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The Canadian Engineer

ESTABLISHED 1893.

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TORONTO, CANADA, SEPTEMBER 17, 1909.

CONTENTS OF THIS ISSUE.

Copy and cuts for changes of advertisements must be in our hands by the Monday preceding date of issue. If proofs are to be submitted, changes should be in our hands at least ten days before date of issue. When advertisers fail to comply with these conditions, the publishers cannot guarantee that the changes will be made.

THE NEW QUEBEC BRIDGE.

Will the new Quebec Bridge be ready for traffic before the completion of the National Transcontinental Railway? It is very doubtful. But the construction of the new bridge is absolutely necessary to the completion of the Transcontinental Railway scheme.

It is fortunate that the Board of Engineers have made such satisfactory progress with their examinations and preliminary plans. We are informed that the centre span will be shortened by one hundred feet, thus leaving six hundred feet one hundred and fifty feet above high water. It is to be eighty-five feet wide, twenty-four feet wider than the old bridge. A new pier will be built on the Quebec side, and the span will be reduced from eighteen hundred to seventeen hundred and fifteen. The south side pier will be enlarged. This will be necessary, since the increased width and heavier members to be employed in the new structure will make it about fifty per cent. heavier than was calculated for the original structure.

The most important decision, however, is that which intimates that the new bridge may be a suspension one. Tenders will be called for both the cantilever and suspension type, and the cost and time of erection will have some considerable influence on the design to be adopted.

Another important announcement that has been made is in reference to the use of nickel steel. In the Canadian Engineer, Vol. XVII., page 83, Mr. R. E. Chadwick summarizes Dr. Waddell's paper on "Nickel Steel Bridges." In this paper particular stress was placed upon the use of nickel in bridges with such large spans as the Quebec Bridge. The new bridge will have nickel steel members. It is said the eye-bars and compression members are to be of this material.

It is some satisfaction to know that the Board of Engineers are having a free hand, and that the want of neither time or money is to be the cause of another failure.

BOILER AND ENGINE FAILURES.

An interesting report is that of the chief engineer of the British Engine, Boiler and Electrical Insurance Company. And although written largely for their own company, yet it contains information of great value to the profession.

The first paragraph closes with this statement: "The ratios of breakdown of steam and gas engines have been approximately equal, viz., 1 in 9.4 and 1 in 9.1, as against 1 in 11.7 and 1 in 11.1 in 1907."

Following this are two tables showing the proportions in which the various parts of insured engines broke down. In 1908 the valves and valve gears of steam engines were responsible for 34.8 per cent. of the breakdowns. In gas engines the same parts were responsible for 31.3 per cent. of the failures. It should be noted, however, that in the case of the steam engine the number of failures was 14 per cent. above the average, and in the gas engine 1 per cent. below. Cylinders and cylinder ends were responsible for 6.2 of the failures in steam engines, but in gas 19.4. Connecting-rods and bolts—steam, 2.9; gas, 10.8, and so on throughout the tables

the efficiency of the various parts—as to wear and tear—of the two classes of engines.

From a study of the figures in each class the conclusion is arrived at, because of the increase in per cent. of breaks, that the design and workmanship on valves and valve gear is not as efficient as formerly.

The causes of breakdowns are also of some interest. To accidents and causes unascertained, 35 per cent.; old defects, 20; bad design, workmanship or material, 18, and negligence of owners or attendants, 27.

A GREAT COMPANY'S ANNUAL REPORT.

Elsewhere we give in some detail figures from the anual report of a $459,318,424.41 company.

The Canadian Pacific Railway, with 10,543 miles of track, 1,478 locomotives, 53,000 cars and 25 lake and 38 ocean steam vessels, is first among the great transportation companies of the world, and it still grows. During the past year 403 miles were added to the system, and at the present time miles and miles of new road are under construction.

In the West, besides the building of branch lines, the C.P.R. acquired through the Minneapolis, St. Paul and Sault Ste. Marie Railway the Wisconsin Central Railway, and in the east the Orford Mountain Railway Company, a fifty-eight mile road in Quebec.

One noticeable figure in the report is the passenger income per mile. For carrying 9,784,450 passengers they received $20,153,000, or 1.88 per mile, or less than the two cents per mile that some are so anxious should be the legal fare in Canada.

This railway, run on commercial lines, serving the community so cheaply and well, has been, and will be, one of the great forces that have done so much to develop our country; and we should not forget that it took men with vision and courage to launch such an undertaking, nor that the capital invested represents a legitimate business venture, now successful, but not always so.

It was well for Canada and the credit of the country that the directors had at their disposal at the end of the year fifteen million dollars.

EDITORIAL NOTES.

Time is not the only thing the builders of the Hydro-Electric Power Commission's line have to fight. The other day was developed an amusing phase of the work, when a conflict ensued between several farmers of Lincoln county and some members of a construction gang. According to newspaper despatches, the spoils of victory fell to the lot of the agriculturists, whose sense of fair play, however, cannot be admired. Pitchforks and shovels were their weapons of defence, or rather attack, and several of the workmen, who sustained injuries, will probably enter suits for damages. They had no desire to meet such indiscreet action.

* * * *

Owen Sound stands unique amongst Ontario towns in that it has discarded all street names and adopted numbers. Nearly sixty years ago Owen Sound was incorporated as a village, and each new street opened has added to the confusion of similar names and indefiniteness of location. By their new system all thoroughfares running north and south become avenues and number from the Sydenham River. The streets run east and west. The house numbering will be by the block system. Owen Sound council are to be congratulated for the enterprise they have shown in adopting this sensible method of street naming and house numbering. Strangers and visitors will appreciate the good points of the scheme, and Owen Sound will find she has set a good example.

DOMINION STEEL CO. AUGUST OUTPUT.

