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ESTABLISHED 1893.

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The Canadian Engineer

ESTABLISHED 1893.

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Editor.—E. A. James, B.A.Sc.
Business Manager.—James J. Salmond.
Advertising Manager.—A. E. Jennings.

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Montreal Office: B33, Board of Trade Building. T. C. Allum, Editorial Representative, Phone M. 1001.
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TORONTO'S TUBE REPORT.

Of the Canadian cities, Toronto stands among the first in size of population trading facilities, customs and clearing house returns, bank deposits and post-office sales. Toronto is a city of homes and warehouses, a city of large residential districts free from trading places, and a city with miles of streets lined with warehouses, factories and stores. On the northern shore of a great inland lake, her growth has been forced in three directions. The formation northward from the city has provided many admirable sites for residential sections and the almost complete segregation of business sections from the city homes, together with the beautiful avenues and parks and driveways, has led many visitors to describe it as the City Beautiful.

The community, like an individual, is not happy without a fetish, and for years the Toronto Street Railway has been the fetish upon which the community has heaped their curses. Annually the Board of Aldermen has offered some fancied solution for the convenient handling of Toronto's crowd during rush hours.

Parallel lines, elevated tracks, electric buses and tubes have in every conceivable manner been presented as proper solution for this difficulty.

As early as 1907 the Council of the city of Toronto instructed their city engineer, Mr. C. H. Rust, to report upon the cost of building certain subways to be used in connection with the street railway system of the city. Mr. Rust's estimate of the cost amounted to something like twenty-three and a quarter millions of dollars.

Some three years later a new Council, thirsting for revenge on the Toronto Street Railway and for a convenient means of conveying passengers quickly from the business to the residential section of Toronto, invited a firm of New York engineers to report upon a subway for the city of Toronto. This firm of New York experts gathered what information they could from the engineering staff of Toronto, from the city engineer's reports, and, in addition, required further information from city employees.

The opinions and facts submitted to them they have embodied in a report, which has been forwarded to the City Council, and for which this firm charged the city of Toronto $5,000.

As a compilation of statistics, as a report upon what has been done in other cities, as a matter of reference for transportation experts, this report is quite interesting,—we hope to publish sections of the report next week—but as an engineering report it is without value, either to the city of Toronto or to the city engineer.

Two years ago the city of Toronto engaged a principal assistant engineer that Mr. Rust might have more time at his disposal in which to deal with the large general engineering problems that face the city of Toronto. Toronto is one of the most important cities of the Dominion, and the position of city engineer for Toronto is one of the most responsible in the Dominion. It is strange that a corporation that has had so many years of faithful, public-spirited service from Mr. Rust is not prepared to give him a freer hand to deal with the city's engineering problems.

It may be that this report will do one thing: it will impress upon the city fathers that they have paid a firm of American engineers a sum equal to the city engineer's salary to be told just what he told them three years ago.

PUBLIC CURIOSITY.

(Railroad Age Gazette.)

Another class of automobile items in which railway men take an interest is illustrated in the following:—

Nahant, Mass., Sept. 11.—Albert E. Hanna and Mrs. Fannie Reed were killed when an automobile, in which they were riding, crashed into an electric light pole on the Nahant Road early to-day. The tires on both rear wheels burst, and Hanna lost control of the machine while it was travelling at high speed.

If a prominent citizen was killed by the derailment of a passenger train the public's demand for information would cover all questions that the reporters and editors could possibly think of. Imagine these questions applied to this case (or to the case of the President of the United States if he had been killed on that 75-mile fast motor trip from the New Hampshire mountains to Beverly): What was the quality of those tires? Did they come from the shop of the best maker? Had the proprietor of the car been so penurious as to let them become too much worn? Were they carefully inspected at every stop? Was the steering gear in good order? Was the chauffeur's brain in good order? Had he a first-class record for sobriety, experience, cautiousness and all the other virtues? Was he strictly complying with the by-laws of the town through which he was passing? Was he sleepy from having worked long hours? Was the proprietor of the car an oppressor of "labor"? And so on. It will, indeed, be a considerable time before automobile travelling will be as safe as railway travel.

EDITORIAL NOTE.

The annual report on highway improvement in Ontario for 1910 has just been received. One of the most interesting sections is that dealing with the new Eaton road.

PRECIPITATION FOR AUGUST.

In British Columbia the rainfall was very deficient over Vancouver Island and the Lower Mainland, but rather more than usual at certain interior points. Alberta and Southern Saskatchewan recorded a rainfall of from 2 to 4 inches, which is from one-third to a half in excess of the average amount. In North Saskatchewan and Manitoba the rainfall did not reach the usual quantity. In Ontario and over Western Quebec it was nearly everywhere heavy and well above the average, whereas in Eastern Quebec and over the Maritime Provinces it was generally moderate and much below the average. The total fall at Charlottetown was less than an inch, being 2.70 inches below average. Halifax was also 1.80 inches below the average. The greatest total fall for the month reported from any one station was 6.2 inches at Wiarton, Ont., and the smallest 0.25 inch at Cowichan, B.C.

The table shows for fifteen stations included in the report of the Meteorological Office, Toronto, the total precipitation of these stations for August.

Ten inches of snow is calculated as being the equivalent of one inch of rain:—

Station.	Depth in inches.	Departure from the average of twenty years.
Calgary, Alta.	4.00	+ 1.48
Edmonton, Alta.	2.90	+ 0.60
Swift Current, Sask.	2.30	+ 0.40
Winnipeg, Man.	2.10	— 0.20
Port Stanley, Ont.	1.20	— 1.30
Toronto, Ont.	3.10	+ 0.40
Parry Sound, Ont.	4.60	+ 1.60
Ottawa, Ont.	4.40	+ 1.20
Kingston, Ont.	3.90	+ 1.00
Montreal, Que.	5.90	+ 1.90
Quebec, Que.	3.50	— 0.40
Chatham, N.B.	3.10	— 0.90
Halifax, N.S.	2.70	— 1.80
Victoria, B.C.	0.40	— 0.20
Kamloops, B.C.	1.60	+ 0.58

UNIT COST OF CONCRETE BUILDINGS.

In a recent paper on the "Cost of Reinforced Concrete Construction," Mr. Leonard C. Wason, president of the Aberthaw Construction Co., Boston, Mass., presents specific costs upon a large number of buildings, among which are several designated as factories, mills, etc. The figures relating to these have been arranged in the accompanying table, which presents not only costs for given floor areas, but also unit costs per square foot of floor and per cubic foot of space. In some cases these figures are based upon exact total costs and in others upon bona fide bids:—

Cost of Concrete Manufacturing Buildings.

Job Cost.	Volume in cu. ft.	Floor Area in sq. ft.	Unit Cost per cu. ft.	Unit Cost per sq. ft.
$ 12,774	112,440	7,519	$.114	$1.70
44,652	746,674	49,546	.060	.902
39,830	312,000	24,960	.127	1.60
19,292	212,400	15,000	.091	1.28
141,529	1,327,868	106,022	.107	1.335
91,377	1,380,500	90,240	.067	.101
13,064	105,500	8,800	.124	1.485
75,604	1,211,364	74,604	.0625	1.01
23,332	180,000	16,394	.129	1.42
66,516	544,788	44,175	.122	1.51
113,288	1,271,300	129,920	.0891	.875
90,703	1,622,128	152,200	.056	.60
72,048	1,331,200	83,200	.054	.865
85,754	1,752,609	81,500	.048	1.05
122,128	2,641,000	98,059	.046	1.25
94,341	2,036,731	147,000	.046	.542
129,405	2,867,535	157,730	.045	.82

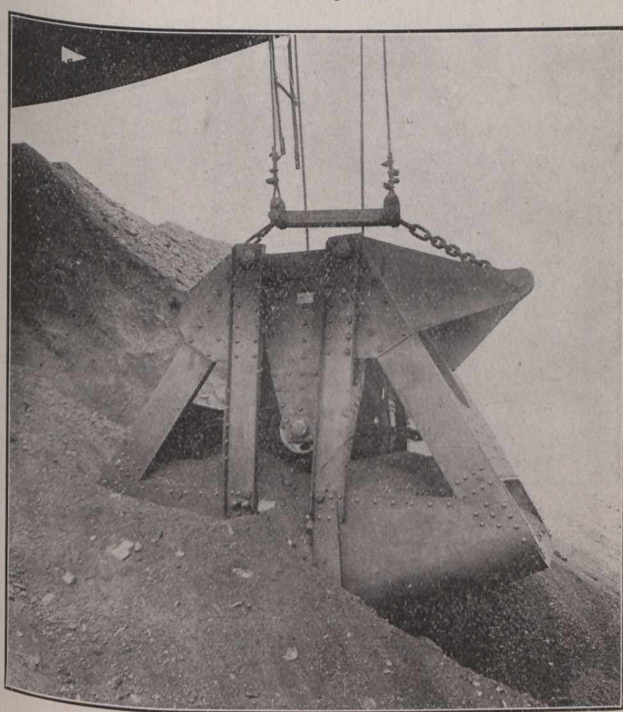
Mr. Wason calls attention to the wide variety in the unit costs, due in part to the different classes of buildings. He also points out the desirability of more careful and accurate methods of estimate, such as are being followed by experienced contractors.

AUDRESEN-EVANS GRAB BUCKETS.

Excavating.

The accompanying illustrations give a quite clear idea of the general features of construction of a new type of patented excavating bucket that the Andresen-Evans Company, Chicago, Ill., have developed with special reference to contractors use.

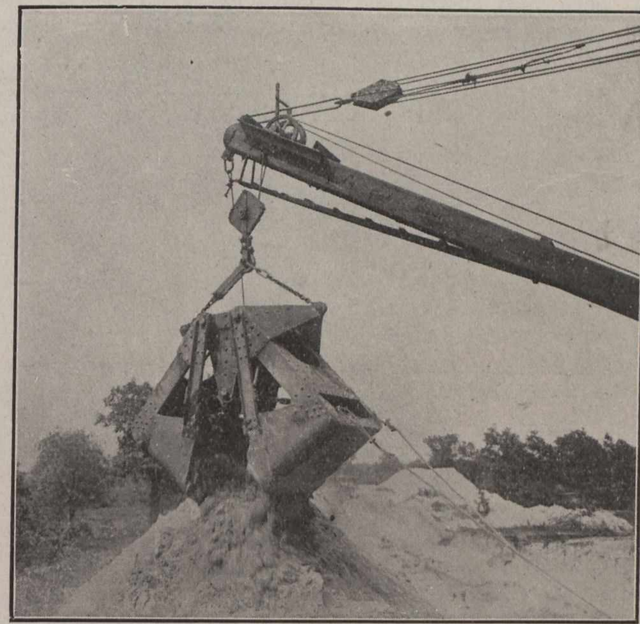
Because of the large differential drum used for closing it might be confused by some with the ordinary clam-shells which have not sufficient digging power to dig many kinds of material from their original bed. This new grab differs radically from all others that have become familiar to every contractor who has had to do with the excavation or handling of bulk materials. Unlike the clam-shells the differ-



ential drum is not fastened to an extension of the scoops but is carried by a separate frame. This central frame carries at its upper corners bearings for the hinge shafts upon which the scoops swing, a shaft for each scoop and these separated by a considerable distance so that the already wide opening is greatly increased. In addition to securing an unusually wide opening, over 50 per cent. greater than clam-shells, this separation of the pivots gives a particularly favorable cutting motion, the securing of which designers of other types of excavating grabs have resorted to compound motions obtained by the use of separate linkages pivoted to both the front and rear corners of the scoops or other equivalent mechanism. In the grab shown this result is obtained by a simple swinging motion of a scoop rigidly fixed to one pivot located some distance from the center line of the grab. It is evident that this construction permits of unusually rigid bracing of the scoops and perfect and continued alignment.

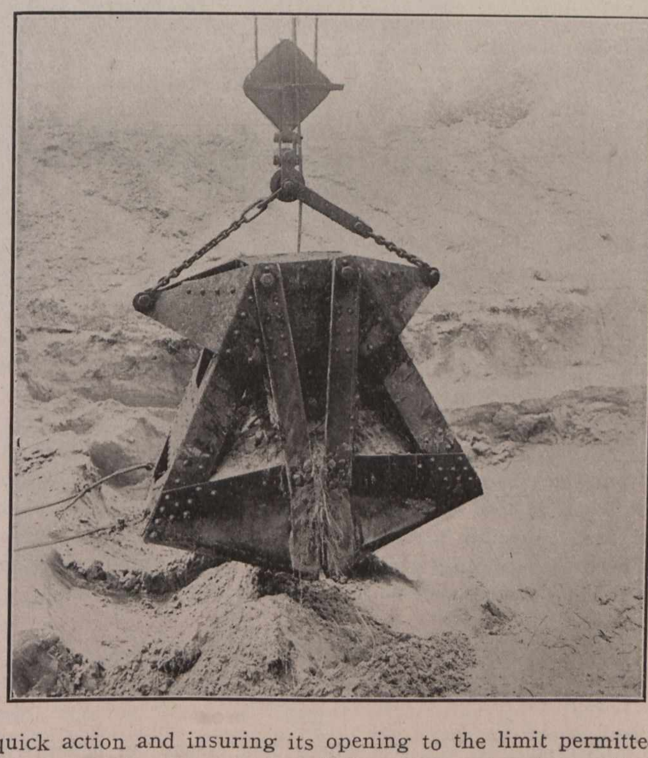
A wide opening is desirable in practically all classes of work for the wider the area covered the more certain is the securing of a full grab, but the most noticeable advantage secured by this element comes in cleaning up barges and like conditions where it saves a large amount of hand labor.

As stated before, the differential drum is carried by a separate frame and not from extensions of the scoops. The effort of the closing rope is transmitted from this drum to



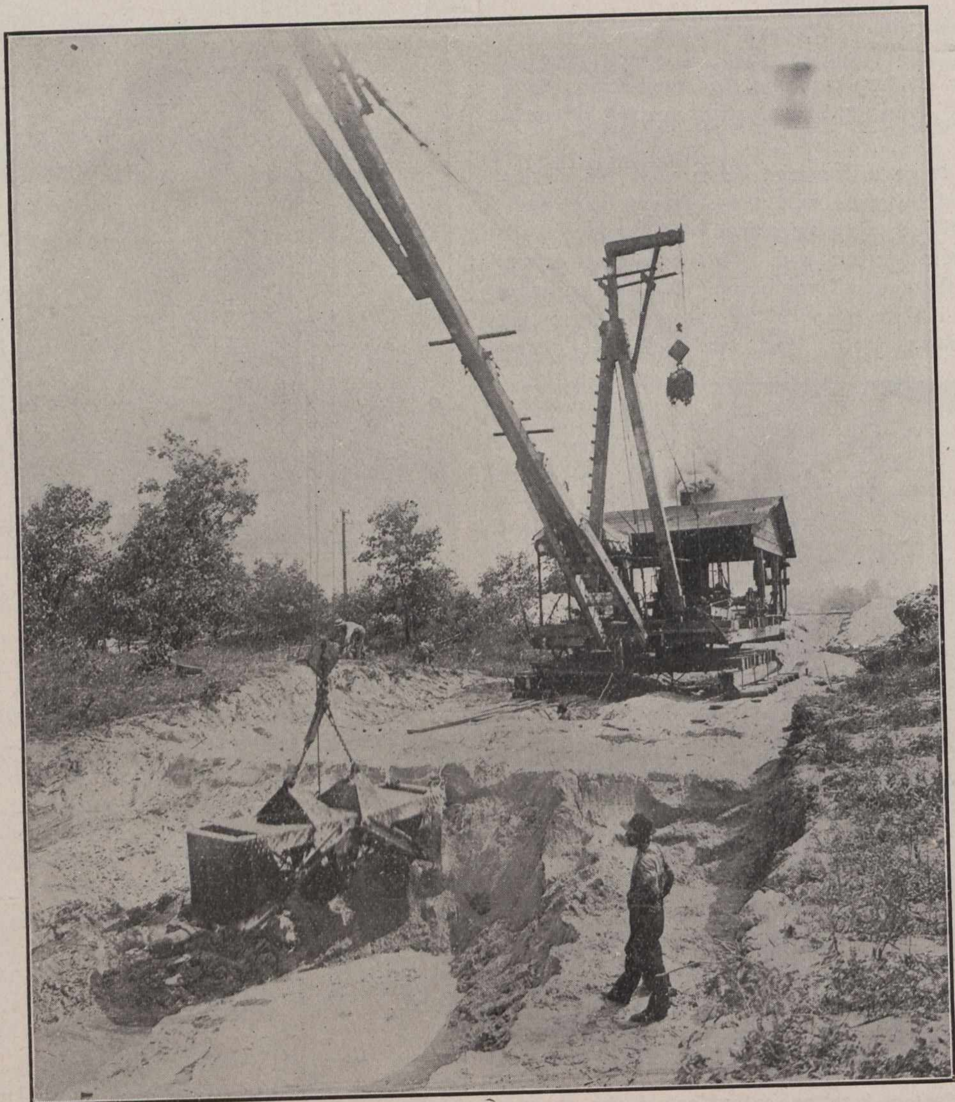
the scoops by means of the four two-part closing chains seen in the illustrations.

The opening of this grab is done in the same manner as with a clam-shell by simply releasing the brake on the closing line drum and holding the opening line, but unlike the clam-shell, all of the weight of the grab is suspended from the opening chains and therefore effective in securing



quick action and insuring its opening to the limit permitted by the length of the closing chains which serve also as limit stops.

The digging of fine compacted sand from under water has heretofore proven an especially difficult task in many cases for grab bucket dredges, as the action of water and super-imposed material so packs it that the penetrating power of an orange peel is required while at the same time the form of scoops of the clam-shell is needed to retain the readily flowing mixture resulting from the stirring that the orange peel points give it. For these reasons such material has been most successfully handled up to the present time only by the expensive hydraulic or dipper dredges. Under such conditions this new grab promises considerable for the contractor for it has proven its ability to handle such materials in a very satisfactory manner.



For economy in operation it is necessary that the ratio of the weight of the bucket to the total weight lifted must be kept as low as possible. Digging power may be increased by weight alone but this is at a sacrifice of economy. The makers of this grab claim that it will handle more material per pound weight of grab than any other.

RAILWAY SIGNAL ASSOCIATION.

Secretary C. C. Rosenberg has issued an advance notice of the annual meeting at Richmond, Va., in October. A separate supplement, filling 183 pages, contains an elaborate index to signal literature, which has been prepared by a special committee for the promotion of signaling education, of which W. J. Eck, of the Southern, is chairman, and A. D. Cloud, of the Signal Engineer, is vice-chairman. This is a thorough and exhaustive work. The principal items in the order of business for the annual meeting are as follows:

Tuesday, October 11.

10.00 a.m.—Opening.
11.15 a.m.—Proposed Amendments to the Constitution.
12.00 noon.—Mechanical Interlocking.
2.30 p.m.—Power Interlocking.
4.30 p.m.—Signal Practice.

Wednesday, October 12.

9.00 a.m.—Report of Sub-Committee on Standards.
10.30 a.m.—Automatic Block Signaling.
11.30 a.m.—Electric Signaling for Electric Railroads.
12.15 p.m.—Automatic Stops and Cab Signals.
1.30 p.m.—Adjourn for the day. Visit Exhibits.

Thursday, October 13.

9.00 a.m.—Wires and Cables.
10.45 a.m.—Storage Battery.
11.15 a.m.—Signal Failures.

H. M. Buck, secretary of the Signal Appliance Association, 30 Church Street, New York City, has issued the announcement of the arrangements for exhibits at Richmond, together with a program of the social functions proposed in connection with the annual meeting.

THE

Sanitary Review

SEWERAGE, SEWAGE DISPOSAL, WATER SUPPLY AND WATER PURIFICATION

POLLUTION OF WATER IN SHALLOW WELLS.

The question is often asked:—

"How far must sewage-polluted water travel underground in order to become harmless?"

The question does not admit of a definite answer. Much depends on the character of the material through which the water passes. Pollution has been known to travel very long distances in limestone rock or rock characterized by fissures, forming open underground channels. On the other hand, water is very readily purified to a high degree by passage through soil, especially of a sandy nature.

The question is of great importance in connection with municipal shallow wells, or wells which obtain their supply from sand in gravel layers situate near the ground surface.

Charles B. Burdick (sanitary engineer, Chicago), has collected some interesting and instructive data on this subject which tend to show that municipal shallow wells may exist in certain localities surrounded by contaminated influences, and yet show very little signs of pollution, either by analysis or in the typhoid rate.

Well pollution (even with comparatively shallow wells) is much more generally due to direct surface pollution through lack of protection, than to underground sources.

Burdick refers to two pointed illustrations, the water supplies of Winona, Minnesota, and of Manistee, Michigan. In both cases municipal wells are located on the banks of rivers at a depth of less than sixty feet. They are practically within the towns, and are surrounded on all sides by possible sources of sewage pollution to such an extent that the sites have been condemned by the State Boards of Health as dangerous.

With reference to the Winona wells, the Minnesota State Board of Health states: "No wells could be recommended which receive surface water in relatively thickly-settled portions of the town, and situated as close to a badly-polluted water as that of the Mississippi River." Practically the same conclusions were arrived at in the case of the Manistee supply. Yet in neither case could it be shown that the water was bad, or that the typhoid rate was abnormal.

Periodical analyses of Winona water showed bacterial counts from 3 to 50 per c.c. The typhoid rate per 100,000 in fifteen years has never exceeded 40, and has been less than 10 for over 50 per cent. of that time.

Manistee water usually showed bacterial counts of less than 50 per c.c., and in about 140 observations the presumptive test by B. Coli was negative in all tests in .1 c.c.; in 1.0 c.c. it was positive only once. The typhoid rate per 100,000 in a ten years' period has exceeded 40 only once, and has been less than 10 four times, or 40 per cent. of the time.

Burdick confesses surprise that the continued public use of water from such sources has apparently done so little harm.

There is very little data relating to possible extension of underground pollution. In the year 1909 an experiment was made at Berlin, Europe. The tests were made in order to ascertain the safe distance which may exist between a well used for water supply and a broken, leaking sewer pipe. The well was located in a water-bearing material of sand and gravel. Two distinct tests were made, one by inoculating the soil below the level of sub-saturation, and the other above this level. In both cases bacillus prodigiosis was inoculated.

In the first experiment the well was 177 feet deep, and water was drawn for thirty days at the rate of 380,000 gallons per day. The inoculated water was introduced sixty-nine feet distant from the well through a special well-point at the rate of 1,000 gallons per hour. Tests of the well water were made with great care, and the inoculated bacillus made its first appearance in the well water after nine days, and at several times thereafter. It was concluded that one in 40,000 of the bacilli reached the well, and, inasmuch as dangerous bacteria are more sensitive to cold water, they would be less likely to survive.

The second experiment was made upon a well 140 feet deep. The inoculated water was introduced fifty-eight feet from the well and four feet above the level of sub-saturation. The test occupied a period of one and a half months. Water was drawn from the well at the rate of 85,000 gallons per day. In this test no trace of bacteria was found in the well, although 8,240,000 millions of the bacillus were poured into the soil.

A comparative study of the above experiments points to the conclusion **that polluting influences, as represented by bacteria,** travel less distance in subsoil, when they enter above the level of sub-saturation, and not direct into the subsoil water.

The Burr-Hernig-Freeman Commission also conducted an experiment upon the travel of pollution in connection with the water supply of Greater New York. This experiment consisted in constructing a cesspool in connection with a camp of about three hundred Italians and noting the quality of the ground water at varying distances from it. The subsoil was of sand, and showed negative tests for B. Coli at all depths up to seventy-two inches.

