PAGES

MISSING

Contents of this issue on page 683

THE CANADIAN ENGINEER

An Engineering Weekly.

Statement as to Electric Light and Power Rates in various places in Canada.

Together with Prices from one United States City.

		Street Lights, per Arc Lamp.	Power, per Horse Power.	Arc Lamps, for Commercial Use.	Meter Rate, for Private Lighting, per K.W. hour net.	Meter Rate, for Commercial Lighting, per K.W. hour net.	Flat rate, for Commercial Lighting, per 16 Candle Power Lamp.
					c.	c.	
Brantford	Company	$55 00	$30 to $63	.....	$8\frac{1}{10}$	$8\frac{1}{10}$	.....
Brockville	Municipal	62 50	.....	$105.00	10	10	$9 down
Buffalo, N.Y.	Company	75 00	$28 to $53	.....	10	*4 to 12	.....
Calgary	Municipal	156 00	$*4\frac{9}{10}$ to $5\frac{95}{100}$ per K. W. hour	.....	$10\frac{1}{5}$	$7\frac{8}{10}$ to $10\frac{4}{10}$	$9.00
Cornwall	Company	82 12	$20 to $30	$73.00	$13\frac{1}{2}$	$13\frac{1}{2}$	$5.40
Edmonton	Municipal	*5c. per K.W. hour	$*3\frac{1}{2}$c. to 8c. per K.W. hour	*7 c. per K.W. hour	$7\frac{1}{2}$	$7\frac{1}{2}$	.....
Fredericton, N.B.	Company	.....	.....	.....	12	12	.....
Fort William	Municipal	45 00	$25 00	$*6\frac{3}{10}$c. per K.W. hour	$6\frac{3}{10}$	$6\frac{3}{10}$	.....
Galt	Company	75 00	.....	$52.00	12	.....	.....
Guelph	Municipal	60 00	*3c. to 5c. per K.W. hour	$73.00	10	10	.....
Halifax	Company	65 00	$*11\frac{1}{4}$c. per K.W. hour	.....	15 with 10 p.c to 25 p.c. dis.	15 with 10 p.c. to 25 p.c. dis.	....
Hamilton	"	47 50	*1c. to 3c. per K.W.hour A.C. $40 to $80 D.C.	$*4\frac{5}{100}$c. per K.W. hour and $12.00	$*5\frac{04}{100}$ to $7\frac{65}{100}$	.....	$1.20 and $*4\frac{5}{100}$ per K.W. hour
Kingston	Municipal	60 00	*5c. to 10c. per K.W. hour	.....	10	10	.....
London, Ont.	Company	83 95	.....	.....	9	.....	.....
Montreal	"	60 00	$30 to $70 A.C. $95 to $120 D.C.	.....	$7\frac{1}{2}$ to $13\frac{1}{2}$	$7\frac{1}{2}$ to $13\frac{1}{2}$	....
Niagara Falls, Ont.	Municipal	85 00	$20 00	....	$4\frac{1}{2}$	.....	$2.64
Owen Sound	"	51 00	.....	.....	$7\frac{1}{2}$ to 10	$7\frac{1}{2}$ to 10	.....
Ottawa	"	45 00	$17 50 limited $25 00 A.C. $30.00 D.C.	$30 limited $36 unlimited	$7\frac{1}{5}$	$7\frac{1}{5}$	$2.52
Pembroke	Company	55 00	.....	.....	8 to 12	.....	$3.60 to $6.00
Peterborough	"	50 00	$20 to $40	*10c. per K.W. hour	$7\frac{1}{2}$	10	$3.00
Port Arthur	Municipal	48 00	$25.00	$45.00	6 to 10 with discount	.....	$2.88
Quebec	Company	62 10	.....	.....	12	12	....
Regina	Municipal	87 50	.....	.....	8	8	.....
St. John, N.B.	Company	75 00	*5c. to 10c. per K.W. hour	*10c. per K.W. hour	10 to $13\frac{1}{2}$	10 to $13\frac{1}{2}$	.....
Sherbrooke	Municipal	60 00	$24 to $60	$*9\frac{1}{2}$c. per K.W. hour	$9\frac{1}{2}$	.....	$5.70
St. Thomas	"	91 25	*7c. per K.W. hour	$91.25	10	10	.....
St. Catharines	Company	50 00	.....	$35.04	7	7	.....
Toronto	"	69 35	$30 to $90	*12c. per K.W. hour	8	12	.....
Windsor	Municipal	.....	.....	$72.00	....	.....	.....
Victoria, B.C.	Company	.....	*2c. to 7c. per K.W. hour	.....	8 to 12	.....	.....
Vancouver	"	38 00	*2c. to 7c. per K.W. hour	*3.00 and 3c. to 10c. per K.W. hour	*3 to 10	*3 to 10	.....
Winnipeg	"	61 12	$*2\frac{7}{10}$c. to $5\frac{4}{10}$c.	*9c. per K.W. hour	9	9	.....

Where there are blanks, prices are not obtainable, or services not given.

*Rates marked thus, reduced to same basis as Ottawa Municipal rates, are greater than the latter.

1 cent per K.W. hour for power=$23.00 per horse power. 1 cent per K.W. hour for Arc lamps=$15.00 per lamp.

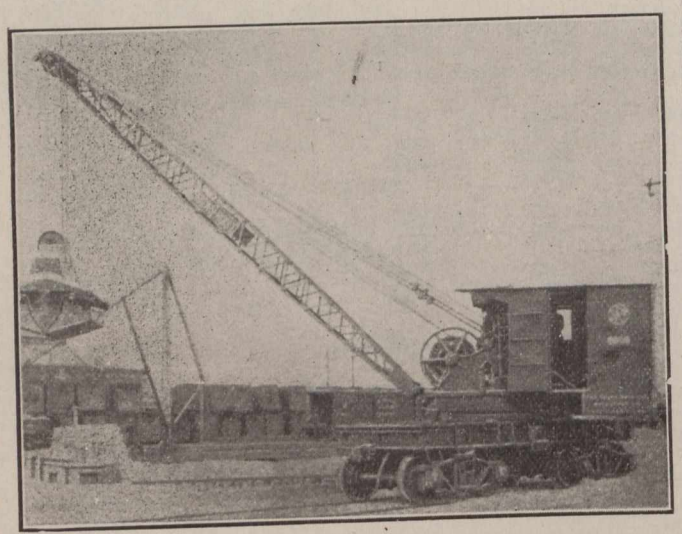
THE ECONOMICAL MAINTENANCE OF TRACKS AND ROADWAYS.*

By Martin Schreiber, Engineer Maintenance of Way, Public Service Railway Company, Newark, N.J.

Probably no department of the street railway industry offers more possibilities for improvement in maintenance and construction than that of the track and roadway, and the fact is now just becoming thoroughly appreciated by managements. It is well known that the resources of trackmen have been in great part in the past supplied from the odds, ends and scrap of the other departments. This results in track equipment of shocking inefficiency, and it is not surprising that it is reflected in the cost of the up-keep when extended over a term of years. The writer appreciates that this subject is too broad to be covered entirely in a single paper, but it is proposed to bring out only some of the most important features.

Headquarters.

On account of the rough and heavy nature of the material used in the execution of the work for tracks and paving, adequate yard room should be provided for the way department. Suitable space is necessary for a neat and orderly storeroom, shop space for ties, rails, special work, paving material, and other accessories, so that they may be properly stored, or racked up and spaced, in order that the material may be economically handled and intelligently checked. The way department should have quarters large enough to allow of purchasing material in quantities and storing it in advance. Such an arrangement is the only guard against delays. It insures the advantage of getting proper supplies, and gives time to buy them under correct specifications and careful inspection, thereby obtaining the benefit of honest competition and of getting the best for the least outlay. The location of the yard should be convenient to the centre of distribution for the system, at the same time providing a steam road siding. Extra hauling charges would soon pay the interest on an investment for a location of a proper size, to say nothing of the inconvenience and loss of time. Size and fitness may only be determined by the amount of work to be done.



Economical Track Maintenance—Locomotive Crane.

* Abstract of paper presented as Appendix B of Report of Committee on Way Matters, American Street and Interurban Railway Engineering Association, Atlantic City, N.J., October 10th to 14th, 1910.

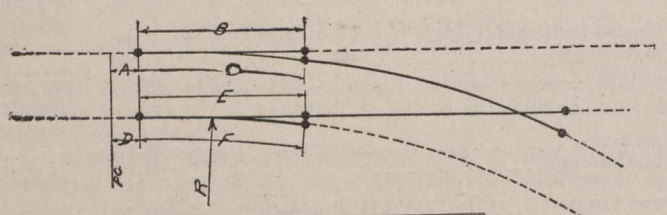
Yard Machinery.

Few street railway companies can afford to be without some power machinery for unloading heavy material from the steam cars and loading it again on the work cars. The first step in this direction is the use of a stationary derrick. A good design has a 45-ft. boom, a 50-ft. mast, and handles 4-ton loads with boom fully extended. The operating engine is driven by a 40-h.p. 500-volt d.c. motor, and has four main drums that provide for boom, load, revolving line and extra drum for closing line in case a clam-shell bucket is required. Such a machine is entirely under the control of one man, and costs installed complete approximately $2,500.

The locomotive crane illustrated represents the highest type of machine for loading and unloading material. It is not only speedy and substantial for handling the supplies, but on its own power operates over the tracks and at the same time may be used to push steam or flat cars. The purchaser of such a crane for yard work should be careful to get one with a boom of such a length that the machine may operate through a radius of at least 35 ft., and the requisite number of drums should be provided for taking care of the possibilities of equipping the machine with a bucket or clam-shell for handling coal, sand or crushed stone.

Work-car Equipment.

The cost of repairs to the tracks and roadway is very materially reduced by hauling all supplies by work-cars or trains. Instead of a discarded passenger car, which seems to have been the standard in the past for the track engineer, the most substantial car and equipment that can be obtained are recommended. Motor work-cars equipped with power cranes are exceptionally economical for gathering up scrap, rail and special work; handling bridge timbers and other heavy pieces which would otherwise require a large number of men; also they serve the purpose of the work cars, as material may be carried on them to and from the yards, as well as be conveniently and cheaply handled on and off the work. The ordinary railway would, in a comparatively short time, save the investment required for a proper crane-car. For the smaller road the crane-car could do all the lifting work in the yards as well as out on the tracks. In selecting a crane-car precaution should be observed to get the hoisting apparatus from a recognized company making a specialty of this class of machinery. Some home-made cranes. mounted on a scrapped passenger car, take so many men to work the apparatus, and lose so much time doing it, that the outfit is often little in advance of the hand method.



Standard Switches and Mates

Stated Radius	R for all Gages	Dimensions A	B & C	D	E & F
50' Lateral	47'7½"	-6"	10'0"	-6"	10'0"
75' "	72'7½"	0"	12'0"	0"	12'0"
100' "	97'7½"	0"	12'0"	0"	12'0"
150' "	147'7½"	12"	14'0"	12"	14'0"
200' "	197'7½"	18"	15'0"	18"	15'0"
100' Wye	97'7½"	-6"	10'0"	-6"	10'0"
150' "	147'7½"	0"	12'0"	0"	12'0"
200' "	197'7½"	0"	12'0"	0"	12'0"
350' "	347'7½"	12"	15'0"	12"	15'0"

Note- It is recommended that the 100 foot Radius Lateral and 200 foot Radius Wye, shall be used wherever Practicable. It will rarely be found necessary to use others.

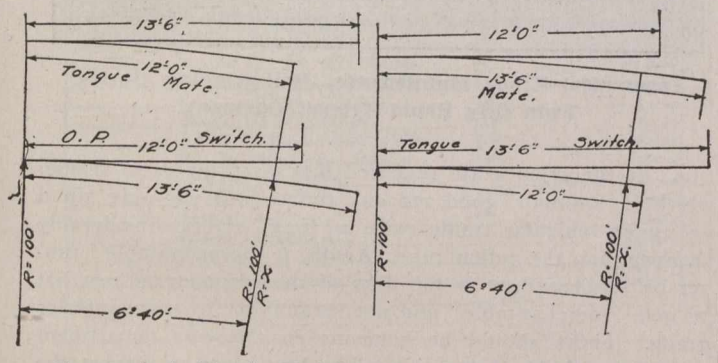
Economical Track Maintenance—Table of Proposed Standard Switches of Different Radii.

Shops.

Only the largest roads require special shops for the track department, except a smithing shop to take care of the tools, make temporary plates, bend rail, and the like. Other work, such as making split switches and frogs, may be taken care of by the mechanical department, an arrangement that is fairly satisfactory if there is proper co-operation. For urban properties, the large use of manganese for specials has minimized the local shop work to a large degree. Some companies bend a large proportion of their own track curves. An hydraulic rail-bender is a fair substitute for a power bender.

Standards.

The adoption of standards to meet particular conditions is strongly recommended because of the importance not only of keeping the stores and stocks down to a minimum, but of increasing the general efficiency of the work executed. Laborers, skilled or unskilled, after handling the same type of rail, special work and accessories naturally become more proficient in making repairs, and not only is the work done better and more quickly, and, therefore, more cheaply, but also without requiring the strict supervision and inspection that would otherwise be necessary. Moreover, there is a material saving to be effected by being able to make proper repairs promptly.



Economical Track Maintenance—100-ft. Inside Radius Switch Pieces with Broken Joints.

It might be well to briefly consider special work. The maintenance of track and roadway for urban roads amounts to as much as $600 per mile per year. One hundred and fifty dollars, or 25 per cent. of this, would be a fair average for special work, including the installation and paving. Hence the importance of a close study of this item. Guard-rails should be standard to fish with the regular rail section, without compromise joints. Little may be accomplished in getting standard frogs, except for cross-overs or turnouts, but it is well to have standard switch pieces, standard at least as to lengths and radii. It would not be very practicable to standardize the details of design. A standard switch makes it convenient in replacement for any location. The switches may be shifted around without cutting in and out the straight rail. Also, with a few switches in stock, renewals may be made at any time, which is no small item when special work exists with switches of varying lengths and radii. It appears that a 100-ft. radius switch is satisfactory for many urban roads and its possibilities are illustrated by one lay-out, in which, under many conditions, 186 standard switches and mates were utilized.

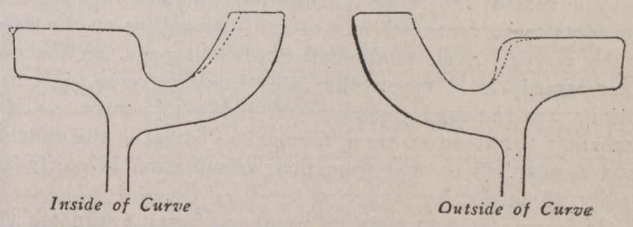
Accompanying sketches show 100-ft. inside radius switch pieces with joints broken, and a table gives dimensions of the proposed standard switches of different radii that were recommended by the special work manufacturers, consisting of the Wharton Steel Company, Lorain Steel Company, Pennsylvania Steel Company, New York Switch and Crossing Company, Cleveland Frog and Crossing Company, Buda Company, and Barbour-Stockwell Company. Another table, on the following page, gives a list of proposed standard frogs, designating the frogs by numbers, following steam road practice, which is to be commended.

One illustration shows a 100-ft. radius switch applied to make up a standard cross-over. In the cross-over for a distance between tracks of more than 4 ft. 10 in. two jump frogs may be used; otherwise one jump frog. Open-point switches, or switches on the outside curve, should be utilized where the cross-over is seldom used, as in this case the mate will last longer than the switch in the main line track.

It was interesting to note that from the records of one of the large manufacturers it was shown that over half of all the switches ordered were of 100-ft. radius; also that very few data sheets showed that any of the street railway companies favored spiral switches.

The use of solid manganese for switches, mates, frogs and curves is steadily increasing. There is no doubt that in the case of any curve of 75-ft. radius or less for permanent street work money is eventually saved by using the solid manganese rail.

Illustrations show cast manganese steel guard-rails that have been in service since February, 1908. The old curve was Bessemer, and if renewed with same material it would now be ready for replacement for the second time. From



Economical Track Maintenance—Cross Sections of Cast Manganese Guard-rails Showing Wear.

the experience of the Interborough Rapid Transit Company, of New York, there seems little doubt that the open-hearth rail of 0.75 per cent. carbon is very superior to the present market Bessemer steel.

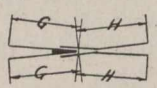
For city traffic the solid manganese switch is gaining favor. It means an additional cost of probably one-third to one-half, yet the advantage of a one-piece casting, with manganese arms, as well as other wearing parts, appeals to the ordinary engineer, as the switch pieces of the hardened centre type often batter down and fail at the arms if the joints are not first class. Another point in favor of solid work is that those who have used the special work speak favorably of it, and are still ordering. This is not true, however, for the solid manganese frogs. Undoubtedly, since the frog wears away at the point, it seems rather extravagant to scrap the whole piece of material whose first cost is ten times as much as it is worth in scrap. Therefore, the solid frog is not recommended at this time in preference to the hardened centre one. Of course, the frogs referred to above are understood to be those found in turn-outs and branch-offs rather than crossing frogs with the larger angles. For crossing frogs at intersection of two trolley roads, in case of severe traffic, solid manganese construction is preferable.

Corrugations.

Few maintenance troubles have attracted so much attention and study as corrugations in rails. We are having more corrugations than ever before, and the problem is to get rid of what we have in the large quantity of rail that

is now in service, and to do it in the most efficient and inexpensive way. One of the simpler methods of removing corrugations is by means of an ordinary file or emery block set in a frame and operated by hand. The Twin City Rapid Transit Company, Minneapolis, Minn., uses a device which consists of a holder for carborundum blocks which are rubbed back and forth over the rail by a car to which the device is attached. Power-operated grinders also are used by some roads

The Detroit United Railway Company is using a rail-grinder devised by John Kerwin, superintendent of tracks. Two emery wheels are attached to a swinging frame, projecting out from the car and over each rail. The frame is kept in adjustment by means of a screw arrangement and a flat shoe that rests and slides along the rail, so that the



No. of Frog	Angle	Arm Length G	Arm Length H
#4	14°16'	4'-0"	4'-0"
#5	11°25'	4'-6"	4'-6"
#6	9°32'	5'-0"	5'-0"
#8	7°-3'	5'-6"	5'-6"

Economical Track Maintenance—Table of Proposed Standard Frogs for Turn-outs and Cross-overs.

emery wheel cuts level. The car is also equipped with regular propelling motors.

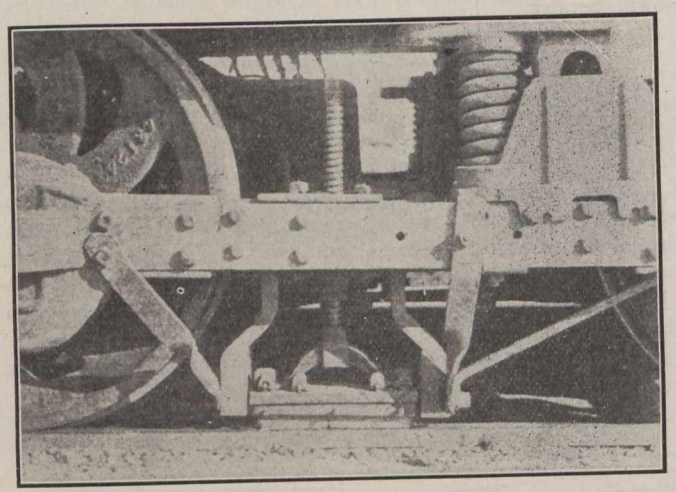
The cost of removing corrugations in rails varies from a few cents to 50 cents per foot of rail, depending on the depth of the waves. Even at the latter price it pays, as the only other remedy is to renew the rail. Luckily, once the corrugations are removed they are not likely to return, so it is important to attend to their removal as soon as the indentations appear, as at that time their elimination is easily and readily affected.

It is now held by a large number of way engineers that all joints should be ground when first installed. There is no question that a joint should not be left if there is any variation whatsoever between the running surfaces of abutting rail ends. Once the wheels have an opportunity of pounding the rail the receiving side will rapidly cup out and the track will fail. Rail could have its life considerably extended if, as soon as the joints began to pound, the plates were pulled up and the rail so ground that the abutting rail ends were a true, level surface. Such practice should be resorted to instead of neglecting the joints to such an extent that nothing can be done except lose the rail or apply some expensive method in reclaiming it.

The practice of making home-made offset or compromise joints should be discouraged. It is not practicable for the ordinary smith to make compromise plates for rail that are fit to use.

