintenance of roads.

Town Scavenging and Refuse Disposal. By Hugh S. Watson. London: St. Bride's Press, Ltd.

We have read this interesting booklet on this all important subject and agree with Mr. Watson that the matter contained may prove of interest to engineers and the people's representatives in municipal affairs.

It is welcome inasmuch as it brings many matters up to date and is useful owing to the thorough way in which it deals with the scavenging branch of the subject.

The destruction of refuse by fire is also dealt with, and our only regret in this respect is that Mr. Watson does not go far enough. The costs of destruction are indeed misleading, but we think this will always obtain because every case has to be considered upon its own merits and circumstances and no method is practicable to bring them to a common basis of reckoning. Literature on this subject is so far very much lacking, and Mr. Watson has gone only a short way to supplying a long-felt want. We therefore await a comprehensive work dealing with the whole subject.—R. R. K.

Power Plant Testing. A manual of testing engines, turbines, boilers, pumps, refrigerating machinery, fans, fuels, materials of construction, etc., by James Ambrose Moyer, S.B., A.M., M.Am. Soc. M.E., Am. Inst. E.E., Professor of Mechanical Engineering, University of Michigan. McGraw-Hill Book Company, New York and London. Cloth; 6x9½ ins. 422 pages. $4 net.

The book is intended primarily as a text-book for technical schools for use in the experimental engineering laboratory, but its use as a reference book by the professional engineer has not been lost sight of. The purpose of the book is to present descriptions of apparatus used and calibration required for accurate testing of engines, turbines, boilers and various power plant machinery. The first four chapters describe instruments for measuring pressures, temperatures and areas and the determination of the amount of moisture in steam, also the testing and calibration of them. Chapter five is devoted to engine indicators and reducing motions and the following one to the measurement of power by the various kinds of brakes and dynamometers. The measurement of the flow of air, gases, steam and water is taken up in chapter seven. Two chapters are devoted to the calorific value of fuels and flue gas analysis. Considerable space is then taken up by the four chapters on the testing of boilers, steam engines, steam turbines, gas engines and producers, in which the author has taken as a basis the widely used codes of the American Society of Mechanical Engineers. Methods correcting steam turbine and engine tests to standard conditions are given in chapter thirteen. The remaining five chapters include the testing of ventilating fans, blowers, air compressors, refrigerating machines, hot air engines, hoists, belts, rope drives, friction wheels and hydraulic machinery, the chapter on the latter being rather short and incomplete. The final chapter on tests of the strength of materials contains a few of the most important methods of testing for tensile and compressive strengths.

The book contains numerous illustrations, tables, curves and forms for reporting tests. It is well printed, the headings, formulas, characters and important passages being in heavy type, which makes it very easy reading.—H. J. C.

"Direct and Alternating Current Manual"—"With directions for testing and a discussion of the theory of electrical apparatus," by Frederick Bedell, Ph.D.. Published by D. Van Nostrand Company, New York, and Constable & Company, London. Price, $2 net.

While intended primarily as a laboratory manual for electrical engineering students, this book should also prove useful to all desiring a clear understanding of the operation of electrical apparatus. The treatment is by means of theoretical discussion of principles, classified and applied by specific tests of apparatus and numerical illustrations.

As a laboratory guide for students it is admirably planned to direct attention to the underlying principles involved, the significance of the results obtained, and to encourage individual investigation. Explicit instructions are given only for sufficient tests in each case to give proper direction to individual initiative, and detailed discussion is confined to representative examples of the various types of apparatus, special applications of general principles being covered by suggestion and reference.

As a reference book it should be of value especially by virtue of its clear and not too mathematical expositions of the principles and characteristics of operation of the various types of apparatus, and also as a guide in the development and interpretation of test data.

The book presupposes no more than a knowledge of fundamental principles; its arrangement is logical and consistent and its scope as comprehensive as its purpose requires.—J. A. J.

Mill and Factory Wiring. By R. Geo. Devey, published by Constable & Company, London. Cloth; 4¼ x 6½ in.; illustrated. Price, 2s.

An electrical installation manual, one of a series published by this company. It is written from practical standpoint and is kept free from all complicated mathematical treatment. The book is intended to be useful to electricians interested in installation work. Layouts for wiring of installations in factories are given, and diagrams of connections for all types of electrical machines in common use are shown.

Electrical Mining Installations. By P. W. Freudemacher, published by Constable & Company, London. Cloth; 4¼ x 6½ in.; 182 pp.; illustrated. Price, 2s.