In spite of the fact that it has been somewhat handicapped by the coal supply, the Dominion Steel Company's output in August showed a big gain, while for the past three months,, as will be seen by the following figures, the output is away ahead of the corresponding months in 1908:—

	Tons, 1909.	Tons, 1908.
Pig iron	68,237	62,197
Ingots	80,529	67,916
Blooms	71,404	63,243
Rails	46,854	42,415
Rods	19,276	10,856
Sulphate	625	714

The shipments for the three months were 72,022 tons, against 71,745 tons last year.

CANADIAN MINING INSTITUTE.

Meeting of Western Branch at Nelson This Month — Members will Visit Spokane.

The sixth general meeting of the members of the western branch of the Canadian Mining Institute will be opened in Nelson, B.C., on Saturday morning, September 25th, when routine business will be transacted and several papers read and discussed.

The council of the branch having approved of the acceptance of an invitation received from the reception committee to adjourn to Spokane and there join in welcoming the American Institute of Mining Engineers to the northwest, there will be at the close of the session in Nelson an adjournment to Spokane, where a joint session of the two institutes will be held, at which several papers relative to the "Coal Resources of South-eastern British Columbia and Alberta" will be read and discussed.

NEW LOCOMOTIVES.

C. T. R. Orders 25 from The Canadian Locomotive Co. of Kingston.

A few days ago the Grand Trunk Railway placed an order with The Canadian Locomotive Company, Limited, of Kingston, Ontario, for twenty-five locomotives of the Mogul type. Through the courtesy of that firm we are able to publish the following particulars:—

ENGINE.

Gauge	4′ 8½″
Type of Engine	Mogul
Fuel used	Bituminous Coal
Wheel Base of Engine, Rigid	14′ 0″
Wheel Base of Engine Total	22′ 7″
Wheel Base of Engine and Tender	50′ 3″
Height over all, Engine and Tender	14′ 8″
Heating Surface, Fire Box	160.2 sq. ft.
Heating Surface, Tubes	1551.5 sq. ft.
Heating Surface, Total	1711.7 sq. ft.
Diameter of Driving Wheels	63″
Material of Driving Wheels Centres	Cast Steel
Diameter and Length of Driving Journals	9″ x 10″
Diameter of Cylinders	19″
Stroke of Cylinders	26″
Type of Boiler	Extended Wagon Top, Radial Stayed
Working Pressure of Boiler	180 lbs.
Number of Tubes	266
Diameter of Tubes	2″
Length of Tubes	10-10″
Injectors	No. 9 Handcock
Safety Valves	World
Brakes	Westinghouse American E. T.
Kind of Packing	U. S. Metallic

TENDER.

Weight of Tender, Loaded	138,800 lbs.
Capacity of Tank in Imp. Gallons	6,000
Style of Tank	Water Bottom
Coal Capacity	10 Tons
Style of Truck	Arch Bar Type, Cast Steel Bolster
Diameter of Wheel	34"
Kind of Wheel	Cast Steel Centre, Steel Tired
Diameter and Length of Journal	5½" x 10"
Brake Beam	Ry. Co. Standard

AGE OF MUNICIPAL EMPLOYEES.

The labor force in the average city is overloaded with superannuated men, many of whom had already passed their years of active service or usefulness at the time of their appointment to the city's service. As a result the city virtually pensions these men at full pay, a rate at least double that contemplated by the ordinary pension system. This naturally makes a rank injustice to the men who have grown old in the service of the city and exerts an influence demoralizing in its effect upon the efficiency of the force. While age alone is less potent as a cause of inefficiency than others which must be considered in connection with municipal work, nevertheless it demands careful consideration.

This has been given in the searching analysis made by Metcalf & Eddy, of Boston, consulting engineers to the Finance Commission, in their investigation of the Boston Water and Sewer Departments. In the case of the former it was found that with a force of 538 men the average age was forty-nine years and the average length of service about thirteen years; and, what is not apparent from this simple statement of fact, the average age at time of appointment is much greater now than it was some years ago, so that if the present policy of appointing men upwards of forty or even fifty years of age to do the work properly belonging to young and vigorous men is persisted in, the efficiency of the labor force is bound to be more and more seriously affected. This becomes clearly evident when we consider that most of the employees to-day are drawn from the ranks of city-bred men, whereas twenty years ago the labor was drawn mostly from the country, and moreover from a class accustomed to hard manual labor.

The average ages at time of appointment of the men in the labor force are shown in the following tabulation:

Ages at Time of Appointment of Men Now in Labor Force.

	Distribution Division.		Income Division.	
Age when Appointed.	Per Cent. of Force.	No. of Men.	Per Cent. of Force.	No. of Men
Under 20	4.0	19	4.6	3
20-25	9.1	43	7.6	5
25-30	18.4	87	12.2	8
30-35	16.5	78	16.7	11
35-40	16.3	77	19.8	13
40-45	12.8	60	16.7	11
45-50	14.4	68	12.1	8
Over 50	8.5	40	10.3	7
Total	100.0	472	100.0	66

A study of the relation of length of service to ages of employees indicates clearly that the average term of service does not keep pace with the increased age of the employees.

Substantially the same conditions prevail in the Sewer Department. It further appears that whereas in the Sewer Division 13 per cent. of the labor force is composed of men over sixty years of age, in the Water Department, as shown in the following table, nearly 18 per cent. of the labor force in the Distribution Division, and 16½ per cent. in the Income Division, are over sixty years of age; and whereas in the Sewer Division about 31 per cent. of the present labor force were appointed when they were more than forty years of age, nearly 36 per cent. of the force in the Distribution Division and over 39 per cent. of that in the Income Division were over forty at the time of their appointment. Doubtless this condition would be even more marked in both departments if it were feasible to tabulate the ages of all the men who were appointed to the force in former years, since it is a safe conclusion that there were men appointed when over forty years of age who are now by reason of death or resignation no longer connected with the force:—

Boston Water Department.