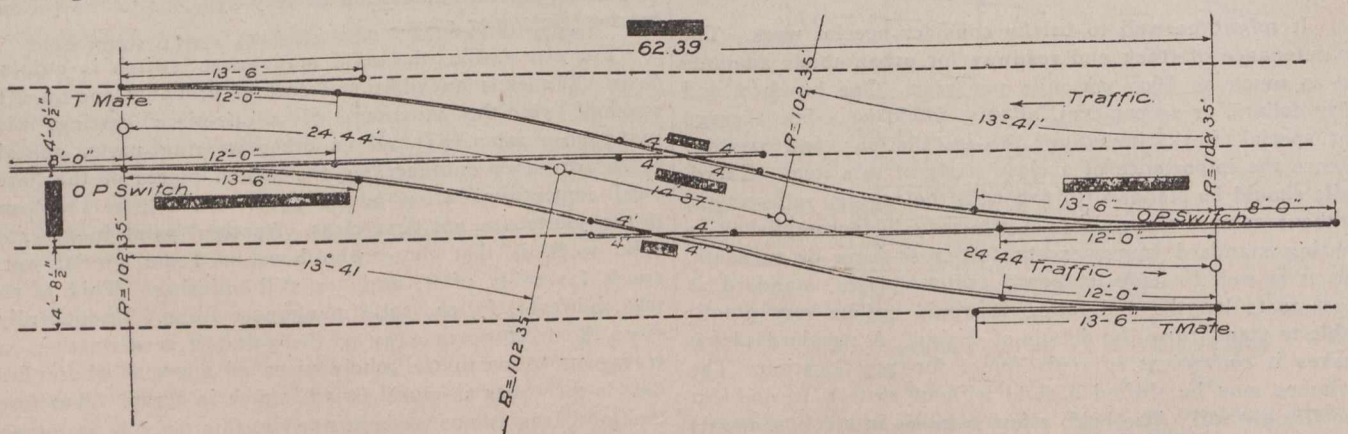
Ties and Structural Timber.

In no material has a greater waste been permitted than in structural wood for railways. Even without preservative treatment, a good deal may be accomplished by purchasing under proper specifications and intelligent inspection. In crossing planks it is often the practice to purchase "merchantable" yellow pine, regardless of what is the cause of renewals, whether due to traffic wear or natural deterioration. If the repairs are rendered necessary by street traffic, which is common, good red oak timber will not only stand up under vehicular traffic twice as long, but is considerably cheaper than the yellow pine. Again, if "merchantable" timber be purchased, it is the duty of the engineer to see that he gets "merchantable" and not "standard" or some inferior grade. There should be someone in the way department trained for timber inspection. The best place to inspect the timber is at the mills or point of shipment. Few dealers will object as much to having 50 per cent. of the proposed order cancelled at the yards as they will to have 10 per cent. rejected at delivery point.



Economical Track Maintenance—Rail-grinding Device, Twin City Rapid Transit Company.

It is now generally conceded that it pays to treat timber with some accepted preservative, especially when the cheaper woods may be used. The pressure method is no doubt the most reliable, but unfortunately it costs the most, and the work must be done outside, as few railroad companies can afford to own a treating plant. Trestles, bridges, ties, and



Economical Track Maintenance—Application of 100-ft. Radius Switch to Standard Cross-over.

the like have their life extended by even a simple dipping treatment in a hot bath of coal tar distillate.

When a thoroughly seasoned tie is immersed for twenty minutes in a hot preservative at 220 deg. Fahr. the liquid fills all the crevices, and creates an antiseptic fungi-resisting zone around the stick; also gives a penetration of at least 3-16 in. in the solid sap wood. A deeper penetration may be obtained by placing the tie in a cold bath of creosote or a solution of zinc chloride after it is removed from the hot bath. Indeed, it is possible by this method to obtain complete penetration of the sap wood in such woods as the pines and the gums. It is well to use sound and square-edge yellow pine ties for treating, and if any commercial creosote is used, to specify coal tar creosote, after the specification of the American Railway Engineering and Maintenance of Way Association. If the dipping process is resorted to, a high distillate of coal tar should be used. Ties and all lumber should be thoroughly seasoned before being used. A tie treated by pressure with ten pounds of coal tar creosote per cubic foot of timber is increased in price 40 to 45 cents; treated by open tank to eight pounds per cubic foot, about 30 cents, and treated by dipping in hot coal tar distillate, about 25 cents. If sound and square yellow pine tie were

Job No. 74 Account No. 101A Auth No

Department Maintenance of Way July 29 1910

ESTIMATE for Repairing and paving on Bridge St. Elizabeth from Arch to West Jersey St.

8	60 ft. 116-434 Rails	66	31680
240	6x8x8 Creosoted Ties	84	20160
240	7" Rail Braces	25	6000
3 kegs	5/16x5 Spikes	360	10800
8 pairs	Continuous Joint Plates	400	32 00
16	36" 4/0 Crown Bonds	75	1200
50 yards	1½" Stone	100	5000
50 bbl	Cement	135	6750
25 yds	Sand	50	1250
Labor, Hauling etc			7000
Paving			50000
			$1463 —

This Job Order to be closed into Permanent Job Order No 117-

Total Estimate

Approved

Gen'l Manager Head of Dep't

Economical Track Maintenance—Form of Estimate of Cost of Track Repairs.

bought at 45 cents, the total cost of the tie with the above treatment would be approximately 85, 75 and 70 cents, respectively.

Crushed Stone.

On account of the extensive use of crushed stone or gravel in some form as ballast, paving foundation and paving, any of the large companies could show a saving in maintenance by acquiring a gravel-producing plant or a stone quarry.

One company has a stone crusher mounted on a work-car. This may be moved about the road, crushing up old paving block and the like on the street, and will show a saving in its proper field. About 50 yards of 1½-in. stone may be made for a day's work out of old paving blocks at a cost of approximately 40 cents per cubic yard. A jaw crusher is mounted on an old car and driven with a G.E. 1,200 railway motor, rewound as a shunt motor.

Paving.

Paving comprises one-third of all the maintenance costs of track and roadway. As the work requires skilled labor it offers the best field for piece work. Some companies contract the paving, it being a very good plan to anticipate the important repairs at the beginning of the season, and then to take figures for the various paving from different contractors on a unit or yardage basis. When asphalt is required, creosote wood block should be substituted, if possible, or at least a block header or binder course should be used just adjacent to the rail. It should be kept in mind that a cheap pavement, such as macadam, when under heavy traffic, is a great deal more expensive to maintain than a permanent block pavement.

In removing old granite or stone block pavement it may be reclipped, and when used again makes a first-class pavement at a considerably smaller cost than if new block were used.

STANDARD SYMBOLS.

Rubble uncoursed.	Property lines.	Public Crossing	Trolley Pole.
Rubble in mortor.	Property line foreign	Private Crossing	Trolley P. foreign
Brick	County lines.	Private and 2ndry road.	Telegraph pole.
Ashlar Masonry.	Township lines.	Streams.	Telephone pole
Dressed Masonry.	City lines.	Canals.	Electric light pole
Concrete & Steel.	Street or block lines.	Roads	Combination pole
Concrete.	Cattle guard.	Contour lines.	Catch basin
Solid rock.	Original center line.	Hitching post.	Arc. lamp.
Seamy rock.	Survey lines and points	Dimension lines.	Incandescent lamp.
Earth.	U.S. Harbor lines.	Block Signal.	Gas lamp
Sand	Turnstile	Signal line.	oil lamp
Gravel.	Railroad under construction	Present track.	Hydrant.
Marsh.	Railroads	Proposed track.	Manhole.
Mud.	Street railroad	Foreign track.	Meter.
Stone ballast.	Surface & Grade line.	Abutments Walls etc.	Riser.
Cinder ballast	North point	Bottom of Slope.	Valve.
Timber.	Bldgs and Villages	Top of Slope.	Wagon Scale.
Water.	Cities and Towns	Cribbing.	Power house.
Glass	Bench mark.	Road Crossing.	Gas holder
Tree.	Triangulation Station.	Track Scales.	Gas generator
Water pipe.	Monument.	Interlocking tower.	Sub. Station
Conduit	Transit point.	Compressed air box	Car barn
Steam pipe.	Telegraph line	Track drain	Draw bridge
Compressed air pipe.	Mail Box	Watering Trough.	Culvert
Compressed air Station.	Embankment	Derail Derail lever	Truss
Sewer pipe.	Cut	Switch Stand.	Trestle

Economical Track Maintenance—Standard Symbols Suggested for Use of Way Department.

Of all the block pavements the granite is to be preferred, on account of having best wearing qualities. It is of interest to note that in New York it was found that the cost of repairs with large blocks on streets under heavy traffic was much less than with the smaller block paving; also that the costs of the various pavements per square yard per year were as follows: Sheet alphalt, 55 cents; wood block, 45 cents, and granite, 27 cents. Grouted joints with brick or stone block make the paving less susceptible to economical repairs. For this reason many prefer the sand or gravel and tar joints.

Minimum maintenance may only be effected by careful study through an efficient and systematic method of accounting. Records should be intelligently and conveniently kept, and in sufficient detail to allow a most thorough analysis. Probably the job order system represents the most advanced practice. With this arrangement, whenever the roadmaster, or whoever has responsible charge of the particular piece of trackage, thinks it is necessary to make repairs, he makes out an estimate, as shown, and it is forwarded to the engineer, or the head of the department. If the engineer approves the expenditure, the job order is sent to the general manager or next responsible officer, and if the work is thought to be desirable it is authorized. A copy of this job order is sent to the storekeeper, the chief timekeeper and the auditor. At the end of the year it is possible to add all the job orders and account for the entire expenditure on definite sections of trackage, and so by analysis be able to tell whether or not the expenditure is justifiable.

The stores account requires intelligent supervision, the special work, rails, ties, paving stones being as carefully accounted for as all the smaller supplies. Until this is done accurately, no accounting system will be effective. The engineering office records should be complete. Accurate records should be kept of each special piece for comparison and for study in making renewals. On large roads it is certainly desirable to have a proper index system, so that the drawings and all records may be speedily produced. Standard survey notes should be easy, readable and systematic. One illustration shows a suggested list of symbols that are applicable to an electric railway.

Conclusions.

I. Proper organization and ample headquarters for the way department, including proper facilities for shipping material, storing supplies, a shop and offices, are necessary.

II. Suitable unloading and loading machinery is desirable; a stationary derrick or locomotive crane may often be economically utilized.

III. Eliminate teaming and trucking as far as possible and use work cars.

IV. (a). Provide proper equipment. The motor work cars to be built preferably with steel body framing, especially heavy trucks, motors and independent air brakes.

(b) A motor car with an electrically operated crane is recommended where the scope of the work will permit, crane-car to be used either in yards or on the street. It may also include clam-shell bucket to handle sand or crushed stone.

V. (a) Standardize where possible and consistent with conditions; use standard switch pieces in special work.

VI. (a) Grind the rail at all joints where there is not a true running surface of abutting rail ends.

(b) Compromise joints should always be avoided where possible. Home-made compromise joints should not be used.

(c) Grind out corrugations as soon as the indentations appear.

VII. (a) Purchase supplies, including lumber, under a proper specification and inspection.

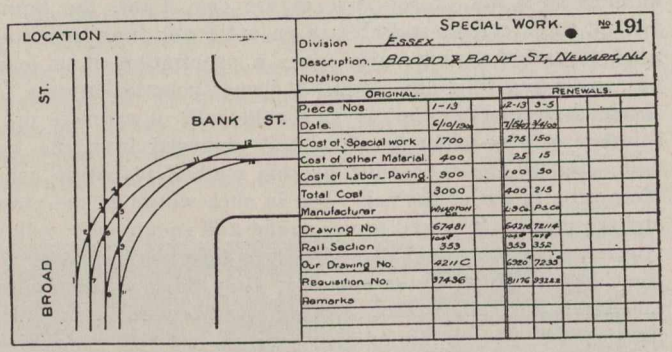
(b) Treat ties and structural timber for permanent work with an accepted method and preervative.

VIII. Consider owning a gravel or crushed stone producing plant.

IX. (a) Consider doing own paving or any other work where practicable by the piece-work system.

(b) Also consider contracting paving on a unit basis.

X. Adopt a proper accounting system for convenience and thorough auditing and analysis to obtain a minimum maintenance cost—use the job order system or its equivalent.



Economical Track Maintenance—Index Card for Engineering Department Files.

XI. (a) Compile accurate, convenient and complete engineering records, including a physical survey of the tracks and roadway.

(b) Make standard drawings, properly indexed and filed.

(c) Surveys and reports should be made intelligent and complete, and systematized with standard signs and symbols.

RESULTS OF AN EXAMINATION OF THE STEEL WORK IN A FOUNDRY BUILDING TEN YEARS OLD.

An examination of the steel work of a foundry building was recently made by Lockwood, Greene & Co., of Boston, and portions of their report contains matter of much general interest regarding the depreciation of structural steel work.

The structure inspected is of conventional steel mill building design, 500 ft. long and 120 ft. wide, three bays.

The south bay contains two 5-ton cranes of 30 ft. span. In the 60-ft. central bay there are four cranes, two 10-ton, one 20-ton, and one 30-ton. The 30-ft. north bay is equipped with one 5-ton crane for a portion of its length. The furnaces are located at the west end of the building in the south side bay, which is widened to 40 ft. for a length of about 80 ft. to accommodate them.

The following extracts from the report indicate the condition of the steel work ten years after the erection of the building. The reader is left to draw his own conclusions. We quote:—

"In inspecting the steel work a most rigid examination was made wherever the eye or hammer showed cause for suspicion, the scale, if any, being chipped off and the remaining metal scraped.

"No evidence could be found of any damage from gases. The steel columns on the south side are badly rusted near the base, due to constant contact with the earth, 25 per cent. of the total area being lost. This corrosion does not extend more than one foot above the bottom of the column, above which point the metal is in very good condition.

"In many of these columns the outstanding legs of column angles have been badly bent, in some cases being folded inward about 45 degrees.

"The columns on the north side have suffered somewhat from rust near their bases, and from the same cause as on the south side. In addition, their upper portions are rusted sufficiently to reduce the area 10 per cent. None of these columns have angles bent as is the case on the south side.

"The lower portions of the main columns are in very good condition as far as rust is concerned. Two places were noted where sufficient rusting has taken place to reduce the

area 5 per cent. within one foot of base. Above this point and in the lower portions of all the other main columns the metal is sound and clean.

"The upper portions of all the main columns opposite the monitor windows are slightly rusted, but not sufficiently as to cause any appreciable reduction in area.

"In the trusses the outstanding leg of the top chord angles has lost about 10 per cent. of its area through rust, due to a leaking roof. With this exception the trusses are in first class condition.

"One knee-brace over charging platform has been cracked.

"When the large cranes pass the columns there is a perceptible jar. This is doubtless due to the loosening of bolts in the end connections of crane-track girders. Examination revealed many loose bolts at these points.

"We were unable to observe any lateral swaying of the building, as a whole, more than would be expected in a building of this type.

"Our representative made a number of trips on the cranes, and also stood on various parts of the structure while the regular work of the cranes was being done, and even had the crane operators run their carriages back and forth, starting and stopping as quickly as possible, but no unusual amount of swaying could be observed, and certainly not enough to cause any apprehension. There was no wind blowing at the time our observations were made.

"Longitudinally, the building is exceptionally rigid.

"We also were unable to note, at the time of our visits, any appreciable vibration of the whole plant, which has been suggested as sometimes taking place when the engines were running.

"The monitor windows are pivoted at their centres, so that when open the lower part projects outside the lines of eaves of the monitor. In the early spring, when the windows are open, icicles fall from the roof and break large numbers of panes of glass. This trouble may be remedied by extending the eaves of the monitor."

GAS RATES IN QUEBEC PROVINCE.

Enquiry to be Made Into Price of Gas in Montreal—Public Utilities Commission Will Act.

One of the principal topics of conversation in Montreal, concerns the price of gas. The matter is of no small importance in financial circles, inasmuch as if the Montreal Light, Heat & Power Company should be compelled to reduce the price of gas it would materially affect the profits of the concern, even though the reduction brought about a consumption which would ultimately give increased profits.

The Public Utilities Commission, to which reference has before been made in these columns, is about to fight its first battle, and much depends upon the result. Complaint concerning the price of gas, has been lodged before the Commission by a citizen, and an investigation is to be held unless the Power Company is able to sustain the claim that the Public Utilities Commission has no jurisdiction in the matter. As the Commission is invested with the authority of the Supreme Court, the general belief is that some way will be found to circumvent any claims of no jurisdiction made by the Power Company. The city council has been displaying much interest in the matter, and is urging the necessity of immediate investigation. Outlying municipalities which have hitherto not had any gas mains are urging that the Public Utilities Commission should order the company to immediately lay gas mains, and at the same time exercise their jurisdiction over the matter of price.

Act Creating the Commission.

The following paragraphs in the Act creating the Public Utilities Commission would seem to cover the question of jurisdiction, which has been disputed by the Montreal Light, Heat & Power Company:

"The Commission shall have jurisdiction in all contestations respecting the tolls which may be demanded by any public utility, but subject to any contract existing between a public utility and a municipality with reference to such tolls, and subject as to electric railway companies, to paragraphs 6a and 6b, of article 5172 of the Revised Statutes, as enacted by the Act Edward VII., chapter 35, section 12;

"And for the purposes thereof it may fix such tariff as it thinks reasonable for the services rendered or the commodities supplied by such public utility, and may likewise disallow or change, as it may think reasonable, any such tolls as in its opinion unjustly discriminate between different persons or different municipalities."

The Power Company's lawyers must appear before the Public Utilities Commission next Monday to argue the objections raised of no jurisdiction. The non-existence of a gas contract apparently gives the Commission its opportunity.

Should be Flat Rate for Gas.

In the complaint made, it is urged that there should be no difference between the price of cooking and lighting gas. Many months ago the Montreal Light, Heat & Power Company announced that it would make a flat rate all the way round for gas, making no distinction between heating and lighting, and that this charge would be one dollar. Subsequent to the laying of the complaint, the company put this announcement into effect, so that the company is to some extent robbed of its force. At the same time it has a much wider application and there is every reason to suppose that the Commission will push the matter to a conclusion.

Until recently the price of lighting gas in the city of Montreal was $1.20 per 1,000 cubic feet. Upon this was allowed a rebate of 15 cents, if paid within a certain length of time. Even when this time was exceeded, citizens were enabled to get the rebate in a great number of instances, so that in reality $1.05 has been the prevailing price for lighting gas for some time past. The reduction which recently took place brings the price down to $1.00 per 1,000 cubic feet both for cooking and lighting, but in addition to this is a meter rental. When the citizens of Montreal compare these prices with those of Toronto—where the price is 75 cents, and about to be reduced to 70 cents—they feel that they are paying an altogether disproportionate price for gas.

The Power Company makes the claim, that it costs more to produce gas in Montreal and also to maintain the service, more especially during the winter months. Making allowance for all this, it is felt that gas should, in modern times, never have been more than 80 cents per 1,000 cubic feet in Montreal, and that it ought now to be less. Whether the efforts of the Public Utilities Commission will be balked by the defence put up by the Montreal Light, Heat & Power Company or not, is difficult to say.

Commission Created A Year Ago.

The Commission was created about a year ago. The present investigation will be its first experience, and it is not at all impossible that the Act will be found wanting in many particulars, in its capacity or powers to act effectively in the public interest, in matters which may be brought before it from time to time. This investigation of the Power Company should uncover any of these weaknesses, and as the life of the Commission depends upon its utility, there can be no question that the Quebec Legislature will be called upon to amend or extend its powers to make it effective.

When Mr. E. W. Bemis, of Cleveland, an acknowledged authority on the gas question, came to Montreal by request of the city council to investigate the question of the gas supply of the city, he requested the Montreal Light, Heat & Power Company to furnish him with statements which would be helpful in the matter, but the company would give him no assistance. The Public Utilities Commission will not ask the Power Company to assist them, but will order it to bring its books, or to otherwise furnish it with any particulars, and if necessary, will send its own men to make examination for themselves. It not only has the power to do this, but if the Power Company refuse to carry out the

Commission's orders, it has the power to use the most extreme measures, even to the extent of operating the company itself.

Unquestionably, the creation of the Public Utilities Commission was one of the most important acts of the Quebec Legislature in many years. The matter did not perhaps receive as much attention at the time as it was entitled to, the reason being possibly that many did not regard the matter as very serious. There is every reason to suppose that the Commission will take itself quite seriously. Colonel Hibbard, K.C., who is at its head, is a fighter and a lawyer, and other members of the Commission are also skilled lawyers and engineers.

Quebec Gas Rate is High.

In the city of Quebec at the present time, gas is selling at the rate of $1.20 per 1,000 cubic feet, notwithstanding that previous to the creation of the Quebec Railway, Light, Heat & Power Company, a year ago—which is an amalgamation of all the public utility concerns of the city of Quebec—it was selling as low as 50 cents. A victory in Montreal would mean much for Quebec. The Commission must justify its existence, and should the citizens of Quebec be slow in coming forward to make complaint or to ask for an investigation into the lighting problem of that city, undoubtedly the Commission would see to it that it had an opportunity to exercise its powers.

The lowering of the price of gas in Montreal would in all probability double the consumption, and this would mean increased profits to the company, unless, as has been alleged, one of the objects of the company in keeping the price of gas at a high figure, is to compel the citizens to use electricity, upon which the company makes greater profits. There is promise that not only will the price of gas be reduced by the intervention of the Public Utilities Commission, but that the price of electricity will also be reduced during the next few years, if not by the Commission, at least by the rise of a number of rival lighting concerns.

INDUSTRIAL ACCIDENTS LAST YEAR.

Many Deaths from Explosives—Metal Trades First in Non-fatal Accidents.

The statistics relating to industrial accidents collected by the Department of Labor during the year 1909, show 1,279 fatal, and 2,178 serious non-fatal accidents throughout Canada. This is a slight increase, namely seven, in the number of fatal accidents compared with the preceding year, and an increase of 441 in the number of non-fatal injuries. The record is below that of 1907, when 1,353 fatal, and 2,752 non-fatal accidents were reported. As in previous years, the summer and autumn months, during which industrial activity is at its height in Canada, show a proportionately higher return of accidents.

The largest number of fatalities, namely 283, occurred in the railway service, agriculture standing second, with 256; mining third, with 160; and lumbering fourth, with 130. It will be remembered that the industries ranked in the same order, from this standpoint, in 1908 and 1907.