This little volume is intended especially for mining engineers and contractors engaged in the installation of electrical plant for mining purposes. The first chapter deals briefly with the elementary principles of electrical engineering, with special reference to alternating current. Although the main portion of the book is descriptive of different types of installations, still the necessary formulae and tables are given so that calculations in regard to output, power, etc., may be made.

Pointers For Inventors, by Egerton R. Case; published by the author, Temple Bldg., Toronto; price, 25c.

A pamphlet of 16 pages, published for the inventor. The author states thoroughly the different methods employed by inventors in securing capital to develop perfect or patent their inventions. This author also has brought out a similar pamphlet entitled "Pointers For Patentees," which may be obtained for the same price as "Pointers For Inventors."

He has published these books as the result of many years' experience in the patent soliciting profession, and it is intended for patentees who are not business men to acquaint them with the methods of commercially exploiting their inventions.

The above two pamphlets are valuable additions to literature on this subject, the information being in very concise form.

The Water Supply of New York City. Edited and published by The Blaw Collapsible Steel Centering Company, Pittsburg, Pa.

This book has a card-board cover, volume of 152 papers, exceedingly well printed on a heavy mounted paper with splendid half-tone illustrations. It contains an extensive and thorough description of the Catskill Mountain waterworks for the extensions of the water supply of New York City, dealing with a short history of the water supply of New York City, and leading on to a description of the present supply.

The Blaw Collapsible forms were used on the Catskill aqueduct, and a very thorough description is given of the method of construction and design.

The volume also includes the specifications for the different works, a list of the names and addresses of contractors, the personnel of the Board of Water Supply, and much other valuable data on this work. The Blaw Collapsible

Steel Centering Company are to be congratulated on the publishing of this volume, as it brings together in compact form a great deal of valuable information in connection with this work.

PUBLICATIONS RECEIVED.

The Decimal Association.—A pamphlet listing the prices of books, rules, etc., of the Metric System can be obtained from the Decimal Association, Finsbury Court, Finsbury, Pavement, B.C.

American Road Builders' Association.—A small pamphlet issued by The American Road Builders' Association, 150 Nassau St., New York City; contains plan and purposes of the organization, its constitution, by-laws and the officers for 1911.

The Report of the Health of the City of Manchester, 1910.—A report by James Niven, giving a statistical review of the diseases, and including the work done by the Department of Health of Manchester, under the different regulations. A resumé of the work of the Sanitary and Cleansing Departments is also included.

The Works of Messrs. Escher-Wyss Company, Zurich, Switz.—Messrs Escher-Wyss Company have forwarded a handsome pamphlet entitled "The Works of Messrs. Escher-Wyss & Co.", being the reprint of an article published in Engineering, July 21, 1911. It includes a very complete description, well illustrated, of their work at Zurich, Switzerland.

Astronomical Field Tables.—A pamphlet issued by the Topley Company, of Ottawa, importers of scientific and surveying instruments. This is a sample of their astronomical field tables for the use of engineers and surveyors. Tables of the same kind have been in use for a number of years on the survey of Dominion lands, and are much appreciated by Dominion land surveyors, but they do not extend south of latitude 49 degrees. Since it is necessary in making the calculations to know the number of the township, these tables were not suitable in places surveyed otherwise than under the Dominion system. The Topley Company's tables extend from latitude 45 degrees to 53 degrees north, and as the lattude is shown, they can be used anywhere between those limits. The tables are for the determination of the meridian and local time. Their main object is to dispense with night observations and thus avoid the troubles and discomforts peculiar to artificial illumination.

Report on Mining Operations, Province of Quebec, 1910.—This is a report by the Department of Colonization, Mines and Fisheries, the Mines Branch, of the Province of Quebec. It includes a review of the Quebec mining laws, the mineral production of the province, under the different headings of the minerals, with a description of the different mining districts. This pamphlet is a book of 104 pages, very well printed and well illustrated by many half-tones.

Uses of Commercial Woods of the United States.—Bulletin 99, Forest Service of the U.S. Department of Agriculture. This is the second pamphlet on the uses of commercial woods, covering the pines of the United States, and is a most valuable compilation. It covers all the different types of pines found in the United States, with the description of their physical properties, supply, early uses, manufacture and product, etc.