Percentage of the Total Labor Forces who are Older or Younger than Designated Age.

	Distribution Division. Percentage of Labor Force who are		Income Division. Percentage of Labor Force who are	
Present Age.	Older.	Younger.	Older.	Younger.
20	99.8	0.2	100.0	—
25	99.2	0.8	98.5	1.5
30	96.9	3.1	97.0	3.0
35	92.9	7.1	94.0	6.0
40	83.8	16.2	82.0	18.0
45	70.5	29.5	65.5	34.5
50	57.0	49.0	45.5	54.5
55	33.6	66.4	36.5	63.5
60	17.7	82.3	16.5	83.5
65	7.7	92.3	6.0	94.0
70	2.6	97.4	1.5	98.5
75	1.3	98.7	—	100.0

RAILWAY ORDERS.

7865—August 20—Approving location of C.P.R. station at McTaggart, Sask.

7866—August 20—Authorizing the C.P.R. to construct an extra track across road allowance between Sections 21 and 16, Township 10, Range 20, west Principal Meridian, Manitoba.

7867—Aug. 20—Authorizing the C.P.R. to reconstruct bridge No. 113.9, over the Illecillewaet River, B.C.

7866—August 24—Authorizing the town of Barrie, Ont., to lay sewer under tracks of G.T.R. at Essa Street.

7869 and 7870—August 24—Authorizing the Bell Telephone Company to erect an underground conduit across tracks of G.T.R. and Michigan Central Railways at Waterloo Street, London, Ont.

7871—August 20—Rescinding Order No. 7749, dated August 7th, 1909, in re G.T.R. station at Guelph, Ont., and staying proceedings under Order No. 7394, June 28th, 1909, in same matter, until the question of subway at Neeve Street is disposed of.

7872—August 20—Authorizing the Pembroke Southern Railway Company to construct spur to the Lee Manufacturing Co., Pembroke, Ont.

7873—August 20—Directing the C.P.R. to provide and construct two level highway crossings over public highway known as the Gravel Pit and Andrews Road Crossing, in the district of Matsqui, B.C.

7874—August 20—Approving location of C.P.R. Station at Gull Lake, Sask.

7875—August 20—Authorizing the C.P.R. to construct branch to the Rogers-Cunningham Lumber Company, Ltd., Lethbridge, Alta.

7876—August 20—Authorizing the C.P.R. to construct spur to the premises of the Citizens Lumber Company, Lethbridge, Alta.

7877—August 20—Authorizing the C.P.R. to construct spur to the premises of J. Wilson, Parish of Vaudreuil, Que.

7878—August 24—Authorizing the C.P.R. to construct spur to the Alberta Lumber Company, Vancouver, B.C.

7879—August 24—Authorizing the C.P.R. to construct spur through blocks 21, 12, and 5, and across the lanes and streets in the town of Saskatoon, Sask.

7880—August 19—Dismissing the application of the C.P.R. for Order No. 6856, dated April 17, 1909, by providing that the wires at the crossings of the Seymour Power & Electric Company, Ltd., shall be supported by a four-pole structure on each side of the track.

STRESSES IN MASONRY DAMS.*

By William Cain, M. Am. Soc. C.E.

The object of this investigation is to determine the amounts and distribution of the stresses in a masonry dam, at points not too near the foundations, having assumed the usual "law of the trapezoid," that vertical unit pressures on horizontal planes vary uniformly from face to face.

Experiment indicates that such vertical stresses increase pretty regularly in going from the inner to the outer face, for reservoir full, until we near the down-stream or outer face, where the stress gradually changes to a decreasing one, which decrease continues to the end of the horizontal section. The law of the trapezoid is thus only approximately true over part of the section, but, as it gives an excess pressure where it attains a maximum, it errs on the safe side.

The profile of the dam selected is of the triangular type, with some additions at the top, but the method used in determining the stresses is general, and will apply to any type of profile. The final equations will give at any (interior or exterior) point of horizontal section considered the vertical unit stress on the horizontal section, the normal stress on a vertical plane, and the unit shear on either horizontal or vertical planes. From these stresses, the maximum and

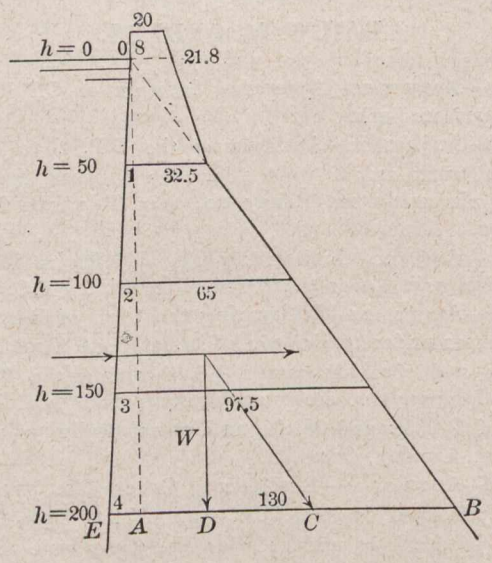


FIG. 1.

minimum normal stresses, and the planes on which they act, can be determined, and ultimately, if desired, the stress on any assumed plane can be ascertained.

The solution presented is approximate, which is justifiable in view of the approximation involved in "the law of the trapezoid" used. The results, however, are practically correct, as will be evident from the checks applied, resulting from the exact theory given in the Appendix. The theory used, being simple, should be easily followed.

Let Fig. 1 represent a slice of the dam contained between two vertical parallel planes, 1 ft. apart and perpendicular to the faces. The batter of O B is, $\frac{130}{200} = \frac{0.65}{1}$; that of O E being $\frac{4}{200} = \frac{0.02}{1}$. The batter of the inner face was found by trial, so that the centers of pressure on horizontal sections, for reservoir empty, should nowhere pass more than a fraction of a foot outside the middle third of the section. The simple type of profile shown was adopted for ease of computation.