Metal Trades First in Non-fatal Accidents.

Of the non-fatal injuries, the largest number occurred in the metal trades, namely 482; agriculture standing second, with 374; and the railway service third, with 293. In 1908, the railway service stood second and agriculture third, the metal trades standing first as in 1909.

Comparing the record of the year in the several groups, it will be seen that there was a decrease in the number of fatal accidents recorded in the building, food and tobacco preparation, and leather trades, and among civic employees and the classes included under the headings of "general transport," "miscellaneous," and "unskilled labor." In the remaining groups, increases in the number of accidents occurred. In the number of non-fatal injuries increases were shown in all the groups except in the textile trades, and under the heading of "miscellaneous."

Causes of Accidents.

From the standpoint of possible remedial action, a very important portion of the information collected by the Department is that relating to the causes of accidents. A tabular analysis of the causes of the several fatal and non-fatal accidents in the various industries and trades is given below. It will be seen from these tables that in the agricultural industry the largest number of deaths through accident occurred from being run over by vehicles, while the largest number of the non-fatal injuries resulted from falls and from injuries received from machinery and tools. In the fishing industry, drownings made up almost the entire list of fatalities. Drownings also accounted for fifty-one of the 130 fatal accidents occurring in the lumbering industry, while seventy-eight of the 181 non-fatal injuries recorded were received about machinery and engines. Under the heading of mining, explosions caused over thirty-five per cent. of the deaths, and over twenty per cent. of the non-fatal injuries.

Many Deaths Result of Falls.

Falls accounted for nearly all of the deaths, and over sixty-six per cent. of the non-fatal injuries in the building trades. The largest number of accidents in the metal, woodworking, clothing, textile, food and tobacco preparation, and leather trades were occasioned by machinery, belting, etc., and by falling material. In the railway service, ninety-three employees lost their lives by being run over by trains, forty-two in derailments, and thirty-one in collisions. The largest number of non-fatal injuries among railway employees were caused by falls from trains and cars, but there were fifty-six such injuries received in derailment, thirty-five in collisions, and thirty from being run over by trains, while thirty-one employees were seriously injured by being struck by falling material. Under the heading of navigation, sixty-two of the ninety-five fatalities reported were drownings, while twenty-six of the ninety-one non-fatal injuries were caused by falls and nineteen by explosions. Falls accounted for thirteen fatal and sixty-seven non-fatal accidents under the heading of general transport. The largest number of fatalities and non-fatal injuries among civic employees, occurred to firemen. Among unskilled laborers, twenty-one men were killed by being run over by vehicles and seventeen by falling material; fifty-three of 123 non-fatal injuries were also occasioned by falling material.

Department of Mines Investigate.

An important incident of the year, and one that is probably destined to have a far-reaching effect in the prevention of a certain class of industrial accidents, was the investigation carried out by the Department of Mines, Canada, into the general question of the supervision of explosives throughout Canada. For some time past, and especially since the beginning of the extensive railway construction operations at present in progress, there has been an alarming increase in the number of fatalities among workpeople engaged in the handling of explosives. In the mining industry, also, the death rate from this cause has been exceedingly high. By referring to the subjoined tables it will be seen that not less than seventy-two workmen lost their lives from explosives during the past year, and it should be remembered that these statistics are confined to employees killed while in the actual performance of their duties. Legislation bearing on the matter differs considerably in the different provinces, and it is understood that as a result of the investigation above referred to an Act will be introduced at the next session of Parliament to deal in full detail with the manufacture, transportation, storage, and use of explosives. At the past session an appropriation of $10,000 was voted for the purpose of engaging expert assistance in the framing of this legislation, and in other matters arising out of the investigation aforesaid.

An Interesting Statement.

The following is a statement of the number of fatalities in the several industries and trades caused by explosives during 1909: Agriculture, 1; fishing and hunting, 3; mining, 31; unskilled labor, 4; metal trades, 1; railway construction, 22; public employees, 3; miscellaneous, 7; total, 72.

CONCRETE SECTION

REINFORCED CONCRETE PILE.

Edward Mohun, C.E.

The following is a description of my newly invented method of reinforcing moulded concrete piles by the use of angles in connection with expanded metal.

The inventor claims that the weight of the steel is reduced to a minimum; that its surface in contact with the concrete is largely increased, and a far greater degree of rigidity and resilience attained than is possible under the usual method of reinforcement with round or hexagonal rods; that longer piles than have hitherto been constructed can be built, and that, being moulded in a horizontal position, it is easy, from the open construction of the reinforcement, to see that the concrete is homogeneous, and that no voids are left unfilled.

The pile is not a steel pile, as the Moran, protected by concrete, placed after the steel pile has been driven, in which the steel is assumed to bear the stresses, but a concrete pile, reinforced with a minimum of steel, partly to meet the danger to which moulded concrete piles are exposed through rough handling before being driven.

The pile, being provided with a 2-in. jet pipe, can be driven as may be most convenient by either of the usual methods, viz., the water jet or the hammer, or both combined.

The accompanying drawings illustrate the invention:—

Fig. 1 is an elevation of a portion of a bearing pile, showing the face of any of the four sides of the reinforcement, in which A A represents the angle-bars; B, a cast-iron frame (frames B B are spaced about eight feet apart), which maintains the angle-bars in their correct position during construction, and has cross-arms radiating from a central hub, through which passes the pipe C (Fig. 3), which can be used as a jet pipe when required; D represents the expanded metal; E the wiring fastening the angle-bars and expanded metal together, and G represents the concrete.

Fig. 2 is a cross-section of the pile on the line X X of Fig. 1, and shows the positions of the four angle-bars A A; and the pipe C (Fig. 2) also shows the mode of wiring (E) the angle-bars and the expanded metal together, G representing the concrete.

Fig. 3 is a cross-section of the pile on the line Y Y of Fig. 1, showing the position of the angle-bars A A and of the jet pipe C in the frame B, in which the angle-bars are secured in place by horseshoe nails used as wedges. Fig. 3 also shows the wiring of the frames (B) and the expanded metal (D), G representing the concrete.

Fig. 4 is an outside elevation of a wrought-iron shoe (H), in which I I are rivets.

Fig. 5 is a cross-section, showing the interior of the shoe (H), in which J J are screw-hooks holding the frame (B) in its position on the lugs K K.

Fig. 6 is a vertical section through the centre of the shoe (H), in which K K are lugs cut out of the sides of the shoe and bent horizontal, on which the frame (B) rests, being secured to it by the hooks J J

Fig. 7 shows a cover angle L and the method of splicing the angle bars A A.

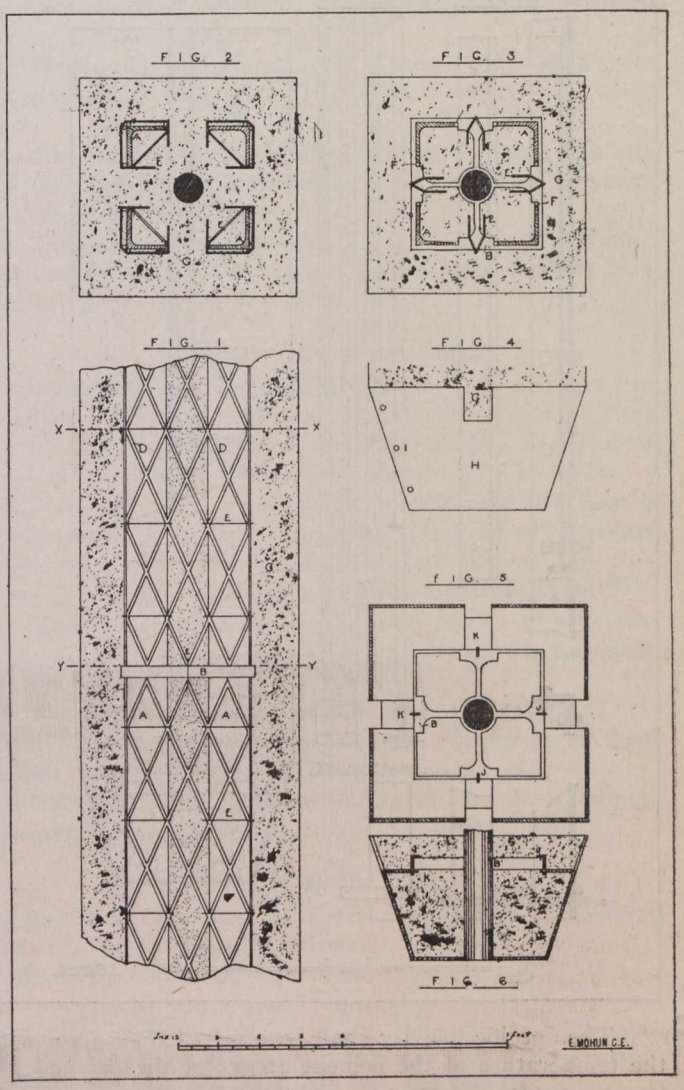
Fig. 7A shows the relative position of the splicing (R R) of the angle-bars. No two splices are in the same plane, but are from seven to eight feet apart. At each splice there is one of the cast-iron frames (B), which is not shown in the figure.

Fig. 8 is a cross-section of the splice.

Fig. 9 shows the method of connecting the lowest angle-bars A A to the frame B in the interior of the shoe H, in which M is a rod passing through each pair of angle-bars immediately below the frame B.

Fig. 10 is a vertical section through the centre of the pile, in which O is an anchor bolt passing through the frame B for attachment of the superstructure, if of timber. The top of the jet pipe is provided with a removable screw-cap, to which the pressure hose is attached when the pile is jetted.

When the pile is driven to rock, the cap of the pipe being removed, a cartridge of cement mortar is dropped down it, followed by a heavy rammer, forcing the mortar



into any irregularities of the rock, and making a level bearing for the pile.

In an experiment made the 16th and 17th July, 1909, a pile 15-in. square, reinforced with four 3 x 3 x ¼-in. angles and four sheets 9 in. wide of No. 10 expanded steel, with a clear span of 20 feet, had a total distributed load, included weight of pile, of 21,000 pounds for seventeen hours, having been previously loaded with 13,000

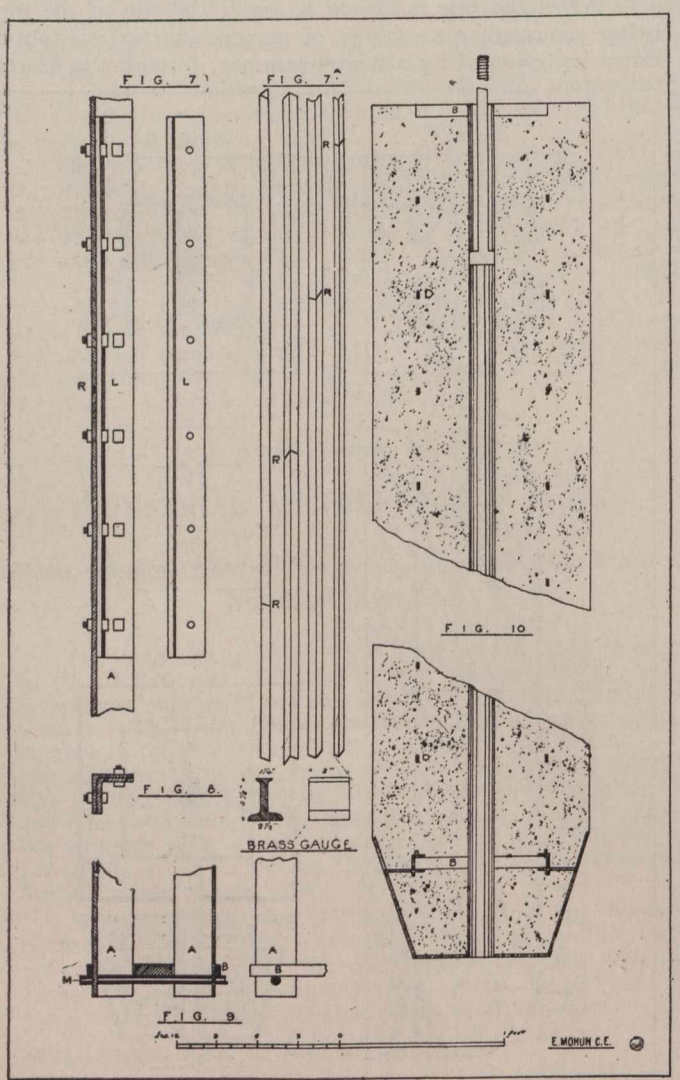
pounds for nine hours. The deflection at the expiration of the time was 13/16-in., making the constant for deflection .00092433. Upon the removal of the load the pile immediately recovered and became perfectly straight.

The following are the proposed dimensions of angles, subject to revision, the piles being 16 x 16in. :—

Length.	Angles.
Under 40 ft.	3 x 3 x ¼-in.
40 to 60 ft.	3 x 3 x ⅜-in.
60 to 80 ft.	3 x 3 x ½-in.
80 to 100 ft.	3 x 3 x ⅝-in.

The cement shall be the best Vancouver Island or English Portland cement.

As a basis of measurement, 100 pounds in weight shall be considered equivalent to one cubic foot in capacity.



The specific gravity shall be not less than 3.10, with the temperature of the cement at 212° Fahr.

It shall have a residue of not more than 25 per cent. on the No. 200 sieve (40,000 meshes to the square inch); the residue shall then leave not more than 8 per cent. on the No. 100 sieve (10,000 meshes to the square inch). The percentage to be determined by weight.

Initial set, which is when the cement ceases to be fluid and plastic, shall not develop in less than thirty minutes after the water is added. The cement shall be taken as having developed "initial set" when a wire 1-12-in. diameter, loaded to weigh ¼ pound, shall leave a distinct mark on the pat, but not appreciably penetrate the surface.

Hard set shall not develop in less than one hour or more than ten, and the cement shall be considered as having developed "hard set" when a wire 1-24-in. diameter, loaded to weigh 1 pound, shall leave a distinct mark on the pat, but not appreciably penetrate the surface.

The minimum tensile strengths for briquettes shall be within the following limits, and shall show no retrogression in strength within the periods specified:—

Neat Cement.

Age.	Strength in lbs. per sq. inch.
24 hours in moist air.....	150 to 200
7 days (1day in moist air, 6 days in water)	450 to 550
28 days (1 day in moist air, 27 days in water)	550 to 650

One Part Cement, Three Parts Sand.

7 days (1 day in moist air, 6 days in water)	150 to 200
28 days (1 day in moist air, 27 days in water)	200 to 300

The sand to be used in making tests shall be clean and sharp, screened to pass through a sieve having 400 meshes, and be retained on one having 900 meshes to the square inch.

Pats of neat cement about 3 inches in diameter, ½-in. thick at centre, and tapering to thin edges, shall be made on pieces of plate glass, and shall be tested as follows:—

1. The pat, after 24 hours in moist air, shall remain in air of ordinary temperature and be observed at intervals during 28 days.

2. Another pat shall be immersed in water maintained as nearly at 70° Fahr. as possible for 28 days, and be observed at intervals.

3. A third pat shall be exposed to the action of steam above boiling water in a loosely closed vessel for five hours.

The results of these tests are satisfactory when the pats remain firm and hard, showing no signs of cracking, distortion or disintegration.

Samples shall be taken at random in such a manner as to be fair averages of the contents of the consignment.

CONCRETE SCOW.

Another field for reinforced concrete has been opened in Canada, that of concrete boat-building. While this does not seem so marvellous in this present age of concrete, nevertheless it does show to what dimensions the scope for concrete is attaining. It may greatly facilitate marine construction in the near future.

The specific case referred to is that of a concrete scow, which was launched in the canal at Port Dalhousie on Wednesday last. The craft, which was built at Port Dalhousie under the supervision of Superintendent Weller, is 80 feet long by 24 feet wide and 7 feet deep. The deck, sides and bottom are 2½ inches thick, and it has three bulkheads, two running crosswise and the third lengthwise.

This is the first of the kind to be built in Canada, and its success will be watched with interest by the cement public.

NATIONAL ASSOCIATION OF CEMENT USERS.

The tentative programme of the Seventh Convention of the National Association of Cement Users, will be held at Madison Square Garden, New York, N.Y., December 12-20, 1910. This programme is subject to change and rearrangement and is issued for the information of the technical press.

Monday, December 12th.

Meeting of the Sectional Committees—2 p.m.

Meeting of the section on Roadways, Sidewalks and Floors. General discussion covering the preparation of materials, laying, finishing and costs.

8.00 P.M.

Formal Opening of the Convention, Concert Hall, Madison Square Garden.

Address of welcome on behalf of the city of New York.—Hon. William J. Gaynor, Mayor.

Response by the President.—Richard L. Humphrey, Consulting Engineer, Philadelphia, Pa.

Address.—Benjamin D. Traitel, President, Building Trades Employers' Association.

Business Session.

Dustless Concrete Floors.—L. C. Wason, President, Aberthaw Construction Company, Boston, Mass.

Some New Methods in Sidewalk, Curb and Gutter Construction.—Jerome B. Landfield, Hotchkiss Lock Metal Form Company, Binghamton, N.Y.

Report of the Committee on Sidewalks, Roadways and Floors.—C. W. Boynton, Chairman.

Tuesday, December 13th.

Meeting of the Section on Concrete and Reinforced Concrete.

General discussion on selection of materials, methods of construction, costs, etc.

Report of the Committee on Reinforced Concrete and Building Laws.—A. E. Lindau, Chairman.

Web Reinforcement of Concrete Beams.—Peter Gillespie, President, Canadian Cement and Concrete Association; Lecturer, Faculty of Applied Science, University of Toronto, Toronto, Canada.

Web Reinforcement of Concrete Beams.—Major John Stephen Sewell, Consulting Engineer, Gantts Quarry, Alabama.

Flat Slabs of Reinforced Concrete.—Arthur N. Talbot, Professor of Municipal and Sanitary Engineering, University of Illinois, Urbana, Ill.

Discussion of Flat Reinforced Concrete Plates.—Angus B. MacMillan, Engineer, Aberthaw Construction Company, Boston, Mass.

Analysis of Results of Load Tests on Panels of Reinforced Concrete Buildings.—Emile G. Perrot, Architect, Philadelphia, Pa.

8.00 P.M.

Annual Address by the President.—Richard L. Humphrey, Consulting Engineer, Philadelphia, Pa.

A Comparison of the Concrete Industry in Europe and America.—Dr. Otto Schott, Director, Offenbach Plant, Heidelberg, and Mannheim Portland Cement Company, Heidelberg, Germany.

The National Fire Protection Association and Its Work.—W. H. Merrill, President, Chicago, Ill.

Some Thermal Properties of Concrete.—Professor Charles L. Norton, Professor, Heat Measurement, Massachusetts Institute of Technology, Boston, Mass.

Wednesday, December 14th.

Meeting of Sections on Fireproofing and Insurance. Topical discussion on Fire-Resistive construction of buildings and the effect on insurance rates.

Report of the Committee on Fireproofing.—Rudolph P. Miller, Chairman.

Report of the Committee on Insurance.—William H. Ham, Chairman.

An Incident of Value of Concrete in Reducing Cost of Insurance.—Emile G. Perrot, Architect, Philadelphia, Pa.

Effect of Electrolysis on Metal Imbedded in Concrete.—Cloyd M. Chapman, Engineer-in-charge. Westinghouse, Church, Kerr and Company, New York, N.Y.

8.00 P.M.

Construction Problems of the Azisconoes Concrete Gravity Dam.—Seth A. Moulton, Sawyer and Moulton, Portland, Me.

Preparation and Handling of Concrete.—H. M. Cryder, Vice-President, William P. Carmichael Company, St. Louis, Mo.

Advantages and Comparative Cost of Spouting Concrete.—F. E. Engstrum, Vice-President, F. O. Engstrum Company, Los Angeles, Cal.

The Use of Compressed Air in the Handling of Mortars and Concrete.—G. L. Prentiss, Vice-President, Parsons Manufacturing Company, New York, N.Y.

Thursday, December 15th.

Meeting of the Section on Specifications for Cement Products. Discussion on the Manufacture, Curing, Cost, Etc., of Cement Hollow Building Blocks, Architectural Concrete Blocks, Fence Posts, Drain Tile and Pipe.

Report of the Committee on Specifications for Cement Products.—P. S. Hudson, Chairman. (a) Proposed Standard Specifications for Architectural Concrete Blocks. (b) Proposed Standard Specifications for Plain Concrete Drain Tile.

General Considerations in the Construction of a Cement Products Plant.—Charles D. Watson, Consulting Engineer, Syracuse, N.Y.

Cement Tile Plant; Layout and Operation.—C. M. Powell, Assistant Inspecting Engineer, Universal Portland Cement Company, Chicago, Ill.

Additional Notes on Steam Curing Plants.—F. S. Phipps, Manager, Central Stone Company, St. Joseph, Mo.

Friday, December 16th.

Report of Committee on Exterior Treatment of Concrete Surfaces.—L. C. Wason, Chairman.

Proposed Specifications for Stucco on Metal Lath.

Comparative Cost and Maintenance of Various Types of Building Construction.—J. P. H. Perry, Turner Construction Company, New York, N.Y.

Concrete Filled Arches.—H. H. Quimby, Engineer of Bridges, Bureau of Surveys, Philadelphia, Pa.

Reinforced Concrete Sewers.—J. A. Hooke, Assistant Sewer Commissioner, St. Louis, Mo.