Annual Report of the City Engineer of Toronto, 1911.—The City Engineer's annual report is a most comprehensive and valuable one. The preface gives some interesting statements concerning the city, its institutions, and various municipal departments. The report contains 246 pages, and is well illustrated with many half-tones and photographed drawings. It includes a concise account of the various works carried on in the city of Toronto during the year 1910, and contains some interesting costs on the different works.

The report is most exhaustive and complete, and will be valuable for reference purposes.

The Twentieth Annual Report of the Bureau of Mines, 1911.—This report contains 301 pages and includes many papers of exceptional interest. The contents include, among other things, a statistical review, a chapter on Mining Accidents, a description of the Thunder Bay silver region, and the report of Prof. M. B. Baker, who investigated the lignite deposits near the Mattagami River. This report is reproduced on the first page of this issue. Mr. T. W. Gibson's Statistical Review is an exceedingly interesting one, his summary being a model of careful condensation. The report is a most valuable one and should be in the library of every engineer.

CATALOGUES RECEIVED.

Pioneer Asphalt. A pamphlet describing the different products of the American Asphaltum and Rubber Company, and showing views where the material has been used. Copies may be obtained from the American Asphaltum & Rubber Company, 614 Harvester Building, Chicago.

Graphite Lubrication. An address by Dr. Edw. Acheson, describing different types of graphite manufactured by the company, namely "Aquadag" and "Oildag," with their advantages as a lubricant. Acheson Oildag Company, Port Huron, Mich.

Drag Scraper Buckets. The new type of drag scraper buckets, manufactured by the Hayward Company of New York, is described in their pamphlet No. 576.

Cutter and Surface Grinders. Circular No. 168, issued by the Garvin Machine Company, describing their different types of grinders.

The Priestman Ejector. We have received advance proofs of a catalogue, on the Priestman Ejector System, to be published shortly by Merritt & Company, Camden, N.J.

Gas Engines. Bulletin No. 38 of the Camden Foundry Company, Limited, Toronto, describing their different types of gas engines.

Transformers. The Canadian Moloney Electric Company of Windsor, Ont., forward pamphlet illustrating their different types of transformers.

Grantoid. A pamphlet, well illustrated, forwarded by the Rudolph S. Blome Company, describing their patented Grantoid Concrete Pavement. Copies may be obtained from the company's general offices, Bank Floor, Unity Building, Chicago.

Friction Clutches. A pamphlet issued by Thomas Broadbent & Sons, Ltd., Huddersfield, describing their automatic friction clutches.

Atlas Crude-Oil Engine. Bulletin No. 201 of the Atlas Engine Works, Indianapolis, describes their crude-oil engines of the Diesel type, and includes a report of test of one of these engines in June, 1911, by C. E. Sargent, Consulting Engineer of Chicago.

Second-Hand Machinery. The Willis Shaw Machinery Company, of Chicago, Ill., forward pamphlet giving list for September of second-hand machinery for sale by them.

Sewage Filters. The Pacific Flush Tank Company, of Chicago, forward a very artistic pamphlet illustrating various installations of bacterial sewage filters, using their equipment. The pamphlet is divided into sections, part one covering domestic installations; part two, Intermittent Sand Filters; part three, Comtact Beds; part four, Percolating Filters. Those interested in sewage design or construction may obtain copies by writing the Pacific Flush Tank Company, The Temple, 184 La Salle Street, Chicago.

Olympia Electrical Exhibition. Bruce Peebles & Company, engineers, Edinburgh, have just gotten out a booklet, No. 708, describing their exhibit at the Olympia Electrical Exhibition, London, 1911. The booklet is profusely illustrated, and shows a large number of performance curves. The publication deals entirely with types of machines which were shown there.

Graphic Meters.—The Westinghouse Electrical and Manufacturing Company has issued Circular 1131 describing graphic meters for switchboard service. The publication shows illustrations of the meters together with typical charts taken from same, indicating the various uses to which graphic meters may be put with advantage to the user.

Small Motors.—The Westinghouse Electric and Manufacturing Company has just issued the first edition of a small monthly publication entitled "Small Motors," which is devoted to forming a co-operative bond between the manufacturer and the dealer in small electric motors for general household, store, and office work.

The publication is devoted to practical applications of small motors, showing views of motors in actual service, such as operating ice cream freezers, small lathes, washing machines, grinding wheels, and numerous other household devices.