The bottom of the cesspool was located about eight feet above the level of sub-saturation. The test wells were sunk ten feet from the cesspool drawing water two feet, seven feet and seventeen feet below the sub-water level. Analyses continued for over a month showed greatly contaminated water.

Wells were also sunk 50 feet, 130 feet, 160 feet, 220 feet and 300 feet distant from the cesspool. All wells beyond distances of 50 feet showed absence of B. Coli in 1. c.c. tests, and beyond 160 feet showed absence of B. Coli in 10. c.c. tests. In all cases the nitrogens were high and indicated organic matter undergoing decomposition. The Commission concluded: "With low velocities polluted water passing through fine sand for a distance of twenty-five feet may be considered as practically safe for use."

As a rule, subsoil water in sand or gravel travels very slowly; in fact, usually not more than a few inches per day. The bacteria of typhoid are very sensitive organisms, and do not live long in a free state. The most important factors in their preservation is the presence of mucus and epithelium, which accompanies their discharge. The probable action of the sand or soil is to remove the larger particles containing the bacteria, and the others, in a free state, perish because of unsuitable environment.

It is when we have conditions by which organic particles containing the bacteria pass direct into a water supply that absolute danger occurs.

Protection of wells from direct surface pollution is of more importance than the leaking sewer pipe situate at some distance from the well, when the space is occupied by sand or material of a good filtering nature.

MODERN FILTER PLANTS.†

By Langdon Pearse.*

It is not my intention to take up any new phase of the problem of filtration, but simply to show you a number of slides illustrating typical modern plants of the mechanical or rapid filter type and of the slow sand type.

First, I want to call your attention to a noval use of an abandoned reservoir for a coagulating basin in connection with a mechanical filter plant of the old pressure type. This is part of the system of the People's Water Company, Oakland, California. There is a battery of 12 filters built to run about four million gallons a day at a rate of 100 m. g. d. per acre; often ten to fourteen million gallons a day are forced through. No time was allowed for the period of reaction and coagulation. Mr. DeBerard and I endeavored to improve the operation of the filter plant by using an old reservoir with a capacity of 1,500,000 gallons, giving from 2½ to 4 hours period of flow. We built a baffle around the inlet at the center and constructed a number of orifices in an old flume box. We had upwards of 80 orifices, about 2½ inches in diameter, under a head of about 2 feet, which we used to measure the raw water. The coagulant was applied by a grid, in the flume, supplied from a couple of 5,000 gallon tanks by an orifice box. The old flume was originally built to screen out the algae in the water through muslin. We thus secured regularity in the application of a known amount of coagulant, time for reaction and settling, and cut down the filter washings from three to two in twenty-four hours. The overload on the filters is so great that the bacterial efficiency and removal of the turbidity seldom exceeds 60 per cent. The sand is exceedingly coarse, about 0.69 mm. effective size, uniformity coefficient 1.64.

The first plant of modern design I wish to show you is that at Harrisburg. Mr. J. H. Fuertes was the consulting engineer. It is a plant built at a low price, but accomplishes good results. The various details of the settling basins, filters, coagulant mixers, boiler room, engine room, etc., are shown by the slides. I would call your attention particularly to the type of controller here used on the filters, an orifice box with a float, controlling a hydraulic valve by means of a four-way cock. The strainer system is also noteworthy, built up of a cast iron manifold from which extend horizontal 1¼-inch galvanized wrought iron pipes six inches on centers, drilled with 7-32-inch diameter holes, 3 inches center to

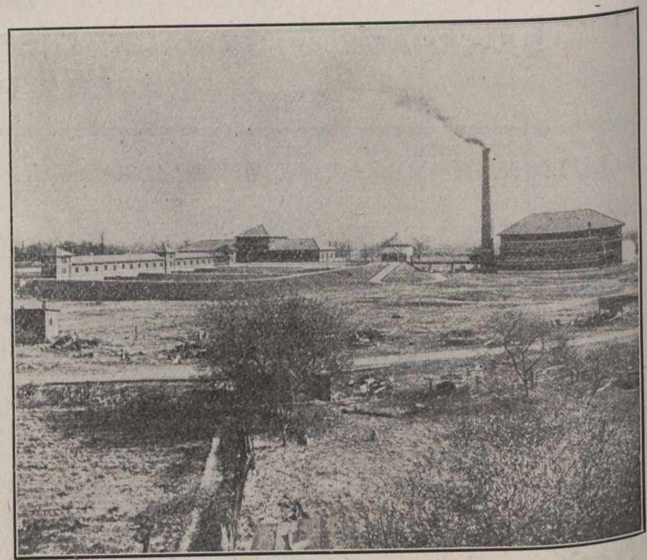


Fig. 1. Filtration and Softening Plant, Columbus, Ohio.

center. This strainer system works on the combined principle, that is air and water are discharged alternately through the same strainer system.

The principal data of the plant is as follows:

Capacity—12,000,000 gallons daily nominal.
Settling basins—4,000,000 gallons, 8 hours storage.
Two secondary coagulating basins—33 x 45 x 16 feet, 334,000 gallons.

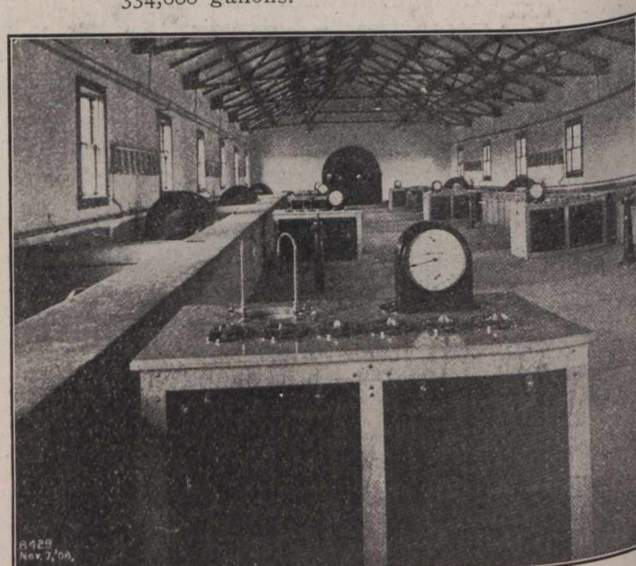


Fig. 2.—Interior Filter Gallery, Columbus, Ohio.

Filters—12, 16' x 27' x 9', 0.01 acre area.
Sand, 30 inches. Effective size, 0.38 mm. Uniformity coefficient, 1.3.
Clear well, 760,000 gallons or 1½ hours' storage.
Amount of wash water used, about 2.5 per cent.
Bacterial removal in 1908, average for year 99.62 per cent.

The Susquehanna River water is very variable in character, and at times is so soft that soda ash has to be used

* Assistant Engineer, The Sanitary District of Chicago.
† Read before the Illinois Water Supply Association.

to provide the alkalinity necessary to react with the coagulant. The turbidity runs from 1 to 1,400 parts per million, so that at times clay is added to obtain a good floc.

Cost per million gallons for coagulant and operating	$5.91
Fixed charges per million gallons	6.85
Total cost per million gallons	$12.76

We will now turn to a more recent and extensive plant, the softening and purification works at Columbus, Ohio. Messrs. Hering and Fuller were the consulting engineers, Mr. John H. Gregory the engineer in charge. The Scioto River water is a hard water from a limestone region and is polluted at times, so that both softening and filtration are carried on in the same plant. This is the largest water softening plant in the world. Lime and soda ash are used to soften the water, and sulphate of alumina is used as a coagulant. The river water flows through a screen chamber to low lift centrifugal pumps, which force the water into the head house. There the stream is diverted, part going to the saturators to be charged with lime, the major portion going into the mixers, where it meets the lime-charged water and later receives the soda ash. The velocity is kept up in the

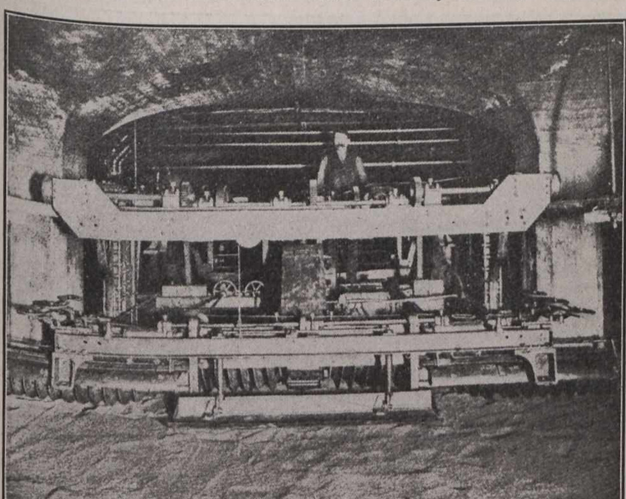


Fig. 3. Filter, Showing Strainer System in Place, Columbus, Ohio.

mixer, so no sedimentation will occur. From the mixer the softening water flows to the settling basins, where it settles. Coagulant may be added. The settled and coagulated water then passes to the filters and the filtered water travels down into the filtered water basin. The high lift pumps which serve the city are supplied from the filtered water basin. A point of interest in the Columbus plant is the strainer system, built up in successive layers of concrete as shown, with circular brass strainer plates. The air pipes are a separate system placed in the gravel above. The controllers are novel, of a submerged type, invented by Messrs. Gregory and Jackson, working between 1 and 4½ m. g. d. with a loss of head of 12 inches.

The principal details of the plant are:

Pumping Station—

- Four 300 h.-p. boilers, B & W type at 160 lbs.
- Two Worthington volute low-lift centrifugals, 26″ suction and discharge, direct connected to tandem compound Fleming engine, capacity 20 to 25 million gallons daily.
- Two Holly high lift pumps, triple expansion, working against a head of 205 feet, capacity 7 to 25 million gallons per day.

Filter and Softening Plant—

- Six saturators, capacity 6¾ m. g. d. lime water.
- One mixer, 1 hour period, velocity 0.37 feet per second at 39 m. g. d.
- One settling basin, 15,000,000 gallons capacity, 20 feet deep, 12 hours storage, nominal.
- Ten filters at 3 m. g. d. each, at 125 m. g. d. per acre, 26′ 2″ x 46′ 8″ x 8′ 10½″ deep, net area 0.025 acre.

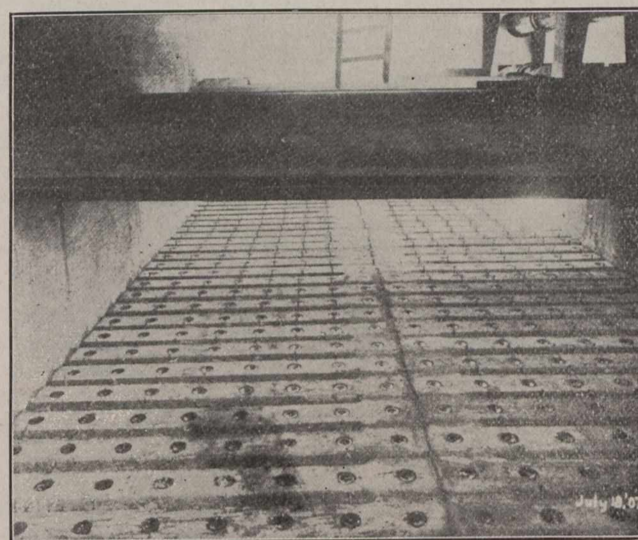


Fig. 4. Filter Showing Air Pipes and Gravel, Columbus, Ohio.

- Filtered water basin built in halves, each of capacity 5 million gallons. Total storage 8 hours nominal.
- One wash water tank. Capacity 104,000 gallons. Supplied by a wash water pump. This is sufficient to wash 2 filters at the rate of 8 gallons per minute per square foot for 7 minutes each, with the wash water pump running.

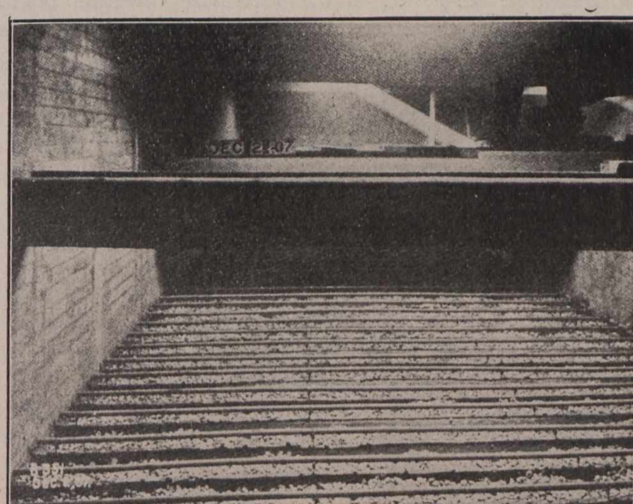


Fig. 5. Filter, Scraping Machine, Pittsburg, Pa.

In am now going to show you a machine for washing sand in place in a slow sand filter. In this scheme the slow sand filter may be run at as high a rate as 10,000,000 gallons daily per acre, in contrast to the usual rate of 3 m. g. d. per acre. The machine is the invention of Mr. Blaisdell of Los Angeles, California, and is in operation at Yuma, Wilmington, Delaware and elsewhere. The apparatus I am illustrating I saw at Yuma and is the original experimental machine. Some improvements have been made in the details since. To describe it in brief: There is a steel box with a top but no bottom, which is lowered into the sand. This contains a set of revolving hollow arms from which jets of water play into the sand. There is a pump connected to the box which carries away the dirty water as it rises.

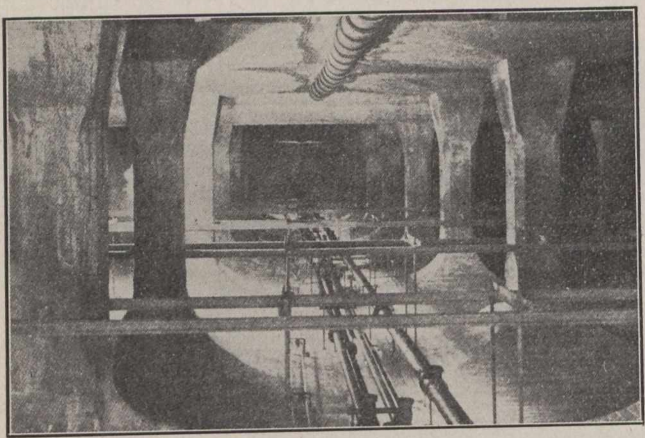


Fig. 6. Gallery, Filters During Construction, Pittsburg, Pa.

The machinery is carried on a bridge which moves along the filter. The machine travels across, thus giving two motions. Thus the entire area is covered. When I saw the machine the filter was treating Colorado River water of turbidity about 200 p. p. m. with a rate of filtration of 10 million gallons per acre per day. The filter contained fine said, about 0.17 mm. effective size, uniformity coefficient 2.07, and was washed daily, the rate of upward flow being about 1 foot per minute for the wash water. The machine has its application in specially designed plants, and if the first cost is made low enough, should allow a low cost of operation. Prior to the invention of this machine, Mr. Blaisdell invented a sand-scraping machine and a sand-replacing machine which he furnished to the Pittsburg filtration plant. The pictures will show you the details of this large slow

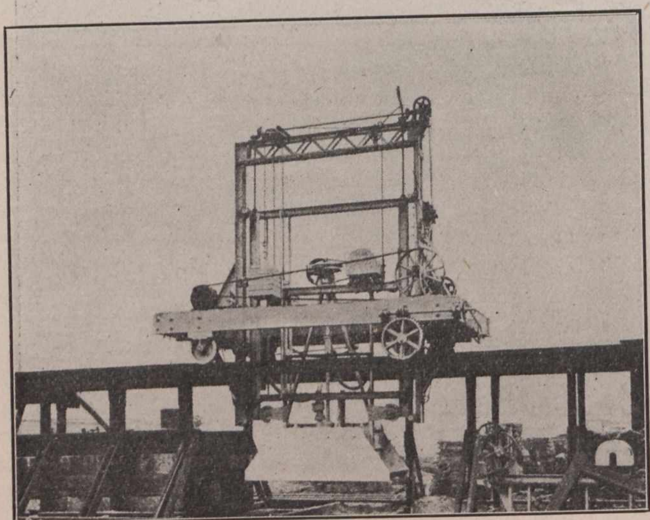


Fig. 7. Blaisdell Filter and Washing Machine, General View.

sand filter plant, designed under the direction of Mr. Morris Knowles, the groined arches, operating galleries, and the construction. The novel features are the two machines. The principal data of the plant are:

Nominal capacity—100,000,000 gallons per day.

Settling basins—1 basin 20 m. g.; 2 basins each 65 m. g. Total capacity, 150,000,000 gallons, or 36 hours flow.

Filters—46 beds, each 1 acre in area, covered with groined arches.

The scraping machine and the sand-replacing machine travel on tracks hung from the columns of the filters. The gauge is 12 feet. The scraper is intended to remove ¼" layers of sand when the water is drained 10 inches below the surface of the bed. The spirals are 16 inches diameter, revolving at a peripheral speed of 300 feet per minute. An automatic device works a 10" auxiliary spiral in and out between the pillars. The machine can travel at a forward rate of 2 to 10 feet per minute, and at a return rate of 50 feet per minute.

A 3 h. p. motor runs the bucket elevator and spiral.

A 2 h. p. motor gives the motive power and revolves the hose-reel.

A 2½-inch hose supplies the connection from the hopper to the pipes in which the sand is conveyed to the washers in a suspension of water.

The machinery for washing the sand in place, and the scraping and replacing machinery, show the steps taken

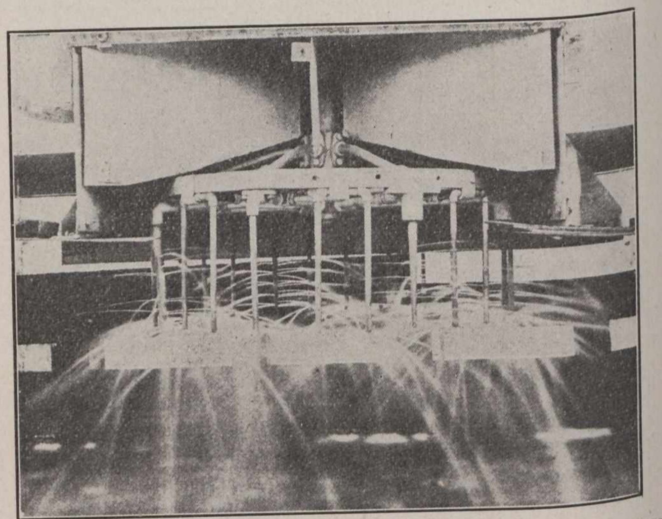


Fig. 8. Blaisdell Filter and Washing Machine, Showing Water Jets.

from the simple method first adopted with sand filters of scraping by hand, and wheeling the sand out of the filters. Later, sand ejectors were developed, to force the sand in a watery suspension through pipes. In small plants the hand scraping method is still as effective and cheap as any.

In conclusion, I wish to thank Messrs. Gregory, Blaisdell, and Knowles for their courtesy in allowing the exhibition of photographs and drawings, sent me for my personal use.

ELEMENTARY ELECTRICAL ENGINEERING.

L. W. Gill, M.Sc.

This series of articles will be continued for some months. They will be of particular interest to the student of electrical work and the civil engineer anxious to secure some knowledge of the simpler electrical problems.

CHAPTER VII.

ELECTRIC LIGHTING.

Electric lighting systems may be either "constant current" or "constant potential." In the former the lamps are connected in series, and in the latter they are connected in parallel. In some cases two or more lamps are connected in series between the two wires of a constant potential system, but such an arrangement is not very common. The series system is used almost entirely for the lighting of streets and large areas where the lamps are all turned on and off at the same time. Direct current series systems may be supplied with current from an independent constant current generator provided with a regulator for maintaining a constant current, or from an alternating current constant potential system through the medium of a "rotary converter" or a "mercury arc rectifier." The rotary converter is a combined direct current generator and alternating current motor, and the mercury rectifier is a tube filled with mercury vapor, which acts as an electric valve and allows the current to pass through in one direction only, thus converting the current from an alternating one to a unidirectional but fluctuating one. Alternating current series systems are supplied with current from a constant potential system through the medium of a "constant current" transformer, the function of which is to maintain a constant current in the circuit, which it supplies by varying the voltage to meet any change in the resistance of the circuit. (See Fig. 69.) In cases where the voltage between the feeders of a constant potential system is fairly high, two or more lamps may be connected in series on either direct or alternating current systems. This scheme is satisfactory in the case of stores or factories where the conditions are favorable to the switching of several lamps at one time.

Lamps.—Electric lamps may be divided into three classes—arc lamps, incandescent lamps, and vapor lamps. In the arc lamp the current passes between two electrodes, which are separated a short distance so that the current has to jump across a small gap. In the older type of lamps, which are operated with direct current, the positive electrode, being heated to a very high temperature by the passage of the current, constitutes the source of light. The electrodes are, therefore, placed vertically with the positive on top so that it will throw the light downward. In the later forms of arc lamps the heated vapor between the electrodes emits a large amount of light.

Arc lamps may be divided into two classes, "open" and "enclosed." The enclosed type are practically obsolete at the present time, except for special work. In this type the electrodes are of carbon, and are open to the atmosphere. On account of the free access of oxygen the carbons burn away very rapidly. In the enclosed type the carbons are surrounded by a glass tube or bulb, which prevents the free access of air, and the carbons last much longer. Within recent years this type of lamp has been much improved by impregnating the carbons with salts of various metals or by making them of some other material. Such lamps are known as "flaming arcs," "flame arcs," "luminous arcs," "metallic flame arcs," etc.

To operate successfully, the mechanism of an arc lamp must perform the following functions: (1) It must bring the carbons together and separate them as soon as the current begins to flow; (2) it must maintain the length of the arc, so that the energy used is practically constant; (3) it must feed one or more carbons as they are used; and (4) it must provide a continuity of the circuit in case the arc fails. The last function is essential only when lamps are operated in series. The mechanism of lamps for operation in series is slightly different from that of lamps for parallel operation. In either case the mechanism which is necessary makes this type of lamp bulky and expensive. The cost of "trimming" (putting in new electrodes to replace burnt ones) is another factor which materially increases the cost of operating these lamps.

Incandescent or glow lamps are those in which the light is given off from a solid rod or filament, which is heated to incandescence by the passage of current through it. Such lamps are made in much smaller units than is possible with the arc lamp. For this reason they are more suitable for the illumination of small rooms and all spaces where a good distribution of light is required. The filament of the older forms of glow lamps are made of carbon, and require 2.5 to 4.0 watts per c.p. (candle power), while arc lamps consume 1.0 to 2.2 watts per c.p. The latter were consequently used wherever a large amount of light was required. Within recent years, however, incandescent lamps have been made with filaments of various other materials, and the efficiency has been gradually improved so that the power consumption does not exceed 1.0 to 1.3 watts per c.p. The result of this is that the incandescent lamp is now replacing the arc lamp for street lighting, not only because they are practically as efficient and cost less, but also because they can be conveniently made in smaller units than arc lamps, and a better distribution of light can be obtained by the use of a larger number of lamps.

Most incandescent lamps are enclosed in a glass bulb, from which most of the air is exhausted to prevent the filament from being oxidized (burned). The Nernst lamp is an exception to this. The filament or glower of this lamp is composed of oxides of some of the rare earths, and is a non-conductor at ordinary temperatures, but a good conductor at high temperatures. The glower must, therefore, be heated by some auxiliary device before current will pass through it. Since the resistance of the glower decreases as the temperature increases, a "balancing" resistance must be connected in series with it to limit the strength of the current. This resistance, together with the auxiliary heating device, constitute a serious handicap to this make of lamp.