8.00 P.M.

The Hudson Memorial Bridge.—William H. Burr, Professor of Civil Engineering, Columbia University, New York, N.Y.

Reinforced Concrete Construction in San Francisco and Vicinity.—John H. Leonard, Consulting Engineer, San Francisco, Cal.

Reinforced Concrete School Buildings.—John T. Simpson, President, American Concrete Steel Company, Newark, N.J.

The Use of Reinforced Concrete for Hospitals and Similar Structures.—R. A. McCullough, Chief Engineer for Raymond F. Almirall, New York, N.Y.

Advantages of Reinforced Concrete for Farm Buildings.—Alfred Hopkins, Architect, New York, N.Y.

Saturday, December 17th.
9.00 A.M.

The Advantages of Admixtures of Tufa to Portland Cement.—J. B. Lippincott, Assistant Chief Engineer, Los Angeles Aqueduct, Los Angeles, Cal.

Use of Reinforced Concrete in Sea Water.—R. Haffrey, President, Hennexbique Construction Company, New York, N.Y.

The Relation of the Lime Contents of Cement to Durability of Concrete.—Henry S. Spackman, President, Henry S. Spackman Engineering Company, Philadelphia, Pa.

The Insulation of Concrete Structures.—Edward W. DeKnight, Manager, Hydrex Engineering Company, New York, N.Y.

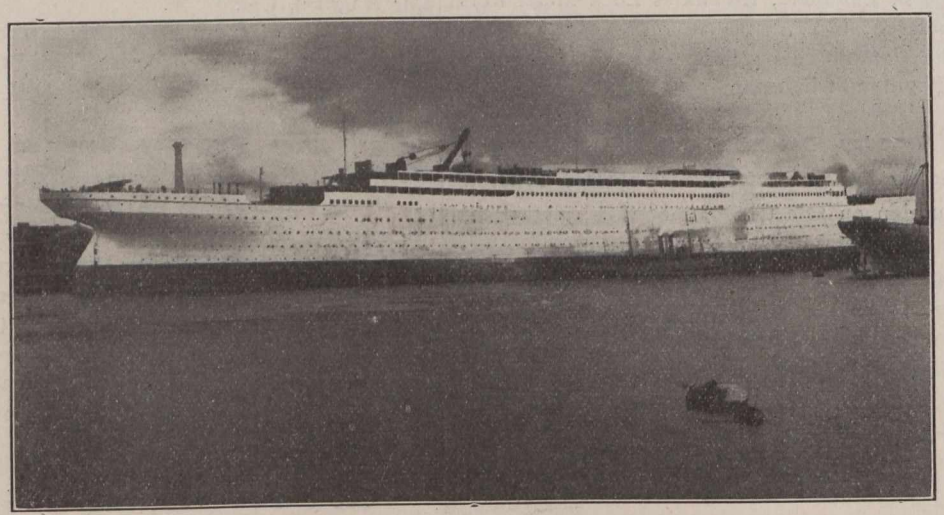
The Waterproofing of Tunnels.—A. H. Harrison, Harrison Waterproof Materials Company, New York, N.Y.

Waterproofing with Water.—Cloyd M. Chapman, Engineer-in-charge, Westinghouse, Church, Kerr and Company, New York, N.Y.

OLYMPIC.

In January, 1899, when the Oceanic was launched, comparisons were naturally suggested between that vessel and the Great Eastern, which she was the first to surpass in length. One of the most enthusiastic spectators of that event was the founder of the White Star Line, the late Mr. Thomas H. Ismay, whose enterprise and foresight contributed so largely to the upbuilding of the British mercantile marine, and whose interest in that vessel was indicated by his giving it the name which had been borne by the pioneer vessel of the line. The first Oceanic, in 1871, inaugurated an era in British shipbuilding and ocean travel, and the second Oceanic was Mr. Ismay's latest legacy to the Empire, which owes, perhaps, more to its shipping than to any other material element. He did not long survive this great production; but the spirit of energy and progress he inspired in his successors has led to even greater achievements during the last decade, until we have in the Olympic a vessel surpassing the most optimistic prophecies of the Oceanic period. A vessel nearly 900 feet long, 45,000 tons gross register and 66,000 tons displacement would, a few short years ago, have been considered a prodigy. To-day, this leviathan floats proudly on the water, a monument to the enterprise of her owners, the faith of her builders, and a prophecy of the continued vitality and progress of an Imperial race, whose ships encircle the globe, enrich the world with the treasures of industry and commerce, and bring the whole human family into peaceful relations and friendly intercourse.

The name Olympic has been fittingly reserved for a vessel that is the result of the highest intelligence and skill, combined with the greatest experience. The vessel follows a long line of predecessors, each marking an advance on the other and every step that has been taken has been based on actual knowledge of its practical possibilities conjoined with a firm belief in the future of steam navigation that has been amply justified. Every advance has been fully appreciated by the commercial and travelling public, who have long learnt to expect continued progress in the White Star Line, and found in its enterprise the greatest assistance in the development of international interests.



Broadside View after Launching.

The Olympic, as an instrument of commerce, will represent the highest skill and perfection yet reached in naval architecture; and in the struggle for supremacy it is confidently anticipated she will easily hold the place of honor, and prove her title to the historic name that has been given her.

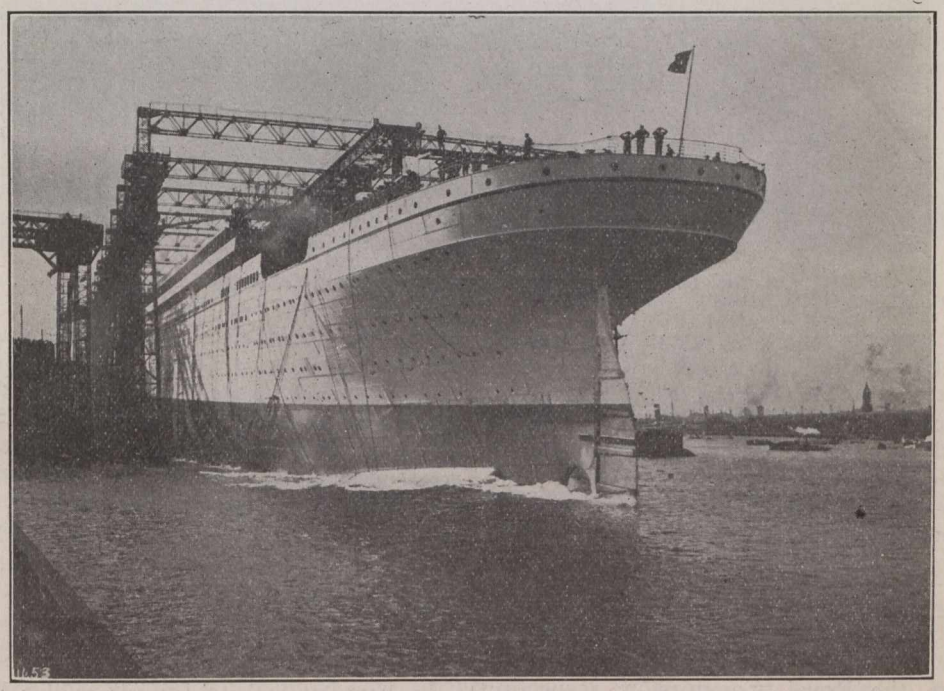
The new vessel's principal dimensions are as follows:—

	Ft.	In.
Length over all	882	6
Breadth over all	92	6
Breadth over boat deck	94	0
Height from bottom of keel to boat deck	97	4

Height from bottom of keel to top of captain's house	105	7
Height of funnels above casing	72	0
Height of funnels above boat deck	81	6
Distance from top of funnel to keel	175	0
Number of steel decks		11
Number of watertight bulkheads		15

These particulars give some idea of the vastness of the structure; but, although she is the largest vessel ever built, her mere size is not impressive to the accustomed eyes of those who are concerned with modern shipping. Like all the White Star ships, the Olympic is very graceful, and only by contrast with other ships can her magnitude be appreciated.

The launching weight, about 27,000 tons was the heaviest weight ever transferred from land to water, and this operation, always (in spite of long experience) a matter of anxiety to those responsible, was naturally, in the case of such a vessel, an undertaking of unusual importance. The method of launching, however, was one of the simplest imaginable, the vessel being held on the ways by hydraulic triggers, only requiring to be released by the opening of a valve in order to let the vast structure glide into the water.



SS. Olympic Leaving the Stocks.

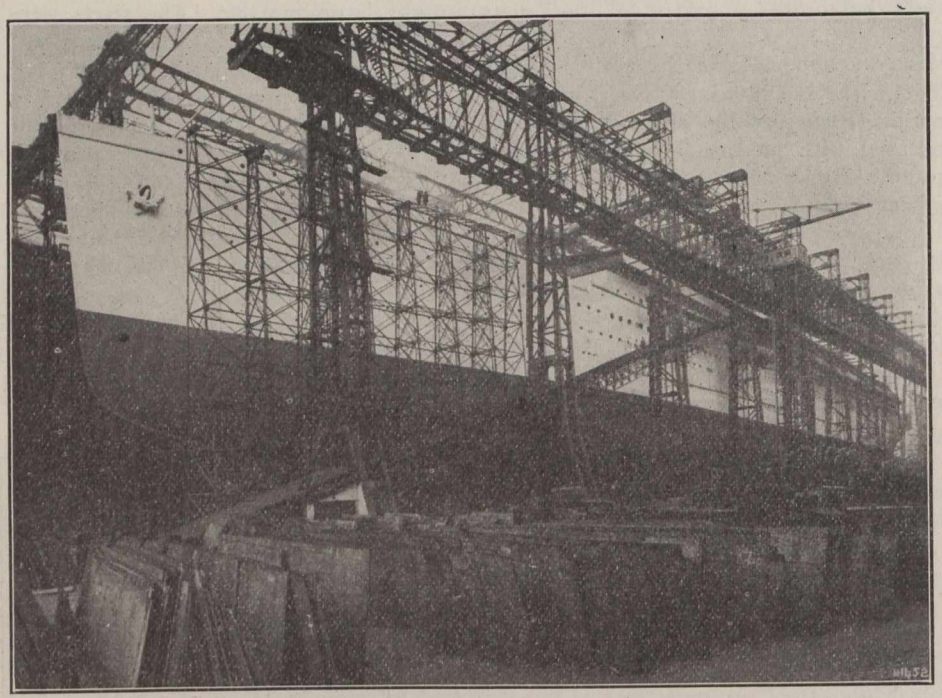
Besides being the largest and heaviest vessel ever launched, the Olympic is undoubtedly also the strongest. Both in design and workmanship this has been kept in view, and the most approved structural arrangements suggested by the ripest experience have been adopted, and every mechanical device requisitioned to secure this end. Never before in the history of shipbuilding have such elaborate means been employed, or such a combination of science, invention and skill in the production of a ship; nothing has been left to chance; everything has been carefully thought out and skilfully planned, down to the most minute details, and from keel to truck the Olympic will be as perfect as human ingenuity and skill and the most powerful appliances can make a vessel. The double bottom, extending the whole length of the vessel, 5 ft. 3 in. deep (increased under the reciprocating engine room to 6 ft. 3 in.), the massive beams and close framing, the large shell plates, the steel decks and watertight bulkheads combine to make a structure of exceptional strength and rigidity. The hydraulic riveting in the vessel is also an important factor, the whole of the shell plating up to the turn of the bilge being riveted by hydraulic power, and an immense amount of this riveting having also been carried out in other parts of the vessel—shell, top sides, decks, stringers, etc. The rivets were closed by means of the powerful 7-ton riveting machines suspended from the travelling frames on the gantry; and, while making the sound, tight connection so essential in this mighty hull, it will be seen that the rivets studding the shell plating present a very pleasing and symmetrical appearance. As illustrating the importance of the riveting in this vessel, there are half a million rivets in the double bottom alone, weighing about 270 tons, the largest rivets being 1¼ inches in diameter; and in the complete ship there will be something like three millions, weighing about 1,200 tons.

The following particulars will also be found interesting: The largest shell plates are 36 feet long, weighing 4¼ tons each; the largest beam, 92 feet long, the weight of the double beam being 4 tons; the stern frame weighs 70 tons; the after boss arms, 73½ tons, the forward 45 tons; the rudder, 100 tons; the engine crank shafts, 118 tons each; bedplate, 195 tons; columns, 21 tons each; the heaviest cylinder, with liner, 50 tons; wind propellers, each 38 tons—finished weights. The castings for the turbine cylinder weighed 163 tons, and for the centre (turbine) propeller, which is of solid bronze, 22 tons.

The arrangements in connection with the launch of a ship do not end with the release of the vessel so that she may slide down the ways into the water, they include provision for checking the way on the vessel when in the water, as most launching rivers or basins are more or less limited in breadth, and in the case of a gigantic fabric like the Olympic the means adopted will doubtless be found interesting. In the bed of the river were placed three heavy anchors on each side of the ship, each anchor being connected by a 7-inch steel-wire hawser to eyeplates riveted to the shell plating. There were also placed in the bed of the river two piles of cable drags, each weighing over 80 tons, connected in a similar manner with an 8-inch steel-wire hawser. These were

all arranged so that when the vessel was nicely clear of the end of the slip the drags and anchors acted simultaneously in bringing the ship to a standstill. As a further precaution the ship's own bow anchors were stowed in the hawse pipes, ready for letting go in case of emergency. So effectual were these methods, that from the time the triggers were released, allowing the vessel to move, until the Olympic was stationary in the water, less than two minutes elapsed.

As already announced, the machinery decided on for the Olympic and her sister ship Titanic is the combination of reciprocating engines with a low-pressure turbine, so successfully adopted in the White Star Canadian liner Laurentic, this arrangement having proved the most satisfactory from an engineering point of view, and at the same time the most beneficial to passengers, retaining for them the most highly perfected reciprocating engine on the "balanced" principle, eliminating vibration, and thus securing the utmost comfort by the smooth working of the ship. There will be accommodation for about 2,500 passengers in all, besides a crew of 860.



On the Stocks—Showing Housing during Construction.

The launch of the Olympic brings the tonnage of the White Star Line up to 418,907 tons, a fleet remarkable for its efficiency and modern character; twin-screw or triple-screw steamers of the latest type, and one fine sailing ship, the Mersey, employed in the important work of training officers.

RAILROADS, BUSINESS STUPIDITY AND CREDIT.

The report of the Royal Commission respecting transactions in connection with the Alberta and Great Waterways Railway is a sorry and incomplete document. In the review of the evidence taken, Mr. Justice Scott, Chief Justice Harvey and Mr. Justice Beck, the commissioners, chronicle some disagreeable incidents. The report concludes thus: "The imputation . . . is that that motive is personal interest. Many of the facts and circumstances related are consistent with such a conclusion. . . . But the facts are consistent with other conclusions, and in addition direct testimony is given by Dr. Rutherford and Mr. Cross, explicitly denying any personal interest whatever. . . . As there is room for doubt that the inference of personal interest is the only reasonable inference to be drawn from the circumstances related and in view of the positive denial . . . the evidence does not warrant the finding that there was or is any such personal interest." With that conclusion The Monetary Times agrees, having months ago expressed its belief that the Alberta provincial cabinet was more sinned against than sinning.

This particular Royal Commission was not armed with necessary powers. Mr. W. R. Clarke, of Kansas City, who handled the railway bonds, who took an active hand in many vital events, and who should have been, therefore, an important witness, did not give evidence at all. The jurisdiction of the commissioners to compel the attendance of witness before them was limited to Alberta, and later extended to Manitoba. Thus was a splendid loophole created. Those gentlemen who did not particularly relish an examination by three judges, simply shook Western dust from their shoes, passed over the boundaries of the prairie provinces, and smiled. The result is that the commission's report is a conglomeration of facts and figures, half-hearted insinuations, and, finally, the exoneration of the former premier and attorney-general.

That makes a very incomplete report, and one which will probably be read with mild disgust by the investors who have purchased the bonds of the railway. The commissioners, not having been granted powers even to summon witnesses whenever and wherever they desired, the commissioners can scarcely be blamed. This does not mitigate the farcical nature of the inquiry. One may gather inferences from the report. The most obvious is that in their anxiety for railroad development, the

Alberta provincial government and others interested allowed their province to become the playground of financiers and company promoters. One, Mr. W. R. Clarke, hailed from Missouri, a State which requires demonstration before action. Its proverbial expression, "Show me," might have been adopted by Premier Rutherford and his colleagues before committing themselves to an important enterprise such as a railroad for colonization and development purposes.

Here is a sample of the childlike business methods employed. The only material the members of the provincial government had on which to form an opinion, other than official documents, was that furnished by Mr. Clarke and his friends. Though the premier and the attorney-general at least had known for months that an application for financial assistance would be made to the government as soon as surveys had been completed, they took no steps to have a survey made or to obtain any reliable information as to the cost of building the railway. They had nothing to rely upon except such evidence as might be submitted by persons who were seeking an advantage, and who were almost absolute strangers. The only evidence submitted by the attorney-general were reports and estimates by colleagues of Mr. Clarke, the Kansas City financier, "all of which," says the Royal Commission's report, "appear to have been prepared for this purpose, and were misleading, unreliable, and in many respects absolutely false." Indeed, what was furnished to the provincial government as a copy of a certain report has the figures raised in several instances, indicating an even greater cost.

When it came to a question of interest on the bonds, Premier Rutherford fixed it at five per cent. In reply to criticisms, he stated the usual rate recently had been 4 per cent., but his decision in this case was because it was a pioneer road, and had to go on the market in competition with roads that were guaranteed to run through prairie country, easy country, settled country. That may be so, but, as the commissioners remark in their report, it is "a very poor reason for making the annual fixed charge against it one-quarter greater."

The commission's report appears to get near the heart of the matter when it discusses the provincial government's relations with Mr. Clarke. The evidence shows that in 1908, when encouragement or assistance by way of a bond guarantee was given to Mr. Clarke, an absolute stranger from the United States, who had no interest whatever in Alberta, only a few months had elapsed since the Athabasca syndicate, composed almost entirely of Western Canada men, had been refused any assistance, although they had asked only for a small bond guarantee.

The commission's report does not charge anyone with dishonesty, but the report lacks a homily which might well have been given. The commissioners were unable, in the absence of Mr. Clarke as a witness, to estimate his personality or persuasive powers. These assets were of great advantage to Mr. Clarke, on whose behalf much anxiety was shown that the least possible publicity should be given to the legislation effecting the railway company's incorporation. The outcome reveals a well-defined lacking of business acumen on the part of the provincial government representatives who matched intellects with that of Mr. Clarke, of Kansas City. The railway bonds have been sold. Mr. Clarke has drawn his profit. He now has the pleasure of seeing the railroad scheme collapse, obliterating the cabinet and badly blotting the credit of Alberta province, and in proportion, the credit of the Dominion. How can we hope to encourage the flow of British and foreign capital to this country in the face of such extraordinary exhibitions of infantile business methods?

THE BENCH MARKS OF THE GEOLOGICAL SURVEY.

The reports of the United States Geological Survey show that since 1897, when Congress authorized the work of determining elevation above sea level and the setting of bench marks, over 200,000 miles of spirit levelling have been run by that bureau alone, in connection with which more than 24,000 substantial metal bench marks have been set.

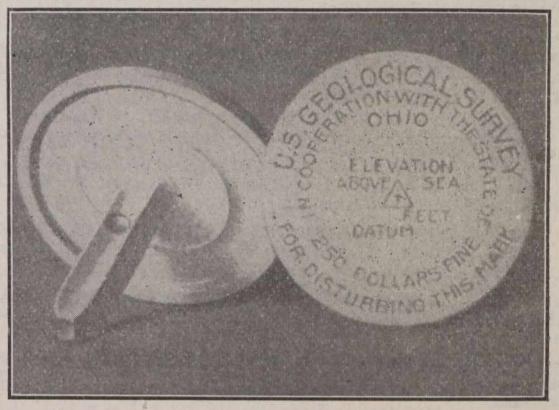


Fig. 1.
Bench Mark Tablets Used by Geological Survey.

One of the types of bench marks used by the survey is shown in the illustration. The tablet is 3¾-in. in diameter with a stem 3-in. long. They have been cast of brass, aluminum, and recently of aluminum bronze, and are used whenever substantial masonry structures, large boulders, solid rock, and rock or cement posts are available. Drill holes are made for the stems, which are fastened therein with cement.

NEW INCORPORATIONS.

Alexandria, Ont.—Eastern Pipe & Construction Co., $50,000; E. J. Mullaly, F. H. Mackay, F. M. Carbray.

Guelph, Ont.—J. & A. McHardy Co., $100,000; J. McHardy, A. McHardy, W. E. Buckingham.

Trenton, Ont.—Loomis-Morden Cooperage Company, $30,000; C. Loomis, Armada, Mich.; H. B. Loomis, W. A. Morden, Trenton.

Montreal, Que.—G. H. Anson & Co., $50,000; E. Languedoc, C. G. Greenshields, E. R. Parkins. Canadian Mono-Rail Car Corporation, $2,000,000; L. A. David, J. H. Brittle, J. J. Robson. Bishop Construction Co., $500,000; R. C. McMichael, R. C. McMurty, F. G. Bush. Mercantile Lumber & Supplies Co., $50,000; P. E. Brown, E. E. Kent, Ste. Anne de Bellevue; P. Deslauriers, Montreal. Tooke Bros., $600,000. W. J. White, A. W. P. Buchanan, J. H. Dillon. St. George Dillon, $50,000; L. Barry, E. A. Barnard, E. D. Maguire. Mexican Mahogany & Rubber Corporation, $1,000,000; L. Barry, E. A. Barnard, E. D. Maguire. Imperial Engineering Company, $100,000; J. J. Creelman, A. Jodoin, C. S. LeMesurier. Brinton Carpet Co., $350,000; R. O. McMurtry, F. G. Bush, G. R. Drennan. Ogilvy Engineering Co., $10,000; R. F. Ogilvy, J. A. T. Richards, R. Genest.