An interesting application of the small motor for the household is its use as an auxiliary to the furnace, assisting in the heating and ventilating of same. By means of a blower attachment the motor may be used:

To increase the draft; to increase the distribution of heated air by drawing it from the pipes and forcing it into the room; ventilating a steam-heated room; and in numerous other ways assist in the heating and ventilation of the home

Advice as to installation, operation, and care of the motors is given in short practical talks.

"Small Motors" is distributed to central stations and dealers, the first of every month.

Rotary Converters for Railway Service.—Descriptive leaflet 2378 has just been issued by the Westinghouse Electric and Manufacturing Company. This is a four-page leaflet, nine and a half by eleven inches, and contains quite a number of illustrations describing the various parts of rotary converters, such as armature coils, spider, equalizer connections, collector rings, commutator brush riggings, etc.

Under each picture is given a short description of the method of construction of the part illustrated. One page is devoted to pictures of the rotary converters completely assembled.

Flumes.—A unique idea comes in the form of an original catalogue, gotten out by the Hess Flume Company, of 635-636 First National Bank Building, Denver, Colorado, showing their metal flumes as used for irrigation, power, mining and substructures for various purposes.

This interesting booklet is printed in what our printer friends call "reverse," that is the type and the pen drawing illustrations are in white and the paper a dark blue in imitation of blue-prints. It contains much information on the subject of flumes in general that is of value. Two pages are devoted entirely to tables of the carrying capacity of different sized flumes and various specifications. These will be of help to the engineer, or, in fact, to anyone figuring on flumes.

The Hess Company claim certain advantages for their improved galvanized Toncan Metal flumes. First, the fact that they are made of Toncan Metal sheets, supplied by the Stark Rolling Mill Co., Canton, O., which are claimed to be particularly adaptable to meet the severe conditions and exposure to which all flumes are certain to be subjected. Second, they claim that the Hess is the only flume with a perfectly smooth interior. The inter-locking sections are easily assembled, and a water-tight joint is secured without the use of either solder or rivets.

Their unique catalogue illustrates this joint, and the pen pictures show in detail the construction of the Hess flume. The other lines, metal lumber substructures, metallic intakes and outlets, headgates, pressure pipe, are each briefly mentioned and described. Judged from both the standpoint of originality and from that of practical utility the Hess flume catalogue is certainly a most unique and interesting book, well worth the perusal of every one interested in flumes in any way.

Westinghouse Railway Equipment is the title given by the Westinghouse Electric & Manufacturing Company to its Folder No. 4184, dated September, 1911. This is an art folder, time-table size, and it has a very attractive cover. In the folder are described the spider armature construction used by the Westinghouse Company, its railway motor brush holders, its armature and axle bearings, and its unit switch control systems, both for 600 and 1,200 volts. Discussions are also given of the comparative advantages of interpole and non-interpole railway motors, and of box frame vs. split frame motors. Many photographic reproductions are given of modern interurban and street railway cars, and beside each is tabulated an outline specification for each car, indicating what electrical and mechanical equipment is used on it and its dimensions.

Westinghouse Auxiliary Contactor Equipments.—In its folder No. 4186, dated September, 1911, the Westinghouse Electric & Manufacturing Company, East Pittsburg, Penna., describes an auxiliary line switch for use on trolley cars equipped with ordinary drum type controllers. The auxiliary line switch is electro-pneumatically operated and is mounted underneath the car. The line current is broken by this switch, which is in effect a very rugged circuit breaker. The folder contains a complete description and photographic illustrations of the line switch and wiring diagram showing how it should be installed.

Turbine Blower Sets.—The Terry Steam Turbine Company has issued "Bulletin No. 12," dated September, 1911, which is a report on 50 installations. Rather complete data is given concerning the sizes, types and methods of operating. A description of the new type, delivering at 40 inches pressure, is included. Copies can be obtained upon request.

Stokers.—A new catalogue of the Taylor Stoker has just been issued by the manufacturers, the American Ship Windlass Co., Providence, R.I. The stoker is well illustrated with the parts named in several views. Other illustrations show well-known power plants such as the New York Edison Waterside Station, the Christian Street Station of the Philadelphia Electric Light Co., the Detroit Edison Co., the Everett Mills of Lawrence, and the Oxford Paper Co., of Rumford Falls, Maine. An interesting cut is shown of the largest stokers ever built, these being the two 14-retort stokers for the Hartford Electric Light Co. This catalogue is of forty pages, 6 x 9.