For convenience in subsequent computations, the breadth, b = E B, of horizontal sections, corresponding to various depths, h, below the surface of the water in the reservoir, are given, all dimensions being in feet:

h = 199.0, b = 133.330
h = 199.5, b = 133,665
h = 200.0, b = 134.000
h = 200.5, b = 134,335
h = 201.0, b = 134,670

Take the weight of 1 cu. ft. of masonry equal to 1; then the weight of masonry above any section is equal to the corresponding area in Fig. 1 above that section. The area of the portion above E O B is readily found to be 712, and its moment about the vertical, A O, is 11 603, the unit of length being the foot. In Fig. 1, D is where the vertical through the centre of gravity of the dam above the joint, E B, cuts that joint, and C is the centre of pressure on that joint when the water pressure on E O is combined with the weight of masonry, W, above E B.

As h varies, suppose each horizontal joint, in turn, marked similarly to the joint at h = 200, with the letters E, A, D, C, B; then, for any joint, on taking moments of the triangles, A O B, A O E, and the area above O B, we find,

$$A D = \frac{\frac{A O}{6}(A B^2 - E A^2) + 11\ 603}{W}$$

Assuming that the masonry weighs 2½ times the water per cubic unit, then the weight of a cubic foot of water is $\frac{2}{5}$. It would entail but little extra trouble here, where the inner face has a uniform batter throughout, to include the vertical component of the water pressure on the face, E O; but it will be neglected as usual.

The horizontal water pressure for the height, h, is thus, $\frac{2}{5} \times \frac{h^2}{2} = \frac{1}{5} h^2$, and its moment about C is, $\frac{1}{5} h^2 \times \frac{1}{3} h = \frac{1}{15} h^3$.

Taking moments of W and water pressure about C, we have at once,

$$D C = \frac{1}{15} \times \frac{h^3}{W}.$$

From the last two formulae, we derive the following results:

h	W	A D	D C
199	13 978.335	40.49141	37.58483
200	14 112.000	40.70316	37.79289
201	14 246.335	40.91488	38.00089

A seven-place logarithmic table was used throughout, the aim in the computations being to get the seventh significant figure correct within one or two units. The necessity for this accuracy will be seen later.

The distances, E C and C B, are now readily derived.

For, h = 199, E C = 82.05624, C B = 51.27376
h = 200, E C = 82.49605, C B = 51.50395
h = 201, E C = 82.93577, C B = 51.73423.

On any plane, E B, the vertical unit pressure,

$$\text{at } B = p_1 = \frac{4b - 6CB}{b^2} W,$$

$$\text{at } E = p_2 = \frac{4b - 6EC}{b^2} W;$$

where b = E B, and W is the weight of masonry above the plane. This follows from the assumed "law of the trapezoid."

From these formulae we derive,

At h = 199, p_1 = 177.45483, p_2 = 32.22542,
h = 200, p_1 = 178.3855, p_2 = 32.24139,
h = 201, p_1 = 179.3160, p_2 = 32.25798.

Call p the vertical unit stress at a distance, x′, from E; then,

$$p = p_2 + \frac{p_1 - p_2}{b} x';$$

and the total stress on the base, x′, is,

$$P = \frac{1}{2}[p_2 + p] x' = p_2 x' + \frac{p_1 - p_2}{2b} x'^2 \quad \ldots\ldots\ldots\ldots (1)$$

*Proceedings of the American Society of Civil Engineers Vol. XXXV. Page 38, not read before the Society.

To find the unit shear on vertical or horizontal planes*, consider a slice of the dam, bounded by horizontal planes at h = 199 and h = 200, the water face and a vertical plane, at a distance, x, from the inner face (Fig. 2), in equilibrium under the water pressure acting horizontally on its left face and the forces exerted by the other parts of the dam on the slice. These forces consist of the uniformly increasing stress, P′, on top, acting down; the uniformly increasing stress, P, on the bottom, acting up; a shear acting on the vertical plane at the right, of average intensity q_1 per square foot; the weight of the body (x — 0.01), besides the horizontal forces to be given later. The vertical component of the water pressure is here neglected, as usual. The origin for x is taken, here and in all subsequent work, at the level, h = 200, at the inner face.

For equilibrium, the sum of the vertical components must be zero.

Therefore, $q_1 = (x - 0.01) + P' - P$ ..... (2)

To find P′, substitute in Equation 1, $x' = x - 0.02$, $p_2 = 32.22542$, $p_1 - p_2 = 145.22941$, b = 133.330, giving $P' = 32.20364\ x + 0.5446238\ x^2 - 0.6442906$. P, $x' = x$, $p_2 = 32.24139$, $p_1 - p_2 = 146.1441$, and b = 134; therefore

$$P = 32.24139\ x + 0.5453138\ x^2.$$

Substituting in Equation 2, we derive the average unit shear,

$$q_1 = -0.6542906 - 0.96225\ x - 0.0006900\ x^2 \quad (3)$$

This value of q_1 is strictly correct when $x > 0.02$. It is slightly in error when $0 < x < 0.02$.

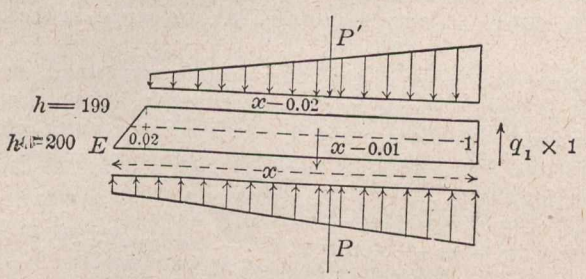


FIG. 2.

A similar investigation holds to obtain the average unit shear q_2 (Fig. 3) on a vertical plane, at a distance, x, from E, extending from the level, h = 200, to the level, h = 201.