ENGINEERING SOCIETIES.

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

Chairman, A. E. Doucet; Secretary, P. E. Parent. 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, A. A. Dion, Ottawa; Secretary, H. Victor Brayley, N. T. Ry., Cory Bldg.

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, Kings 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, J. 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, C. 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 30th 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.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—Ottawa Branch, 177 Sparks Street, November 30th, 1910, Programme, A. R. Dufresne, A.M., Can. Soc. C.E. Subject: St. Andrew's Locks and Dam. Secretary, H. Victor Brayley, N. T. Ry., Cory Bldg.

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.

ARCHITECTS' ASSOCIATION OF VICTORIA, B.C.

To aid the city of Victoria, B.C. to revise its public building by-laws and in the general interest of the profession, the architects of this city have formed what will henceforth be known as the Architects' Association of Victoria. Officers have been elected and a constitution drawn up and regular meetings of the association will soon be forthcoming.

The following officers elected:

F. N. Rattenbury, Hon. President; S. Maclure, president; W. Ridgeway Wilson, vice-president; H. S. Griffith, J. C. S. Keith, Crawford Coates, committee; P. Leonard James, secretary-treasurer.

The Canadian Engineer

ESTABLISHED 1893.

Issued Weekly in the interests of the

CIVIL, MECHANICAL, STRUCTURAL, ELECTRICAL, MARINE AND MINING ENGINEER, THE SURVEYOR, THE MANUFACTURER, AND THE CONTRACTOR.

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

Present Terms of Subscription, payable in advance:

Canada and Great Britain:		United States and other Countries:	
One Year	$3.00	One Year	$3.50
Six Months	1.75	Six Months	2.00
Three Months	1.00	Three Months	1.25

Copies Antedating This Issue by Two Months or More, 25 Cents.

ADVERTISEMENT RATES ON APPLICATION.

HEAD OFFICE: 62 Church Street, and Court Street, Toronto, Ont. Telephone, Main 7404 and 7405, branch exchange connecting all departments.
Montreal Office: B33, Board of Trade Building. T. C. Allum, Editorial Representative, Phone M. 1001.
Winnipeg Office: Room 404, Builders' Exchange Building. Phone M. 7550. G. W. Goodall, Business and Editorial Representative.
London Office: Grand Trunk Building, Cockspur Street, Trafalgar Square, T. R. Clougher, Business and Editorial Representative. Telephone 527 Central.
Germany and Austria Hungary: Friedrich Lehfeldt, 2 Lindenstrassa, Berlin, S.W., 68. Telephone IV., 3198; Telegrams, Advertise, Berlin.
Address all communications to the Company and not to individuals.
Everything affecting the editorial department should be directed to the Editor.

NOTICE TO ADVERTISERS.

Changes of advertisement copy should reach the Head Office by 10 a.m. Friday preceding the date of publication, except in cases where proofs are to be mailed to distant points, for which due time should be allowed.

Printed at the Office of The Monetary Times Printing Company, Limited, Toronto, Canada.

Vol. 19. TORONTO, CANADA, DECEMBER 1, 1910. No. 22.

CONTENTS OF THIS ISSUE.

AN 84-PAGE PAPER.

Throughout 1910 we have been gradually enlarging the scope and size of The Canadian Engineer, and with this issue it is enlarged to an 84-page weekly. The widening of the field which The Canadian Engineer has been covering; an increase in the number of firms desirous for Canadian business, and the wish on the part of the publishers to give the maximum of service at the minimum cost, has led to this further enlargement.

We do not anticipate that these additional pages will answer our requirements for any length of time, for we have hopes that before 1911 we will have a hundred-page paper.

With the continued co-operation of our contributors, our advertisers and our readers we have every expectation that the development of a Canadian National Engineering paper will continue.

THE CANADIAN CEMENT AND CONCRETE ASSOCIATION.

During the third week in January, 1911, the Canadian Cement and Concrete Association will hold their third annual Exhibition and Convention in the city of Toronto.

The cement machinery manufacturer, the manufacturer of machinery used in concrete work, and the man interested in the manufacture and the disposal of cement will at this gathering have an opportunity to become better acquainted with each other, and to demonstrate to the purchaser—the general public—the advantages to be gained in the use of cement as a material of construction.

Mr. R. E. W. Hagarty, of 662 Euclid Avenue, Toronto, is secretary of the Association which is planning this convention.

UNITED STATES STEEL CORPORATION EARNINGS.

The earnings of the United States Steel Corporation have admittedly been on a down grade. By quarters we give the earnings for 1908-9 and the first nine months of 1910:—

	1908.	1909.	1910.
First	$18,229,005	$22,921,269	$37,616,876
Second	20,265,756	29,340,492	40,170,960
Third	27,106,275	38,246,907	37,365,187
Fourth	26,246,675	40,982,746	.....
Year	$91,847,711	$131,491,414	*$115,153,023

* Nine months.

While the earnings have been on the decrease, there is good reason to believe that their tonnage has increased, the estimated output for 1910 being twelve million tons, or almost two and a half million over that of 1909.

This would indicate that lower prices ruled for steel products in the United States during this year, or that the cost of manufacturing increased, due almost entirely to advance of wages and exhausting of good material, for it must be admitted that processes in steel manufacture have improved.

IMPROVEMENTS IN STREET LIGHTING.

During the past few days citizens of Toronto have witnessed demonstrations of street lighting creditable alike to the engineering staff that conceived the design and construction and to Toronto, the beautiful city that she is.

With the introduction of the Tungsten incandescent lamp for street lighting, a much more uniform and a less glaring effect has been secured. For the business streets of Toronto they have adopted clusters of five lights on ornamental iron pillars, and for the residential streets lighting, single lights attached to concrete poles. In the business section the lights are fed from conduits placed under ground, and in the residential section the lights are suspended from concrete poles.

The purpose of the Engineering Department is to eliminate entirely from the central part of the city the arc lamps. It may take some time to accomplish this, but the effect on the streets already lit by the new lamps has been so pleasing that there is no doubt the demand for the enlarging of the system will be incessant until the whole of the city streets have been so equipped.

ACCIDENTS ON STEAM RAILWAYS.

For the year ending March 31st, 1910, the Chief Operating Officer of the Dominion Railway Board reports that 456 persons have been killed and 11,023 injured on Canadian railroads. They are classified as follows:—

	Killed.	Injured.
Passengers	51	211
Employees	194	745
Other persons	211	167
	456	1,123

This list includes the large number killed and injured in the Spanish River wreck.

EDITORIAL NOTE.

The annual statement of the Cargo Fleet Iron Company, Middlesborough, England, which was submitted to the shareholders on the 29th of November, shows a decided improvement in the business of the company over that of the previous twelve months. The works have been fully employed during the past year, with the exception of a closing down of the finishing mill in the early part of the season. The output of the blast furnaces, the steel furnaces and rolling mills have been steadily increasing.

MONTREAL HARBOR DEVELOPMENT.

Some Interesting Demonstrations—Harbor Commissioners Excavating on Account of Proposed Drydock.

How a new front may be put on a growing city, and how a harbor, which a few years ago was regarded by many as the next thing to obsolete, may be modernized, was demonstrated on a tour of inspection of the harbor of Montreal on Nov. 15th. The tour was made by special train and was personally conducted by Major G. W. Stephens, the head of the harbor commission. With him were the other two commissioners, Messrs. Geoffrion and Ballantyne; Mr. F. W. Cowie, chief engineer; Mr. Seath, the secretary-treasurer; Hon. L. P. Brodeur, Minister of Marine and Fisheries; Col. Anderson, Mr. Victor Geoffrion, M.P.; Hon. Chas Doherty, M.P.; Mr. F. D. Monk, M.P.; Honore Gervais, M.P.; Dr. Finnie, M.L.A.; Messrs. C. E. Gault, M.L.A.; M. J. Walsh, M.L.A.; and G. Langlois, M.L.A.; Senators Boyer, L. J. Forget, J. P. B. Casgrain, F. L. Beique and Wm. Owens. The trip lasted almost two hours.

Among the interesting demonstrations made during the trip was the lifting power of the Harbor Commissioners' floating crane, a 40-ton boiler being lifted out of a barge and deposited on a car of the Intercolonial Railway. A little further on, the electric hoist which has been in operation during the present season was inspected. It was stated that 20,000 tons of cargo had been raised by this hoist to the upper storey of the sheds. Horses with their loads are driven on to the hoist and raised and lowered at the will of the operator. By this means is saved much time and labor in the delivery of freight to and from the different floors of the sheds.

Next came an inspection of the Commissioners' No. 2 elevator, upon which the work of construction has been proceeding during the past six months. Much of the foundation is laid so deep that it was impossible to get an adequate idea of the enormous amount of material which had entered therein, although the party, during their investigation, stood far below the level of the river. Portions of the beams which had formed the original wharf many years ago were plainly to be seen. It was explained that these beams were a source of difficulty to the engineers, one old water-soaked fir log having given more trouble than thousands of tons of rock.

Victoria Pier, which hitherto has been a low level pier, is being rapidly transformed for the use of ocean steamers and will soon be on a level with the other docks. All the way down the new elevated line to Hochelaga could be seen the concrete subways constructed by the commissioners' to connect with the streets.

Excavating for Proposed Drydock.

The most interesting and significant development of all was the excavation which the commissioners' have been carrying forward on account of the floating drydock. A considerable portion of the work is being done by dredges and shovels under water, so that little can be seen save the banks of the excavated material deposited alongside. These are sufficient evidences of the magnitude of the work, regarding the outcome of which there now seems to be some complication with the government, and which the commissioners and the various business interests of the port of Montreal are trying to have straightened out. The engineer stated that 800,000 cubic yards of dirt had been excavated by the commissioners on account of the proposed drydock, and that the site could be ready for Messrs. Vickers Sons & Maxim by the middle of next year.

The inspecting party was the first which ever passed over this new elevated line, connecting the drydock site with the upper portions of the harbor, a distance of 3½ miles. At the upper end an interesting development is in progress in connection with the laying of the concrete foundations for a quick-acting flood gate near the commissioners' building. This work is being carried out by the commissioners on account of the city. The unanimous opinion of those present was that the commissioners have practically made a new harbor of Montreal since their appointment to office a few years ago, and that Canada as a whole has every reason to be proud of her farthest inland ocean port.

The Engineers' Club of Toronto

96 KING STREET WEST
TELEPHONE MAIN 4977

Meetings for December, 1910

THURSDAY, 1st, 8 p.m.

General Business Meeting according to notice.

THURSDAY, 8th, 8 p.m.

"Methods of Rail Production by the Dominion Iron and Steel Co." Address by Mr. A. W. Sinnamon, Chief Engineer, Canada Foundry Company.

THURSDAY, 15th, 8 p.m.

"Method of construction of the Queen Street Bridge, Toronto." Illustrated address by Mr. R. E. Chadwick, Bridge Engineer, City of Toronto.

THURSDAY, 22nd, 8 p.m.

"Seven years Engineering in Burma," Illustrated address by Mr. W. G. Bligh, Toronto.

THURSDAY, 29th, 8 p.m.

Meeting of Toronto Branch, Canadian Society of Civil Engineers.

C. M. CANNIFF, President, 15 TORONTO ST
L. J. STREET, Treasurer, 209 STAIR BLDG.
R. B. WOLSEY, Secretary, 25 LOWTHER AVE.

MR. McCREA ON RAILWAY FINANCES.*

The Pennsylvania system east of Pittsburg has cost very much more than the capitalization represents. On that capitalization it has never paid more than a fair return—less, in fact, than most other characters of investment, such as manufacturing, mining and agriculture. The results of constant increases in its business have been distributed either through reductions in rates, increases in amounts paid for wages and material, or by reinvestments in the property not capitalized. It has always been typical of good and constantly improved service—in fact, the character of service which, if I understand the American people, they desire perpetuated and improved. A railway system of this character being so capitalized and rendering a service which is not only of the highest character, but satisfactory to the public and to its patrons, deriving as it did in the year 1909 net earnings to the amount of but 5.01 per cent. of the amount actually invested in the property, it is difficult for me to understand how a system of rates which secures such results can be regarded as on too high a basis.

The Pennsylvania Railroad Company has for many years past, as a result of its operations, realized a substantial surplus in each year over and above the amount required to enable it to meet its interest charges and pay moderate dividends on its stock to its stockholders. This surplus has varied in amount from year to year. For the last ten years the average has been about $12,000,000 a year, practically all of which has been expended on the property for the purpose of enabling the company to conduct its operations more safely, more efficiently and more cheaply.

Since the passing of the Interstate Commerce Act in 1887 the amounts expended on the property of the lines east of Pittsburgh out of the earnings and from other sources than the proceeds of the sale of bonds or stock or other securities aggregate $262,000,000, and the company was enabled to provide almost all of this large sum out of the surplus earnings derived from the operation of its property. The Pennsylvania Railroad and many of the roads embraced in its system were built at a time when it was difficult to secure capital for such enterprises. The country through which the roads were built was at that time comparatively thinly settled and the business light. The character of the construction, which was suitable for the time and the existing conditions, was, to a large extent, unsuited to later conditions. The safety of the public and of employees required elimination of grade crossings of highways, the use of safety appliances and the use of improved material and equipment, all of which in themselves do not yield much, if any, net return, and it was to meet these conditions and to adapt its road and equipment to modern requirements that the uncapitalized earnings in the form of surplus have been so freely spent. Had these earnings not been available, and had they not been expended for the purposes indicated, the Pennsylvania Railroad would to-day be a very different railway and would have been wholly unable to render the service to the public which it is to-day rendering. The accumulation of the surplus earnings which have been thus expended has only been possible because the rates of freight in force since the passing of the Interstate Commerce Act have been sufficient to realize for the company amounts in excess of its expenses, taxes, interest and dividends.

The fact that these surplus earnings were being earned in each year has not been a matter that has been concealed from the public, but, on the contrary, the existence of the surplus and the disposition made of it have not only been public property, but the method or practice pursued by the company in providing in part, at least, for the necessary additions to and improvement of its property in this manner has been generally and publicly commended and approved. It is vitally important that in the future the company should be enabled to continue to pursue the policy which has guided it in the past, and to provide in part, at least, for future additions and improvements out of surplus earnings. It is fairly to be expected that the company will be required to make as great expenditures in the future as it has made in the past. An enormous amount of work remains to be done, for which additional funds will have to be secured. The public of to-day is demanding a service of a far more costly character than ten or twenty years ago was expected or desired, and in order to make the improvements required to meet the constantly increasing demands of this character and to furnish a service which, according to modern views and standards, the public, in a sense, has a right to ask for, large expenditures must continue to be made upon the property, and if this company is to meet these conditions and is to continue to progress and not to go backward (because there is no such thing as a large railway system standing still), it must continue to derive earnings from its operations, not merely sufficient to enable it to make a fair return to its stockholders, but sufficient to earn a surplus which can be expended

*Testimony of James McCrea, president of the Pennsylvania Railroad, before the Interstate Commerce Commission, at Washington, October 12th.

on the property sufficiently large to maintain the credit which it has established.

In the last ten years the Pennsylvania Railroad Company has expended upon its property out of income upward of $116,000,000, and has also secured, through the sale of its stock, exclusive of premiums, to the amount of about $275,000,000, and through the increase of its bonded debt, exclusive of car trusts ($25,000,000) of about $172,000,000. Its ability to sell its stock and bonds has been due to the fact that it has not merely paid dividends of 6 per cent. or 7 per cent., chiefly the former, but that it has been able to show at the end of the year large surplus earnings, which it has put back into the property.

When investors have been asked to purchase its stock or bonds the company has been able to show that it was then in receipt of enough income to enable it to make a fair return on the securities that it proposed to issue, even if the proceeds of these securities could not be so invested as to enable the company to derive an immediate return thereon. In other words, the existence of the surplus earnings established a credit which enabled the company to secure the additional funds necessary to make improvements or additions as these became necessary.

What would have been the condition if the company's earnings had been so restricted in the past as to prevent it from accumulating surplus earnings available for the improvement of its property? If the $262,000,000 which has been thus expended on the lines east of Pittsburg had been realized through a sale of securities these securities would have had to have been sold at a price which could have been realized for them, and if the earnings of the company had been such as to barely cover the amounts required to meet its interest and dividends on its then outstanding securities, the prices realized for any additional issues of securities would have been such that the additional charges to which the company would have been subjected would have to-day necessitated rates higher than those which have been prevailing, in order to enable the company merely to meet its interest and dividend charges.

But there is another feature to be borne in mind in this connection, and that is that a large part of the $262,000,000 thus expended upon the property has been spent for purposes which would hardly justify an increase of its capital. Take, for instance, the amounts expended in changes of line in order to eliminate curves or to reduce grades. In almost all cases of expenditures of this character the old line is abandoned. Take, also, the large amounts which have been spent in the elevation of the railway through cities and many other items of a like character. Expenditures of this character, which do not result in any additions to the property which would tend to increase its gross earnings or revenue, ought not, where it is possible to avoid it, to be treated as capital expenditures.

During all the period that these large expenditures were being made—mainly out of surplus earnings—one of the main purposes that the company had in view was the reduction in the cost of transportation. Throughout this period the general trend of wages has been upward, and the same has been true of its taxes and of many other items which enter into and affect operating cost. Increased cost resulting from these features has been largely met by the reduction in cost resulting from expenditures made for this purpose, and thus it has been possible to avoid constant and frequent increases in rates of freight which otherwise would have had to have been made in order to enable the company to meet its increased operating cost.

In the present year the expenses of the companies whose lines are embraced in what is known as the "Pennsylvania lines east of Pittsburgh" have increased, due to an increase in the rate of wages paid to their employees, between $7,000,000 and $8,000,000 per year, and it is necessary for this company in some way to recoup itself for this additional tax on its income. Heretofore in similar cases this has been accomplished partially by advances in rates and partially through economies resulting from reductions in grades increased hauling capacity of locomotives, increased capacity of cars and increased volume of business.

So far as concerns economies which will result from reductions in grades, increased hauling capacity of locomotives and increased capacity of cars, the companies are to-day already practically deriving the full benefit from those which are possible in this direction, due to expenditures heretofore made, for we have practically completed our grade reductions and have probably reached the maximum size for our cars and engines. And it is to be borne in mind in this connection that we are now largely unable to secure the benefit of increased economies resulting from larger engines and cars and reduced grades with respect to our preference freight trains, in which the merchandise class traffic as a rule is transported, due to the fact that the amount hauled by these trains is limited by higher speed and the maximum grades over which they must pass, this being necessary in order to avoid the breaking up of the trains at transfer points.

For the last three years there has been practically no growth in business. The records of 1910 will show that the business of that year is below that of 1907. I do not mean that it should be inferred from this that there is not, in my opinion, going to be any future growth in business, but east of the Mississippi, at least in my judgment, it is going to be at a markedly slower rate than in the past, and with that growth will probably come a diminishing length of haul, thereby tending to reduce the gross earnings of the companies. But even if our gross earnings are to continue to grow as the result of growth in this business, the additional net earnings that will be derived from the increased business will in all probability fall very far short of making good the additional cost put upon the companies by the wage increase.

That this is true is largely demonstrated by the results of the company's operations for the five months following the advance in wages. In these five months the gross earnings of the lines east of Pittsburgh increased about $6,700,000, while the net earnings (including in the expenses expenditures heretofore made for additions and betterments, in order to enable a comparison to be made with last year, when expenditures of the same character were also included in operating expenses) decreased about $3,000,000. Treating these months as typical months—and there is no reason why they should not be regarded as such—and extending the figures so as to embrace a year's business on this basis, the result would be that with increased gross earnings of about $16,000,000, there would be a decrease in the net earnings of about $7,200,000. The results of the five months' operation already referred to have also shown that (treating again the expenditures heretofore made for the additions and betterments as part of the operating expenses, in order to enable a comparison to be made), the operating ratio has risen from 69.70 per cent. in 1909 to 75.51 per cent. in 1910, an increase of almost 6 per cent. There is no reason, in my judgment, for expecting that further increases of gross earnings will tend materially to reduce this operating ratio, except to the extent to which increased rates of freight will

(Continued on page 697).

LETHBRIDGE: ITS SEWAGE DISPOSAL PROBLEM.

The city of Lethbridge discharges its raw sewage into the waters of the Belly River. Lethbridge draws its own water supply above the sewer outlets. Lethbridge does not drink its own diluted sewage, but towns below Lethbridge rely on diluted Lethbridge sewage for domestic water supply.

Typhoid fever is general in the towns below Lethbridge located on the Belly River. The towns are mostly coal mining centres. Lethbridge, as well as being the chief distributing centre in the southern Province of Alberta, also depends upon the surrounding coal industry.

The city of Lethbridge is anxious to at once adopt a system of sewage purification which will protect the purity of the waters of the Belly River.

The City Council and Board of Health have recently accepted a proposed scheme of sewage purification. The scheme embodies three distinct processes, viz. :—

Removal of solids by sedimentation.

Removal of putrescibility by coarse percolating filters.

Removal of germs by disinfection.