Air Pumps.—Bulletin 103 just issued by the Wheeler Condenser & Engineering Company, is a new edition of their bulletin on the Wheeler-Edwards Air Pump for operation in connection with surface condensers, handling both the air and condensed steam.

The function of the air pump and its relation to the condenser proper are first taken up and then the construction and operation of the Wheeler-Edwards air pump and a comparison of the efficiency of the Wheeler-Edwards air pump with other types of pumps handling air and condensate discussed in detail. The pages following are devoted to the various uses for the Wheeler-Edwards air pump, such as high vacuum Wheeler dry tube condensers for steam turbines, special application in marine work, giving a drawing showing how the Wheeler-Edwards air pump is built into the main engine frame, the use of the Wheeler-Edwards air pump in connection with small jet condenser and in connection with sugar effects for handling both the sweet water and the air and water from the condenser.

This bulletin contains upwards of fifty illustrations, including photographs of the numerous types of Wheeler-Edwards air pumps, for instance, single steam driven, twin steam driven, triplex motor and steam driven, twin steam driven with separate hot well pumps, combined engine driven single air pump and centrifugal pump, combined motor driven, triplex Edwards pump and centrifugal pump, and also several charts relative to the question of air and its removal from condensers, line drawings showing the manner of installation of the Wheeler-Edwards air pump on board ship and also for use in connection with multiple effects, and lastly, numerous illustrations of Wheeler-Edwards air pumps installed in connection with condensers for various classes of services. The frontispiece of the bulletin shows eight notable power plants wherein Wheeler condenser equipments of a rated capacity of over 4¾ million pounds of steam per hour are installed.

The last pages of the bulletin contain an outline drawing of a Wheeler-Edwards air pump, together with a list of details which may be used in ordering repair parts. This list is also furnished in blueprint form for posting in the engine room. Pages 30 and 31 give an illustrated condensed catalogue of the Wheeler line of condensing apparatus covering the following headings: Wheeler surface condensers, Wheeler Volz combined condenser and feed water heater, Wheeler dry tube condensers, Wheeler rectangular jet condensers, Wheeler barometric and jet condensers, Wheeler-Edwards air pumps, Wheeler rotative dry vacuum pumps, Wheeler centrifugal pumps, Wheeler-Barnard cooling towers, Wheeler feed water heaters, Wheeler atmospheric exhaust valves.

Copies of this bulletin, No. 103, will be sent by the Wheeler Condenser & Engineering Company, of Carteret, N.J., to engineers and others on receipt of their name.

THE CANADIAN RED CROSS SOCIETY.

Empress Marie Feodorovana Prize Competition.

To Be Held in Conjunction With the Ninth International Red Cross Conference, Washington, D.C., May 7-17, 1912.

Programme.

1. A scheme for the removal of the wounded from the battlefield with the minimum number of stretcher bearers.
2. Portable wash-stands for use in the field.
3. The best way of carrying dressings for use in regimental aid posts and dressing stations.
4. Wheeled stretchers.
5. Transport of stretchers on mule back.
6. Easily folding portable stretcher.
7. Transport of the wounded between warships and hospital ships and the coast.
8. The best method of heating railway carriages by a system independent of steam from the engine.
9. The best model of portable Roentgen Apparatus for the employment of X-rays on the field of battle at the regimental aid posts.

Inventions entered in this competition are to be displayed at an exhibition to be held on the occasion of the Ninth International Red Cross Conference at Washington, D.C., May 7-17, 1912.

Persons intending to compete for these prizes must forward to the General Secretary, at Toronto, on or before December 23rd, 1911, a statement of such intention, giving the number of cubic feet which will be required for the exhibition of their inventions.

Articles entered in this competition must be received carriage prepaid, at Washington, D.C., on or before April 15, 1912. Arrangements are being made with the United States Customs for the free entry of objects intended for the competitions.

Further information may be obtained from Dr. C. R. Dickson, General Secretary, Canadian Red Cross Society, 192 Bloor Street West, Toronto.

PERSONAL.

Mr. F. McCormick, assistant solicitor of the Department of Railways, has been sent by the Hon. Frank Cochrane to Sault Ste. Marie to investigate the accident at the Soo Canal caused by the collision of the steamer Emperor with the locks, and resulting in a partial blockade of the channel.

Mr. Rueben W. Leonard, of St. Catharines, has been appointed successor to Hon. S. N. Parent as chairman of the National Transcontinental Railway Commission. Mr. Leonard is better known as a mining capitalist than as a railwav engineer, although he has had some experience in railway construction in connection with the building of some of the C.P.R. lines and of the St. Lawrence & Adirondacks Railway.