We have, for equilibrium,

$$q_2 = (x + 0.01) + P - P'' \quad (4)$$

We find P″ by substituting in Equation 1, $x' = (x + 0.02)$, $p_2 = 32.25798$, $p_1 - p_2 = 147.05802$, and b = 134.67. $P'' = 32.27982\ x + 0.5459941\ x^2 + 0.6453780$. Substituting this, and the value previously found for P, in Equation 4, we derive,

$$q_2 = -0.6353780 - 0.96157\ x - 0.0006803\ x^2 \quad (5)$$

This is strictly correct only when $x > 0$.

The mean, $\frac{1}{2}(q_1 + q_2)$, of these average shears will be assumed as approximately equal to the intensity of shear at the point, G (x = E G), at the level, h = 200. Call q this intensity of shear on a vertical plane at G; therefore,

$$q = -0.6448343 + 0.96191\ x - 0.0006856\ x^2 \quad (6)$$

Checks.—By Appendix (b) and (d), the exact value of q, at either face, = p tan. ϕ, where p = vertical unit normal stress at the face and ϕ is the angle the face makes with the vertical. Thus, at the inner face, $q = -32.24139 \times 0.02 = -0.6448278$, whereas Equation 6 gives, for x = 0, $q = -0.6448343$.

At the outer face, the exact value is, $178.3855 \times 0.65 = 115.9506$, whereas Equation 6 gives, for x = 134, q = 115.9405.

A still more searching test can be devised. It is a well-known principle that the intensity of shear at a point on vertical or horizontal planes, is the same [Appendix (a)]. Therefore, regarding Equation 6 as giving the horizontal unit shear, at the level, h = 200, where b = 134 ft.; the total shear, from face to face, on this level, is,

$$\int_{x=0}^{x=134} q\ dx = 7999.75$$

This should equal the total water pressure down to the same level, $\frac{1}{5}(200)^2 = 8\,000$. Formula 6 thus gives practically exact results.

In order to find the normal unit stress on a vertical plane, we shall assume that q_1, given by Equation 3, equals the intensity of shear on a vertical or horizontal plane at the point x, at h = 199.5; and that q_2, given by Equation 5, gives the shear intensity at x at h = 200.5. This evidently supposes that the shear intensity increases uniformly, vertically, from h = 199 to h = 201.

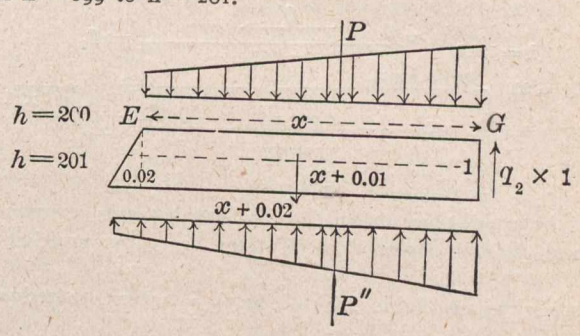


FIG. 3.

Consider a portion of the dam, Fig. 4, bounded by the water face; the plane, F M, at the level, h = 199.5, on which the total shear is Q′, the plane, E N, at the level 200.5, on which the total shear is q, and the vertical plane, M N, 1 sq. ft. in area, on which the average normal stress is p′. The water pressure on E F will be supposed to be exerted horizontally. It is equal to 80 units. Assuming, as stated, that q_1 = intensity of horizontal shear at M, and q_2 = the corresponding intensity at N, we have, taking the origin as before, O,

$$Q' = \int_{0.01}^{x} q_1\ dx; \qquad Q = \int_{-0.01}^{x} q_2\ dx;$$

or,

$$Q' = 0.006494794 - 0.6542906\ x + 0.481125\ x^2 - 0.00023\ x^3$$

$$Q = -0.00640186 - 0.6353780\ x + 0.480785\ x^2 - 0.0006803\ \frac{x^3}{3}$$

Checks.—The total water pressure for h = 199.5 is $\frac{1}{5}(199.5)^2 = 7960.05$ and for h = 200.5, $\frac{1}{5}(200.5)^2 = 8\,040.05$. The first should equal Q′, for x = 133.665, or 7 959.22; the second should equal Q, for x = 134.335, or 8 041.12. The slight differences tend to give confidence in the results.

For equilibrium, the sum of the horizontal forces acting on E F M N, Fig. 4, must be zero;

therefore, $p' = 80 + Q - Q' \quad (7)$

$$p' = 80.01 - 0.0189\ x + 0.00034\ x^2 - 0.00000323\ x^3.$$

This average stress will now be assumed to be the intensity of the horizontal unit stress on vertical planes at h = 200.

It will now be perceived why a seven-place table was necessary in the computations, the coefficients of x^2 and x^3

* The writer desires here to acknowledge his indebtedness to a recent paper on "Stresses in Masonry Dams" by Ernest Prescot Hill, M. Inst. C. E., published in Minutes of Proceedings, Inst. C. E., Vol. CLXXII., p. 134. Mr. Hill considers the case of a dam with a vertical inner face. By the aid of the calculus, he effects an exact solution, which leads to general formulae for shear and normal pressures on vertical planes.

Mr. Hill ascribes to Professor W. C. Unwin the suggestion, "that the shearing stress at any point may be found by considering the difference between the total net vertical reactions [between that point and either face] along two horizontal planes at unit distance apart," and states that Prof. Unwin "has applied the principle to a triangular dam by the use of algebraical methods."

having only two or three significant figures in the final result. If the planes originally had been taken 0.1 ft. apart vertically, a ten-place table would have been required.