The system is, therefore, complete and up-to-date, as it does not only include the removal of the visible nuisance, but also the removal of the unseen, but, no less important, sanitary nuisance, viz., the capability of the sewage to transmit disease infection.

The working parts of the system are to be made frost-proof. No septic action will be allowed, and the smells which generally accompany such action will be avoided.

The city engineer recently submitted the proposals to the Provincial Board of Health of Alberta.

The Provincial Board of Health have given only a half-hearted consent to the scheme. They, in a letter recently sent to the city engineer, acknowledge that the inhabitants below Lethbridge will be protected, but point out the possibility of foul odors from the works and the liability of a fly nuisance from the percolating filters; and, therefore, although they consent to the scheme, will take no responsibility.

In view of the fact that it has been clearly shown, both by the British Royal Commission and other leading authorities, that any nuisance from odors is almost entirely eliminated by treating sewage fresh and non-septic, and that the fly nuisance is easily and effectually overcome, the position of the Alberta Provincial Board would be somewhat extraordinary if it were not for the fact that the Board has become strongly prejudiced to all existing systems of sewage disposal in favor of one special method of treatment, advanced by one of the members of its board.

Only lately we published a letter, sent out by the Provincial Board to Alberta municipalities, advising them to stay their hands in installing sewage plants for the present, as all existing systems were found wanting, and they were about to ask for an appropriation to test and experiment with a new system, called "The Live Earth System."

We have given a full description of this so-called "Live Earth System," which is simply a contact bed, or succession of contact beds, filled with concrete slabs placed in layers. These beds are part of the time standing full, when they are simply septic tanks, and the remainder of the time standing empty, when oxygen is admitted to the beds. They are in every way simply contact beds, which, instead of containing the ordinary filtering material, are filled with these concrete slabs, thus copying the slate bed system of Dibden in England for sludge-digesting purposes.

Thus, in order to wait for the results of an experiment on an improved septic tank, municipalities in Alberta can only receive half-hearted consent to any scheme of sewage disposal which is even in advance of many of the up-to-date schemes in Great Britain and in America.

We are, however, at a loss to understand what the Alberta Provincial Board of Health really mean when they state as they do: "By allowing you (the city) to assume all responsibility for the installation of the system, the Board are prepared to give such a limited approval to the plans."

Under any case or circumstances will the Provincial Board of Health accept full responsibility and grant a continuous guarantee in connection with any system, whether it be their own pet one, on which they are about to experiment, or any other system, advised and based upon the accumulative experience and practice of other countries?

Does the Provincial Board of Health of Alberta really suggest that there may be some scheme submitted to them which will carry with it a consent which will relieve the municipalities from all further responsibility? That with such a scheme they will find and provide all sums necessary to meet any future desired alterations incurred by any errors of judgment or construction? Absolute hot air nonsense and piffle on the part of the Provincial Board of Health, or, if not so, then the sooner the Legislature look into the responsibilities which their Board of Health suggest they will assume, the better for the Province of Alberta.

SANITARY RIVER SURVEYS IN QUEBEC PROVINCE.

We publish in this issue an interesting paper by James O. Meadows (Sanitary Engineer of the Provincial Board of Health of Quebec).

Mr. Meadows has been, and is at the present time, engaged in making useful sanitary surveys of the Quebec rivers which are in use as municipal water supplies.

The data which the author is enabled to lay before us at present applies chiefly to the Ottawa River, as also to the result of mechanical filtration with and without the use of a coagulant. The observations dealing with the pollution of the Ottawa from Pembroke to Montreal are both interesting and instructive to those municipalities located on the banks of the river.

The data shows a very slightly sewage polluted water above Ottawa city, with a slight increase below Ottawa, and a falling off in pollution content near Montreal. An interesting observation made has reference to the low bacterial count, owing to the numerous lakes on the river, and the consequent purification by sedimentation. The chief natural characteristics of the Ottawa River are its softness, making it an ideal domestic supply, and its slight brown color, owing to vegetable content. The color, Mr. Meadows points out, is effectu-

ally removed by mechanical filtration, together with the use of a coagulant, such as sulphate alumina, to the amount of two grains per gallon.

Mr. Meadows was the responsible adviser in connection with the adoption of the hypochlorite disinfecting process to the Montreal water supply last winter. The adoption of his well-timed advice proved the means of procuring for Montreal a water supply at once free from intestinal germs.

The work being done in Quebec Province in collecting river sanitary data is the most valuable work possible with the view of putting the pure water supply problem on a scientific and practical basis. It is understood that Dr. McCullough, of the Ontario Provincial Board, has in view the adoption of a policy of systematic sanitary river surveys in Ontario, together with the appointment of a sanitary expert engineer to advise the Board on sanitary engineering questions.

PROGRESS IN DRAINAGE WORKS AT TORONTO.

"Progress in the Construction of Toronto's Main Drainage Works" was the subject of an address by Mr. A. C. D. Blanchard at a meeting of the local branch of the Canadian Society of Civil Engineers, held in Toronto last week. The address was illustrated by aid of the stereopticon.

In the absence of the chairman, Mr. C. H. Rust was elected temporary chairman of the meeting. Among the items of business the resignation of Chairman A. W. Campbell was read. Mr. Campbell's resignation was due to the fact that business kept him out of the city. The pleasure of the meeting was that Mr. Campbell be asked to continue as chairman until the elections in January.

Mr. Blanchard gave a very interesting account of the progress to date of the Toronto drainage works as shown by facts drawn from the report of Mr. Rust, city engineer, and from Mr. Blanchard's personal supervision of this work. The speaker said: While the city of Toronto is favorably situated for the collection of all the sewage at one point, and, while this proposal has been advocated from time to time by each city engineer in succession since the year 1855, funds for the carrying out of the undertaking were not provided until the year 1908. At that time the sum of $2,400,000 was appropriated for the construction of two intercepting sewers, a disposal plant and an effluent carrier. This work is now in course of construction.

The sewage tanks are situated in the east end of the city on low-lying land, a few feet above the lake level.

There are two intercepters. Beginning at the screen-house, near the sewage tanks, the high-level intercepter will extend westerly for a distance of eight miles, with the exception of 1,200 feet at the lower end. The sewer is circular in form. Its maximum size is 9 ft. 6 in. diameter, and the size gradually decreases to a minimum diameter of 3 ft. 6 in. This sewer will collect practically all the sanitary or dry weather flow of sewage which can be carried to the disposal works by gravity.

The low-level intercepter, commencing also at the screen-house and pumping station, extends for a distance westerly of 5½ miles, and varies in size from a diameter of 5 ft. 6 in. to an egg-shaped sewer, 2 ft. 9 in. by 4 ft. 3 in.

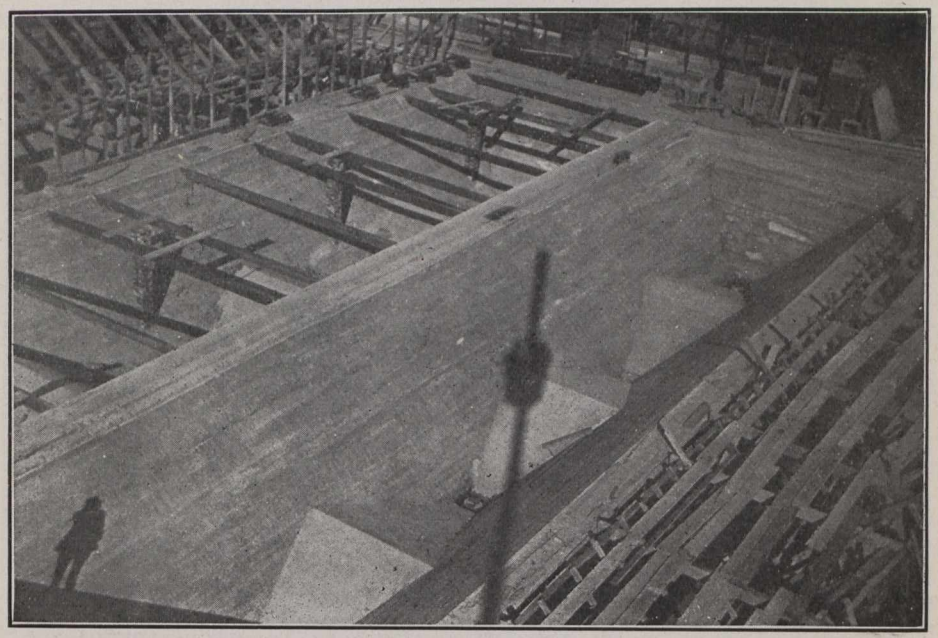
The rate of fall of these sewers is such as to give us a minimum velocity of well over two feet per second under present conditions, with a maximum velocity in the neighborhood of four feet per second.

The sewage carried to the disposal works by the low-level intercepter is required to be pumped a height of about 24 feet.

The disposal works are intended to furnish for the sewage a partial treatment, consisting of screening and sedimentation. A large building is to be erected west of the sewage tanks, containing the screens for both high and low-level intercepters, four centrifugal pumps, electrically driven, for the low-level sewage (having a combined capacity of nearly 100 cubic feet per second), an auxiliary gas engine, generator, etc., and a sludge well, through which is drawn all the sludge from the sedimentation tanks. The sludge is pumped from this well by means of two centrifugal pumps and carried through pipes to points on Ashbridge's Marsh, which will be enclosed for the purpose. It is intended that a sand-pump or street cleaning department will work in conjunction with the disposal of the sludge in order to obviate any nuisance. The screens are to be ½-in. bars, having ½-in. spaces between each, and will be cleaned by a mechanical device operated by electrical power. Bucket conveyers will be placed in front of the screens to remove

Excavation and commencement of Concreting for Sewage Tanks.

such material which gathers in front of the screens and which cannot be removed by the rakes. This building will be equipped with two cranes, one in the screen chamber and the other in the pump chamber, for the purpose of handling the machinery, etc.



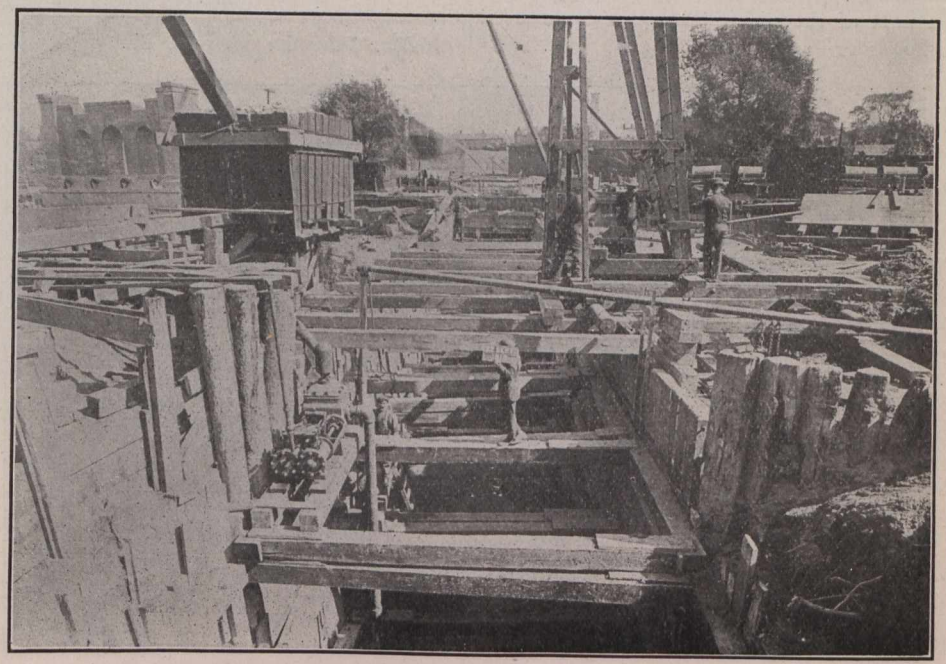
Bottom Tanks showing Drain for taking away Sludge.

The sewage from the low-level sewer, after passing through the screens, is pumped into a channel, which thus conveys the high-level and low-level sewage to the tanks.

The sewage tanks are somewhat after the design of the "Dortmund" tanks, modified to suit the conditions of this city. The tanks are constructed of concrete, reinforced where necessary, and are each 100 feet long and 25 feet wide. The four upper side walls of the tank are vertical, but for the lower twelve feet the four sides converge on 45 degree slopes. The bottom of each tank is divided into four hopper-shaped compartments by means of slopes placed at an angle of 20 degrees from the horizontal. At the bottom of each of these compartments is a valve, which is opened and closed by a stem reaching above the roof of the tank. This valve is connected to the cast-iron pipe, which is the outlet for the sludge from the bottom of the tanks.

The sewage from the screen-house is distributed among the tanks by the main inlet channel and its branches.

The present scheme embraces the construction of twenty-four tanks. These tanks are placed under one roof, having two tanks lying end to end in one direction and twelve tanks side by side in the other.



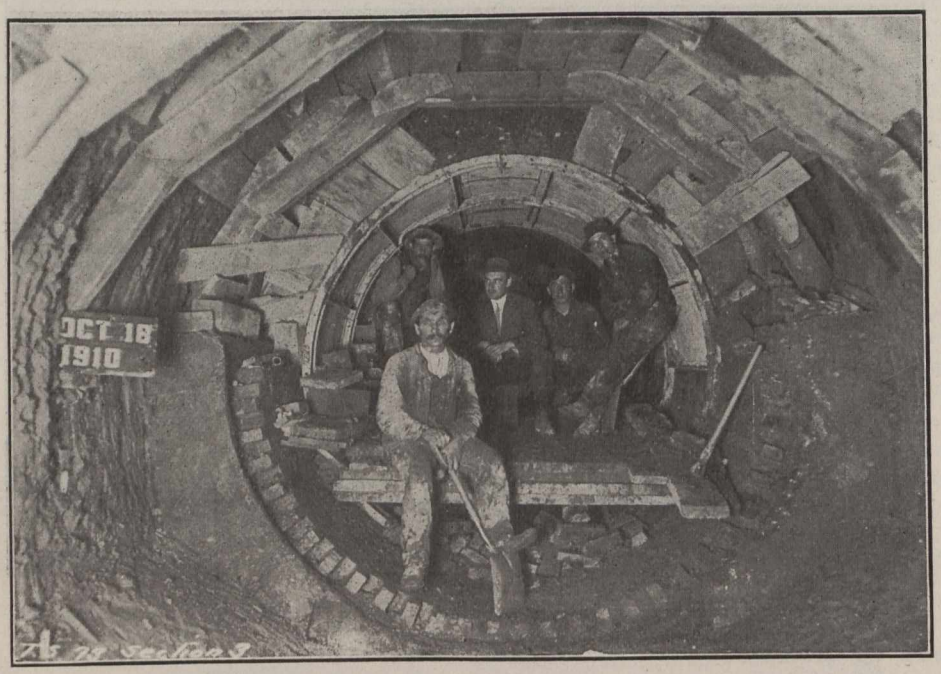
Don Siphon. Excavation of trench for pipe below bed.

Inlet and outlet branches of the main inlet and collecting channels are placed alternately between the sets of tanks. At the side opposite to that on which the main inlet channel is placed is the main collecting channel. This conducts the tank effluent to the outlet chamber, from which

it is discharged into the effluent carrier. The height of liquid in the tanks is controlled by movable wires between tanks and collecting channel.

The effluent carrier is a 60-inch circular pipe, of which about 1,800 feet is constructed in reinforced concrete and the balance of 3,100 feet is a steel pipe, the total length being about one mile.

control of the flow of the sewage at the disposal works, stop-gates and penstocks were arranged in such a manner as to permit shutting off any tank or series of tanks, or the sewage could be discharged direct into the effluent carrier and the tanks emptied into the sludge well. A storm overflow into the Bay is also provided at the entrance to the tanks.



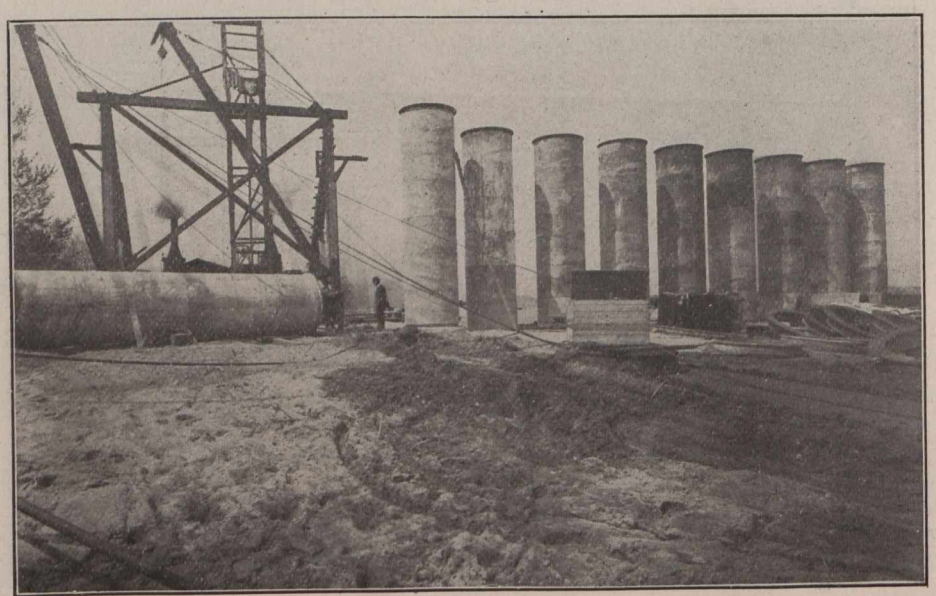
Construction of High-level Intercepting Sewer.

The concrete pipe, while somewhat cheaper in first cost, is not nearly as satisfactory to lay as the steel pipe. It is constructed in 24-ft. lengths, each section weighing 16½ tons. Cast metal flanges, drilled for bolts, are supplied at the ends, forming a part of the pipe. The pipe is lowered in place and bolted together by divers.

At the present time the sewage disposal works and high-level intercepter are nearly one-half completed, and work is being commenced on the low-level intercepter.

It is expected that a portion of the system will be in operation next summer.

Mr. John D. Watson, M.I.C.E., Chief Engineer of the



Reinforced Concrete Pipes (Meriwether patent) for effluent carrier.

The steel pipe, which is much more satisfactory to put to position, is built in 50-ft. lengths. The contractor is laying two sections at a time, bolted together.

For the purpose of giving alignment, platforms were built on piles in the lake at each change of grade. For the

Birmingham Drainage Board, of Tyburn, near Birmingham, England, and Mr Rudolph Hering, A.S.C.E., of New York, Consulting Engineer, were consulted with regard to the general schemes of sewage disposal in February, 1909.

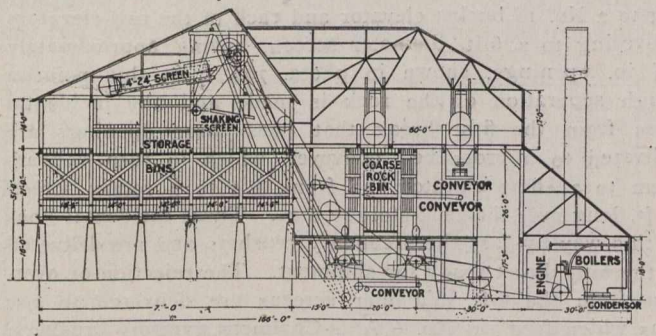
(Continued on Page 696.)

ROCK-CRUSHING PLANT OF MESSRS. LAURIN & LEITCH.

Paul C. Van Zandt.

General Description:

The rock crushing plant of Messrs. Laurin and Leitch engineers and contractors, Montreal, Canada, is unusually interesting from its enormous capacity of production and remarkable flexibility of operation.



Section Through Conveying, Screening and Storage Department.

Having obtained from the Montreal Water and Power Company, the contract for constructing within four years a reservoir of 43,000,000 gallons at Outremont, one of the city's suburbs, they recognized the advantage of crushing and marketing the rock at the time the excavation is made instead of piling it on a waste bank, the usual custom in the past.

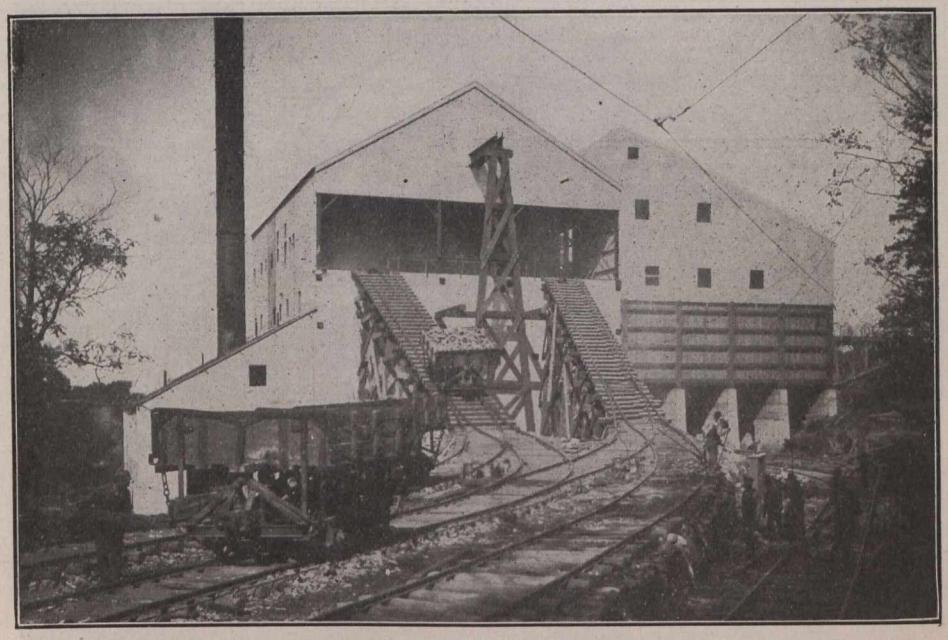
As the reservoir will be 800 feet long, 400 feet wide and 40 feet deep, formed partly by excavation and partly by enclosing walls, it will be necessary to crush within four years approximately one million tons of hard trap and granite rock and to provide storage for approximately one hundred and fifty thousand tons in various sizes after crushing so that it can be marketed to the best advantage.