Vapor lamps are those in which the light is emitted by certain vapors under very low pressure (approaching a vacuum). The vapor is placed in long, glass tubes, and the passage of the current through the tube causes the vapor to glow without generating much heat. This type of lamp is handicapped in the same way as the Nernst lamp in that the resistance to the flow of current decreases as soon as the current begins to flow. An auxiliary starting device and a balancing resistance are, therefore, necessary. The mercury-vapor lamp is the only one of this type which can claim to be at all successful commercially. Its efficiency is higher than any other type of lamp with the exception of some of the flame arcs, but it is expensive to construct, its life is not very long, and is more or less uncertain, and the character of the light is objectionable in that it is deficient in red rays, and consequently produces a very unpleasant distortion of light values. On the other hand, it is the most efficient source of illumination for photographic work, and is used to a considerable extent for lighting machine shops, warehouses and draughting-rooms.

The following table gives the voltage, current, approximate spherical power, approximate power consumption per candle power, and the life of the various types of lamps. In the case of arc lamps the life applies to the time required to burn one or more electrodes:— not necessary under ordinary conditions, it is advantageous in case of a breakdown on one side, or in case it is desired to operate the system as two-wire. In the latter case the two outside wires are connected in parallel. The amount of copper required for a two-wire system as compared with a three-wire system using three wires of the same size is in the ratio of 1 to 0.35, the percentage loss being the same in each case.

In calculating the size of wire for a. c. circuits the inductance of both the load and the circuit itself must be taken into account. The inductance of the load is expressed by its power factor; i.e., the greater the inductance, the lower the power factor and the greater the current for a given amount of power. The power factor of incandescent lamps is .98 to .99, and for all practical purposes may be assumed to be unity. The power factor of arc lamps varies from .75 to .9, averaging about .85, while the average power factor of induction motors is about .80.

When the two wires forming a circuit are placed in one conduit so that they are not more than one inch apart, the inductance is so small that it may be neglected. The size of wire for such circuits may, therefore, be calculated by means of equation (35), care being exercised in each case to use the proper value for power factor in determining the current. When the wires are placed several inches apart the inductance of the circuit itself must be taken into account. To determine this accurately requires considerable labor, and is beyond the scope of this text.

In dealing with local circuits an allowance for the inductance of the circuit may be made by increasing the constant in equation (35) from 21.6 to 24 if the load consists of incandescent lamps only, to 26 if the load consists of lamps and motors, and to 28 for motors only. If the power factor of the load cannot be determined accurately the values given above will be found sufficiently close to meet the average case. These constants will not apply to long transmission lines. The inductance of the latter must be calculated accurately.

Local circuits in two-phase systems may be calculated in the same way as single-phase circuits by treating each phase as a simple circuit carrying one-half the total power. In the same way a three-phase system may be treated as two circuits with one common wire. The size of wires for either system may, therefore, be determined by changing the constant in equation (35) from 24 to 12 for incandescent lighting load, to 13 for a mixed load, and to 14 for a motor load only.

Example 19.—A number of 440-volt motors, aggregating 75 horse-power, power factor .8, are to be supplied from a distributing point located 500 feet from the switchboard. Allowing a drop of 4 per cent. in the feeder, what size of wire would be required (a) with a single-phase system, and (b) with a two or three-phase system?

(a) The current will be $I = \dfrac{75 \times 746}{440 \times .8} = 159$ amperes.

Section of wire required is $A = 2{,}800 \dfrac{159 \times 500}{4 \times 440}$

$= 126{,}000$ c.m.

(b) Section of wire is 126,000/2 = 63,000 c.m.

The following table gives the dimensions and resistance of pure copper wire (solid):—

Copper Wire Table.

A. W. G. or B. & S.	Dimensions. Diameter. Inches.	Dimensions. Area. Circular mils.	Weight. Lbs. per Ohm. @ 20 deg. C.	Weight. Lbs. per Ohm. @ 50 deg. C.	Length. Feet per lb.	Length. Feet per Ohm. @ 20 deg. C.	Length. Feet per Ohm. @ 50 deg. C.	Resistance. @ 20 deg. C.	Resistance. Ohms. per lb. @ 20 deg. C.
0000	.460	211,600	13,090	11,720	1.561	20,440	18,290	.00007639	.00008535
000	.4096	167,800	8,232	7,369	1.969	16,210	14,510	.0001215	.0001357
00	.3648	133,100	5,177	4,634	2.482	12,850	11,500	.0001931	.0002158
0	.3249	105,500	3,256	2,914	3.130	10,190	9,123	.0003071	.0003431
1	.2893	83,690	2,048	1,833	3.947	8,083	7,235	.0004883	.0005456
2	.2576	66,370	1,288	1,153	4.977	6,410	5,738	.0007765	.0008675
3	.2294	52,630	810.0	725.0	6.276	5,084	4,550	.001235	.001379
4	.2043	41,740	509.4	455.9	7.914	4,031	3,608	.001963	.002193
5	.1819	33,100	320.4	286.7	9.980	3,197	2,862	.003122	.003487
6	.1620	26,250	201.5	180.3	12.58	2,535	2,269	.004963	.005545
7	.1443	20,820	126.7	113.4	15.87	2,011	1,800	.007892	.008817
8	.1285	16,510	79.69	71.33	20.01	1,595	1,427	.01255	.01402
9	.1144	13,090	50.12	44.86	25.23	1,265	1,132	.01995	.02229
10	.1019	10,380	31.52	28.21	31.82	1,003	897.6	.03173	.03545
11	.09074	8,234	19.82	17.74	40.12	795.3	711.8	.05045	.05636
12	.08081	6,530	12.47	11.16	50.59	630.7	564.5	.08022	.08962
13	.07196	5,178	7.840	7.017	63.79	500.1	447.7	.1276	.1425
14	.06408	4,107	4.931	4.413	80.44	396.6	355.0	.2028	.2266
15	.05707	3,257	3.101	2.776	101.4	314.5	281.5	.3225	.3603
16	.05082	2,583	1.950	1.746	127.9	249.4	223.3	.5128	.5729
17	.04526	2,048	1.226	1.098	161.3	197.8	177.1	.8153	.9109
18	.04030	1,624	.7713	.6904	203.4	156.9	140.4	1.296	1.448

Determination of Size of Wire.—In Canada and the United States the size of wires is specified either by B. & S. (Brown & Sharpe) gauge or by section in circular mils. Small wires are usually specified by gauge and large cable by section in circular mils. The current which the various wires are allowed to carry according to the National Code is shown in the following tables:—

Carrying Capacity of Copper Wires.

Size of Wire.		Allowable Current.	
B. & S. Gauge.	Circular Mils.	Rubber Insulation.	Other Insulations.
18	1,624	3	5
16	2,583	6	8
14	4,107	12	16
12	6,530	17	23
10	10,380	24	32
8	16,510	33	46
6	26,250	46	65
5	33,100	54	77
4	41,740	65	92
3	52,630	76	110
2	66,370	90	131
1	83,690	107	156
0	105,500	127	185
00	133,100	150	220
000	167,800	177	262
0000	211,600	210	312
	200,000	200	300
	300,000	270	400
	400,000	330	500
	500,000	390	590
	600,000	450	680
	700,000	500	760
	800,000	550	840
	900,000	600	920
	1,000,000	650	1,000
	1,100,000	690	1,080
	1,200,000	730	1,150
	1,300,000	770	1,220
	1,400,000	810	1,290
	1,500,000	850	1,360
	1,600,000	890	1,430
	1,700,000	930	1,490
	1,800,000	970	1,550
	1,900,000	1,010	1,610
	2,000,000	1,050	1,670

In most cases the size of wire is fixed by the allowable voltage drop. Short circuits are the exception to this rule, the size of wire being fixed in this case by the above table. The voltage drop allowable depends on the distance and the opinion of the individual engineer. The "Canadian Electricity Inspection Act" requires that "the variation of pressure at any purchaser's terminals shall not under any conditions of supply which the purchaser is entitled to receive exceed three per cent. from the declared pressure." To keep the variation of voltage within this limit the total drop in voltage must be small. If the installation is to be permanent and a satisfactory service is required, the total drop on the inside wiring should not exceed 3 per cent. for incandescent lamps and 5 per cent. for motors. The usual allowance for lighting is 1 to 1.5 per cent. on the branch circuits and 1.5 to 2 per cent. on the feeders, the larger drop being allowed on long circuits. In central station work the **total** drop on lighting circuits may be 6 per cent. and on motor circuits 10 per cent. These figures will necessarily be exceeded with long transmission lines, but in this case special means for regulating the voltage should be provided.

Having decided upon the allowable voltage drop in any given circuit, the size of wire **for direct current** may be calculated as follows: At 25° C. the resistance of wire l feet long with a sectional area of A circular mils is (see equation 1a)

$$R = 10.8 \frac{l}{A} \qquad (33)$$

If **e** represents the allowable drop in volts, I the current to be carried, and D the distance, then from Ohm's law,

$$\mathbf{e} = IR = I \times 10.8 \frac{2D}{A} = 21.6 \frac{ID}{A} \qquad (34)$$

Transforming this equation,

$$A = 21.60 \frac{ID}{\mathbf{e}} \qquad (35)$$

If the voltage drop is expressed as a percentage **p** of the total voltage E, then **e** = **p**E/100, and

$$A = 21.60 \frac{ID}{\mathbf{p}E} \qquad (36)$$

If P represents the loss of power in per cent. of W, the power delivered, then

$$A = 2{,}160 \frac{WD}{PE^2} \qquad (37)$$

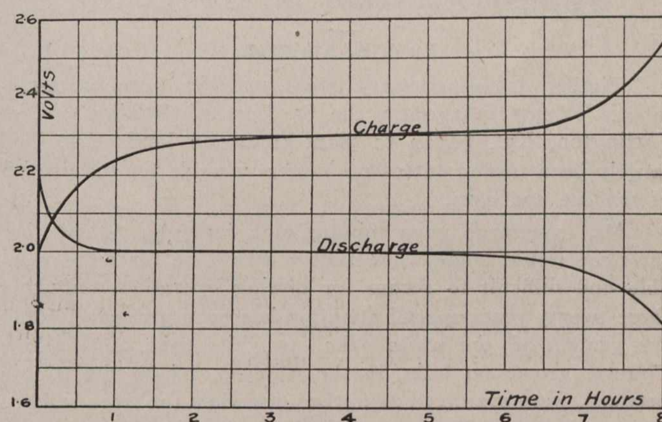


Fig. 72.

To facilitate calculations a chart prepared by R. W. Stovel and N. A. Carle is here given. This chart may be used to find the value of any one of the four factors in equation (35) when the other three are known, or, taking the limiting capacity allowed by the National Code, two factors may be determined when the other two are known. In using this chart it must be noted that **the length of circuit on the chart represents the total length of wire, which is equal to 2D in equation (35).** The following examples will illustrate the method of using this chart:—

Example 17.—What size of wire will carry 150 amperes a distance of 300 feet (600 feet of wire) with a drop of five volts?

Starting with "drop in volts" of five, read up to "line" of 600 feet length of circuit, then over to 150 amperes, and it is found that the size of wire is between 3/0 and 4/0. The latter would be the proper size.

Example 18.—How many volts will be lost in transmitting 100 amperes over 200 feet, using the smallest allowable rubber-covered wire?

Starting with 100 amperes, read up to line marked "Rubber Insulation" and get No. 1 B. & S. gauge wire, then read over to 400 feet of circuit, then down to 5.5 volts drop.

In making calculations for a three-wire direct current system the sizes of the outside wires are determined by assuming that the neutral wire carries no current. The capacity of the neutral is then made equal to that of the outside wires in the case of interior circuits and about one-third to one-half for exterior circuits. Some engineers prefer to make the capacity of the neutral equal to that of the outside wires in all cases. While this is

Electric Lamp Table.

Terminal Voltage.	Candle Power.	Watts per c.p.	Life (hours).	Name of Lamp.	Current. Kind.	Current. Value.
47—50	700—850	1.4—1.6	8—10	Open arc	d.c.	6—10
30—35	......	......	6—8	Open arc	a.c.	10—15
70—80	400—800	2.0—2.5	100—120	Enclosed arc	d.c.	5.0—6.6
70—80	......	......	75—100	Enclosed arc	a.c.	5.5—8.0
45—60	1000—3000	.5—1.2	15—30	Flaming arc	d.c.	6.0—12
45—60	1000—2500	......	15—30	Flaming arc	a.c.	8.0—12
......	1000—3000	......	60—70	Regenerative flame arc	....	....
75—80	1000—2000	1.2—1.4	150—175	Metallic flame arc	d.c.	4.0—5.0
2—250	2—250	2.5—4.0	500—1000	Carbon incandescent	a. or d.c.	.2—5.0
100—125	20—40	2.0—2.2	600—900	Tantalum incandescent	d.c.	....
2—110	1—400	1.2—1.3	800—1000	Tungsten incandescent	a. or d.c.	.3—8.0
25—250	25—1000	1.0—1.2	800—1500	Osram incandescent	a. or d.c.	1—1.2
100—240	20—50	2.0—2.5	400—800	Nernst incandescent	a. or d.c.	.2— .8
50—150	250—750	.5— .7	800—1500	Mercury-vapor	d.c.	3—3.5

FOREST PLANTING IN KENTUCKY.*

By J. B. Atkinson.

Timber is as necessary to all mining operations as is labor. Twenty years ago the St. Bernard Mining Co., of Earlington, Ky., began to plant trees on lands that had largely been turned out as no longer valuable for the growth of tobacco and corn.

My experience as a mining man indicated to me that the time would come when timber would be far more valuable and difficult to secure for mining operations. During these twenty years special attention has been given to finding the growth of the white oak; 45 white oaks of Hopkins County, grown on hills, in the valleys, and on the slopes between, were examined as to the ages when the trees reached 12 ins. diameter. The average age was found to be 101 years. The average age when cut was 231 years, with average diameter of 31 ins. The oldest tree when cut was 325 years old, with a diameter of 41 ins., and was 95 years growing to a diameter of 12 ins. The youngest was 142 years old when cut, with a diameter of 27 ins., and was 75 years growing to 12 ins.

From these facts collected I have made a table of the time it takes certain trees, in Kentucky, to grow to a diameter (at the stump) of 12 ins. This is not infallible, but is based on actual tree growth as observed in the forest, and has no reference to isolated growth, or to unusual conditions. The pine oak will grow to 12 ins. diameter in 40 years; black locust, 445; tulip, 50; black walnut, 56; Texas red oak, 58; sweet gum, 62; ash, 72; hickories, 90; white oak, 100 years.

The first tree planting was with the black walnut. The nut was planted in the autumn with the hull on, when the nuts became mature. The ground was prepared as for corn, and the nuts planted 4 ft. apart each way, or 2,770 to the acre, being covered with ½-in. to 1-in. of soil. The land was cultivated for three or four years the same as for corn, and then blue grass sown, the idea being that in 10 or 12 years the trees would be large enough to permit pasturage.

On the poorer of the thrown-out farm lands we plant black locust. This tree, belonging to the pulse family (the family of the clover and the peas), draws its nitrogen from the air and enriches the soils. We plant these trees 7 or 8 ft. apart each way, and cultivate as we do the walnuts.

*Abstract of a paper in the August number of "American Forestry."

We also plant the catalpa speciosa, a rapid-growing tree from the Wabash valley. I have found this tree growing from 21 to 24 ins. in diameter at the stump in 38 years. It is spaced 7 or 8 ft., and cultivated like the walnuts for three or four years. The tulip tree, commonly called the yellow poplar, is a most durable tree, and should be planted on good land, the trees 10 ft. apart each way, or 435 to the acre.

Up to the present time, the above-mentioned four varieties are the only ones planted by us for the growing of new forests. From the autumn of 1888 to the spring of 1909, inclusive, my company had planted 430,000 black walnuts on 162 acres; 160,000 catalpa speciosa on 230 acres; 200,000 black locust on 280 acres; 10,000 tulip on 20 acres, and 850,000 black walnuts in vacant places in the forest, largely in bottom lands, a total planting of 1,650,000 trees.

The forest planting of walnuts 20 years ago has been thinned out until the stand is much less than 1,000 to the acre; 29 trees, 25 to 35 ft. high, occupying 1,100 sq. ft., have now an average circumference of 17½ ins., or 5½ ins. diameter. The largest tree is 9.3 ins. diameter, the smallest is 3.4 ins. A young tulip forest, 11 years old from the seed, has produced trees 6 ins. in diameter.

When a natural forest is grazed, the cattle destroy much of the young growth, and my company is fencing its woodlands as rapidly as possible. The preserving of seed trees, together with fencing, will let nature do much to increase growth of present forests. Then reduce the cutting of timber to something below the annual growth, and a good beginning will have been made to restore Kentucky forests to their original glory. Besides this, there are tens of thousands of acres of cleared land in Kentucky that should be returned to the forest. Let the farmer select 10 to 20 acres of medium good land and plant it in walnuts and blue grass. A better or more profitable combination could not exist. On poor land plant the black locust, and presently be possessed of a perpetual woodlot. On meadow lands plant catalpa speciosa, and again have a perpetual and quick-growing forest.

Kentucky has too much land in so-called cultivation. Half the acres, well cultivated, would bring larger and better crops than are now secured. Hence the planted woodlots could be spared. The State has about half its area still covered with forest, and is in better condition to retain its present acreage and increase the annual growth than most of the States of our country. We are a patriotic people, but patriotism alone will not increase the production of our forests or add to its acreage. Legislation is required. If the Commonwealth of Kentucky can protect its quail, it can protect its trees.

I believe the theory of free forests and revenue from the product of the forest may aid in the solution of the tax question. Then the man who plants trees would have an inducement. He would not be taxed on his growing crop until he sold his trees. The owner of forest lands would not be apt to cut immature trees, but await mature growth. One thing the American people may as well understand at once, there will never be cheap lumber again. A nation that cuts 3 ft. to 1 ft. that grows, as at present, will require generations of skilled forest management to increase the annual growth of the forests to meet the wants of civilized life.

REMEDIES FOR LANDSLIDES AND SLIPS ON THE KANAWHA AND MICHIGAN RAILWAY.*

By R. P. Black, Assoc. M. Am. Soc. C.E.

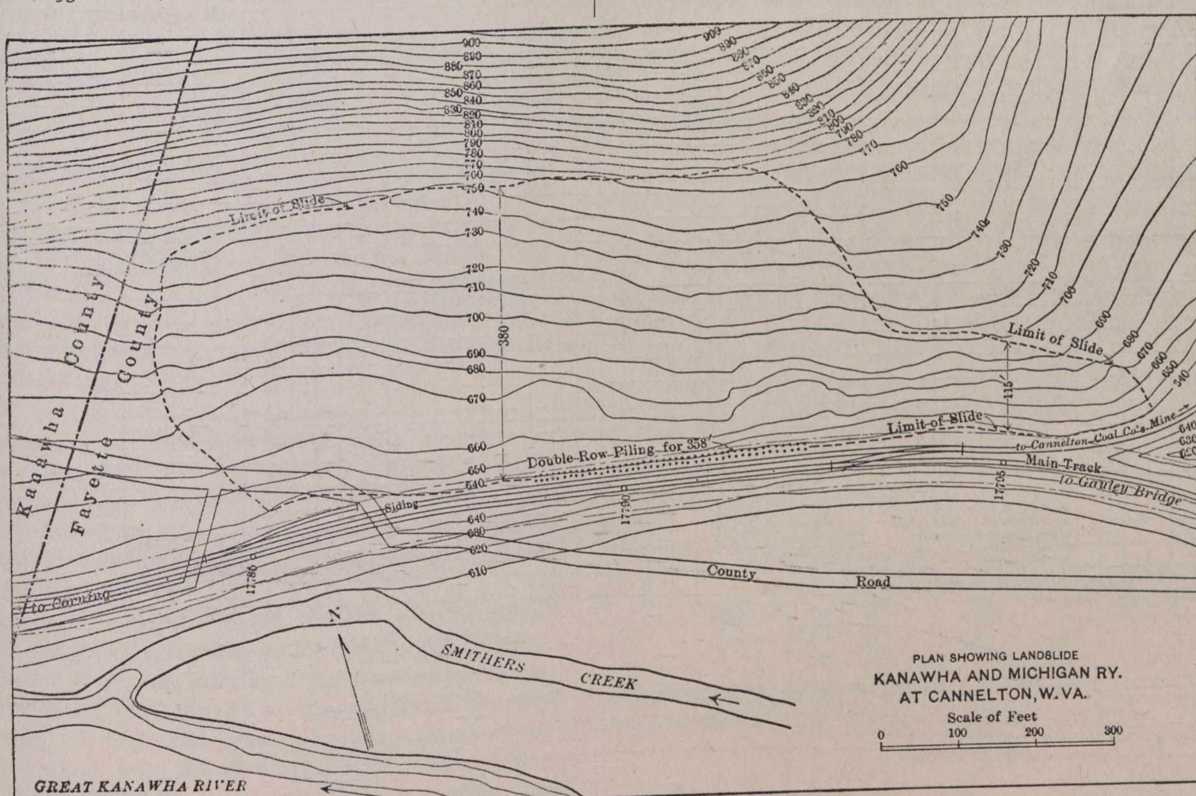
To reach the Kanawha Valley Coal Fields of West Virginia, the southern portion of the Kanawha and Michigan Railway, for 93 miles (from Point Pleasant to Gauley Bridge, West Virginia), is located on the east side of the Great Kanawha River. For about one-third of this distance the road is close to the banks of the river, on a hillside location, where there is practically no valley, the mountains rising directly from the stream.

Owing to the character of the soil, there is considerable trouble, due to landslides and slips, the term slips being used where the fill, or embankment under the tracks, settles or slips toward the river.

Excessive rains occur during the winter, and small landslides are numerous, but do little damage; in most cases the water rushing from the mountains brings with it one or two uprooted trees and a few yards of earth. There is much more trouble with the larger landslides, that is, where the whole hillside gradually slips down toward the river, pushing the track ahead of it, and giving bad line and surface. At some places the track is not only pushed out of line but raised.

Landslides occur in almost every case where the hill or mountain side has been cleared of all forest. The top soil, or earth above the rock, which varies in depth from 8 to 20 feet, is mucky clay, which holds water in every low place, apparently being impervious. This clay soil soon becomes saturated, soft, and mucky, and, not having any roots or vegetation to hold it in place, and being on a slope, starts a downward movement, slipping on the rock, covering the ditches and ballast of the track, and pushing it out of line. These so-called landslides do not come down at once, but move slowly, thereby causing no immediate danger. In several places reverse curves have to be given to the alignment, in order to keep the track in surface.

At Point Pleasant, where there was a small landslide, the earth, as it came in, was removed by a steam shovel at the



toe of the slope. The soil at this point was slippnig on an inclined stratum of rock, the top of which was smooth and had the appearance of soapstone.

In cases where it was impracticable to remove the slide, the top-soil drainage system on the hillside above was at first tried, but did not work successfully, as the ditches, due to the slippery soil, soon filled up. It appeared that the small amount of surface water collecting in the low places caused by the roughened surface was sufficient to cause the slipping.

At Leon, where considerable expense was incurred in maintaining the track around a slide, the hillside was removed, and the track, for 2,000 feet, was relocated on the rock bottom, obtained by cutting back to a side-hill location. By this method the entire landslide was removed and the track put on rock bed, thereby doing away with the trouble, at a cost of $20,000.