Checks.—The value of p′, for x = 0, p′ = 80.012896, is the same as that given by Appendix (a), 80 + 0.6448 × 0.02. When x = 134, the formula gives p′ = 75.81, whereas the exact theory, Appendix (b), gives $p' = m^2 p = (0.65)^2 \times 178.39 = 75.37$. The difference is 0.44 at the outer face. For any other point, it might be assumed to vary with x, so that it could be corrected by subtracting $\frac{0.44}{134} x = 0.0033\ x$ from the value of p′ above. For ease of computation, the formula will be written,

$$p' = 80.01 - 0.02\ x + 0.00034\ x^2 - 0.00001\ \frac{x^3}{3} \quad \ldots\ldots (8)$$

The first coefficient of x^3 cannot be counted on to the last two figures, hence we are permitted to change 323 to 333 in that coefficient. When x = 134, Equation 8 gives p′ = 75.41, nearly the exact value.

The three formulae for p, q and p′, at the level h = 200, are thus as follows:—

$$p = 32.24 + 1.09063\ x.$$

$$q = -0.64 + 0.962\ x - 0.000686\ x^2.$$

$$p' = 80.01 - 0.02\ x + 0.00034\ x^2 - 0.00001\ \frac{x^3}{3}.$$

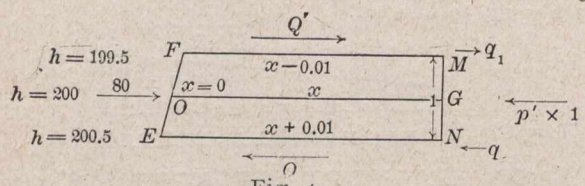


Fig. 4.

Since the weight per cubic foot of masonry was assumed as two and one-half times that of water, we must multiply the stresses given in Table 1 by $\frac{5}{2}(62.5) = 156.25$, to reduce to pounds per square foot; or by 1.085, to reduce to pounds per square inch.

TABLE 1.

x	0	10	25	50	75	100	134
p′	32.24	43.15	59.50	86.77	114.04	141.30	178.39
q	−0.64	8.91	22.98	45.75	67.65	88.70	115.95
p′	80.01	80.02	79.66	79.11	79.01	78.08	75.37
max f	80.02	82.06	94.67	128.85	166.40	203.85	253.71
min. f	32.23	41.11	44.48	37.03	26.64	15.52	0
θ for max. f.	90°46′	76°06′	56°50′	42°36′	37°44′	35°12′	33°01′

In Table 1 the stresses are those experienced at the level, h = 20.

p = vertical unit stress on a horizontal plane,

q = shearing unit stress on horizontal or vertical planes,

p′ = horizontal unit stress on vertical planes,

Max. f = maximum normal stress acting on a plane inclined to the horizontal at the angle θ, given on the last line,

Min. f = minimum normal stress acting on a plane perpendicular to the last.

From max. f and min.f, with θ, the ellipse of stress can be drawn, and the stress in any direction, with the plane on which it acts, can be ascertained.

It will be observed that there is no tension exerted anywhere, and that the maximum compression is 253.71, or 275 lb. per sq. in., which is exerted at the outer face, upon a plane at right angles to the face.

In Appendix (e), the important formula, for the maximum normal intensity at the outer face, acting parallel to that face,

$$f = \frac{p}{\cos.^2 \phi}$$

is proved. In this instance, p = 178.39, tan. φ = 0.65, therefore φ = 33°01′, whence f = 253.71.

This stress is unaccompanied with any conjugate stress, perpendicular to the face. In the interior of the dam, where conjugate stresses prevail, the masonry is perhaps better able to withstand a certain compressive stress than at the face. The distribution of stresses, at the level h = 200, is shown in Fig. 5, on the supposition that the base of the dam is a little below that level. The connection with the foundation materially modifies this distribution; but Fig. 5

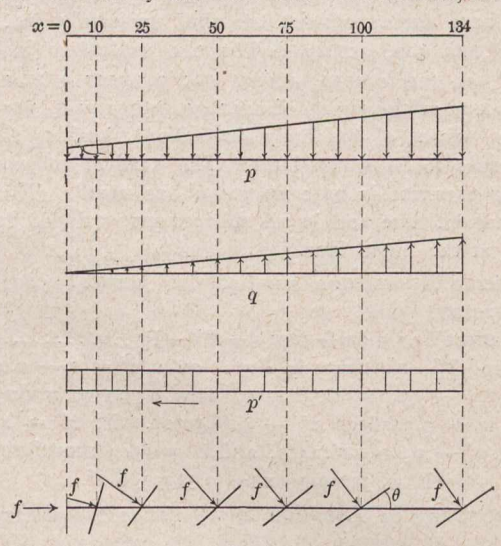


Fig. 5.

shows the distribution for sections, say, from 10 to 20 ft. above the base, up to the level h = 50, fairly well, on the basis of the trapezoid law. As has been mentioned before, this law gives a pressure greater than the actual at the outer face.

Since the batter of the inner face is very small, the results of Table 1 should agree approximately, except near the inner face, with those found by Mr. Hill in the paper referred to in the foot-note. Substituting numerical values, Mr. Hill's formulae, for h = 200, reduce to,

$$q = 0.9426\ x - 0.0005768\ x^2,$$

$$p' = 80 - 0.0001289\ x^2 - 0.0000009615\ x^3;$$

giving,

x	0	10	25	50	75	100	134
q	0	9.36	23.20	45.69	67.45	88.49	115.95
p′	80	79.99	79.90	79.56	78.87	77.75	75.38

To be concluded in next issue.

EDMONTON STREET RAILWAY.

The total number of passengers carried by the Edmonton Street Railway since the commencement of operations on the 9th November, 1908, to August 31st, 1909, was 1,347,600. For the month of August the number was 193,704. The net earnings in August were $8,161.87.

The Halifax Electric Company's gross earnings for the week of September 7th, 1909, were $4,719.70, a decrease of $2,315.23, and from January 1st, $122,512.95, an increase of $565,976.