Mr. C. C. McFarlane, Belmont, Ont, has been appointed chief engineer of Division "F," National Transcontinental Railway.

Mr. L. Uglow, B.Sc., of Kingston, Ont., has been awarded the gold medal and cash prize by the Canadian Mining Institute in a competition open to students of all Canadian universities. The competition consists of an investigation and thesis of some problem in connection with mining.

OBITUARY.

Samuel Hooper, Provincial Architect, Province of Manitoba, died in London, Eng., of asthma. He had held this position for 30 years and designed some of the largest buildings in the city of Winnipeg, and all the public buildings in the province for the past 10 years. He came from London, Ont., where he was in the marble business.

INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS.

At the fifth congress of the International Association for Testing Materials, held at Copenhagen in September, 1909, it was voted, on the invitation extended by the American Society for Testing Materials, to hold its sixth congress in this country in 1912. It will be under the patronage of

President Taft and will take place during the week beginning September 2, 1912, at the Engineering Societies Building, New York City.

One of the most important functions of this association is the establishment of standard specifications for materials used in manufacture and construction; improve the methods of testing; investigate properties which are capable of industrial usefulness; unify the methods of testing throughout the world, and to introduce standard international reception specifications for materials with a view to facilitating international trade. Twenty-eight countries are represented in the association's membership.

Under the stirring influence of American industrial conditions the coming congress promises, through its interchange of experience and investigations, to act with stimulating effect on these various subjects.

As these specifications are of great value to engineers and others who are engaged in the purchase and use of the raw materials of the trades, H. F. J. Porter, secretary of the organizing committee, urges that all concerned join the association in order to attend the congress and aid in establishing these specifications.

Full information can be had by addressing H. F. J. Porter, secretary, 1 Madison Avenue, New York City.

COMING MEETINGS.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—Nov. 9. Monthly Meeting, 413 Dorchester Street West, Montreal. C. H. McLeod, Secretary.

THE AMERICAN ROAD BUILDERS' ASSOCIATION (150 Nassau Street, New York). Nov. 14-17. Annual Convention, Rochester, N.Y.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—Nov. 15. Sixth Annual Convention, Toronto. F. Dagger, Secretary, 21 Richmond Street West, Toronto.

THE CANADIAN PUBLIC HEALTH ASSOCIATION.—Nov. 21-23, Montreal. F. C. Douglas, M.D., D.P.H., Secretary, 51 Park Avenue, Montreal.

AMERICAN ASSOCIATION FOR HIGHWAY IMPROVEMENT.—Nov. 20-24. First Annual Convention, Richmond, Va. Logan Waller Page, President, United States Office of Public Roads, Washington, D.C.

ENGINEERING SOCIETIES.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—413 Dorchester Street West, Montreal. President, C. H. Rust; Secretary, Professor C. H. McLeod.

QUEBEC BRANCH—
Chairman, P. E. Parent; Secretary, S. S. Oliver. Meetings held twice a month at Room 40, City Hall.

TORONTO BRANCH—
96 King Street West, Toronto. Chairman, H. E. T. Haultain, Acting Secretary; E. A. James, 57 Adelaide Street East, Toronto. Meets last Thursday of the month at Engineers' Club.

MANITOBA BRANCH—
Secretary E. Brydone Jack. Meets every first and third Fridays of each month, October to April, in University of Manitoba, Winnipeg.

VANCOUVER BRANCH—
Chairman, Geo. H. Webster; Secretary, H. K. Dutcher, 319 Pender Street West, Vancouver. Meets in Engineering Department, University.

OTTAWA BRANCH—
Chairman, S. J. Chapleau, Ottawa; Secretary, H. Victor Brayley, N. T. Ry., Cory Bldg.

MUNICIPAL ASSOCIATIONS.

ONTARIO MUNICIPAL ASSOCIATION.—President, Chas. Hopewell, Mayor, Ottawa; Secretary-Treasurer, Mr. K. W. McKay, County Clerk, St. Thomas, Ontario.

UNION OF ALBERTA MUNICIPALITIES.—President, H. H. Gaetz, Red Deer, Alta.; Secretary-Treasurer, John T. Hall, Medicine Hat, Alta.