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At Cannelton, where the largest slow-moving landslide occurred, the main track had been pushed out of line. Reverse curves were made, in order to get back to the alignment on either side, but, on account of the continual lining out of the track, the curves became too sharp for operation, and the side track between the hillside and the main track became completely covered. As this slide was of such extent and depth, Fig 1, it was out of the question to remove it in order to get back far enough for a rock sub-grade, as at Leon. The change of line not being feasible, it was proposed to remove part of the landslide, permitting the relocation of the tracks on their original alignment, and, after completing this, to protect them from further slides.

braces were carried diagonally, at an angle of 45°, to the lower row of piles, and these were sawed off at the ground level. Steel bands, with 1-inch rods to hold the two sets of piling together, were put on about 8 inches below the top of the brace pile. The depth of penetration of the piling varied from 15 to 30 feet. The piling was selected large white oak, and oak timber was used for the stringers and braces. Moving the shovel ahead about 30 feet, then cutting it back, and driving the piling as shown, constituted a day's operation. The work was completed **successfully** without further serious landslides. In four weeks about 12,000 cubic yards of earth were removed, the track was thrown back to its original

PLATE CII.
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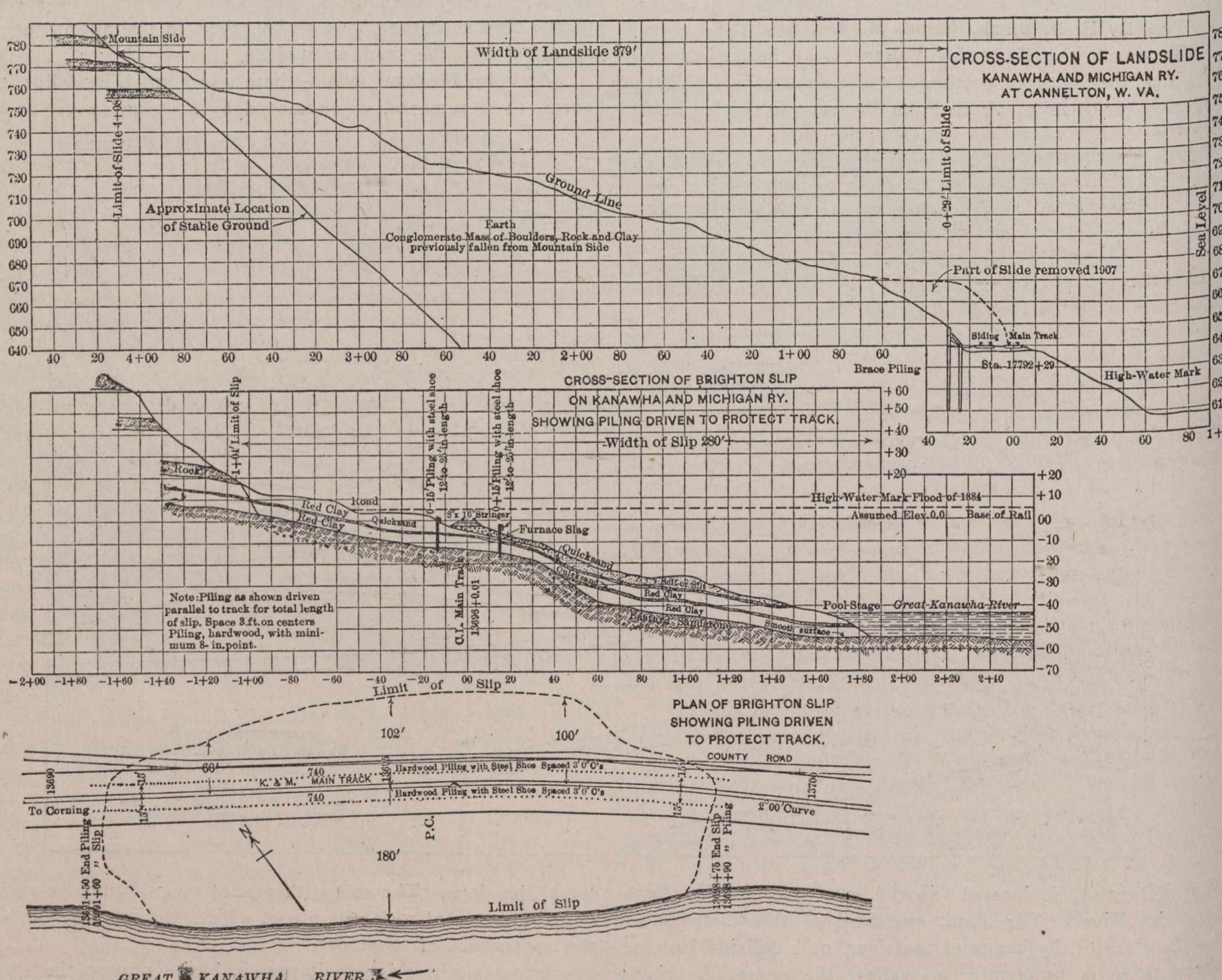
REMEDIES FOR LANDSLIDES AND SLIPS.



A steam shovel was cut in at one end, and removed enough of the landslide to allow the two tracks to be changed to their original location. After the shovel had worked about three days a slide occurred one night, half burying the shovel. Steps were then taken to hold back the hillside before further slides could develop. This was done successfully by driving two parallel rows of piling, 5 feet apart, about 3 feet from centre to centre, as shown on Fig. 2. The upper rows, against the hill, were backed with 3-inch plank, the front rows being driven against this brace in order to aid in supporting the upper row. A 10 by 10-inch stringer was placed against the upper row, and from this 8 by 8-inch

alignment, and the landslide was stopped. This work cost $16,000.

The upper limit of the slide is about 135 feet above the track. The slide consists of about 200,000 cubic yards of moving earth. This work was done in the spring of 1907, and has been successful. At several places, due to excessive pressure, the braces have been embedded in the stringers. The earth from the top of the piling was given a slope of 1½ to 1; at several other points smaller slides have been stopped with one row of piling. The piles were driven 3 feet apart, centre to centre, and cut off 3 feet above the top of the rail, the ground above being given a slope of 1½ to 1. At one or two places, where one row was not sufficient, the trouble was stopped with brace piling. At points where the single row of piling showed signs of leaning, due to the pressure against that part of the piling above ground, this overturning, apparently due to too much length above ground, was stopped by cutting off the piling 3 feet above the ground and giving the earth above it a slope of 1½ to 1.

In contending with landslides of this character in West Virginia, all that seems to be necessary is to obtain a good toe hold, which stops the movement of the earth above. The so-called slow-moving landslides on the Kanawha and Michigan Railroad have been stopped successfully by one of these methods.

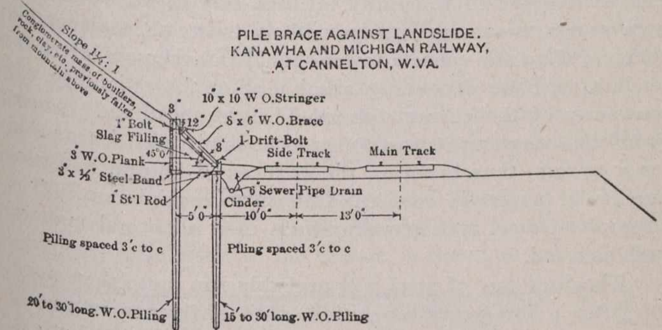


Fig. 2.

Slips.—The term, "slips," as the conventional name indicates, is applied to places where the soil slides into the river. These slips occur when the roadbed is constructed on a fill, ranging in depth from 5 to 10 feet, across narrow flats, between the hill and the river. Due to the constant movement of the earth, no trees grow on the land between the river and the railroad. The ground slips gradually into the river where, from time to time, its toe is cut away by the current.

The peculiarity of these slips is the fact that they may continue for one or more seasons without giving any trouble. Slips are due to high water and not to surface water. A quick rise and fall of the river will not cause the soil to move, but continued high water, or several successive floods, will start the slipping action.

In the spring of 1908, the length of track affected by the slips was 7,600 feet, necessitating, at several different points, the maintenance of speeds ranging from 6 to 20 miles per hour for five months, until the dry season, when this slipping action stopped. On Plate CII is shown a cross-section of the Brighton slip, which gave the greatest trouble. The section is taken at right angles to the track, the information for which was obtained by levels and test rods driven to rock. A stratum of rock, below the earth, slopes toward the river, ranging from 1:0.2 to 1:1. This rock is covered by successive layers of red clay, varying from 3 to 6 feet in thickness. Immediately above the rock, and in thin seams, from 4 to 8 inches thick, between the layers of clay, is found a quicksand mixed with fine clay. When the quicksand and fine clay become thoroughly saturated with water, the mixture affords a smooth surface over which the top soil or successive layers of clay slide toward the river. After high water these seams of quicksand can be traced readily by the water seepage. The quicksand is very slimy, and contains no grit. The water must remain over the ground long enough to force its way back into this quicksand and saturate well before the slipping action can take place.

In 1908, in order to keep the track safe, the gangs on four sections were increased from three—the normal force—to ten men each, and these increased forces were maintained for four months. The tracks had to be resurfaced and lined continually. At three different times, it was necessary to put on filling material and ballast in order to keep the track up to grade. This entailed a cost of $4,400 more than the normal expenses for the year. The track over the slips was not only costly to maintain, but dangerous, due to wrecks resulting from derailments on account of rapid settlement of the roadbed.

At Poca, where a trestle was maintained over a slip for about 800 feet, due to the heavy cost of changing the alignment, the trestlework was filled with heavy quarried rip-rap, and the fill was widened so that the stone reached the river's edge. The weight of this stone fill caused settlement, but, after adding stone from time to time for five years, the roadbed became solid. It is thought that the stone fill settled to the rock stratum below the slip, thereby stopping the movement.

For slips at other points where small fills were maintained, several remedies were suggested, one being to construct, at the river's edge, a wall which would act as a toe to hold back the moving soil. Owing to the necessary height of the wall, however, this was deemed too costly. At Brighton and Leon slips, where the alignment could not be changed, the remedy shown on Plate CII was proposed, the scheme being to drive two rows of piling, one on each side of the track, with a track-driver, the piling to be equipped with steel shoes (Fig. 3) for penetrating the rock strata. It was supposed that, with the toe hold in the rock, and the pinning together of the successive moving clay strata, this slipping action in the vicinity of the track would be stopped.

In the spring of 1909, test piling was driven for a distance of 50 feet in the centre of the Brighton slip. Transit observations taken from a base line, showed that the piling did not move any appreciable distance. The track held up

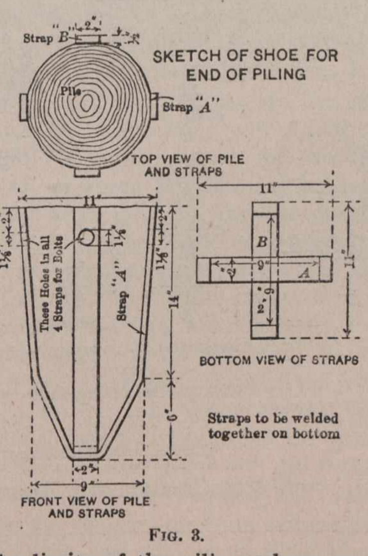


Fig. 3.

well within the limits of the piling where, as on either side, it had been necessary to resurface continually.

The test being successful, two rows of piling were driven during December, 1909, on either side of the track at the Brighton slip, and between its limits, for a distance of 740 feet. The piles were equipped with steel shoes and were driven 3 feet apart, centre to centre, on the down-hill side. Continuous 8 by 16-inch. timber bracing was bolted to the piling. The work was done with a self-propelling track-driver. A temporary spur track was constructed at one end of the slip, thus dispensing with the services of a work train. The cost of this work was as follows:—

Hardwood piling, 8,075 feet at 13 cents	$1,049.75
Steel shoes, 12,690 lbs. at 3 cents	380.70
Labor	856.35
Fuel, etc.	120.00
Total	$2,406.80

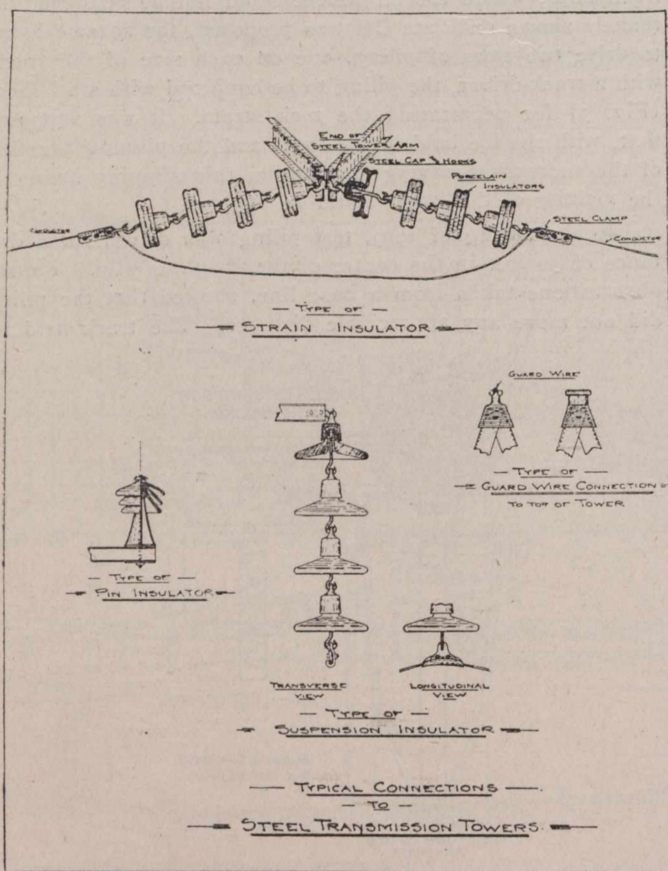
Up to the present time, this remedy has been successful.

At another point, where the rock strata are not at great depth, it is proposed to go down the hillside about 20 feet from the track, put down holes about every 20 feet, and blast the smooth surface of the rock. Thus, by roughening the surface and destroying the stratification, the sliding of the clay may be stopped.

STEEL TRANSMISSION TOWERS.

By J. Edw. Jennings, Mem. B.E.C.

In the last few years a great activity has been manifested in this country in the utilization of water power, its adaption to electricity and the development of long distance electric transmission from remotely situated water power. The hydraulic and electric features are, of course, the main subjects in a project of this kind, but the means of conveying this power for long distances is no small problem.



In the writing of this paper discussion of technical details has been particularly avoided and care has been taken not to enlarge on any one subject, at the sacrifice of the whole.

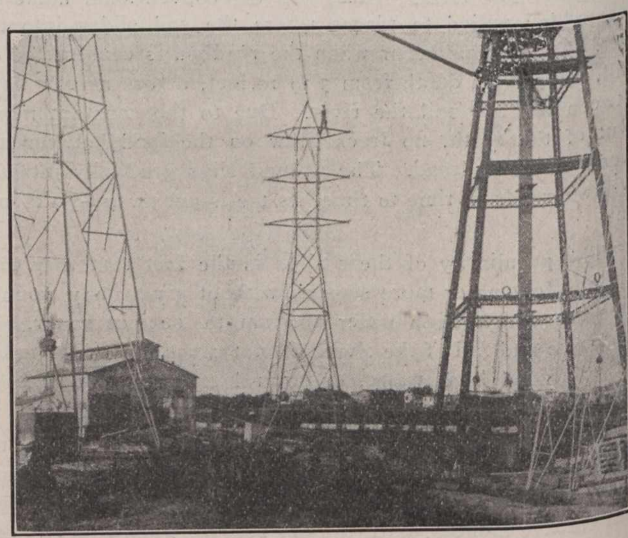
It is intended to cover, in a general descriptive way, the industry of steel transmission towers used to support high tension electric lines. Transmission line engineers have generally adopted the steel tower as the type best suited for supporting transmission lines. The advantages of steel when properly protected with galvanizing are many, and it is intended to point out a few, which, no doubt, will be recognized by engineers and others.

* Read before the Brooklyn Engineers' Club.

From a practical standpoint a steel tower can be made economically to meet any topographical or climatic conditions. The use of guy wires are avoided; they can be made of sufficient height to allow for long spans between the towers, consequently for a given mileage of line there are fewer obstructions at the ground and fewer insulator connections. The durability of galvanized steel towers is practically permanent.

Probably the most essential requirement for high tension lines is the one of reliability. Lines carrying a voltage of from 50,000 to 110,000 volts are likely to create considerable damage, if by any cause a tower should fail. Large interests, whole towns, are depending absolutely on the reliability and continuity of the current for their light, heat and power. From the foregoing it was pointed out that high towers mean fewer towers, thus bringing the chances of failure, as far as number of towers is concerned, down to a minimum. The strength of steel runs more uniform than a natural material such as wood.

The first cost of steel will probably run more than wood, but after a few years' operation, with difference in cost of maintenance, depreciation, renewal of line, etc., the first cost will soon be far exceeded and the steel construction prove cheaper than wood.



Testing Towers.

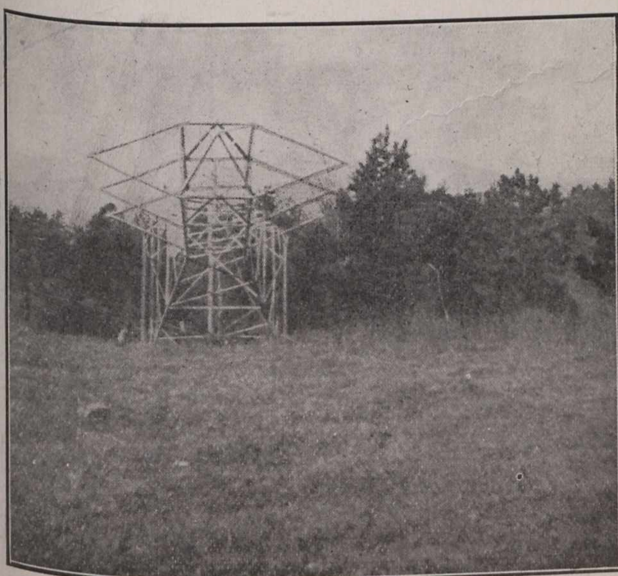
Types.

The towers here described will be unguyed or self-supporting and are divided into four general types, namely, intermediate, terminal, angle and transposition. There are various attachments, extensions, etc., required for special conditions, but the four different types with their names suggesting the respective requirements, cover the equipment of the ordinary tower line.

An intermediate tower is the standard tower of the line. From a strict standpoint of strength, the ideal condition would be to have each individual tower of sufficient strength to safely resist the longitudinal pull of all wires, but from an economical and a practical standpoint this is not at all necessary. If there were no such thing as wires breaking, an intermediate tower would need be strong enough only to resist side wind pressure and vertical loads. Unfortunately the breaking of cables is a condition that must be met and provision made in the tower to properly resist its effect.

As transmission lines extend for hundreds of miles and are composed of thousands of towers, the question of the amount of strength to put into these towers is a most important consideration. It is necessary to make them strong enough to guarantee continuous service, at the same time care should be taken to avoid extravagance. As before stated, intermediate towers are essentially supporting towers, having the wires led to them and passing on to the next towers, exerting no force except vertical dead weight, ice, etc., in addition to the transverse wind. The longitudinal pull of the wires on one side of the tower is equalized by the longitudinal pull of the wires on the other side, and thus equilibrium will be maintained until a wire breaks. When this occurs that particular wire in the one span falls, but in the next adjoining span the wire is still being held up by the tower, owing to its connection to the insulator. This latter wire still exerts its longitudinal pull, and, as the broken span is unable to exert its equal and opposite pull, the tower is called upon to do it, consequently exerting a definite longitudinal pull thereon.

Although wires for high tension lines are carefully strung, being kept well within their elastic limit and with substantial connection to the towers, a break is apt to occur



Erecting Towers.

at any time, but to have two or more wires breaking simultaneously in the same location is a very remote possibility.

Engineers have not fully agreed upon the number of wires to allow for breaking in the same span, but the minimum amount of strength in an intermediate tower should be with all wires covered with ice, the highest velocity of wind, and provision for any one wire breaking.

Terminal towers are different from intermediate towers in that they are called upon to do much heavier work. They are designed for wind and ice and the combined pull of all wires, simultaneously or separately, without any relief of the adjoining span. These are used at the end of the transmission lines, at points where branch lines are taken off, and very often are placed along the line at certain intervals; that is, about every mile is inserted a terminal tower instead of an intermediate tower.

Angle towers are again different from either of the foregoing. Transmission lines are run straight as much as possible, or run with easy curves, but at some points sharp bends are unavoidable. At these bends or angles, special towers are used of sufficient strength to resist the continuous pull of the resultant forces of the converging lines, and in addition must be provided with longer arms to maintain the proper spacing of the wires, and sometimes with auxiliary arms to properly support the wires as they make the turn.

Transposition towers are used at certain intervals for transposing the relative position of the wires. This transposition is done by twisting or turning the entire group after they leave the intermediate tower and leading the wires to the arms of the transposition tower, so named, in that it has specially long arms, in order to spread the wires and avoid the danger of conflicting with each other in the turn or twist of the group.

Other features in tower equipment are extensions for use on steep, sloping ground, guard-arms for supporting protecting wires over highways, telephone wire supports, etc. Then, again, there are especially narrow towers, or rather poles, where they go through city or town streets, and also high towers for river crossings.

Character, Number and Position of Wires.

The character and number of conductors are determined by the electrical engineer; whether he is to use copper or aluminum, and the size of same. He is to determine whether the line will be of three-phase single circuit or three-phase double circuit. In the first case three wires are required, in the second six wires. He also is to determine whether a ground wire is required, and whether the insulators are to be of the pin or hung type. The tower engineer usually has the liberty of deciding on the position or location of the insulators to best suit his particular design.

Forces.—Height and Design.

The forces on a tower are divided into two classes: those acting directly on the tower and those acting indirectly by means of the wires. The direct forces can very easily be obtained, in that they comprise the wind pressure on the tower and the dead weight of the tower itself, sometimes covered with ice. The indirect forces are the weight of the wires and insulators, the ice or sleet coating, the wind pressure on the wires and the longitudinal pull of one or more wires. Ice will vary from almost nothing to 1 in. thick and the wind pressure from 20 to 50 pounds per square foot, all depending on locality. The longitudinal pull cannot exceed the amount that the wire is good for working up to the elastic limit. All of these forces must be taken into consideration, acting separately or simultaneously. The direct forces will not exert any eccentric or torsional action on the tower, but the indirect forces are very liable to.

The height at the tower of the lowest wire is determined by three conditions: the size and material of the wire, the span between the tower and the minimum clearance distance from the ground to the lowest position of the wire. Assuming a certain span, the wires must be so strung and given such a sag that in the coldest weather, when the wires reach their minimum sag, the tension stress will be within the elastic limit of the wires. The sag will fall and rise, due to the linear expansion or contraction from temperature changes. As above stated, the sag will be smallest in cold weather, and as the temperature increases the sag increases, but this increase is largely retarded by the property of the wires shrinking as the tension stresses decrease. In other words, the minimum sag will put the greatest tension stress in the wires, and this stress must be kept within the elastic limit. From this is figured the maximum sag made to correspond with the maximum change of temperature, corrected by the shrinkage from reduction of stress. The minimum clearance from the ground to the lowest point of the lowest wire is determined very often by law or other requirements, but it usually runs from 20 to 30 feet. This distance, added to the maximum calculated sag, will give the height at the tower.