The earnings of the Toronto Street Railway for the week ended September 11th, 1909, show an increase of $7,542.61 as compared with the figures for the same week in 1908. 1909, $114,488.66; 1908, $106,946.05.

Mr. W. H. Jones, acting superintendent of the Idaho division of the Oregon Short Line Railway, accompanied by four minor officials of the same railway, were in Montreal recently. They are looking over the Canadian roads for pointers and will make a full report of their observations to Mr. Julius Kruttchnitt, director of maintenance and operation of all Harriman roads in America and Mexico, who will decide as to the advisability of adopting Canadian methods.

N. T. RAILWAY.

The steel has been put down for 40 miles west of Cochrane on the Transcontinental Railway, and will be extended twenty miles further within the next thirty days.

Two temporary bridges had to be built, the permanent steel structure will be put in place during the winter. The grade is practically completed for 100 miles west of Cochrane.

RAILWAY EARNINGS AND STOCK QUOTATIONS

NAME OF COMPANY	Mileage Operated	Capital in Thousands	Par Value	EARNINGS Week of Sept. 7		STOCK QUOTATIONS TORONTO				MONTREAL			
				1909	1908	Price Sept. 10 '08	Price Sept. 2 '09	Price Sept. 9 '09	Sales Week End'd Sept. 9	Price Sept. 10 '08	Price Sept. 2 '09	Price Sept. 9 '09	Sales Week End'd Sept. 9
Canadian Pacific Railway	8,920.6	$150,000	$100	$1,664,000	1,301,000	.....	182⅜	180½ 180⅜	520	174½	174¼	183 182	181 180 715
Canadian Northern Railway	2,986.9	.....	.....	190. 400	175,300	.....	.....	.....	.....	.....	.....	.....	.....
*Grand Trunk Railway	3,536	226,000	100	939.143	821.962	.....	*1st. pref. 107½, 3rd pref. 68⅞, ordinary 24¾						
T. & N. O.	334	(Gov. Road)	.....	34,965	18,925	.....	.....	.....	.....	.....	.....	.....	.....
Montreal Street Railway	188.3	18,000	100	75,062	74,118	.....	.....	.....	.....	174	170	213 212½	225½ 214 383
Toronto Street Railway	114	8,000	100	93,643	88,125	106	126½ 126	126 125½	110	105¼	105¼	126 125¼	125½ 125 460
Winnipeg Electric	70	6,000	100	.....	.....	170	190 187	187	21	170	165	187	187 .....

* G.T.R. Stock is not listed on Canadian Exchanges These prices are quoted on the London Stock Exchange.

CANADIAN PACIFIC RAILWAY COMPANIES ANNUAL REPORT FOR THE YEAR ENDING JUNE 30th, 1909

The annual report of the Canadian Pacific Railway for the year ending June 30th, 1909, shows total earnings amounting to $76,313,320.96. These earnings were made up as follows: Passengers, $20,153,000.83; freight, $48,182,520.11; mails, $778,822.35; and sleeping cars, express elevators, telegraph and miscellaneous $7,198,977.67.

The working expenses for the year amounted to $53,357,748.06, thus the working expenses amounted to 69.92 per cent. of the gross earnings, and the net earnings to 30.08 per cent. as compared with 69.47 and 30.53 per cent. for 1908.

Equipment.

The equipment of the road consists of:—

Locomotives	1,478
*First and second-class Passenger cars, Baggage cars and Colonist sleeping cars	1,461
First-class sleeping, dining and café cars	275
Parlor cars, Official and Paymasters' cars	60
Freight and cattle cars (all kinds)	47,748
Conductors' Vans	797
Boarding, Tool and Auxiliary Cars and Steam Shovels	3,013

*Includes cars in Line Service

As denoting the volume of freight handled this following table is of interest:—

Description of Freight Forwarded

		Year Ended June 30th 1908	1909
Flour	Barrels	5,843,988	6,683,354
Grain	Bushels	88,345,234	97,236,150
Live Stock	Head	1,349,771	1,371,873
Lumber	Feet	1,764,445,495	1,726,944,584
Firewood	Cords	249,605	249,628
Man. Articles	Tons	3,981,888	4,425,241
All oth'r Articles	Tons	5,102,116	5,916,248

Passenger rates is a favorite discussion for some daily papers. A two-cent-rate is demanded on all steam lines and in view of this the passenger traffic table for three years gives instructive results.

	Year Ended June 30th 1907	1908	1909
No. of pass'gers carried	8,779,620	9,463,179	9,784,450
Ear'gs per pass. per m.	1.83 Cents	1.89 Cents	1.88 Cents

The system is divided into seven divisions with the following mileage:—

Eastern Division	1494.2 miles
Ontario Division	1124.9 "
Lake Superior Division	1102.7 "
Atlantic Division	691.4 "
Central Division	2905.9 "
Western Division	2146.4 "
Pacific Division	1077.9 "

Making a total mileage of 10,543.4.

RAILWAY EARNINGS.

A number of railroads have now reported for the four weeks of August, total gross earnings being $39,069,423, an increase of 12.0 per cent. over last year, and a loss of only 4.4 per cent. compared with August, 1907. Good gains are reported by all roads over last year, especially in the southwest, and compared with 1907 considerable improvement is shown, earnings on some of the roads included being very near the record for that year, when traffic was heavy. In the following table is given earnings of United States roads reporting for August and the two preceding months:—

Gross earnings,

	1909.	Gain.	Per cent.
August	$39,069,423	$4,187,318	12.0
July	22,681,294	1,271,582	5.9
June	28,107,294	2,698,040	10.6

The classified statement for July is now practically complete and shows total gross earnings of United States roads included of $139,541,851, an increase of 10.9 per cent. over last year, and a loss of 6.7 per cent. compared with 1907. Considerable gains are shown by a number of systems as compared with last year, notable on the Eastern Trunk lines. Granger and Southwestern roads; also on the Western Trunk lines and other Eastern. The statement is printed below:—