THE UNION OF CANADIAN MUNICIPALITIES.—President, W. Sanford Evans, Mayor of Winnipeg; Hon. Secretary-Treasurer, W. D. Lighthall, K.C., Ex-Mayor of Westmount.

THE UNION OF NEW BRUNSWICK MUNICIPALITIES.—President, Mayor Reilly, Moncton; Hon. Secretary-Treasurer, J. W. McCready, City Clerk, Fredericton.

UNION OF NOVA SCOTIA MUNICIPALITIES.—President, Mr. A. E. McMahon, Warden, King's Co., Kentville, N.S.; Secretary, A. Roberts, Bridgewater, N.S.

UNION OF SASKATCHEWAN MUNICIPALITIES.—President, Mayor Bee, Lemberg; Secretary, Mr. Heal, Moose Jaw.

CANADIAN TECHNICAL SOCIETIES.

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

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

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

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

BUILDERS, CANADIAN NATIONAL ASSOCIATION.—President, E. T. Nesbitt; Secretary Treasurer, J. H. Lauer, Montreal, Que.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.—President, Charles Kelly, Chatham, Ont.; Secretary, W. A. Crockett, Mount Hamilton, Ont.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Secretary-Treasurer, Wm. Snaith, 57 Adelaide Street, Toronto, Ont.

CANADIAN CLAY PRODUCTS' MANUFACTURERS' ASSOCIATION.—President, W. McCredie; Secretary-Treasurer, D. O. McKinnon, Toronto.

CANADIAN ELECTRICAL ASSOCIATION.—President, N. W. Ryerson, Niagara Falls; Secretary, T. S. Young, Canadian Electrical News, Toronto.

CANADIAN FORESTRY ASSOCIATION.—President, Thomas Southworth, Toronto; Secretary, James Lawler, Canadian Building, Ottawa.

CANADIAN GAS ASSOCIATION.—President. Arthur Hewitt, General Manager Consumers' Gas Company, Toronto; J. Keillor, Secretary-Treasurer, Hamilton, Ont.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, W. Doan, M.D., Harriestville, Ont.; Secretary-Treasurer, Francis Dagger, 21 Richmond Street West, Toronto.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President, W. Doan, M.D., Harrietsville, Ont.; Secretary-Treasurer, Francis Mortimer-Lamb, Windsor Hotel, Montreal.

CANADIAN PEAT SOCIETY.—President, J. McWilliam, M.D., London, Ont.; Secretary-Treasurer, Arthur J. Forward, B.A., Castle Building, Ottawa, Ont.

CANADIAN RAILWAY CLUB.—President, H. H. Vaughan; Secretary, James Powell, P.O. Box 7, St. Lambert, near Montreal, P.Q.

CANADIAN STREET RAILWAY ASSOCIATION.—President, D. McDonald, Manager, Montreal Street Railway; Secretary, Acton Burrows, 70 Bond Street, Toronto.

CANADIAN SOCIETY OF FOREST ENGINEERS.—President, Dr. Fernow, Toronto; Secretary, F. W. H. Jacombe, Department of the Interior, Ottawa.

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto, President, G. Baldwin; Secretary, C. L. Worth, 409 Union Station. Meets third Tuesday each month except June, July, August.

DOMINION LAND SURVEYORS.—President, Thos. Fawcett, Niagara Falls; Secretary-Treasurer, A. W. Ashton, Ottawa.

EDMONTON ENGINEERING SOCIETY.—President, J. Chalmers; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alberta.

ENGINEERING SOCIETY, TORONTO UNIVERSITY.—President, W. B. McPherson; Corresponding Secretary, A. McQueen.

ENGINEERS' CLUB OF MONTREAL.—Secretary, C. M. Strange, 9 Beaver Hall Square, Montreal.

ENGINEERS' CLUB OF TORONTO.—96 King Street West. President, Killaly Gamble; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

INSTITUTION OF ELECTRICAL ENGINEERS.—President, Dr. G. Kapp; Secretary, P. F. Rowell, Victoria Embankment, London, W.C.; Hon. Secretary-Treasurer for Canada, Lawford Grant, Power Building, Montreal, Que.

INSTITUTION OF MINING AND METALLURGY.—President, Edgar Taylor; Secretary, C. McDermid, London, England. Canadian Members of Council:—Prof. F. D. Adams, J. B. Porter, H. E. T. Haultain, and W. H. Miller, and Messrs. W. H. Trewartha-James and J. B. Tyrrell.

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