With the forces and height determined, the design of the tower is then ready to be proceeded with. The engineer in designing his tower must keep four important points in his mind, which are: economy of arrangement, simple shop work, ease of erection, and some regard to pleasing appearance. To attain the first, a few simple calculations will enable him to approximate the base width, fix the panel spacing and general web system. Complete graphic stress diagrams are then made for direct forces and those producing torsional stresses in the tower. Sometimes it is necessary to make several different designs to obtain the most economical form. Then again, different spans between towers are tried, taking into account the differing heights and forces. All of these points must be gone into, in order to know whether the cost per mile of towers is on an economical basis.

Simple shop work means absolutely the smallest amount of work to be done in the shop. Aside from the galvanizing, shop work should be confined to pieces with square ends and necessary bolt holes. Bevel shears, forgings, etc., should be eliminated where possible. Duplication of parts is a very important thing to keep in mind. To keep as few different kinds of pieces in a tower will save trouble and expense in the shop and in the field.

The designer must keep in mind the ordinary difficulties of erection. The material very often has to be carted for miles, through wild and rough country, in which case light weight and few pieces of tower parts is very important.

As far as the pleasing appearance is concerned, which means to an engineer a rational appearance, it is best attained when he designs the tower to carry the stresses down to the ground in the most direct manner, maintaining a limiting $\frac{l}{r}$ (length divided by radius of gyration) for all compression members, and in general arranging the web system so that the different members will fairly represent their stresses by their lateral dimensions rather than by thickness of material.

Tests.

After the design is made with all stresses and sizes determined a complete full-size steel tower is usually built conforming to the design. This tower is then set up on the ground for testing.

The requirement for strength of the tower is that it must safely stand, without permanent deflection, the forces applied, in the proper direction, either separately or simultaneously.

Heretofore nearly all tests of this character were made by placing the tower in a horizonal position and firmly attaching its base to a wall or the side of a building and testing it in a vertical direction. Naturally, this form of testing was not correct, as the dead weight of the tower itself would to some extent affect the results. We, therefore, decided that the only correct way was to place the tower in a vertical position, firmly securing it at its base and taking the strains from the cross-arms, as they would come in actual practice.

The method that we have used has proven very satisfactory, although the apparatus is very simple. The tower is set up in a vertical position on the ground adjoining a high structure and thoroughly anchored down. Lines are fastened to the test tower at the required points and lead off horizontally to the adjacent structure, passed over a sheave and dropped vertically to within about ten feet from the ground. The lower end of the line is then fastened to a hand chain-hoist, which in turn has its lower hook fastened to a large wooden box resting on the ground. By means of the chain-hoist all of the slack is removed from the line and the box gradually lifted a few inches from the ground. This immediately exerts a horizontal pull on the tower equal to the weight of the box and chain-hoist, less an infinitesimal amount of friction of the sheaves. Before this pull is applied a transit is set up, at an advantageous point, and sighted on the zero point of a rule, which had been previously fastened to the tower in a horizontal position. Water is then allowed to flow into the box by means of a hose pipe. By means of a graduated scale on the inside of the box the depth of the water represents certain pounds weight, and careful readings by the transit gives the deflection of the tower toward the pull or load. When the load is at first applied, the top of the tower deflects slightly in the direction of the pull; as the load is gradually increased, sharp metallic sounds are heard throughout the tower, due to the slipping at the bolts. As the different members take up their portion of the stresses, they act on the connection bolts. In the beginning, when the stress is small, the tightness of the head and nut of the bolt is sufficient to hold the member, but as the stress increases this is overcome and the bolts are thrown into bearing against their shanks. This slight jump, of course, is what produces the sounds mentioned. A large increment of deflection is noticeable, by the transit, while this adjustment is taking place. After the sounds subside no action is apparent except the very slight gradual increase of deflection until some member or members are seen to slightly bend or bow; the deflection of the tower rapidly increases and the tower buckles, but is prevented from coming down by means of a head line which had previously been fastened to the top of the tower and supported by an outrigger boom strutting out from the adjoining structure.

Assembled Towers Ready for Erection.

This test to destruction is not always made, and if the tower is able to withstand the required loads it has fulfilled its purpose. The maximum deflection for a 70-foot tower will run from 4 to 5 inches under full load and come back to something less than an inch after release of load.

These tests are interesting, showing up, as they do, the close relation of theoretical and practical results of stress, and also the uniformity of quality of the material. We have had actual collapses take place within 2 per cent. of the theoretical figured collapse.

The result of making tests is that they benefit both the purchaser and the contractor. The purchaser is able to know absolutely what his tower is good for, and the contractor avoids the necessity of throwing away metal, as a precaution to being on the safe side.

Shop Work and Galvanizing.

The actual manufacture of the towers in the shop is practically the same as for other structural steel work. The draughtsman makes up his shop detail drawings from the design plans, then the template maker lays out the full-size tower on the floor to obtain the correct lengths and bevels of the various members, and from this, in conjunction with the detail drawings, makes up his wood templates for every member in the tower.

After all shop work is finished, such as punching of holes, shears, forgings, etc., the material is passed into the galvanizing building. As it is necessary to keep the steel as clean as possible, extreme care is taken from the time it is actually rolled until ready for galvanizing. It is shipped from the mills to the shop in closed box cars and at all times kept under cover.

The galvanizing is done in a separate building. The material is first placed in a long wooden tank and submerged in a pickling bath of sulphuric acid and water, with the temperature of the solution at about 150° Fahr. It is allowed to remain in this bath until all scale and rust has practically been removed. After the steel seems clean, it will have a smooth surface and a dark gray slate color. It is then placed in a storage tank containing enough water to cover it. From the storage tank it is taken to the flux tank, containing muriatic acid and water. This serves two purposes: first, it removes whatever rust or scale the pickling bath had failed to remove; and secondly, it serves as a flux. It is then taken to the drying tables and left there to thoroughly dry, care being taken not to burn the acid. When properly dried, the muriatic acid should show on the surface in the form of a white powder. Without being allowed to cool, it is then taken to the galvanizing or spelter kettle. For tower work the kettle is about 30 feet long, 2 feet wide and 3 feet deep. It is made of 1⅛-inch steel plate, one width piece, curved, giving a cross-section through the kettle in a form of the letter U. This kettle is supported on masonry in such a way that the heat from the fire has direct contact with the entire outside surface. When the zinc spelter has been placed in this kettle and melted down, the kettle is ready to receive the material which is to be galvanized. This operation is simply to submerge the object for a moment or two in the molten spelter, lift it out, rap it sharply on the side of the kettle, to remove all superfluous zinc, and lay it on a rack to cool

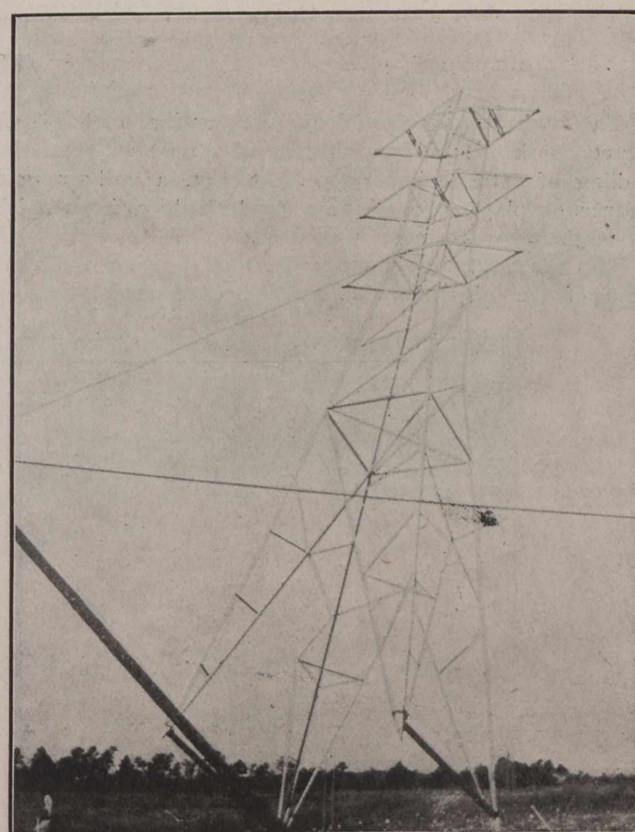
This method of galvanizing is known as the "Hot Process," and when properly done gives almost permanent life to the towers. The standard test for galvanizing is to immerse the sample piece in a solution of sulphate of copper for one minute, then remove it, immediately wash it and wipe dry. This process is repeated, and if after the fourth immersion there should be a copper-colored deposit on the sample, or if the zinc should be removed, the piece must be rejected.

The galvanizing of our towers has stood as high as ten immersions without showing deteriorating signs, and moreover, we have given severe tests for adhesion of the galvanizing. Pieces have been taken out at random from a tower, been twisted, bent on itself and straightened, without the slightest sign of scaling.

Bolts and nuts are usually galvanized by the electrolithic process. This method permits the galvanizing after threading, which it is impossible to properly do by the "Hot Process." This method, however, does not stand the copper sulphate test very satisfactorily. The most recent process, that of "Sherardizing," which we now use, we believe is the best for this class of work. Instead of the zinc applying itself as a shell or coating, it forms an alloy with the steel without seriously increasing the size at all, therefore making it applicable to thread work of bolts and nuts. It stands the copper sulphate test fully as well as the "Hot Process."

Shipping and Erection.

The material is taken directly from the galvanizing building out to the marking and shipping yard. There the various pieces are stenciled with the erection marks corresponding to the marks shown on an erection drawing previously prepared. The towers are all connected at the joints by means of bolts. In order to save freight on shipments, the tower is shipped completely "knocked down." All parts of each tower, which are exact duplicates, are bundled together by wire and tagged. All pieces which are exact duplicates are given the same marks; in other words, they are interchangeable. The required number of bolts for each tower is boxed separately. In arranging to transport material to its final destination, all that is necessary is to pick



Erecting Towers.

out the bundle of each mark which goes to make up one tower and include with the shipment one box of bolts. The material is shipped to railroad distributing stations as close to the line and location as possible and from there carted to their proper location along the line. The complete material for each tower is dropped at their respective locations.

As concrete footings are expensive and unnecessary, in the ordinary tower work, ground stubs are used. These stubs are made of a single angle, going into the ground about 5 to 6 feet, with a channel-plate fastened to its bottom end. This stub projects out of the ground about 12 inches, just enough to bolt the tower to. This connection is made by a "lap" splice; that is, the corner leg angle of the tower fits on the outside of the stub angle and then bolted, which makes it practically a prolongation of the corner leg into the ground.

We have made numerous "pulling-up" tests with ground stubs. We have taken a 3½-inch angle and bolted to its lower end a 12-inch channel 2 feet 6 inches long laid on the flat. This angle was set 8 feet into the ground with 12 inches projecting out. The hole was made in a ground composed of loam and sand, very little clay. After the angle was set in place, the hole was re-filled with the same material, slightly tamping it as the refilling was being done. It was then allowed to stand for three or four days. An upward pull of about 500 pounds was then exerted, and in the space of ten minutes was run up to 30,000 pounds, which it held, when the connecting shackle broke, leaving the stub about two inches above its former level and the ground for about four feet radius slightly humped up.

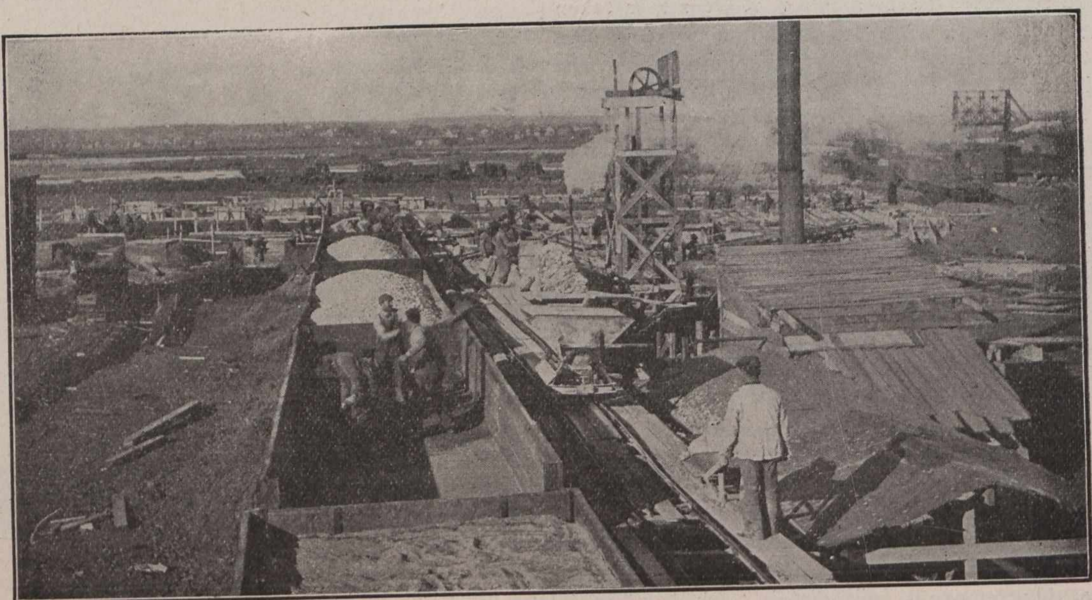
The holes in the field are dug in a similar manner to ordinary post-holes and located in approximately their correct positions. The tower is then assembled and bolted up complete at the site, and lying in such a position that two of its four lower ends are adjacent to two of the ground holes. These two ends are then fastened to a wooden trunnion or roller. A lifting-line is fastened to the tower at its lowest cross-arm and led off to the top of a gin-pole and from there to the ground. By this means the tower is lifted from its horizontal position on the ground to a vertical position and with its two forward legs immediately over the forward ground holes. The two ground stubs, setting loosely in their respective holes, are then bolted fast to the tower legs. The tower is then tilted forward until its entire weight is on these two forward stubs and its rear legs are free of the ground. The trunnion or roller is then taken off, permitting the rear stubs being bolted on as they rest in their holes. The tower is then allowed to settle back, on its four stubs, properly lined up, and its ground holes refilled and tamped. This method avoids expense in accurately setting stubs by templates, and, moreover, is very much better in that the stub is allowed to better adjust itself, both in location and angle of inclination, and avoids all chances of putting initial stress in the tower, due to inaccuracies of setting.

PLANT.

The high proportion of labor cost to the total cost of concrete work makes the question of economical material handling of extreme importance. In fact, a well-arranged construction plant often means a good sized profit on a job that might otherwise show up a loss.

The accompanying photographs and drawing show the layout of the Aberthaw Construction Company's plant on the foundation work for the new Boston & Maine railroad locomotive shops at East Somerville, Mass. These shops are located in low, marshy meadows, and the foundations are supported on piles. They are very heavy and built up several feet above the surface of the marshes. The concrete piles were cast on the ground, each pile exactly the right length to reach hard pan as determined by sounding. A water pipe was cast in the center of each pile and they were formed with a slight taper. A water jet and comparatively light driving sufficed to lower them into place.

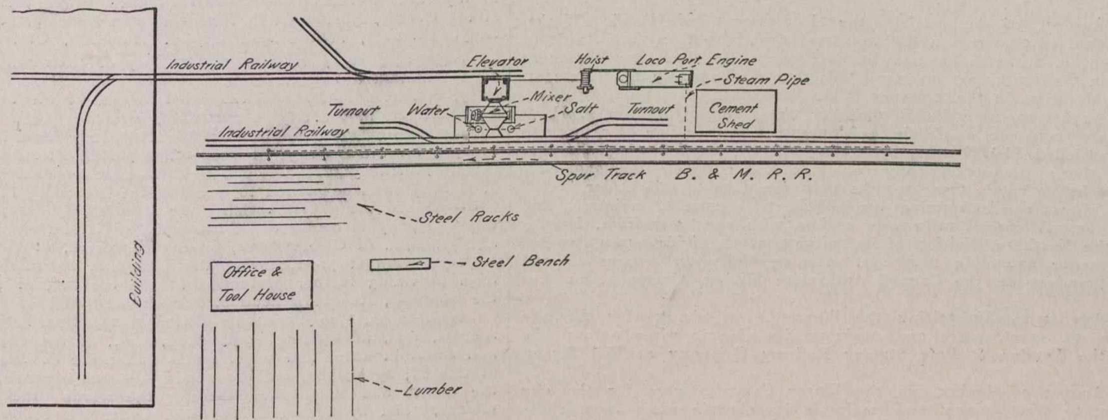
As the contract for this work was placed the middle of November and the railroad company wanted the foundations completed before winter set in, speed and provision to continue work in spite of cold as well as economy of handling materials were elements to be considered in the design of the construction plant. A single spur track from the railroad was run to the site approaching it at right angles to the buildings and about the middle of same. Some 200 feet from the building site and on the right hand side of the spur track approaching the work, the mixing platform, mixer, and elevator were placed. The railroad siding was paralleled by an industrial track on the same side as the mixer. The mixer platform and the industrial track were built about on the level with the body of a freight car. Turnouts on the industrial track were provided on either side of the mixer platform for passage of cars and storage for idle ones. The aggregate could be unloaded to the mixer platform direct from the freight cars or into industrial cars which could be dumped direct into the mixer. The cement shed was located about 100 feet from the mixer alongside the industrial track and railroad siding. Cement was unloaded from the freight cars into the cement shed and transferred to the mixing platform by wheel-barrows or industrial cars.



View of Plant Under Construction.

As the tops of the foundations were several feet above ground level, the track for delivering the concrete was raised so that it could be dumped from the industrial cars direct into the forms. The raising of the industrial track brought the dump cars too high for the mixer to discharge into them so a short elevator tower with an automatic trap bucket was erected. The mixer discharged into this bucket which was hoisted and dumped into the cars. A portable locomotive mixer and nearer the site of the building. The steel was bent and the lumber cut for the forms and carried into place by hand.

The contract for this work was placed with the Aberthaw Company about the middle of November and it was nearly December 1 before the construction plant was erected. Dur-



engine supplied power for the mixer and for a hoist to operate the elevator. The large panorama photograph shows very distinctly the arrangement of the industrial track for delivering concrete to the work.

The reinforcing steel and lumber for forms were unloaded on the opposite side of the railroad track from the ing this time about 400 yards of hand-mixed concrete were placed. After the mixer was in operation the job was completed in twenty working days and the entire construction plant was dismantled and hauled away within a month after it was erected.

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

Copies of these orders may be secured from the Canadian Engineer for a small fee.

11436—August 11—Authorizing the Hamilton Gas Light Company to lay and maintain a gas main on the Lock Street Bridge, and over the track of the Toronto, Hamilton & Buffalo Railway.

11437—August 23—Authorizing the United Fuel Supply Company, Limited, to construct and maintain a pipe for the conveyance of natural gas under the tracks of the Michigan Central Railroad on Third Street, in the village of Brigden, Ont.

11438—August 23—Authorizing the Port Rowan Natural Gas Company, Limited, to lay and maintain a gas main under the tracks of the G.T.R. at Port Rowan Station, Ont.

11439—August 24—Amending Order No. 11405, authorizing the Commissioners of the National Transcontinental Railway to cross with their railway, at grade, the railway of the C.N.R. Company, Dundee Branch, at mile 246.5, St. Boniface, Manitoba, by striking out the word "in" where it occurs in the recital and in the 4th line of the operative parts of the Order, and substitution therefor the word "near."

11440—August 24—Authorizing the G.T.R. to construct, maintain, and operate a branch line of railway or siding and spurs therefrom commencing at a point on the G.T.R., Pinnacle Street, south of Wharf Street, Belleville, Ontario, thence along, upon, and across Pinnacle Street, and Wharf Street, to and into the premises of the Canada Bolt and Nut Company, south of Wharf Street.

11441—August 24—Authorizing the Department of Public Works, Saskatchewan, to construct a highway over the right-of-way and track of the C.P.R., in the south-east quarter of Section 2, Township 25, Range 3, west 2nd Meridian, Saskatchewan.

11442—August 24—Authorizing the C.P.R. as lessee, and exercising the franchises of the Toronto, Grey & Bruce Railway Company, to construct, maintain and operate an additional track across Holland Street, in the village of Dundalk, Ontario, on the Owen Sound Branch of the C.P.R.

11443—August 25—Declaring that the crossing of the highway known as No. 4 side road, by the track of the G.T.R., about two miles west of Glencoe, in the 3rd Concession, Township Mosa, County of Middlesex, Ontario, is protected to the satisfaction of the Board.

11444—August 25—Authorizing the G.T.P. Branch Lines Company to divert the highway in the N.W. ¼ Sec. 2, Township 41, Range 22, west 4th Meridian, District of North Alberta, Alberta.

11445—August 16—Further extending the time within which the C.P.R. were authorized in Orders Nos. 10524 and 11134 to install an electric bell at the crossing of William Street, city of London, Ontario, for a period of thirty days from the 11th August, 1910.

11446—August 2—Amending requirements of the Board regarding the protection of wooden trestles.

11447—August 16—Approving of a memorandum of agreement dated 28th day of April, 1910, made between the Bell Telephone Company and Patrick Kirby Hunt, lessee of the St. Louis Hotel, city of Quebec, Que.

11448—August 16—Further extending the time within which the C.P.R. were authorized in Orders Nos. 9722 and 10753, to construct, maintain and operate an industrial spur for the Standard White Lime Company, Limited, at Beachville, Ontario, until the 31st day of October, 1910.

11449—August 15—Authorizing the G.T.P. to divert the road in the north-east ¼ of Section 35, Township 22, Range 7, west 2nd Meridian, District of Yorkton, Sask.

11450—August 16—Authorizing the C.P.R. to construct, maintain, and operate a branch line of railway or spur from a point on the south-western side of Block 10, of Lot 13, Kildonan, at or near its intersection with the north-western side of the Winnipeg Beach Branch of the Applicant Company's railway; thence north-easterly, northerly, and north-west through said Block 10, and along the north-eastern side of Blocks 11, 12, 13, 14, and 15 of said Lot 13.

11451—August 16—Further extending the time within which the C.P.R. were authorized in Orders Nos. 10523 and 11135, to install an electric bell at the crossing of Colborne Street by its line of railway, in the city of London, Ontario, for thirty days from the date of this Order.

11452—August 16—Further extending the time within which the C.P.R. were authorized in Orders Nos. 10321 and 10883, to install an electric bell where its railway crosses the highway at mileage 81.28, Toronto Section, Township of Markham, County of York, and Province of Ontario, until September 15th, 1910.

11453—August 23—Authorizing the Toronto, Hamilton & Buffalo Railway Company to renew or reconstruct the wooden highway bridge over which the railway of the applicant company crosses the public highway commonly called the London and Hamilton Road, in the Township of Brantford,, County of Brant, Province of Ontario.

11454—August 23—Authorizing the Red Mountain Railway Company to erect and maintain signboards at all highway crossings on its line of railway in compliance with the requirements of Section 243 of the Railway Act, and that it limit the rate of speed of all trains and engines to not more than six miles an hour from Rossland Station to a point 100 yards west of Second Avenue Crossing.

11455—August 27—Authorizing the C.N.O.R. to construct its railway across the public road between Lots 32 and 33, Concession A, Township of Haldimand, County of Northumberland, Province of Ontario, at Station 271.90.

11456—August 23—Authorizing the C.N.O.R. to take possession of, use or occupy the tracks, right-of-way and incidental facilities of the Central Ontario Railway Company, in the town of Trenton, from the junction with the Central Ontario Railway, south of Wragg Street, to a point on the said line near the intersection of Joseph and Queen Streets; and to join with the said Central Ontario Railway at or near the intersection of Joseph and Queen Streets aforesaid.