The limited time at the disposal of the contractors and the enormous quantity of stone to be removed within that time necessitated the erection of one of the largest rock crushing plants in the world.

The site of the reservoir from which the rock is quarried is upon the north slope of Mount Royal, and quarry operations have been started at the lowest point in the reservoir site, where an excavation of approximately twenty feet has been commenced. From this point the quarry face will be gradually cut back towards the mountain parallel with the lower edge of the reservoir. The rock as fast as quarried is loaded direct by steam shovels into six yard side dump quarry cars, which are made up into trains of four each, to be hauled to the crushing plant. The rock is drilled by Temple electric drills along the quarry face which is 800 feet in length, and after blasting the cars are brought to the proper location alongside of the steam shovel, close to the bank of blasted rock, by Shay locomotive, which is of the geared type so as to take the grades, pushing the empty cars up to the quarry face, and bringing the loaded cars from the quarry face to the bottom of the incline haulage system leading from the lowest point in the reservoir to the crushing plant.

Hoisting System:

The crushing plant is advantageously located upon an excellent site about 1,500 feet from the centre of the reservoir, and to bring the rock from the excavation to the crusher a haulage system has been installed operating in balance, drawing a train of four loaded cars up the haulage incline of about 4 per cent. to the foot of the two incline trestles leading from the ground to the dumping hopper over the large crusher. At the same time, a train of four empty cars is lowered down the haulage incline back to the quarry, balancing in part the up-going load. At the upper end of the haulage incline there is a third track for empty cars, and the trains of loaded cars which are gathered upon first one and then the other of the two outside tracks shown upon the cut accompanying this article, are hauled up these incline trestles of approximately 20 per cent. grade, one at a time and alternately upon each of the two trestles, as shown in photo. 776, so that the large crusher is receiving a carload of rock first upon one side and then upon the other, making its operation almost continuous. The empty cars are dropped to the middle track for assembling into trains for the down-going trip on the haulage incline. All

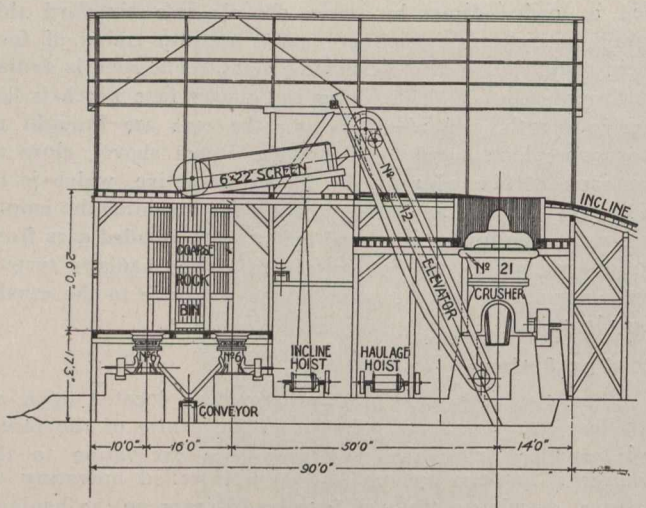


General View of Crushing Plant in Operation.

the switches shown are spring switches operating automatically, excepting the one that delivers the empty train to first one and then the other of the haulage tracks going back to the quarry.

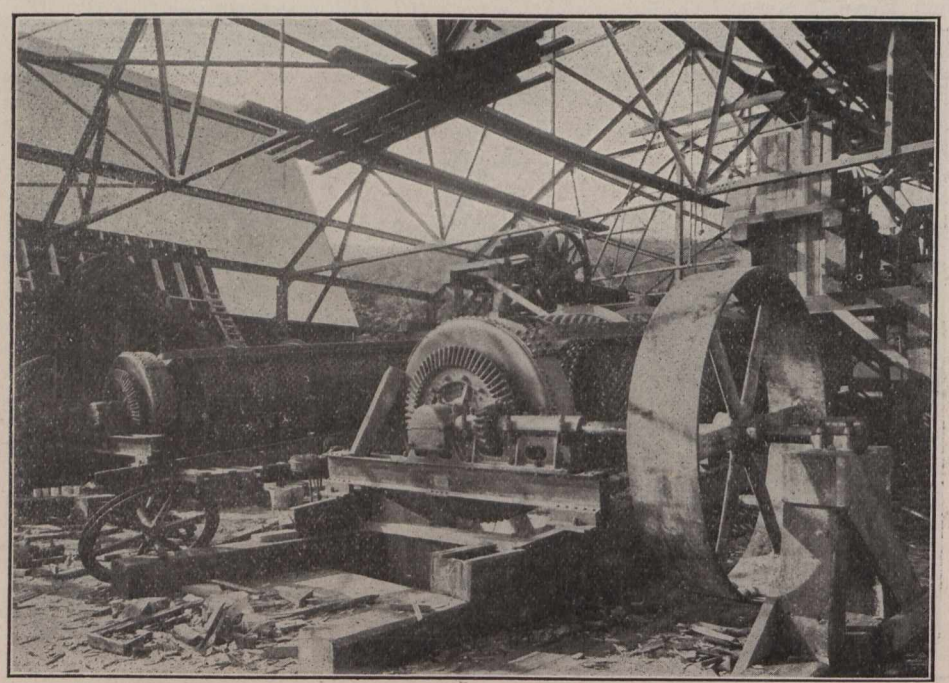
Crushing Plant:

The crushing plant contains five Allis-Chalmers gyratory crushers. One of these is a No. 21, which is the largest



Section Through Crushers.

gyratory crusher in use at the present time, having a capacity of 1,000 tons per hour. It has two openings, 42 in. across by 8 ft. in length, shown in photo. 779, each opening easily capable of receiving a piece of rock 3 ft. x 5 ft. x 10 ft., weighing 10 tons, which is the limit in size of any single piece that can be loaded by a steam shovel or carried on a single truck. This crusher, shown in photo. 757, which weighs 225 tons has crushed a piece of rock this size in forty seconds down to pieces the size of a man's head and smaller. The primary object of this large crusher and the great advantage in its use are the elimination entirely, of hand-sledging in the quarry, and almost entirely of the re-drilling and re-blasting of large pieces of rock which may have been broken from the ledge in the quarry by a primary blast. Almost everything that comes down after a blast in the quarry, can be loaded at once by the steam shovel and sent up to the crusher without further work being done upon same. As hand-sledging, re-drilling and re-blasting of pieces once broken from the quarry face, when smaller primary crushers are used, are always the largest item of expense in quarrying, it can readily be seen that the use of so large a crusher effects a great saving, even if we eliminate consideration of its large capacity. This crusher is made with a double discharge, each discharge spout delivering to a No. 18 bucket elevator and each of the two elevators delivering to a 6-ft. diameter screen, having approximately 2¾ in. openings, shown in photo. 762. At this point a rough separation of the rock is made and any incidental fines from the first break that pass these openings are delivered to a cross belt conveyer, which in turn delivers them to a short elevator and from this to a rotary screen 24 ft. long over the rock storage bins. These incidental fines in this way by-pass the secondary crushers and are delivered to the bins direct ready for shipment. The rejection or oversize from the 6-ft. diameter screens are delivered to two bins which feed six No. 6 Allis-Chalmers gyratory crushers. One of these bins and four of the crushers, shown in photo. 760, are installed at the present time and a spout is arranged to take the oversize from one of these 6-ft. diameter screens and deliver it direct to the present bin. The rock in this bin runs out of the four corners into the four No. 6 crushers automatically, and these crushing continuously reduce this oversize rock to marketable size (2½ in. and smaller) and all four deliver to a common belt conveyer, from which the recrushed rock is received by a No. 8 elevator, which in turn delivers it to two rotary screens 24 ft. long, duplicates of the one already mentioned, located alongside of it over the finished rock bins. The smallest product from these



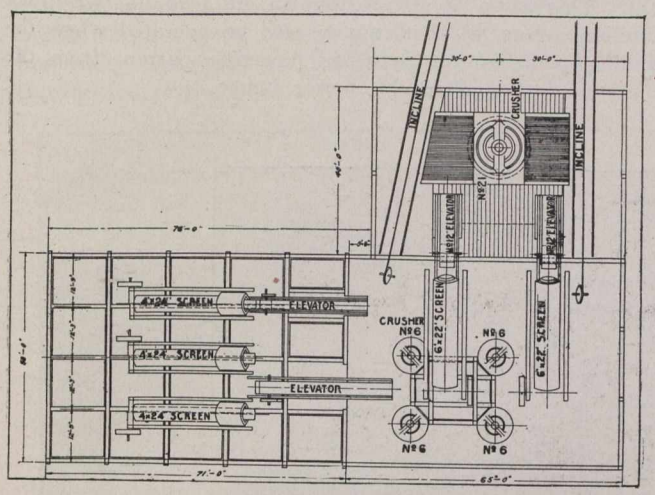
Taken Under Construction to Show the Chief Screens on the Top Floors of the Crushing Building.

three screens consists of rock ¾ in. and smaller, which is divided again upon three shaking screens into dust, ⅜ in. product (which is a fine clean sharp sand), ½-in. product and ¾-in. product. The remaining sections in the 24-ft. screens separate the crushed rock into 1¼-in., 2-in. and 2½-in. sizes. Each of the above sizes is spouted directly into a compartment in the storage bins, directly beneath the

point where it is screened, with the exception of the dust, which is conveyed in a dust-tight screw conveyer to a bin compartment properly covered over. The rock, which is very hard and clean, sizes very accurately, producing the very best of marketable stone.

Storage System:

The storage bins mentioned above have a total capacity of from 2,000 to 3,000 tons, and the bulk of the product is spouted direct from these bins into cars and wagons for shipment. The shipping tracks shown upon the illustration, run under three of the compartments, the remaining



General Plan of Rock Crushing Plant.

two being for teams. The spouts and gates from the storage bins are so arranged that any bin may be made to deliver its product to a car or wagon in the compartment on either side as well as the one directly beneath the bin, making it very easy to load more than one size into a car at the same time or to load the same size into two or more cars at the same time. No provision is made for recrushing any of the different sizes of rock, but the excess of any size that does not market as fast as made is stored on one of four storage piles. The capacity for storage being approximately 150,000 tons is sufficient to take the entire product of the plant for about 75 working days. When rock is to be stored, the particular size of which there is an excess is drawn from its bin on to a belt conveyer, which carries it out from under the bin to the system of storage conveyers extending over the storage yards. There are two belt conconveyers extending under the bin, so that two sizes of rock may be piled at the same time, and the conveying system is so arranged that any size can be piled on any pile. The amount of rock to be stored cannot be predetermined and is not the same throughout the year. Moreover, some sizes are marketable only during the summer time, while other sizes are marketable during the entire year, thus making the flexibility of the storage system above described of paramount importance. The conveyers used in this storage system are partly 20-in. and partly 24-in. belt conveyers of the Stephens-Adamson make, and the long storage piles are provided with movable trippers, which distribute the rock over the pile where desired. On account of the extreme hardness and sharpness of the rock, the belts are made of the best Diamond Rubber Company's brand, with 3/16 in. rubber cover for the narrower belts and ¼-in. rubber cover for the wider. One specially interesting feature of the conveying system is the distributing centre, where the two belt conveyers leading out from under the bins deliver the material into two small hoppers, where the product from either these belt conveyers may be delivered to the same piling conveyer, or to any one of the three piling conveyers, without interfering with the other.

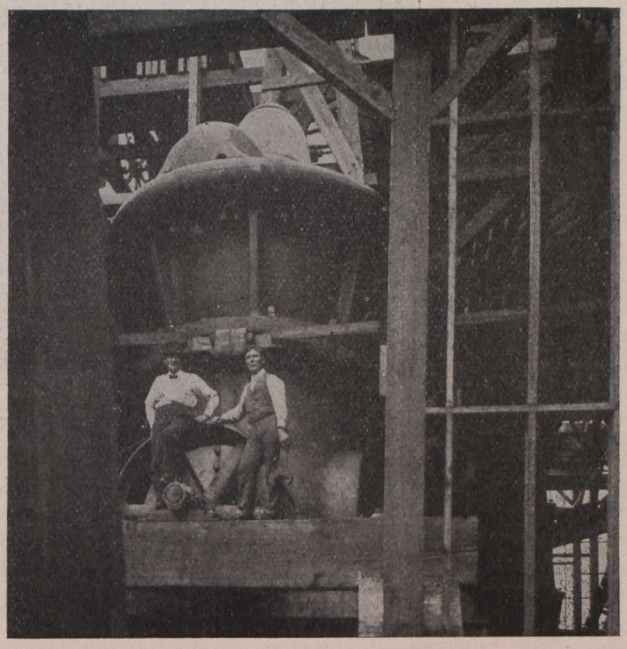
Shipping Arrangements:

The rock loaded directly on the cars from the bins is brought out upon the track shown in the illustration, past the scales (which are of the Fairbanks-Morse recording type) printing upon a ticket the gross and tare, and from this point the railroad track leads to the street railway system of Montreal, upon which it can be distributed to any point in the city, or to any railroad or wharf for further shipment. The wagons leave them properly from the other side, passing over another set of scales. of similar type.

When the rock that has been piled on one of the storage piles is shipped, it is loaded in a railroad car or wagon placed alongside of the pile by steam-operated clam shell derrick crane, made by the Bay City Industrial Works, which has a one-yard clam shell bucket upon a 40-ft. boom so that it can reach from the car to any point upon the storage pile adjacent to it, so that the additional cost of rock taken from the storage pile, when delivered upon cars is only a cent or two more than that delivered direct from the bins.

Power Plant:

The power plant consists of two 250 h.p. Erie City water-tube boilers, and one 720 h.p. vertical triple expansion Belliss & Morcom engine, this engine being connected by an English system rope drive to the main line shaft, which is in turn belted to the various machines mentioned. The belt conveyers are driven by Allis-Chalmers-Bullock induction motors, and the electric current for these (as well as for the Temple drills in the quarry and for lighting) is supplied by 175 K.W. Allis-Chalmers-Bullock generator. This generator is of the belted type, receiving power from the main line shaft, but is placed in the power house in line with a McEwen automatic high-speed self-oiling engine of suffi-



Rock Crusher In Position.

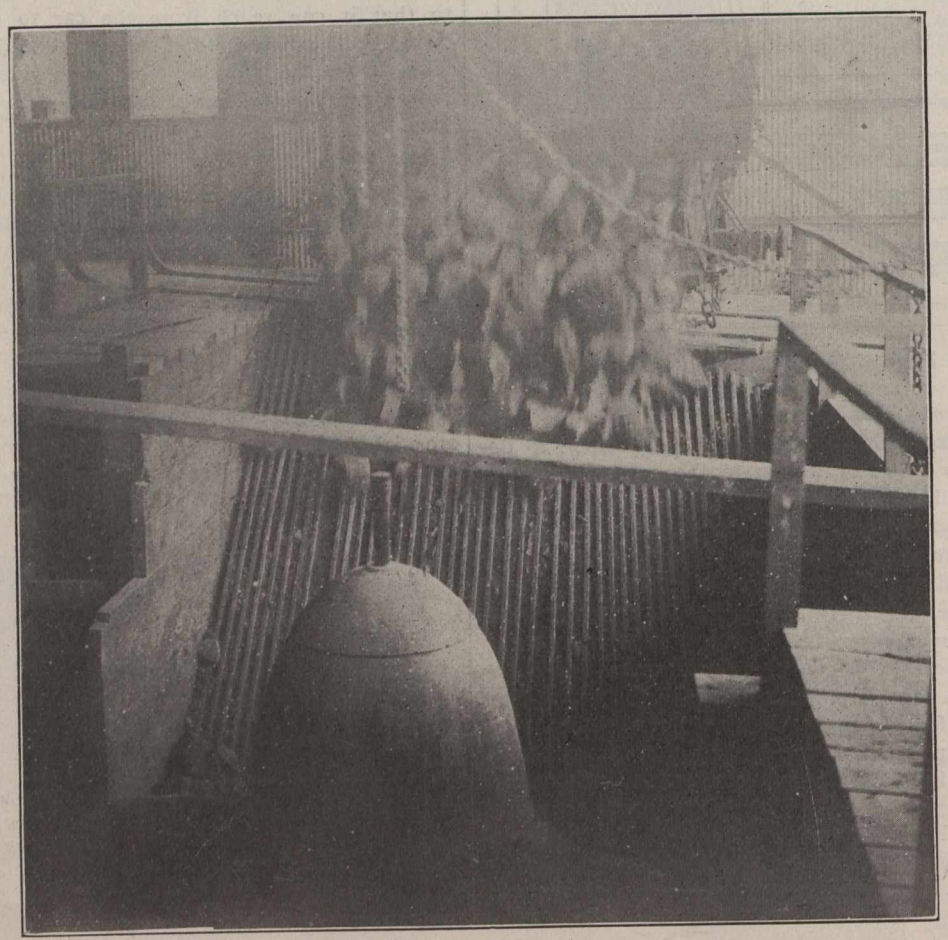
cient power to drive the generator when used either for operating the motors or the drills or the lighting system, when the main engine is shut down. The big engine is run condensing, delivering the steam direct to a Knowles pump and condenser located alongside of it. The hot water from the condenser is elevated by a McDougall centrifugal pump to a water-cooling tower just outside the power house.

Condensed steam from the auxiliaries is sent through a water heater and steam pressure upon the boilers is maintained at a constant amount of 160 lbs. by an automatic blast arrangement. The steam plant is one of the most economical that can be installed, the advantage of which is seldom appreciated in a rock crushing plant.

Hoists:

The hoists are of the Allis-Chalmers friction type. There are three hoists, one for the haulage system with a 4-ft. drum long enough to wind 1,500 feet of rope upon it, which operates the haulage system with two ropes, the down-going cars balancing in part the weight of the up-going loaded cars. The hoist is reversible and operated with a rope speed of 250 feet per minute, bringing a train of cars from the extreme end of the quarry to the plant, in approximately 5 minutes. The remaining two hoists are for the two incline trestles, hoisting by a friction band and lowering by a band brake. The speed of these hoists is also 250 feet per minute, bringing a car from the foot of the incline trestles to the crusher hopper, in about 45 seconds. The three hoists work in unison and are all controlled by one operator, located above the crushing floor at a point where he can see the cars both at the bottom of the incline and at the dumping point. The speed of the hoisting equipment is such, that by the time a train of four empty cars has been lowered to the quarry and four loaded cars have been crushed and returned to the empty track, four additional loaded cars have been brought up from the quarry.

Over the No. 21 crusher are installed two Yale & Towne triplex chain blocks, of 20-ton capacity each, for handling any of the heavy parts of the crusher should occasion require to make repairs. The track for these blocks, which are fastened to a trolley or crawl, may be seen upon the illustration, showing how any part may be lifted clear of the building or a new part lifted in. Smaller crawls and chain blocks are provided over the number sixes and elsewhere around the plant. There is a belt conveyer for carrying coal direct from cars to the boiler house. There is a large machine and blacksmith's shop alongside of the plant, provided with a 24-in. and 18-ft. lathe, a planer, radial drill, blacksmith's forge, steam hammer and other proper equipment. This shop is driven by an Allis-Chalmers-Bullock induction motor, so that it may also be operated when the crushing plant is not running, receiving current from the generator described in the power house.



Dumping Rock Into No. 21 Crusher.

The reservoir, which will be the largest in Montreal, was designed by Frank H. Pitcher, Chief Engineer of the Montreal Water and Power Company. Approximately one-half of this reservoir is to be completed first and put into operation, while the remaining half is being completed. The main water pipe leading from this reservoir is now being laid by Messrs. Laurin and Leitch, and consists of a line of 60-in. cast iron pipe, the laying of which, with its valves, etc., is in itself an item of considerable interest, but which is dwarfed in comparison with the quarrying and crushing operations going on.

This plant is unusual in many respects: primarily, on on account of its size and initial cost in proportion to the amount of work to be done under this contract. The size

(Continued on page 697).

ROADS AND PAVEMENTS

SOME NOTES ON THE DRAINAGE OF COUNTRY ROADS.*

The most important principle involved in road building is that of thorough and proper drainage. The soil upon which the road bed is placed must eventually bear the loads passing over the road. The intensity of the pressure is, of course, not nearly so great on the soil as on the wearing surface of the road, since the severe wheel pressure becomes distributed over a much larger area, the distribution depending on the thickness, character and condition of the roadway materials. But, whatever the distribution, the load is finally transmitted to the soil.

Fig. 1—Deep Side Ditch for Longitudinal Drainage.

The ability of the earth to sustain a load depends largely upon the absence of moisture in it. Most soils can be so compacted as to form a good firm foundation as long as they are kept dry, but on the entrance of water they become soft and incoherent and largely lose their sustaining power. In cold climates there is the additional damage due to freezing, but frost has no disturbing effect on dry material. Therefore, it is the entrance of water which is to be guarded against in every possible way.