11457—August 27—Approving of the Manitoulin & North Shore Railway Company's Standard Passenger Tariff C.R.C., No. 8, applying a rate of four cents per mile, or fraction thereof, between all stations on its line of railway.

11458—August 27—Authorizing the C.N.O.R. to construct its line of railway across the public road known as Byron Street, town of Trenton, Township of Sidney, County of Hastings, Province of Ontario.

11459—August 26—Authorizing the C.N.O.R. to construct its line of railway across the public road known as Marmora Street, in the town of Trenton, Township of Sidney, County of Hastings, Province of Ontario.

11460—August 26—Authorizing the C.N.O.R. to construct its line of railway across the public road known as William Street, town of Trenton, County Hastings, Province of Ontario.

11461—August 26—Authorizing the C.N.O.R. to construct its line of railway across the public road known as Morgan Street, town of Trenton, County Hastings, Province Ontario.

11462—August 27—Authorizing the C.N.O.R. to construct its line of railway across the public road known as Front Street, town of Trenton, County Hastings, Province Ontario.

11463—August 3—Amending Rule No. 6 of the Canadian Classification No. 14.

11464—August 26—Authorizing the Department of Public Works, Saskatchewan, to construct a highway over the right-of-way and track of the Qu'Appelle, Long Lake and Saskatchewan Railroad & Steamboat Company in the south-west quarter of Section 33, Township 19, Range 21, west 2nd Meridian, in the Province of Saskatchewan.

11465—August 26—Amending Order No. 11424, authorizing the T. H. & B. Railway to construct, maintain, and operate a branch line of railway to the Oliver Chilled Plow Works, by adding thereto the following clause,—"8. That the applicant company construct and complete the said proposed branch line within three months from the date of this Order."

11466—August 26—Authorizing the G.T.R. to construct, maintain, and operate a branch line of railway or siding, with spur therefrom, from a point on the Northern Division of its railway, south of Tennyson Avenue, Toronto, thence extending northerly, crossing Tennyson Avenue to and into the premises of the Connell Anthracite Mining Company, on Lot 297.

11467—August 29—Authorizing the Water Commissioners for the city of London, to erect, place and maintain its electric wires across the track of the London & Port Stanley Railway Company at Hill Street, London.

11468—August 29—Authorizing the Water Commissioners for the city of London, to erect, place, and maintain its electric wires across the track of the London and Port Stanley Railway Company at South Street, London, Ontario.

11469—August 29—Authorizing the Water Commissioners for the city of London, to erect, place, and maintain its electric wires across the track of the C.P.R., at Richmond Street, London.

11470—August 29—Authorizing the Water Commissioners for the city of London, to erect, place, and maintain its electric wires across the track of the C.P.R., at Colborne Street, London.

11471—August 29—Authorizing the Water Commissioners for the city of London, to erect, place, and maintain its electric wires across the track of the London and Lake Erie Railway and Transportation Company at Emery Street, London.

11472—August 27—Authorizing the Hydro-Electric Power Commission of Ontario, to erect, place and maintain transmission line across the wires of the Bell Telephone Company, at Asylum Side Road, Township of London, Province of Ontario.

11473—August 27—Authorizing the Montreal Light, Heat and Power Company to lay and thereafter maintain a 12-inch gas pipe under the tracks of the G.T.R., on the east side of Cote St. Paul Road, St. Henry Ward, City of Montreal, Province of Quebec.

11474—August 27—Authorizing the C.P.R. as lessee and exercising the franchises of the Calgary and Edmonton Railway Company, to construct, maintain and operate two extensions to spurs already constructed for the Calgary Brewing and Malting Company, on the North-East Quarter of Section 11, Township 23, Range 1, west 5th Meridian.

11475—August 27—Extending the time within which the C.P.R. were authorized to construct, maintain and operate, by Order No. 10304, an industrial spur across Lot 1, and across the lane in Block 31, Parish Lot 35, St. Johns, Winnipeg, until the 18th October, 1910.

11476—August 29—Authorizing the C.N.R. to construct its railway across the following highways, namely:—Road between Sections 15 and 16, Township 5, Range 6, west 2nd Meridian; road between Sections 16 and 9, Township 5, Range 6, west 2nd Meridian; road between Sections 9 and 8, Township 5, Range 6, west 2nd Meridian.

11477—August 27—Authorizing the C.N.O.R. to construct its line of railway across the public road known as Sidney Street, in the town of Trenton, Township Sidney, County Hastings, Province Ontario.

11478—August 25—Authorizing the C.P.R. to change the location of its station at Keeler, Province of Saskatchewan.

11479—August 25—Authorizing the C.P.R. to construct, maintain, and operate a branch line of railway, or spur, across 9th Avenue, and along a line through Block No. 124, together with a branch of said spur through Lots Nos. 26, 27, 28, 29, and 30, in Block No. 124, of the city of Moose Jaw, for the accommodation of the city of Moose Jaw, the Moose Grocery Company, and the Rex Fruit Company.

11480—August 25—Authorizing the C.P.R. as lessee and exercising the franchises of the New Brunswick Railway Company, to change the location of its station at Bristol, County Carleton, Province New Brunswick.

11481—August 25—Amending Order No. 9273, by approving revised plan No. 4886, and authorizing the construction of the said bridge as shown on plan No. 4886.

11482—August 25—Authorizing the C.P.R. to construct, maintain, and operate an additional siding across the road allowance between the N.W. ¼ of Section 10, Township 17, Range 2, west 3rd Meridian, and the S.W. ¼ of Section 30, Township 17, Range 2, west 3rd Meridian; and also across the road allowance between S.W. ¼ of Section 30, Township 17, Range 2, west 3rd Meridian, and the S.W. ¼ of Section 25, Township 17 Range 3, west 3rd Meridian, at Parkbeg.

11483—August 25—Authorizing the Montreal Light, Heat & Power Company to lay and thereafter maintain an eight-inch gas pipe under the tracks of the C.N.O.R., on the west side of Pie IX. Avenue, in the town of Maisonneuve, Que.

11484—August 25—Authorizing the Hydro-Electric Power Commission of Ontario, to erect, place, and maintain transmission line across the track of the Woodstock-Thames Valley & Ingersoll Electric Railway Company at Mill and Charles Streets, in the town of Ingersoll, Ontario.

11485—August 30—Authorizing the Municipal Council of the town of Wingham to lay and thereafter maintain a six-inch water main under the track of the Grand Trunk Railway Company.

11486—August 30—Authorizing the Water Commissioners for the city of London, Ontario, to erect, place, and maintain electric wires across the wires of the Bell Telephone Company at William Street and Hamilton Road, London.

11487—August 29—Authorizing the Simcoe Railway & Power Company, to erect, place, and maintain transmission wires across the track of the C.P.R. between Lots 10 and 11, Concession 5, Township of Tay, County Simcoe.

11488—August 29—Authorizing the Saraguay Electric & Water Company, to erect, place, and maintain overhead wires across the track of the C.N.Q.R. on Prefontaine Street, Montreal.

11489—August 27—Authorizing the corporation of the city of Hamilton to lay and thereafter maintain a 24-inch sewer pipe under the tracks of the G.T.R., Northern and North-Western Division, at the intersection of Hillyard Street, in the said city of Hamilton, Ont.

11490—August 27—Authorizing the city of Hamilton to lay and thereafter maintain a 12-inch sewer pipe under the tracks of the G.T.R. Company, Northern and North-Western Division, at the intersection of Wentworth Street, in the city of Hamilton, Ontario.

11491—August 29—Authorizing the Nipissing Central Railway Company to open for the carriage of traffic that portion of its line of railway from Cobalt to Haileybury, provided that all trains operated over the said line of railway shall be limited to a speed not exceeding fifteen miles an hour.

11492—August 30—Authorizing the Atlantic, Quebec, and Western Railway Company to construct its railway across road crossing No. 4, at mileage 51, Mun. of Grand River, County of Gaspe, Province of Quebec.

11501—August 31—Relieving the Canadian Northern Railway Company from providing further protection at the crossing of the said railway by the highway, Roseburn Section, immediately west of Hallboro Station.

11502—August 26—Amending Order of the Board No. 11399, dated 15th August, 1910, authorizing A. Leofred, C.E., of the city of Quebec, to lay and maintain water and sewer mains under the G.T.R. tracks at the town of Charny, by striking out the words "its own expense," in the 5th line of the clause and substituting therefor the words "the expense of the applicant," and by adding to the said Order the following clause, namely, "7. That this Order shall be without prejudice to the Railway Company's title to its land."

11503—August 31—Authorizing the St. Maurice Valley Railway Company to open for the carriage of traffic that portion of the extension of its line of railway between Shawinigan Falls and Grand Mere, in the Province of Quebec.

11504—August 31—Authorizing the C.P.R. Company to construct, maintain, and operate a branch line, or spur, across a portion of Block No. 34, across Xante Street, and through the premises of the Imperial Oil Company, situated on Block No. 30, all on Parish Lot 11, D.G.S., St. John, in the city of Winnipeg, Man.

11505—August 31—Authorizing the G.T.P. Company to cross, at grade, the Pheasant Hills Branch of the C.P.R., in the northeast quarter of Section 36, Township 36, Range 16, west 3rd Meridian, District of Saskatoon, Province of Saskatchewan.

11506—August 29—Authorizing the Water Commissioners for the city of London, to erect, place, and maintain its electric wires across the wires of the Bell Telephone Company at Simcoe and Waterloo Streets, London.

11507—September 1—Authorizing the C.P.R. Company to construct bridge No. 78.5 over Baptist Creek, on the Windsor sub-division, Ontario Division of its line of railway.

11508—September 1—Approving of the location of the line of railway of the G.T.P. Company, Prince Rupert, easterly, mileage 434.5, to mileage 482.421, Fort George District, Province of British Columbia.

11509—September 1—Authorizing the Grand Trunk Pacific Branch Lines Company to construct its railway across the highway on its Prince Albert Branch, between Section 36, Township 36, Range 27, west 2nd Meridian, District of Saskatoon, Province of Saskatchewan.

11510—September 1—Relieving the Grand Trunk Railway Company from providing further protection at the crossing of the highway, known as Cataraquie Street Crossing, by the track of the G.T.R., about four miles west of Kingston Junction, in the Township of Kingston, County of Frontenac, Province of Ontario.

11511—September 1—Providing that the notice of the proposed application of the Board for the approval of an amalgamation agreement between the Canadian Northern Railway Company and the Edmonton and Slave Lake Railway Company, shall only be required to be published in the Canada Gazette, and in one newspaper in Edmonton and Toronto, aforesaid; and that such publication shall be deemed a compliance with the requirements of Section 361 of the Railway Act.

11512—August 29—Authorizing the town of Weyburn, Sask., to lay and thereafter maintain a water mai under the track of the North-Western Extension of the Souris Branch of the C.P.R. Company, where the Government Road Allowance crossing the south-east quarter of Section 20, Township 8, Range 14, west 2nd Meridian, crosses the said tracks.

11513—August 29—Authorizing the town of Weyburn, to lay and thereafter maintain a water main under the track of the C.P.R. adjoining the said town.

11514—August 30—Authorizing the C.N.Q. Railway Company to construct a wye to connect the main line of the said company's railway with its spur line to the St. Marc Quarries, Parish of Grondines, County of Portneuf, and to take parts of Lots 312, 314, and 315, in the said Parish of Grondines.

11515—August 29—Authorizing the C.P.R. Company to construct, maintain, and operate a branch line of railway, or spur, to and into the premises of T. W. McColm, situate on Block H, in Parish Lot 53, D.G.S., St. James, in the city of Winnipeg.

11516—August 30—Authorizing the G.T.P. Company to construct, maintain, and operate a branch line of railway, or spur, across McDougall Avenue, Edmonton.

11517—August 30—Approving of the location of the Canadian Northern Railway as successor by amalgamation to the Saskatchewan Midland Railway Company, through Townships 34-30, and Ranges 8-9, west 3rd Meridian, Saskatchewan, from mileage 0 to mileage 27.89.

11518—August 30—Authorizing the C.N.R. Company, as successor by amalgamation to the Alberta Midland Railway Company to place its lines and tracks across the lines and tracks of the G.T.P. Company, Tofield-Calgary branch in the south-west quarter of Section 14, Township 47, Range 20, west 4th Meridian, and to join the said Railway Company's Strathcona-Camrose Branch with the Vegreville-Calgary Branch in the north-west quarter of Section 1, Township 47, Range 20, west 4th Meridian.

RAILWAY EARNINGS; STOCK QUOTATIONS.

The following table gives the latest traffic returns it is possible to obtain at the time of going to press:

Road	Wk ended	1910	Previous week	1909
C. P. R.	....Sept. 14	$2,195,000	$1,958,000	$1,836,000
G. T. R.	....Sept. 14	951,950	969,494	897,498
C. N. R.	....Sept. 14	257,800	286,500	239,700
T. & N. O.	...Sept. 14	24,633	27,380	34,388
Hal. Elec.	...Sept. 14	4,521	5,364	4,199

Figures showing the earnings of Canadian roads since July 1st, this year and last, are appended:

Road.	Mileage.	July 1st to	1910.	1909.
C. P. R.	10,326	Sept. 14	$21,739,000	$17,656,000
G. T. R.	 3,536	Sept. 14	8,979,600	9,189,619
C. N. R.	 3,180	Sept. 14	2,862,400	2,080,700
T. & N. O.	.. 264	Sept. 14	276,064	353,663
Hal. Elec.	 133	Sept. 14	54,839	50,400

Stock quotations on Toronto, Montreal and London exchanges, and other information relative to the companies listed in the above tables, are appended. The par value of all shares is $100.

Co.	Capital. 000's Omitted.	Price Sept. 16 1909.		Price Sept. 8 1910.		Price Sept. 15 1910.		Sales last week.
C. P. R.	$150,000	182½	181¾	188¾	188⅜	189	188¼	851
Mont. St.	18,000	214	213½	235¾	232	243¾	243	53
Hal. Elec.	1,400	118	117	126	123½	.....	.....	17
Tor. St.	8,000	124½	.....	.....	118	123	121	798
G. T. R.		1st pfd., 111; 2nd pfd., 57⅞; com., 27						

The Montreal Street Railway's net statement for August and the eleven months has just been issued. The August surplus was $112,624, an increase of only 4.11 over last year. Gross earnings were $398,828, an increase of $43,598, or 12.27 per cent. over August, 1909. For eleven months the surplus totals $1,134,901. This is $134,901 in excess of a full year's dividend.

BIG GAINS IN RAILROAD EARNINGS.

Canadian Pacific Statistics—Grand Trunk Pays Full Dividends on the Four Per Cent. Guaranteed First and Second Preference Stock—International Regulation of Rates.

One of the most important considerations in connection with the increase last week of the Canadian Pacific dividend from 7 to 8 per cent. is the fact that the directorate evidently anticipate the maintenance of the present high and growing rate of earnings. The increased dividend amount is to be taken from profits and not, as some expected, from the company's land funds.

The gross earnings have increased in three years by 31 per cent., as the following table shows:—

	1907.	1908.	1909.	1910.	Increase to date.	Increase per cent.
Gross earnings	$72,217,528	$71,384,174	$76,313,321	$94,989,490	$22,771,962	31.5
Operating expenses	46,914,219	49,591,808	53,357,748	61,148,534	14,234,315	30.3
Net earnings	25,303,309	21,792,366	22,955,573	33,840,956	88,537,647	33.7
Int. rec. and s. s. earn..........	2,364,480	2,654,480	2,306,488	3,334,713	970,233	41.3
Total increase	27,667,789	24,446,999	25,262,061	37,175,669	9,507,880	34.3
Deductions:—						
Fixed charges	8,511,756	8,770,077	9,427,033	9,916,941	1,405,185	16.5
Fors. s. and ps. pf.............	780,000	880,000	880,000	980,000	200,000	25.6
Total deductions	9,291,756	9,650,077	10,307,033	10,896,941	1,695,185	18.2
Net increase	18,376,033	14,796,922	14,955,028	26,278,728	7,902,695	43.0
Divs.	9,037,028	9,217,207	11,107,867	12,382,728	3,345,700	37.0
Surplus for year	9,339,005	5,579,715	3,847,161	13,896,000	4,556,995	48.1

Large Increase in Surplus.

While the gross earnings since 1907 have gained 31.5 per cent., the operating expenses have increased 30.3 per cent. and the net earnings, 33.7 per cent. The fixed charges show a satisfactorily small gain of 16.5 per cent. The shareholders have benefited in dividends by an increase of 37 per cent., while at the same time the surplus for the year shows a record gain of 48.1 per cent.

Grand Trunk Earnings Show Gain.

Good news also of Grand Trunk earnings comes by cable from London. The gross receipts of this road for the half year just ended, are £3,321,600. Working expenses, including reduction of £120,000 in engine, car renewal expense account, amounted to £2,456,000, and net receipts to £65,600.

After meeting revenue charges and deducting deficiencies on working the Canada Atlantic and Detroit and Grand Haven, there is a surplus of £47,200. This, with £11,800 brought forward, enables the company to pay full dividends on the 4 per cent. guaranteed first and second preference stock; £12,000 is carried forward.

As to Suspense Account.

The Great Western, with balance forward, shows surplus sufficient to meet interest on the first mortgage bonds, leaving £17,200 carried forward.

Of suspense account there should now remain only £77,000 to be cleared up during the current half year. During the second half or last year £260,000 of revenue was absorbed by this account, and the difference of £133,000 in favor of the current year should go a long way toward counteracting the strike loss and higher wages bill.

Past Dividend Record.

The full dividend for the previous half year on the guaranteed 4 per cent. stock, on the first preference issue, and on the second preference stock was paid. In 1908 only 2½ per cent. was paid on second preference. Some of the third preference shareholders in January last had anticipated a dividend, but were disappointed.

The following is a record of dividends paid to Grand Trunk stockholders since 1890:—

Year to Dec. 31st.	Four %. Guaranteed.	Five %. 1st Pref.	Five %. 2nd Pref.	Four %. 3rd Pref.
1890	4	1 19-40	Nil	Nil
1891	3¼	Nil	Nil	Nil
1892	3⅜	Nil	Nil	Nil
1893	2⅝	Nil	Nil	Nil
1894	Nil	Nil	Nil	Nil
1895	Nil	Nil	Nil	Nil
1896	Nil	Nil	Nil	Nil
1897	Nil	Nil	Nil	Nil
1898	4	3	Nil	Nil
1899	4	5	3¼	Nil
1900	4	5	3	Nil
1901	4	5	4	Nil
1902	4	5	5	1
1903	4	5	5	2
1904	4	5	5	Nil
1905	4	5	5	2
1906	4	5	5	3
1907	4	5	5	3
1908	4	5	2½	Nil
1909	4	5	5	Nil

Third Preference Shareholders Still Wait.

The dividends declared for the six months ended June 30th found their way down only to the full five per cent. upon the first preference stock, the seconds and thirds receiving nothing. Just as the seconds then hoped for a partial distribution, so in January the thirds vainly hoped likewise.

This time the four per cent. guaranteed, the first and the second preference shareholders again receive a distribution and the "thirds" still await monetary nourishment.

International Control of Rates.

Apropos of increasing earnings by Canadian roads, much

(Continued on page 411.)

ENGINEERING SOCIETIES.

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

Chairman, L. A. Vallee; Secretary, Hugh O'Donnell, P.O. Box 115, Quebec. Meetings held twice a month at Room 40, City Hall.

TORONTO BRANCH—
96 King Street West, Toronto. Chairman, A. W. Campbell; Secretary, P. Gillespie, Engineering Building, Toronto University, Toronto. Meets last Thursday of the month.

MANITOBA BRANCH—
Chairman, J. E. Schwitzer; Secretary, E. Brydone Jack. Meets 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, 40-41 Flack Block, Vancouver. Meets in Engineering Department, University

OTTAWA BRANCH—
Chairman, W. J. Stewart, Ottawa; S. J. Chapleau, Resident Engineer's Office, Department of Public Works

MUNICIPAL ASSOCIATIONS.

ONTARIO MUNICIPAL ASSOCIATION.—President, Mr. George Geddes, Mayor, St. Thomas, Ont.; 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 Hopkins, Saskatoon; Secretary, Mr. J. Kelso Hunter, City Clerk, Regina, Sask.

CANADIAN TECHNICAL SOCIETIES.

ALBERTA ASSOCIATION OF ARCHITECTS.—President, E. C. Hopkins, Edmonton; Secretary, H. M. Widdington, Strathcona, Alberta.

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.

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.; Vice-President, Gustave Kahn, Toronto; Secretary-Treasurer, R. E. W. Hagarty, 662 Euclid Ave., Toronto.

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, 11 Queen's Park, Toronto.

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

CANADIAN GAS EXHIBITORS' ASSOCIATION.—Secretary-Treasurer, A. W. Smith, 52 Adelaide Street East, Toronto.

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

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President, Dr. Frank D. Adams, McGill University, Montreal; Secretary, H. Mortimer-Lamb, Montreal.

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, 157 Bay Street, Toronto.

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

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto, President, J. Duguid; 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, Dr. Martin Murphy; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton Alberta.

ENGINEERING SOCIETY, TORONTO UNIVERSITY.—President, A. D. Campbell; Corresponding Secretary, A. H. Munroe.

ENGINEER'S CLUB OF TORONTO.—96 King Street West. President, C. M. Canniff; 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.

MANITOBA LAND SURVEYORS.—President, George McPhillips; Secretary-Treasurer, G. G. Chataway, Winnipeg, Man.

NOVA SCOTIA MINING SOCIETY.—President, T. J. Brown, Sydney Mines, C.B.; Secretary, A. A. Hayward.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, S. Fenn; Secretary, J. Lorne Allan, 15 Victoria Road, Halifax, N.S.

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, W. H. Pugsley, Richmond Hill, Ont.; Secretary, J. E. Farewell, Whitby.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, H. W. Selby; Secretary, Killaly Gamble, 703 Temple Building, Toronto.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—President, F. S. Baker, F.R.I.B.A., Toronto, Ont.; Hon. Secretary, Alcide Chausse, No. 5 Beaver Hall Square, Montreal, Que.

ROYAL ASTRONOMICAL SOCIETY.—President, Prof. Alfred T. de Lury, Toronto; Secretary, J. R. Collins, Toronto.

UNDERGRADUATE SOCIETY OF APPLIED SCIENCE, McGILL UNIVERSITY.—President, H. P. Ray; Secretary, J. P. McRae.

WESTERN CANADA IRRIGATION ASSOCIATION.—President, Wm. Pierce, Calgary; Secretary-Treasurer, John T. Hall, Brandon, Man.

WESTERN CANADA RAILWAY CLUB.—President, Grant Hall; Secretary, W. H. Rosevear, 199 Chestnut Street, Winnipeg, Man. Second Monday, except June, July and August, at Winnipeg.

AMERICAN TECHNICAL SOCIETIES.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS (TORONTO BRANCH).—W. H. Eisenbeis, Secretary, 1207 Traders' Bank Building.

AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION.—President, John P. Canty, Fitchburg, Mass.; Secretary, T. F. Patterson, Boston & Maine Railway, Concord, N.H.

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE OF WAY ASSOCIATION.—President, L. C. Fritch, Chief Engineer, Chicago G. W. Railway; Secretary, E. H. Fritch, 962-3 Monadnock Block, Chicago, Ill.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—Secretary, C. W. Hunt, 220 West 57th Street, New York, N.Y. First and third Wednesday, except July and August, at New York.

AMERICAN SOCIETY OF ENGINEERING-CONTRACTORS.—President, George W. Jackson, contractor, Chicago; Secretary, Daniel J. Hauer, Park Row Building, New York.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—29 West 39th Street, New York. President, Jesse M. Smith; Secretary, Calvin W. Rice.

WESTERN SOCIETY OF ENGINEERS.—1735 Monadnock Block, Chicago, Ill. J. W. Alvord, President; J. H. Warder, Secretary.

COMING MEETINGS.

NEW YORK CEMENT SHOW.—December 14-20, 1910. First annual convention in Madison Square Garden, New York. Under the management of the Cement Products Exhibition Company, 115 Adams St., Chicago.

CHICAGO CEMENT SHOW.—February 15-23, 1911. Fourth annual exhibition, at the Coliseum, Chicago, Ill. Under the management of the Cement Products Exhibition Company, 115 Adams St., Chicago.

NEW ENGLAND WATER WORKS ASSOCIATION.—September 21-23. Annual meeting, Rochester, N.Y. Willard Kent, Secretary, Narragansett Pier, R.I.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.—October 11-16. Seventeenth annual convention, Erie, Pa. Prescott Folwell, Secretary, 239 W. 39th Street, New York, N.Y.

TORONTO, CANADA, SEPT. 22, 1910.

CONTENTS OF THIS ISSUE.

C. P. R. EARNINGS.

(Continued from page 409.)

general interest is evidenced in the proposed joint regulation of international traffic between United States and Canada. A conference on this matter was held last week in New York between Chairman Martin A. Knapp, of the Interstate Commerce Commission, and Chairman Mabee, of the Railway Commission of Canada. They have under consideration these aspects of the general question of international rate regulation:—

"Whether existing legislation in the two countries is adequate for the effective control of through traffic, and whether joint control of such traffic would be mutually advantageous to the business interests of both countries.

"Whether it would be necessary to the end in view to negotiate a treaty between the two countries, or whether the result could be accomplished by concurrent legislation.

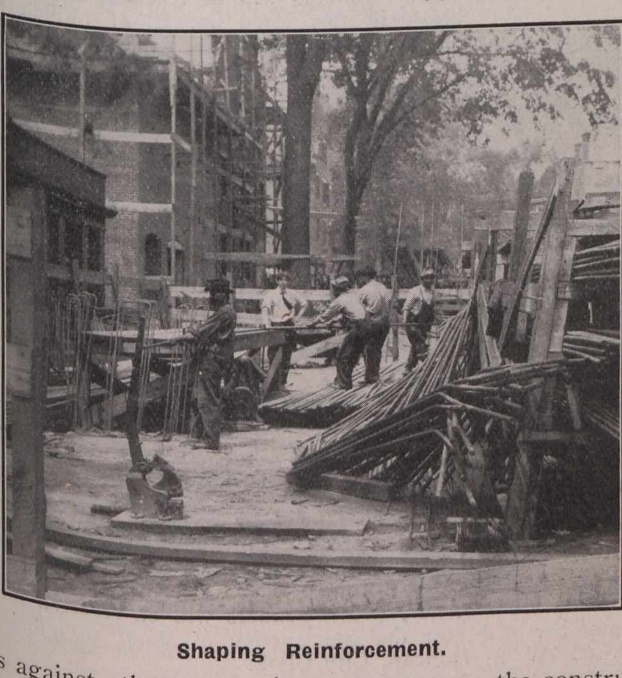
"Whether under a treaty or such concurrent legislation joint control could be enforced through the separate administrative or judicial authorities in each country respectively, or preferably by the creation of a new joint tribunal in the nature of an international traffic commission.

"Whether such joint control should include not only through railway rates and regulations, but also express companies, telegraph companies, and telephone companies operating between the two countries."

Will international regulation have any effect on the railroad earnings?

PLANT ARRANGEMENT ON A LARGE REINFORCED CONCRETE JOB.

In concrete work, almost more than in any other type of construction, the difference between a good-sized profit and a very small profit or an actual loss on a contract often depends upon the economy or waste in the handling of materials. This is because of the relatively high proportion of labor cost in this type of construction



Shaping Reinforcement.

as against other types. As a consequence, the construction plant layout on such a big piece of work as the new warehouse of the Massachusetts Cotton Mills at Lowell, Mass., for which the Aberthaw Construction Co., of Boston, Mass., are the general contractors, is especially interesting.

This building will be 100 feet by 256 feet and twelve stories high, containing over 300,000 square feet of floor area.

It will rest on 1,400 concrete piles, one row under each line of columns and two rows under each fire wall. The contract for the piling was placed by the Aberthaw Company with the Raymond Concrete Pile Co., of New York. Their method is to drive or jetty a sheet steel shell on a collapsible steel core into place, withdraw the core and fill the shell with concrete.

In this particular job the pile core encased in a sheet steel shell is driven to a firm resistance after using

Reinforcement in Place.

a water jet to loosen up the soil, which is quite firm. When the pile begins to bring up at first, a jet is used again and the pile is driven to its final resistance. The sheet steel shells which encase the core are made of No. 20 gauge sheet steel in 8-feet sections, which overlap and fit the core very snugly. A pressed steel boot is placed over the point of the shell to exclude the soil as the pile is being driven. When the desired penetration is reached the core is collapsed and withdrawn, leaving the shell in the ground. The shell is inspected to ascertain its condition, and is then filled with Portland cement concrete of a mixture of one part good Portland cement, two parts sharp sand and four parts crushed stone. The piles are designed to carry a load of 33 tons each, and vary in length with the depth to ledge, and are from 10 to 30 feet in length. The short piles have a point 13 inches in diameter, and on the longer piles the point is 8 inches in diameter, the head of the pile varying in diameter with the length, being approximately 18 inches.

It is a particularly difficult job, because of the character of the material, which is sandy clay and gravel overlying rock. In the photograph, showing a close view of a pile-driver, the water jet used for loosening the soil has reached the lowest point and is about to be withdrawn, while a steel shell and core is hoisted on the derrick ready for placing and driving. Sections of shells can be seen lying on the ground near the pile-driver. The piles are capped with a continuous girder extending the full width of the building. These girders are 5 feet wide by 5 feet 4 inches deep of 1:2:4 concrete, containing sixteen 1⅛-inch steel bars and ⅝-inch stirrups for reinforcement.

(Continued next week.)

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

TENDERS PENDING.

In addition to those in this issue.

Further information may be had from the issues of The Canadian Engineer referred to.

Place of Work.	Tenders Close.	Issue of.	Page.
Goderich, Ont., breakwater	Oct. 4.	Sept. 15.	98
Hamilton, Ont., wharf	Sept. 28.	Sept. 1.	275
Hamilton, Ont., wharf, etc	Sept. 28.	Sept. 8.	308
Kingston, Ont., building	Sept. 20.	Sept. 8.	308
Lakeport, Ont., wharf	Oct. 4.	Sept. 15.	98
Megantic, Que., building	Sept. 27.	Sept. 15.	98
Montreal, Que., waterworks pump	Sept. 23.	Sept. 15.	98
New Westminster, B.C., court-house	Sept. 26.	Sept. 8.	309
Ottawa, Ont., Quebec bridge	Oct. 1.	Aug. 25.	56
Ottawa, Ont., lighthouse	Oct. 31.	Sept. 1.	275
Ottawa, Ont., lighthouse and buoy steamer	Oct. 31.	Sept. 8.	308
Rossland, B.C., court-house repair	Sept. 30.	Sept. 1.	275
Swift Current, Sask., power plant	Sept. 27.	Sept. 15.	124
Winnipeg, Man., rails	Oct. 1.	Sept. 1.	83
Yorkton, Sask., electric light plant	....	Sept. 8.	309

TENDERS.

New Edinburgh, N.S.—Tenders will be received until Oct. 12th for the construction of a breakwater. R. C. Desrochers, Secretary, Public Works Department.

Margaree Harbor, N.S.—Tenders will be received until October 5th, for extension to breakwater. R. C. Desrochers, Secretary, Department of Public Works, Ottawa, Ont.

Bic, Que.—Tenders will be received until October 12th, for the construction of a wharf. R. C. Desrochers, Secretary, Department of Public Works, Ottawa.

L'Assomption, Que.—Tenders will be received until October 12th, for the construction of a concrete ice pier. R. C. Desrochers, Secretary, Department of Public Works, Ottawa, Ont.

Paspebiac, Que.—Tenders will be received until October 10th, for the construction of a breakwater. R. C. Desrochers, Secretary, Department of Public Works, Ottawa, Ont.

River des Prairies, Que.—Tenders will be received until Oct. 17th for the reconstruction of piers. R. C. Desrochers, Secretary, Department of Public Works, Ottawa.

Rouleau, Que.—Tenders will be received until October 1st, for the construction of a telephone line. Fred. J. Fitzpatrick, Secretary-Treasurer.

St. Johns, Que.—Tenders will be received until Sept. 26th, for the construction of concrete piers and abutments and approaches thereto, of a bridge to be erected over the Richelieu River. J. A. Raymond, Secretary-treasurer, Town of St. Johns.

Barrie, Ont.—Tenders will be received until October 1st for the construction of sewers. K. S. Macdonell, Town Engineer. (Advertisement in The Canadian Engineer).

Dundas, Ont.—J. F. Armour, C.E., who recently invited tenders for the removal of 27,500 cubic yards of material from the Desjardins Canal, advises The Canadian Engineer that no bids were received.

Forest, Ont.—Tenders for the heating and ventilation of the Forest High School, on approved and scientific principles, will be received up till 6 p.m., Wednesday, September 28th. The heating may be done by either hot air or steam system. J. M. MacKenzie, Secretary, High School Board.

Fort William, Ont.—Tenders will be received until Oct. 3rd for the construction of piers and abutments for a bridge over the McKellar River. Frank Lee, Division Engineer, C. P. R., Winnipeg, Man.

Hamilton, Ont.—Tenders will be received until Sept. 28th for the construction of a wharf and two retaining walls. R. C. Desrochers, Secretary, Department of Public Works, Ottawa.

North Toronto, Ont.—Tenders will be received until Sept. 27th for approximately 20,000 sq. ft. of concrete sidewalk. Wm. C. Norman, Town Clerk. (Adv. in The Canadian Engineer.)

St. Thomas, Ont.—Tenders will be received by the Rev. T. West, St. Thomas, until 5 o'clock Saturday, October 1st, for the masonry and plastering, carpentry and roofing, etc., required in the erection and completion of a stone church at St. Thomas, Ont. Arthur W. Holmes, architect, 10 Bloor Street East, Toronto.

Toronto, Ont.—Tenders will be received up to noon Tuesday, September 20th, for transformers, pole line supplies, storage batteries and motor generator sets. G. R. Geary, (Mayor), Chairman Board of Control.

Toronto, Ont.—Tenders will be received up till noon Tuesday, September 27th, for the various trades required in the erection of buildings for the Medical Wing and Administration Building of the General Hospital. Darling & Pearson, architects, 2 Leader Lane.

Virden, Man.—Tenders will be received until September 24th, for the construction of a 60-foot reinforced concrete bridge. James F. C. Menlove, Secretary-Treasurer.

Moose Jaw, Sask.—Tenders will be received until Sept. 26th for laying approximately 2,100 lin. ft. of 10-inch tile sewer and 6-inch cast iron water mains. J. M. Wilson, City Engineer.

Regina, Sask.—Tenders will be received until Sept. 26th for the erection of the Traders Bank building. Storey & Van Egmond, Architects, Regina.

Moose Jaw, Sask—Tenders will be received up to 8.30 p.m., Monday, October 10th, for supplying one standard combination chemical and hose wagon with capacity 50 gallons chemical tank and 800 feet of 2½-inch fire hose, or 40 gallons chemical tank and 1,000 feet of 2½-inch fire hose. Wagon to be fitted to carry one 20-foot extension ladder on top. Tenderers are asked to quote prices for either 2½-inch steel or 2½-inch rubber tired Archibald wheels; also for one extra set of Archibald wheels, 1⅞-inch axle, 2½-inch steel or rubber tires. W. H. Heal, City Clerk.

Prince Albert, Sask.—Tenders will be received until September 30th, for the supply and erection of two centrifugal, electrically-driven, automatic control sewage pumps. C. O. Davidson, City Clerk. (Advertisement in The Canadian Engineer).

Yorkton, Sask.—Tenders will be received until October 11th, for apparatus for an electric light plant. W. E. Skinner, Limited, consulting engineers, Winnipeg, Man. (Advertisement in The Canadian Engineer).

New Westminster, B.C.—Tenders will be received until September 26th, for the construction of about 10 miles of sewers. W. A. Duncan, City Clerk.

Vancouver, B.C.—The Bank of Ottawa recently issued an invitation for tenders for a new eight-storey building to cost $300,000.

Victoria, B.C.—Tenders will be received until Oct. 3rd for the building of Dallas road sea wall. W. W. Northcott, Purchasing Agent.

Victoria, B.C.—Tenders will be received until Oct. 24th for brass goods, pipe and fittings. W. W. Northcott, Purchasing Agent.

Blairmore, Alta.—Tenders will be received until Sept. 25th for building of twenty cottages, six store buildings, one residence and for the excavation and diversion of river bed for distance of one mile. The West Canada Collieries, Ltd.

CONTRACTS AWARDED.

Halifax, N.S.—Contracts for the construction of wharves at Dover and Port Felix, N.S., have been awarded to Messrs. Girroir & Sweet, of Antigonish, N.S., at $3,836 and $4,309 respectively.

Edmundston, N.B.—For the installation of a waterworks distribution system, Quellet & Jacques, of Deschaillons, Que., were given a $35,381.15 contract by this municipality. Other bids were: Kennedy & McDonald. Edmundston, N.B., $47,352.75; O. Pelletier, Cabano, P.Q. $60,800.00; J. J. O'Connor, Edmundston, N.B., $55,028.64.

Montreal, Que.—The Structural Steel Company secured the contract for the steel work of the new Central Y.M.C.A. building, and John Stewart & Company the brickwork and masonry work.

Montreal, Que.—The John McDougall Caledonian Iron Works Company have been awarded a contract by the C.P.R. for the installation of eight passenger, two baggage and one kitchen elevator in the new Windsor Station here. This contract, which approximates $100,000, is believed to constitute the largest single order of its kind ever awarded in Canada.

Montreal, Que.—Tenders for the steel and concrete work for the new intake pipe were recently opened before the Board of Control. It had been estimated that the addition, which is to be 3,210 feet in length, would cost $145,000, but the tenders make it appear the sum will be greater. Those companies tendering for the whole work, and the prices they quote, are as follows:

Haney, Quinlan & Robertson, $186,500; Laurin & Leitch, $169,463; Lemoine & Sons, $155,000; Harris & Company, $197,623; Beaudry, Leman, $185,000; M. Connelly, $184,200. Besides this Munderloh & Company and John Inglis Company tendered for parts of the work. As yet the controllers have not recommended the acceptance of any of the offers.

Colchester, Ont.—The contract for the construction of an extension to the pier has been awarded to Messrs. Michael, Matthew J., and Patrick J. O'Leary, of Ottawa, at $14,500.

Ottawa, Ont.—The Board of Control awarded contracts for paving Wellington street from the lane between Irving and Spadina avenues to east side of Pihney street; Flora street from Bank street to Bronson avenue; and on Melgund avenue from Monk street to Ralph street, to the Ottawa Construction Company. The contract for paving Anne street from Mutchmor street to a point 100 feet south of Regent street has been awarded to the Barber Asphalt Paving Company.

The following tenders were received:

Wellington street: Ottawa Construction Co., $15,586; The Barber Asphalt Paving Company, $15,660; The City Engineer, $15,947; Union Construction Company, $16,226.

Flora street: Ottawa Construction Company, $20,560; The Barber Asphalt Paving Company, $20,670; Union Construction Company, $21,000; The City Engineer, $21,500.

Anne street: The Barber Asphalt Paving Company, $1,900; Ottawa Construction Company, $1,926; The City Engineer, $1,963; Union Construction Company, $2,000.

Melgund avenue: Ottawa Construction Company, $4,395; The City Engineer, $4,526; The Barber Asphalt Paving Company, $4,543; Union Construction Company, $4,618.

Toronto, Ont.—The F. H. McGuigan Construction Company of Toronto was awarded the contract for the construction of the Queen street east high level bridge at $193,000. This is exclusive of filling and paving. City Engineer Rust, who recommended the acceptance of the McGuigan Company's tender, reported that a careful analysis of the tenders showed that the city could save a considerable amount of money by doing the filling and paving itself. The total cost of the bridge, including filling and paving, will be $212,000.

Trenton, Ont.—G. Crow & Son, a local firm, secured the contract for constructing the sewerage system, which includes the laying of 824 feet of 15-inch, 1,434 feet of 12-inch, 987 feet of 8-inch pipes and manholes, as well as the building of a sedimentation tank. The bids were as follows: G. Crow & Son, Trenton, $4,215; E. B. Merril, Toronto $4,536; H. Taylor, Belleville, $5,100; J. W. Liton, Kingston, $7,045.

Winnipeg, Man.—The Canadian British Insulated Company, Montreal, have been given a contract to supply the city's power department with 46,000 feet of 13,000 volt three-core cable at $1.12 a foot, $51,520.

Winnipeg, Man.—Contracts for plumbing work in the new technical institutes were awarded as follows: St. John's, $35,650, Standard Plumbing & Heating Company; South End, $35,497, Cotter Bros.

Winnipeg, Man.—C. W. Sharp, of Winnipeg, secured from the C. P. R. a $150,000 contract for the erection of a hotel at Proctor, Kootenay Lake.

Winnipeg, Man.—J. M. and J. J. Kelly were awarded the contract for building the new St. John's telephone exchange for $38,000, exclusive of the plumbing and ventilating systems.

Moose Jaw, Sask.—Mussens, Ltd., were given a contract for a street sweeper at $275.

Regina, Sask.—R. S. Blome & Company were given the contract for paving the Albert street subway with granolithic blocks at $3 a square yard. The Parsons Construction Company offered to lay an asphalt block pavement for $3.50.

Regina, Sask.—Paving contracts were let as follows: National Paving & Contracting Company, 7,000 sq. yards asphalt on McIntyre street at $3; Bitulithic & Contracting Company, 21,500 sq. yards on Smith and Lorne streets at $3.05 a sq. yard; Western Pavers Company, curb and gutter, 67½ cents, also 150,000 sq. ft. of sidewalk at 17½ cents. The other tenderers for pavement complete were: R. S. Blome Company, $2.99; R. Bangham, Windsor, Ont., (2½-inch asphalt block), $3.50; the Kettle River Company (3-inch 16 lb. wood block), $3.94, (3-inch 20 lb.), $4.20. Sidewalks: Clement and Curran, Orillia, Ont, 17½ cents per square foot; R. S. Blome Company, 17¾ cents.

Victoria, B.C.—The tender of the Worswick Paving Company was accepted for paving Fernwood road at $14,978; Rockland avenue, $14,895; Richardson street, $9,770; and the tender of the Pacific Construction Company for a standard asphalt for Fort street at $9,702. Specifications called for a standard asphalt pavement consisting of a 5-inch concrete base, an 8-inch binder and a 2-inch wearing surface.

Vancouver, B.C.—The following tenders were received for sewer pipe: Evans, Coleman & Evans, $19,315; Dominion Glazed Cement Pipe Company, $24,500; G. Gardiner Johnston & Company, $26,265.

Pending the receipt of the city engineer's report on a test of the samples submitted the award was postponed.

Medicine Hat, Alta.—The city recently invited tenders for two d. c. gas-engine-driven 125 k. w. alternating current units for the power plant. The following bids were received:

Gorman, Clancy, Grindley, generator $5,675.

Canada Foundry Co., engine and generators $21,050.

Canadian Fairbanks Co., engine $13,922, generators $5,903.

National Meter Co., engines $13,495, generators $6,500.

Turner, Fricke, Pittsburg, engines $16,706.80, generators $7,851.

Chapman, Walker, Co., engines $17,060, generators $5,630.

Drummond, McCall & Co., engines $13,500.

E. Leonard & Sons, engines $13,974, generators $11,100.

Kilmer, Pullen & Burnham (1) engines $14,500, generators $8,776, (2) engines $17,500, generators $8,776.

Siemens Bros., (1) engines $14,500, generators $4,255, (2) engines $17,500, generators $4,255.

Allis-Chalmers-Bullock, Ltd., engines and generators $24,215.

Canadian Westinghouse Co., engines $20,600, generators $5,690.

Canadian Boving Co., (1) engines $14,500, generators $4,255, (2) engines $17,500, generators $4,255.

Vandeleur & Nichols, (1) engines $14,500, generators $3,050, (2) engines $17,500, generators $3,200.

RAILWAYS—STEAM AND ELECTRIC.

Toronto, Ont.—The Toronto Street Railway Company, recently decided to build a number of new lines and work has already been commenced on two routes.

Toronto, Ont.—The Grand Trunk Railway has commenced work on the elimination of grades between the Bathurst Street yards and the Humber.

Windsor, Ont.—The Michigan Central Railway tunnel beneath the Detroit River has been opened and many heavy freight trains have passed through.

Regina, Sask.—The works committee decided to engage Mr. Thornton, who built the Edmonton Street Railway, to lay out a street car route for Regina.

Calgary, Alta.—Ratepayers carried by-laws for two new subways and street railway extensions, which also will cost $524,000; $484,000 for extensions and improvements, the by-law for 22 miles of track and 12 new cars, making a total of 30 miles of tracking, including double tracks.

Edmonton, Alta.—The Provincial Government has approved the plans of the Pincher Creek, Cardston and Montana Railway Co., which proposes to construct a line through Alberta to the Peace River country, 700 miles in length.

Fredericton, N.B.—It is reported that extensive changes are planned in connection with the I. C. Ry. permanent way on the Canada Eastern division. Two new bridges to cost $200,000 are said to be included in the plans.

LIGHT, HEAT AND POWER.

Montreal, Que.—Council will decide at the next meeting on the engagement of an expert engineer to report upon the question of underground conduits in which all electric wires now overhead may be placed.

Montreal, Que.—Tenders for the electric lighting of Montreal were recently opened by the Board of Control and five were considered.

The Provincial Light and Power Company accompanied their tender by a cheque for $25,000, and quoted a rate $54.80 per lamp for 1,650 lamps and over, as against $72.70 of the Montreal Light, Heat & Power Company on schedule "A," and $63.15 on schedule "B."

The president of the company signing the tender was Rodolphe Forget, and the power is obtained from the Cedar Rapids.

The Saraguay Electric and Water Company tendered for lighting St. George's, St. Joseph, St. Andrew's wards, Longue Pointe and Cote de Neiges, for $90 per lamp per year, but there was an indemnity clause bearing upon those sections where they already hold contracts for twenty-five years.

The Montreal Light, Heat & Power Company for 1,650 lamps or over quoted $72.70 on schedule "A," and $63.15 on schedule "B." These rates operated on a sliding scale. The St. Paul Electric Light and Power Company quoted $90 per lamp per year for St. Gabriel and St. Ann's wards, south of the Lachine Canal.

The Dominion Electric Light Company quoted $85 per lamp per year.

One of the features of the requirements of the tenders this time was that the companies will have the privilege of supplying light to only a portion of the city. The tenderers were asked to state the number of lamps they could provide and the districts they wished to serve. The requirements did not call for any specific form of lamp, any of the standard types being acceptable.

The number of arc lamps at present used in the city is 1,650. there being in addition to this 500 incandescent lamps of different candle powers.