Drainage consists of two kinds: surface and under drainage. Surface drainage is accomplished by using more or less impervious material for the road surface and by having the surface of such form, that water falling upon it will quickly run into the gutters or ditches. The great majority of our improved country roads have a cross section which may be said to be formed of two sloping planes with their intersection slightly rounded along the center line of the road. The side slopes toward the ditches vary from ⅜-in. to 1-in. to the linear foot. For plain macadam roads having a surfaced width of 12 to 16-ft., ¾ to ½-in. to the foot is very commonly used. The earth shoulders from the stone to the ditch are usually given a slope of 1-in. to 1½-in. to the foot, which has been found to be very satisfactory. Very little has yet been done to determine the most suitable side slope for various grades. The formula $H = \frac{W(100-4P)}{5{,}000}$ for the crown of a roadway, where H equals the crown in feet, W equals the width of road in feet from shoulder to shoulder, and P equals the per cent. of grade of the road, has probably been used more than any other in this country, but it is by no means perfect, and further investigations are needed on this subject.

The ditches and cross drains must be of ample size to care for the largest storm flow, and since the rainfall varies very largely throughout the United States, ranging all the way from over 100-ins. to a minimum of less than 3-ins. per annum, it is at once plain why the practice is so varied as to the size, shape, and grade of ditches and culverts. Wherever practicable, however, the grade of the bottom of a ditch should not be less than 6-ins. to the 100-ft. On our country roads the gutters, or side ditches, are as a rule unpaved, except on steep grades where the velocity and volume of the run-off are sufficient to produce appreciable scour or erosion.

Cross drains or culverts are constructed of wood, earthenware, iron and cement pipes, and concrete, both plain and reinforced. Wood as a material for cross drains is rapidly going out of use and should be discarded entirely. For the smaller waterways terra cotta and cement pipes serve fairly well in the warmer climates. In the extremely cold sections the terra cotta and plain cement pipes are very often broken by becoming clogged in time of a thaw which is followed by a sudden, hard freeze. Iron and reinforced concrete do not seem to be injured in this way, and the latter should be used for the construction of all of the larger culverts.

All culverts which are built with any of these materials should have their ends protected by concrete construction, in order to prevent the washing away of materials adjacent to the ends or of the culvert itself. An illustration of the washing away of a corrugated iron pipe culvert is included, which shows its failure, due to the lack of being provided with concrete ends.

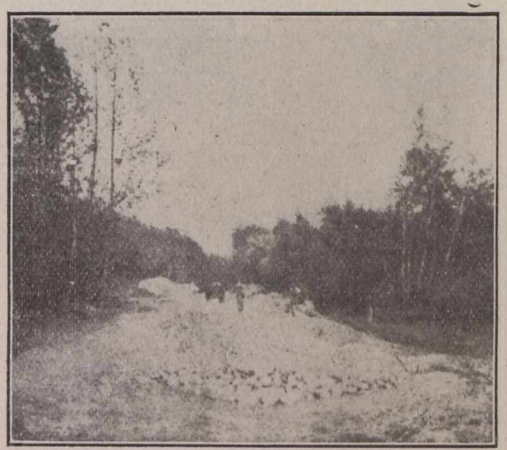


Fig. 2—V-Shaped Drain Construction.

Under-drainage involves the removal of the ground water to a sufficient depth to prevent it from injuring the road, and this depth should be varied according to the climate and the character of the soil, never being less than 2-ft. below the elevation of the road surface. The general method of removing the ground water is by drain tile from 4 to 12-ins. in diameter, laid on a true grade, and not less than 3-ft. below the crown of the road. There may be a line of such tile on both sides of the road, a single line on one side, or a single line down the middle of the road. When the direction of flow of the ground water is found to be strongly from

*Extract from a paper presented to the Second International Road Congress at Brussels, by Vernon M. Peirce, Chief Engineer, Office of Public Roads, Department of Agriculture, Washington, D.C.

one side, as is usually the case in side-hill construction, a single line of pipe, cutting it off before it reaches the road, will be sufficient. In low and swampy land, not having a well defined under flow, and in heavy retentive soils a line of tile on each side will be necessary to properly protect the road. In the latter kind of soils the tile should be laid on about 4-ins. of coarse sand or fine gravel, and then covered to a depth of at least 1-ft. with similar material. This not only insures that the joints and pores of the tile will not become clogged with the almost impervious clay, but it also gives a larger collecting area for the percolating soil water.

One of the later methods employed to drain the subsoil, which has given satisfaction, is the construction of the V-drain. In this work the subgrade should be excavated for the full width of the surfaced roadway and from 6 to 8-ins. deeper at the sides and from 12 to 18-ins. deeper at the center than usual, thus producing a flattened V-shaped trench. This extra excavation is made in order to be filled with pebbles and boulders varying in size from ½ to 12-ins. in their longest dimensions and having the largest stones

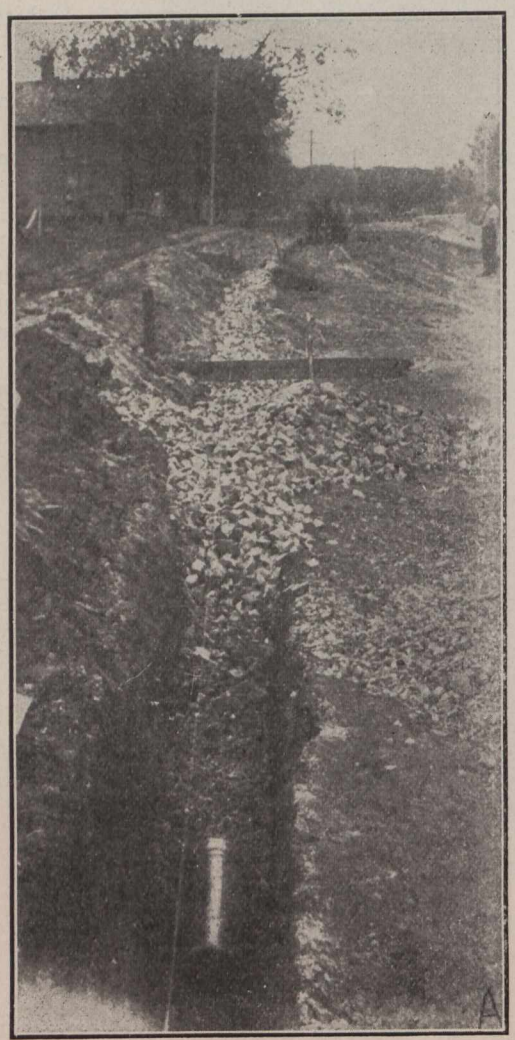


Fig. 3—Tile Under Drain at Side of Road.

placed in the bottom of the trench, which should be graded longitudinally so that the water will run along easily. These stones do not have to be deposited carefully, but should be so placed that they may be compacted with a roller to form a suitable foundation for surfacing. The water drained by such construction should be carried to the outlets provided, through narrow trenches filled with similar sized stones, as should the water drained by all forms of sub-surface drainage be carried to the side ditches, culverts, or open waterways through their own similar forms of construction.

Details of the practice of sub-drainage vary largely in the different sections, but the employment of longitudinally tiled and V-shaped drains to collect and carry off the water is very extensive and rapidly increasing. Road builders are learning more and more from experience, that as a rule it is cheaper in the end and more satisfactory to drain than to

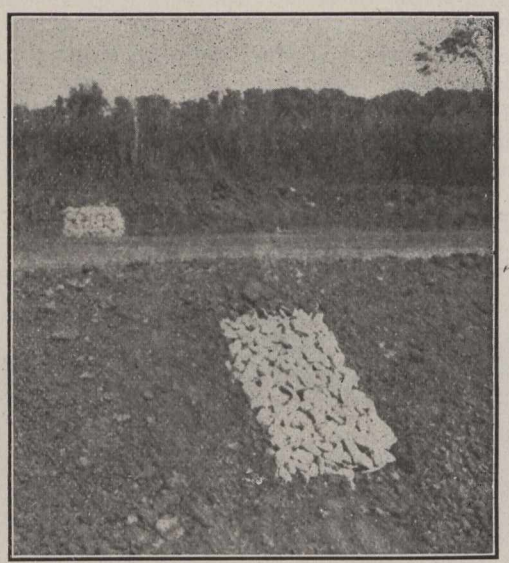


Fig. 4—Shoulder Drain Provided for Outlet for Under Drainage.

lay expensive foundations. To keep the earth dry, hard, and unyielding is necessary to secure the low cost of maintenance and long life of a road. Therefore, the water falling on the road must be carried off quickly and effectively and the water from below must be intercepted and removed before it reaches the roadbed where it can do damage.

All previous records for excavation in the rainy season were broken in the Central Division and in Culebra Cut of the Panama Canal during the month of August, when 1,377,992 cu. yds. of rock and earth were taken out of the cut and 234,404 cu. yds. from the Chagres section.

PROGRESS IN DRAINAGE WORK AT TORONTO.

(Continued from Page 690.)

Mr. Blanchard showed some excellent views of the works in course of construction as they appear at present. A population of 600,000 for Toronto is provided for, the sewers being then half full. In laying the pipes across the bed of the Don River it was necessary to drive piles for bearing them. Thirty-foot piles were driven with a penetration of twenty feet, placed four feet apart. In testing one of the pipes for compressive strength it was proven that 32 tons of pig iron piled on top of a pipe 5 ft. 6 in. in diameter gave a deflection, or increase in width, of only about ¼-in. There are 2,000 feet of steel pipe in the lake now. No plugging up of these drainage works is anticipated, owing to velocity of flow and relatively small amount of solid matter at all times, but in case of any possible stoppage there are manholes, and ample means of immediate relief are provided for. The capacity of the combined sewers will be about 300 cubic feet per second. The residents in the neighborhood of the sludge tanks will suffer no inconvenience from their presence. Septic tanks are not necessary, as these will, it is expected, more than meet the needs of the city.

MR. McCREA ON RAILWAY FINANCES.*

(Continued from page 686).

tend to do this. The company will, therefore, in the future be obliged to expend for operating expenses probably not less than 75 per cent. of any increased earnings which it may derive, but the 25 per cent. which will be thus left will not represent surplus earnings; thus, for example, gross earnings of the Pennsylvania Railroad Company in the year 1909 exceeded those for the year 1900 by about $66,000,000 the operating expenses, including taxes, increased $52,000,000 and the net earnings about $14,000,000.

But in this same period the investment of the company in the property from which this income was derived had increased to the extent of $288,000,000. Interest on this amount at the rate of 6 per cent. would be more than $17,000,000, so that of the increased earnings of 1909, which, as has been already said, amounted to $66,000,000, $52,000,000 was absorbed by operating expenses and taxes, leaving $14,000,000 net earnings, or $3,000,000 less than the interest on the amount necessary to secure them.

In my judgment, therefore, it would be wholly unsafe to assume that the company will, as the result of the growth of its business, be enabled to recoup itself for the depletion in its surplus revenue, which is certain to result from a continuance of the present operating cost. Under these conditions I feel that it is essential, in the interest of the public and of shippers, as well as of the railway company itself, that it should be permitted to secure through an advance in rates the amount which represents its additional outlay on account of the advance in wages in order that its surplus earnings may continue at approximately the rate at which they have been running in the past. It will require the expenditure of more than these surplus earnings to enable the company to keep pace with the demands of the public and of its shippers, and unquestionably additional capital must be secured in the future. If we are to obtain this we must not only be in a position to make a fair return on it, but we must be able to show a margin of safety in our earnings.

I believe, generally speaking, that what I have said in regard to the Pennsylvania Railroad as to the necessity for the rate advance is equally true of almost all railways in the United States, certainly those which are conservatively managed and which are endeavoring to give the public such a service as they have a right to expect.

ROCK CRUSHING PLANT.

(Continued form page 694).

of the plant and the excellence of its equipment are resulting in a saving in the cost of construction of the reservoir and the disposal of the rock taken from it which should pay for the entire equipment. It has sufficient capacity to crush the rock as fast as taken from the quarry, so that the product can be marketed immediately after excavation. The rock is handled but once from the excavation to the marketing, and in this way it is immediately disposed of and is out of the way. The rock is excellent in quality and instead of being thrown away on a waste bank, as was the case of the rock taken from the excavation for the Chicago drainage canal, for example, is made to yield a profit. Messrs Laurin & Leitch use a very great quantity of crushed rock in their own work on other contracts, noticeably, street paving, concrete work, and other engineering work of similar character, and a portion of this rock will be used in this way, the cost of which will be less to them than rock purchased upon the open market. The plant, which was designed and equipped by the engineering force of Allis-Chalmers Company, possesses an unusual flexibility of operation in addition to unusual economy of production, so that it may be operated to suit both the work of excavation and the market for crushed stone, producing rock for the lowest possible cost of production. The plant is exceedingly compact, resulting in the smallest possible buildings, and is well arranged for operating with the smallest crew of men. One man handles the hoisting and haulage equipment, two men the dumping of cars and feeding of crusher, two men the handling of cars at the foot of the incline trestles, one man for the spring floor, one man for the number sixes, one man for the transmission and hoist floor, one engineer, two boiler men, one oiler and two men upon the conveyers, loading, etc., and these men constitute the entire operating force of the plant. One side of the haulage incline may be operated independently of the other if necessary, as can also one of the incline trestles. One side of the No. 21 crusher with its elevator and screen, can be operated independently of or without the other. Any one or all of the number sixes may be cut out temporarily, and when the balance of the plant is shut down rock may still be loaded or piled on the storage piles, or the drills at the quarry may be operated.

DETERMINING THE VALUE OF WATER POWERS BY PROPORTION.

In valuing a large manufacturing property recently, Lockwood, Greene & Co., of Boston, the architects and engineers of industrial plants, used a method of proportion in determining the value of two of the three water powers owned by the property in question.

The three developments had heads of 50, 29 and 12 feet, respectively. These will be indicated by the letters A, B, and C. Both the tangible and intangible value of A was very carefully determined by comparison with the cost and operating expense of a steam plant of equivalent power designed to operate at a maximum efficiency. This value was further corroborated by comparison with another hydraulic plant designed by Lockwood, Greene & Co., which had been operating under very similar conditions for about four years. The actual value of this plant was very closely known.

When the value of A had thus been carefully determined and checked, the values of B and C were determined by proportion in the ratio of their available heads. For example, letting Va, Vb and Vc represent the values of A, B and C, respectively, we have:—

$$Va : Vb = 50 : 29, \text{ or } Vb = \frac{29}{50} Va,$$

and

$$Va : Vc = 50 : 12, \text{ or } Vc = \frac{12}{50} Va.$$

In the case of both B and C, the developments were much older, and the equipments not in as good condition as in the case of A, so that certain allowances and deductions had to be made from the values as determined above.

Winnipeg, Man.—Owl Metal Co., $40,000; E. H. Goddard, A. Farquhar, A. G. Kemp. Security Lumber Co., $500,000; J. P. Jansen, E. E. Sharpe, L. J. Elliott. Cummings Brass, Iron & Wire Co., $50,000; F. J. Cummings, Toronto; T. Cummings, W. J. Cummings, Winnipeg. Transcontinental Townsite Company, $100,000; H. W. Emeny, F. W. Crockett, L. J. Wisner, Elora, Iowa.

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.
Chapel Cove, N.S., breakwater	Dec. 5.	Nov. 10.	622
Grand Falls, N.B., public building	Nov. 30.	Nov. 17.	644
Maccan, N.S., timber supply	Dec. 5.	Nov. 10.	622
Ottawa, Ont., coal	Dec. 12.	Nov. 17.	644
Ottawa, Ont., railway	Jan.	Nov. 24.	42
Port Arthur, Ont., church	Dec. 12	Nov 17.	644
Rigaud, Que., public building	Dec. 5.	Nov. 17.	644
Souris, Man., water works supplies	Feb. 1.	Nov. 24.	54
Stratford, P.Q., landing pier	Dec. 5.	Nov. 10.	622
St. Henri, P.Q., post-office alteration	Dec. 6.	Nov. 24.	42
St. Joseph de Lettelier, Que., wharf	Dec. 6.	Nov. 17.	644
Toronto, Ont., post-office fittings	Dec. 12.	Nov. 24.	56
Toronto, Ont., sewer constructing	Nov. 29.	Nov. 24.	42
Toronto, Ont., pumping equipment	Nov. 29.	Nov. 24.	42
Winnipeg, Man., pole and line supplies	Dec. 1.	Nov. 3.	56
Winnipeg, Man., motor generators	Dec. 15.	Nov. 17.	54
Winnipeg, Man., electric crane	Dec. 15.	Nov. 24.	42
Wolfville, N.S., church	Dec. 1.	Nov. 17.	644

TENDERS.

Monk's Head, N.S.—Tenders will be received until December 19th, 1910, for the construction of a breakwater at Monk's Head, Antigonish County. Plans, specifications and form of contract can be seen and forms of tender obtained at this Department, at the offices of E. G. Millidge, Esq., District Engineer, Antigonish, N.S.; C. E. W. Dodwell, Esq., District Engineer, Halifax, N.S., and on application to the postmaster at Monk's Head, N.S. R. C. Desrochers, Secretary, Department of Public Works, Ottawa.

St. John, N.B.—Tenders will be received until November 30th, 1910, for the construction of a main intercepting sewer at Marble Point, St. John. Wm. Murdoch, City Engineer.

Sherbrooke, Que.—Tenders will be received until December 28th for the construction of a concrete dam and power house near the city of Sherbrooke. F. J. Griffith, secretary-treasurer. (Adv. in the Canadian Engineer.)

Ottawa, Ont.—Tenders will be received until January 4th, 1911, for a Buoy Steamer for the St. Lawrence River, length 170 feet, draught 10 feet 6 inches. Alexander Johnston, Deputy-Minister of Marine and Fisheries.

Ottawa, Ont.—Tenders for the supply of coal for the Intercolonial and Prince Edward Island Railway will be received until December 12th. Louis Lavoie, Purchasing Agent, Ottawa.

Ottawa, Ont.—Tenders addressed to Chas. Macnab, County Clerk, Court House, Ottawa, will be received up to Thursday, the 8th day of December, at 2 o'clock p.m., for the supply and delivery f.o.b. cars Ottawa of the following rock crushing plant: One portable jaw crusher, having a capacity of 15 to 20 tons of 2-inch stone per hour; elevator, rotary screen and portable bin, having a capacity of 20 tons. The lowest or any tender not necessarily accepted.

Toronto, Ont.—Tenders will be received until December 5th for the grading of Woodville Avenue. C. H. Rust, City Engineer.

Toronto, Ont.—Tenders will be received until December 13th for sixty inch steel pipe. C. H. Rust, city engineer, City Hall, Toronto, Ont.

Regina, Sask.—Tenders addressed to the City Commissioners will be received until 12 o'clock noon, December 10th, 1910, for the erection of a fire hall building. Plans and specifications are on file at the office of the city engineer. Tenders must be accompanied by a marked cheque for $600 made payable to the city of Regina. The lowest or any tender not necessarily accepted.

Victoria, B.C.—Tenders will be received by the undersigned up to December 5th, 1910, for clearing the right-of-way of the Cowichan Lake Branch of the E. & N. Railway from Mileage Five (5) to end-of-line at Cowichan Lake. Plans and specifications can be seen at office of the Divisional Engineer of the E. & N. Railway, Victoria, B.C.

Alert Bay, B.C.—Tenders will be received until December 30th, 1910, for the erection of a frame school at Alert Bay. Plans and specifications may be seen at the offices of T. F. Neelands, Inspector of Indian Agencies, Vancouver; W. E. Ditchburn, Inspector of Indian Agencies, Victoria; and W. M. Halliday, Indian Agent, Alert Bay. J. D. McLean, Secretary of Indian Affairs, Ottawa.

Prince Rupert, B.C.—Tenders will be received until January 3rd, 1911, for the construction of a Buoy Depot. Alexander Johnston, Deputy-Minister of Marine and Fisheries, Department of Marine and Fisheries, Ottawa, Can.

CONTRACTS AWARDED.

Montreal, Que.—A contract has been awarded the Bishop Construction Company, Limited, by the East Canada Power and Pulp Company, for the construction of a large water power development and pulp mill on the Malbaie River above Murray Bay, Quebec. The proposition will aggregate at $500,000.

Ottawa, Ont.—A contract for the masonry, brick and concrete work, and the like, for the Blackburn building. This work will reach a figure of about $30,000. Another contract has been obtained by an Ottawa firm in the plumbing and heating for the Rosenthal building. It went to McKinley and Northwood. Dunning and Company of this city got the galvanized iron roofing for the same building.

Toronto, Ont.—The contract for the building of the new lake steamer for the Toronto, Niagara, and St. Catharines Navigation Company has been awarded to the Collingwood Shipbuilding Company.

Vancouver, B.C.—The Northern Construction Company, of Winnipeg, which recently secured the contract for the first sixty miles of the C.N.R. from Vancouver to Chilliwack, has just been awarded the contract for the work as far east as Hope, B.C., a distance of seventy miles from New Westminster.

RAILWAYS—STEAM AND ELECTRIC.

Montreal, Que.—Hon. A. K. McLean, Attorney-General of Nova Scotia, and E. Finn, M.P.P., for Halifax, are here negotiating with J. D. Bartram, president of the Halifax and Eastern Railway Company, and Duncan Cameron, of Toronto, who is manager of the trust company, which is financing the project. It is understood that the work of construction will be started immediately.