The specifications prohibit the use of dangerous or unsightly poles for street lamps, and the apparatus for suspending the lamps must also be acceptable, the whole to be erected in a manner satisfactory to the superintendent of the Light Department. In fact, the written approval of the superintendent is necessary before any additional lamps can be erected, and in all cases the contractor assumes responsibility in case of accident or injury. Straight wooden poles painted throughout their length shall be used. There is a clause reserving to the city the right to compel the companies to place their wires underground in the event of a conduit being built, and another which protects the right of the city to establish a municipal plant. In case the city should decide to erect its own plant it may terminate the contract in whole or in part at the end of the first five years, which would be on the first of September, 1915, after giving six months' notice. It may take over the lamps and accessories on the streets on a basis of 50 per cent. of the original cost, providing they are in good condition. The contract is to begin on the 1st of November, 1910.

The lighting of the city has heretofore been performed by the Montreal Light, Heat & Power Company, which seemed to have a sort of perpetual franchise, the contracts being generally renewed at their expiration. When the last contract expired, however, which was at the end of 1908, the Power Company made the claim that it was losing money on the previous price of $60 per lamp, per year, and demanded a considerable increase, and for this reason could not get the contract renewed. It has now been supplying light to the city for upwards of a year and a half without a contract. The company is now charging the city considerably in excess of the former rates, thus occasioning an outstanding dispute which is being referred to the courts. In its letter to the city early in 1909 the Power Company offered to continue the lighting "at such rate or charge as we may consider fair and equitable to both parties under the circumstances, but such charges we will always be prepared to submit to arbitration." The company forwarded its accounts to the city from time to time and these the city refused to pay on the ground that they were exorbitant. A Board of Arbitration was formed consisting of Professor L. A. Herdt, McGill, representing the city; Mr. R. G. Black Toronto, for the company and Mr. A. A. Dion, Ottawa, the third member of the Board.

The lighting position is further complicated by the fact that the Montreal Light, Heat & Power Company now has contracts covering 487 arc lamps in the city, these contracts having been made by suburban municipalities taken in by the city. These contracts run as high as $116.50 per light, and averaging $88.43, the length of the contracts being as much as 32 years. The claim has been made that if the company undertakes the lighting of the city the lights will have to be supplied for the coming ten years at the contract price, which it is generally thought will not be acceptable to the city if in excess of $75 per lamp. The city, however, in calling for tenders has accepted the sections referred to, so that the final settlement of all the negotiations for street lighting will certainly simplify matters greatly.

Calgary, Alta.—The power committee of the city council favored taking from the Calgary Power Company, Ltd., 2,000 h.p. at $30 per h.p., until the end of December, 1912, and if the council adopt the report, a business manager will be engaged to secure contracts for the sale of power.

Merritt, B.C.—The Merritt Water, Light & Power Co., will install a 1,000 light capacity lighting plant shortly. G. B. Armstrong, secretary-treasurer.

BY-LAWS AND FINANCE.

Gravenhurst, Ont.—The $10,000 good roads by-law was defeated by Muskoka township ratepayers.

Port Arthur, Ont.—The ratepayers voted to provide funds for gas mains, to enlarge the service reservoir at Current River power plant, to build a swimming pool, to complete the car barns and to establish enamel works.

St. Catharines, Ont.—A $15,000 by-law for extension to the water mains will probably be submitted to the ratepayers in January.

Toronto, Ont.—The Bloor Street viaduct by-law will be submitted again in January.

Welland, Ont.—Ratepayers sanctioned the $52,000 waterworks extension by-law.

Melfort, Sask.—A. McN. Stewart, secretary-treasurer, invites bids for $2,500 debentures issued to cover the cost of a well-boring outfit.

Calgary, Alta.—Ratepayers carried by-laws amounting to $524,000 for extensions to the street railway and for the construction of two new subways. The $100,000 parks bylaw was defeated.

SEWAGE AND WATER

Dauphin, Man.—The tenders for the construction of the waterworks and supply of material for the town of Dauphin, were let during this week. The intention of the Dauphin council is to bring in the water supply from Edward's creek, in the Riding mountains, a distance of 8½ miles from the town. The elevation provides a standard pressure on the town service of 90 pounds to the square inch. The contract for the piping was awarded to the Canadian Pipe Company, of Vancouver. The contract for ditching and back filling went to Flanagan and Murphy, of Weyburn and Fort William. The Canada Iron Corporation, of Fort William, secured the tender for the supply of iron pipe for the town distribution system, and the American Sewer Pipe Company were awarded the contract for the supply of sewer pipe. Hydrants and valves will be furnished by the London Foundry Company, of London, Ont. The general installation of the system in the town will be carried out by Flanagan and Murphy, in addition to the outfall sewer running into a septic tank near the Vermilion river. Chipman and Power are the engineers in charge of the work, which will be commenced as soon as materials can be got on the ground. The total cost of the installation will be about $235,000.

Calgary, Alta.—Dr. Dawson, M.H.O., has recommended the construction of 1½ miles of sewers, in addition to those provided for in the $41,000 by-law recently passed.

Gleichen, Alta.—The town council recently called upon R. B. Owens, the provincial health engineer, for advice to connection with waterworks it is proposed to install.

PERSONAL.

Mr. John W. Gerell, manager of the Toronto shipyards, has been appointed manager of the Polson Iron Works, Toronto.

Mr. D. W. McLachlan. A.M. Can. Soc. C.E., of Campbellford, Ont., and Mr. Ernest E. Gagnon, stud. Can. Soc. C.E., of Montreal, Que., have been selected for appointment to two vacancies in the Engineering Department of the Railways and Canals Department, Ottawa.

Mr. Frank Adams, assistant city engineer of Brantford, Ontario, has resigned to accept a position with Messrs. Chipman & Power, consulting engineers, Toronto.

Mr. A. H. Van Cleve, who was last week appointed to the position of head municipal engineer at London, Ontario, entered Lehigh University, South Bethlehem, Pa., in 1886. He was bridge inspector and computer for the Lehigh Valley Railroad Company, Mauchchunck, Pa., during the summer of 1889. Graduated with the degree of civil engineer in 1890. Mr. Van Cleve entered the employ of the Brooklyn Elevated Railroad Company, Brooklyn, N.Y., May, 1890, to April, 1892, in the capacity of draughtsman, designer and instrument man. During this period, the terminals in East New York were being designed and surveys made for the 5th and Fulton Ave. extension. His experience consisted largely in calculations and designs for steel work, and preparation of maps for legal department. From April 1892 to Jan. 1st, 1909, he was with the Niagara Falls Power Company, Canadian-Niagara Power Company, and their allied companies, with whom he occupied various positions. In 1900 he became principal assistant engineer in charge of all designing and all construction, except that in immediate connection with power house and wheel pit. In March, 1904, he was made Resident Engineer in full charge of all construction of the Niagara Falls Power Company, other than electrical. On December 1st, 1904, he was appointed to the same position in respect to the Canadian-Niagara Power Company, and was later made Engineer of both companies. He occupied these positions until January 1st, 1908, when, upon completion of construction, he was made Consulting Engineer for both companies. Since January, 1909, Mr. Van Cleve has been engaged in general consulting work, giving special attention to hydro-electrical development. He spent several months in Cobalt, Ontario, in direct charge of the engineering work of the Cobalt-Hydraulic Power Company. The work of the Canadian-Niagara Power Company and the Niagara Falls Power Company during the period of his connection with them, is perhaps so well known as to require no description. The companies own about 1,500 acres of land, over which it was necessary to build streets, lay a large system of conduits, sewers and water pipes for supplying the various tenants. The hydro-electrical installation of the Niagara Falls Power Company consists of 110,000 H.P. in 21 units, all of this installation being made subsequent to 1892. Mr. Van Cleve had charge, either as principal or assistant, of all the designs for the Canadian Niagara Power Company, other than electrical, was in charge of all said construction of the plant and transmission lines subsequent to December 1st, 1904. The installations of that company consist of a forebay, wheel pit and tunnel with a capacity of approximately 110,000 H.P., while the machinery installed during his connection with the Company aggregates over 50,000 H.P., together with the necessary power house, transmission station, conduits, etc. As consulting engineer, Mr. Van Cleve made reports on hydro-electric developments proposed in various places.

CURRENT NEWS.

Ottawa, Ont.—Several hundred tons of pressed peat, prepared at Albert, near Ottawa, by the Canadian Department of Mines, are to be sold in Ottawa at the rate of $3.25 per ton delivered. This is being done as a demonstration of the commercial success of Government experiments in preparing peat for fuel. The department claims that at this rate peat is equal to the best anthracite coal at $6 a ton. They claim to be able to sell peat fuel at the works for $2.25 a ton and make a profit. This is equal to hard coal at $4 a ton. It is expected that within a short time private enterprise will be putting peat fuel on the market whenever bogs are found in the vicinity of population centres.

SOCIETY NOTES.

New Brunswick Municipal Union: The annual convention of the Union of New Brunswick Municipalities will be held on October 19th and 20th at Woodstock, N.B.

OBITUARY.

Mr. David Murphy, who superintended the construction of the lift locks on the Trent Canal for the Dominion Bridge Company, was killed on Tuesday, September 13th, at Montreal. Mr. Murphy was run down by an automobile whilst motor cycling.

POSITIONS VACANT

THROUGH

CANADIAN ENGINEER INFORMATION DEPT.

Resident Engineer wanted to superintend the installation of a hydro-electric plant in Alberta. Man with experience on crib dams preferred. Work commences immediately; good till February at $100 a month and travelling expenses one way. Write Box I. D. 165, Canadian Engineer Office, Toronto.

Railway Draughtsman for work in Toronto, permanent position, $75 a month. Box I. D. 166, Canadian Engineer Office, Toronto.

Superintendent for large machine shop and manufacturing establishment; man who can both direct and organize. Box I. D. 167, Canadian Engineer Office, Toronto.

Business Manager for power works of a large western Canadian city; to secure contracts and arrange terms for the sale of power; state salary. Box I. D. 168, Canadian Engineer Office, Toronto.

Superintendent for canal work; experienced in concrete construction. Box I. D. 169, Canadian Engineer Office, Toronto.

Draughtsman: Two first-class men accustomed to tool designing. Box I. D. 170, Canadian Engineer Office, Toronto.

MARKET CONDITIONS.

Montreal, September 21st, 1910.

In the United States iron and steel markets, interest is centred principally in the pig-iron situation. Buying for the new year generally commences about the end of September, so that furnaces have been looking for some activity to develop this month. There has been some inquiry, but buyers are apparently not willing to take the iron at higher than present prices, while furnaces are not desirous of doing business for 1911 at the present levels. The market is waiting to see what will turn up in this connection. The principal buyers during the past week have been pipe works. Southern sellers for the most part are holding for $11.50 for No. 2 iron, but sales have been made at $11. Billets and sheet bars are weak, and buyers are bidding under $24.50, Pittsburg, for billets. The United States Steel Corporation is operating 67 per cent. of its blast furnaces' capacity, 45 furnaces being now idle, against 42 at the beginning of September, 39 at the beginning of August, and 35 at the beginning of July. Quite an active demand developed for pig-iron for a day or two recently, but this has again subsided.

The course of the steel market since the first of the month has bee disappointing to manufacturers. They expected a buying movement of no small proportions to set in in September, but so far there has been little change from the August figures. This is likely to be followed by small earnings in the last quarter. Earnings from cement and transportation will not be so much in evidence in the last three months of the year, and deliveries of steel will be on a lower price average. These factors will contribute toward a severe reduction in the income of all steel companies unless there is a decided improvement in the volume of new business particularly from the railroad companies. Steel production to-day ranges from 70 to 80 per cent. of capacity.

There are a number of railroads in the market for steel rails for delivery in the near future. This is taken as an indication that rails are badly needed, although the roads are not inclined to make commitments far ahead. Prices for steel rails remain unchanged at $28 a ton for standard sections, and there are no prospects of a change in quotations.

In England, conditions throughout the iron and steel markets are a little more active than formerly. Prices, however, continue practically unchanged, save for daily fluctuations, which are of little consequence. The labor situation is causing some uneasiness, but so far as can be learned on this side they are not influencing the situation greatly. Reports from Germany and Belgium are fairly satisfactory.

The pig-iron and steel markets throughout Canada are in a very satisfactory condition. One of the largest manufacturers reports that business for the past year has been 40 per cent. better than the previous year. There is a good deal of buying not only among Canadian furnaces, but for importation from Great Britain. Hamilton and Midland furnaces are both booked up for the first quarter of 1911. The Canadian mills are generally well filled up with orders until the end of this year. The Dominion mills and those at the Soo are filled until January 1st, and Nova Scotia Company is probably in the same condition.

Antimony.—The market is steady at 8c to 8¼c.

Bar Iron and Steel.—The market holds dull and steady. Bar iron, $1.90 per 100 pounds; best refined horseshoe, $2.15; forged iron, $2.05; mild steel, $1.95; sleigh shoe steel $1.90 for 1 x ⅜ base; tire steel, $2.00 for 1 x ⅜-base; toe calk steel, $2.40; machine steel, iron finish, $2.00; imported, $2.05.

Building Paper.—Tar paper, 7, 10, or 16 ounces, $1.80 per 100 pounds; felt paper, $2.75 per 100 pounds; tar sheathing, 40c. per roll of 400 square feet; dry sheathing, No. 1, 30 to 40c per roll of 400 square feet; tarred year will be the largest in the history of the country. Prices on foreign fibre, 55c. per roll; dry fibre, 45c. (See Roofing; also Tar and Pitch). (164).

Cement.—Canadian cement is quotable, as follows, in car lots, f.o.b., Montreal:—$1.35 to $1.40 per 350-lb bbl., in 4 cotton bags, adding 10c. for each bag. Good bags re-purchased at 10c. each. Paper bags cost 2½ cents extra, or 10c. per bbl. weight.

Chain.—The market is unchanged, being now per 100 lbs., as follows:—¼-in., $5.30; 5-16-in., $4.70; ⅜-in., $3.90; 7-16-in., $3.65; ½-in., $3.55; 9-16-in., $3.45; ⅝-in., $3.40; ¾-in., $3.35; ⅞-in., $3.35; 1-in., $3.35.

Coal and Coke.—Anthracite, egg, stove or chestnut coal, $6.75 per ton, net; furnace coal, $6.50, net. Bituminous or soft coal: Run of mine, Nova Scotia coal, carload lots, basis, Montreal, $3.85 to $4 per ton; cannel coal, $9 per ton; coke, single ton, $5; large lots, special rates, approximately $4 f.o.b., cars, Montreal

Copper.—Prices are strong at 13¾ to 14c.

Explosives and Accessories.—Dynamite, 50-lb. cases, 40 per cent. proof, 15c. in single case lots, Montreal. Blasting powder, 25-lb. kegs, $2.25 per keg. Special quotations on large lots of dynamite and powder. Detonator caps, case lots, containing 5,000, 75c. per 100; broken lots, $1; electric blasting apparatus:—Batteries, 1 to 10 holes, $15; 1 to 20 holes, $25; 1 to 30 holes, $35; 1 to 40 holes, $50. Wire, leading, 1c. per foot; connecting, 50c. per lb. Fuses, platinum, single strength, per 100 fuses:—4-ft. wires, $3; 6-ft. wires, $3.54; 8-ft. wires, $4.08; 10-ft. wires, $5.

Galvanized Iron.—The market is steady. Prices, basis, 28-gauge, are:—Queen's Head, $4.10; Colborne Crown, $3.85; Apollo, 10¾ oz., $4.05. Add 25c. to above figures for less than case lots; 26-gauge is 25c. less than 28-gauge, American 28-gauge and English 26 are equivalents, as are American 10¾ oz., and English 28-gauge.

Galvanized Pipe.—(See Pipe, Wrought and Galvanized).

Iron.—The market is steady and prices unchanged. Following are the prices, on cars, ex-wharf, Montreal:—No. 1 Summerlee, $20.50 to $20.75 per ton; selected Summerlee, $20 to $20.25; soft Summerlee, $19.50 to $19.75; Carron, special, $20 to $20.50; soft, $19.50 to $20; Clarence, $17.25 to $17.50; Cleveland, $17.25 to $17.50 per ton.

Laths.—See Lumber, etc.

Lead.—Prices are easier, at $3.35 to $3.45.

Lead Wool.—$10.50 per hundred, $200 per ton, f.o.b., factory.

Lumber, Etc.—Prices on lumber are for car lots, to contractors, at mill points, carrying a freight of $1.50. Red pine, mill culls out, $18 to $22 per 1,000 feet; white pine, mill culls, $16 to $17. Spruce, 1-in. by 4-in. and up, $15 to $17 per 1,000 ft.; mill culls, $12 to $14. Hemlock, log run, culls out, $13 to $15. Railway Ties; Standard Railway Ties, hemlock or cedar, 35 to 45c. each, on a 5c. rate to Montreal. Telegraph Poles: Seven-inch top, cedar poles, 25-ft. poles, $1.35 to $1.50 each; 30-ft., $1.75 to $2; 35-ft., $2.75 to $3.25 each, at manufacturers' points, with 5c. freight rate to Montreal. Laths: Quotations per 1,000 laths, at points carrying $1.50 freight rate to Montreal, $2 to $3. Shingles: Cedar shingles, same conditions as laths, X. $1.50; XX, 2.50; XXX, $3.

Nails.—Demand for nails is steady and prices are: $2.40. per keg for cut, and $2.35 for wire, base prices. Wire roofing nails, 5c. lb.

Paints.—Roof, barn and fence paint, 90c. per gallon; girder, bridge, and structural paint for steel or iron—shop or field—$1.20 per gallon, in barrels; liquid red lead in gallon cans, $1.75 per gallon.

Pipe.Cast Iron.—The market shows a steady tone although demand is on the dull side. Prices are firm, and approximately as follows:—$32 for 6 and 8-inch pipe and larger; $33 for 3-inch and 4-inch at the foundry. Pipe, specials, $3 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

Pipe.—Wrought and Galvanized.—Demand is about the same, and the tone is firm, though prices are steady, moderate-sized lots being: ¼-inch, $5.50, with 63 per cent. off for black, and 48 per cent. off for galvanized; ⅜-inch, $5.50, with 59 per cent. off for black, and 44 per cent. off for galvanized; ½-inch, $8.50, with 69 per cent. off for black, and 59 per cent. off for galvanized. The discount on the following is 71½ per cent. off for black, and 61½ per cent. off for galvanized; ¾-inch, $11.50; 1-inch, $16.50; 1¼-inch, $22.50; 1½-inch, $27; 2-inch, $36; 2½-inch, $57.50; 3-inch, $75.50; 3½-inch, $95; 4-inch, $1.08.

Plates and Sheets.—Steel.—The market is steady. Quotations are: $2.20 for 3-16; $2.30 for ⅛, and $2.10 for ¼ and thicker; 12-gauge being $2.30; 14-gauge, $2.15; and 16-gauge, $2.10.

Rails.—Quotations on steel rails are necessarily only approximate and depend upon specification, quantity and delivery required. A range of rails, per gross ton of 2,240 lbs., f.o.b. mill. Re-laying rails are quoted at $27 to $29 per ton, according to condition of rail and location.

Railway Ties.—See lumber, etc.

Roofing.—Ready roofing, two-ply, 70c. per roll; three-ply, 95c. per roll of 100 square feet. Roofing tin caps, 6c. lb.; wire roofing nails, 5c. lb. (See Building Paper; Tar and Pitch; Nails, Roofing).

Rope.—Prices are steady, at 9c. per lb. for sisal, and 10½c. for Manila. Wire rope, crucible steeel, six-strands, nineteen wires; ¼-in., $2.75; 5-16, $3.75; ⅜, $4.75; ½, $5.25; ⅝, $6.25; ¾, $8; ⅞, $10; 1-in., $12 per 100 feet.

Spikes.—Railway spikes are steady, at $2.45 per 100 pounds, base of 5½ x 9-16. Ship spikes are steady at $2.85 per 100 pounds, base of ⅝ x 10-inch, and ⅝ x 12-inch.

Steel Shafting.—Prices are steady at the list, less 25 per cent. Demand is on the dull side.

Telegraph Poles.—See lumber, etc.

Tar and Pitch.—Coal tar, $3.50 per barrel of 40 gallons, weighing about 500 pounds; roofing pitch, No. 1, 70c. per 100 pounds; and No. 2, 55c. per 100 pounds; pine tar, $8.50 per barrel of 40 gallons, and $4.75 per half-barrel; refined coal tar, $4.50 per barrel; pine pitch, $4 per barrel of 180 to 200 pounds. (See building paper, also roofing).

Tin.—Prices are firm, at $34 to $34.50.

Zinc.—The tone is easy, at 5¾ to 6c.

CAMP SUPPLIES.

Beans.—Prime pea beans, $2 to $2.25 per bushel.

Butter.—Fresh made creamery, 22¾ to 23½c.

Canned Goods.—Per Dozen.—Corn, 80 to 85; peas, $1.05 to $1.15; beans, 85c.; tomatoes, 85 to 90c.; peaches, 2s, $1.65, and 3s, $2.65; pears, 2s, $1.60, and 3s, $2.30; salmon, best brands, 1-lb. talls, $1.87½, and flats, $2.02½; cheaper grades, 95c. to $1.65.

Cheese.—The market ranges from 10¾ to 11½c., covering all Canadian makes.

Coffee.—Mocha, 20 to 25c.; Santos, 15 to 18c.; Rio, 10 to 12c.

Dried Fruits.—Currants, Filiatras, 5¾ to 6½c.; choice, 8 to 9c.; dates, 4 to 5c.; raisins, Valentias. 5 to 6¼c.; California, seeded, 7½ to 9c.; Evaporated apples, prime. 8 to 8½c.

Eggs.—No. 1 eggs are 19 to 20c.; selects, 22 to 25c.

Flour.—Manitoba, 1st patents, $6.30 per barrel; and patents, $5.80; strong bakers', $5.60.

Molasses and Syrup.—Molasses, New Orleans, 27 to 28c.; Barbadoes, 40 to 45c.; Porto Rico, 40 to 43c.; syrup, barrels, 3½c.; 2-lb. tins, 2 dozen to case, $2.50 per case

Potatoes.—Per 90 lbs., good quality, 65 to 75c.

Rice and Tapioca.—Rice, grade B., in 100-lb. bags, $2.75 to $2.80; C.C., $2.65. Tapioca, medium pearl, 5½ to 6c.

Rolled Oats.—Oatmeal, $2.20 per bag; rolled oats, $2, bags.

Sugar.—Granulated, bags, $5.05; yellow, $4.65 to $5. Barrels 5c. above bag prices.

Tea.—Japans, 20 to 38c.; Ceylons, 20 to 40c.; Ceylon, greens, 19 to 25c. China, green, 20 to 50c.; low-grades, down to 15c.

Fish.—Salted. Medium cod, $7 per bbl.; herring, $5.25 per bbl.; salmon, $7 per half barrel. Smoked fish.—Bloaters, $1.10 per large box; haddies, 8c. per lb.; kippered herring, per box, $1.20; new smoked herring, 13c. per box.

Provisions.—Salt Pork.—$24 to $31 per bbl.; beef, $18 per bbl.; smoked hams, 17 to 21c. per lb.; lard, 15½ to 17c. for pure, and 12½ to 14c. per lb. for compound

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Toronto, September 22nd, 1910.

Pig-iron shows a steady, almost brisk, movement, but in parcels for the most part small. Copper is firmer in London, but tin has received some battering, and is a cent cheaper in this market.

Lumber moves freely, and there are not a few orders for British Columbia squared product of unusual dimensions. Cement, bricks, roofing, building paper and felt, maintain their prices, and much building continues.

Dairy products show a continued demand; lard and meats are steady; vegetables growing daily more plentiful, and we have revised our list downward.