Gross earnings,

July.	1909.	Gain.	Per cent.
Trunk eastern	$ 27,781,829	$ 3,583,864	14.8
Trunk western	16,649,145	1,729,391	11.6
Coal	7,701,928	482,298	6.7
Other eastern	3,383,503	346,291	11.4
Central western	6,254,183	284,985	4.8
Granger	14,151,534	1,681,956	13.5
Southern	17,768,807	998,730	6.0
Southwestern	22,366,524	2,046,206	10.1
Pacific	23,484,398	2,563,815	12.3
United States roads	$139,541,851	$13,717,457	10.9
Canadian	7,004,000	808,000	13.1
Mexican	4,422,621	209,588	5.1
Total	$150,968,472	$14,735,045	10.8

—Dun's Review.

WINNIPEG ELECTRIC RAILWAY FOR JULY, WITH COMPARISONS.

The earnings of the Winnipeg Electric Railway Company for July show a very substantial increase over those of the previous year. They are given below, together with those for the first seven months of the year:—

	—July— 1909.	1908.
Gross	$ 214,087	$ 178,688
Operating	100,714	89,718
Net	113,373	88,970
Surplus	76,942	56,434
	Seven Months.	
Gross	$1,424,991	$1,197,962
Operating	709,539	598,981
Net	715,452	598,981

The net surplus in August was equivalent to 15.36 per cent. on the common stock. The surplus for the seven months is at the rate of over 16 per cent.

The increase for the first seven months is $227,029, and the increase in Toronto for the first eight months was $202,000. In Montreal the increase for the first eight months was $135,000.

LATE CONSTRUCTION NEWS.

TENDERS.

BARRIE.—Tenders for the construction of the sewage outfall works in connection with the Allandale sewers, now under construction, were opened this week, but in the judgement of the committee and engineer were not acceptable; the town is advertising again in these columns calling for tenders to be in on September 30th, 1909. C. H. & P. H. Mitchell, consulting engineers, Toronto.

MONTREAL AQUEDUCT.

The Waterworks Department have not yet awarded the contract for widening, from 40 to 140 feet, the aqueduct between Lachine and Montreal. On Tuesday the following tenders were opened. Superintendent Janin estimated that the work would cost $1,284,754.

Quinlan & Robertson, Montreal	$ 815,690
Manley & Co., Toronto	856,900
Canadian General Development Co., Montreal	890,700
Cavicchi & Paganlo, Notre Dame du Lac, Que.	948,280
Nova Scotia Construction Co., Sydney	1,047,950
Larkin & Sangster, Trenton, Ont.	1,099,720
Laurin & Leitch, Montreal	1,115,875
F. H. McGuigan, Toronto	1,205,660
M. Connelly, Montreal	1,242,280
P. McGoverin, Boston	1,294,380
P. Mullarkey, Montreal	1,471,205

CURRENT NEWS.

Ontario.

NIAGARA FALLS.—Chippewa is to have another large industry, five acres of the racecourse having been purchased for a site for the Electric Furnace Products Company's plant. Building operations are to begin at once. About 50 hands will be employed, which number will ultimately be more than trebled. The main building will be 180 by 125 feet, of brick, steel and concrete. The company will manufacture railroad switches and rails.

Manitoba.

WINNIPEG.—The C.P.R. despatchers are now handling trains between here and Brandon by telephone over the system which has recently been installed. The work is merely experimental, but if it is successful the telephone will largely supplant the telegraph.

WINNIPEG.—The iron working and steel industries of the West are making great strides this year. The Dominion Bridge Co., Western Canada branch, report that the last three months represent more business than in the twelve months of 1908. In July and August they closed contracts for steel in the many large buildings, all shopped in Winnipeg works.

WINNIPEG.—The Manitoba Rolling Mills are being rapidly pushed forward to completion. The main building, which will be utilized for blast furnace work, is 240 feet long and 150 feet wide, and is erected upon cement pillars. The furnaces will be installed at an early date.

British Columbia.

VERNON.—Representatives of several municipalities in this district, including City Engineer Hawkes, recently petitioned the Forestry Commission to recognize the importance of preserving the timber areas of Mt. Aberdeen and thereby safeguard the water supply of the neighborhood.

MISCELLANEOUS.

Ontario.

TORONTO.—The Ontario Government will take steps to proceed with the reconstruction of the damaged portion of the Parliament buildings at once. A fireproof roof will be placed on the damaged part of the building, and the question of extending this system of roofing over the entire structure will be considered.

WINNIPEG.—Mr. C. J. Brown, city clerk, has given notice of the city's intention to construct numerous sewers, granolithic walks, etc.

WINNIPEG.—The steel work on the twelve-storey J. D. McArthur Building, in which 1,200 tons of steel was used was completed on September 1st, the exact date specified in the contract. This is a record in steel construction, as the first column was not put in place until June 21st. The Dominion Bridge Company were the contractors for the steel as well as the erection, and Mr. M. W. Julien, superintendent of construction for the company, had direct charge of the work, having 52 men employed. A remarkable fact in connection with the steel work on this immense building was that not one serious accident occurred.

Saskatchewan.

REGINA.—The following information in regard to building returns in Regina is furnished by Mr. Angus Smith, city engineer:

	No.	Value	Increase
August 1909	30	$168,224	8.87 %
August 1908	20	153,112	
Jany. to Aug., 1909	203	598,869	62.79 %
Jany. to Aug., 1908	180	367,470	

British Columbia.

COMOX.—E. Millett is building a bridge over Boynes River.

PERSONAL.

MR. G. S. SCOTT, S. P. S., '05, has been appointed assistant in mineralogy by the University of Toronto.

MR. S. DUSHMAN, B.A., has been appointed lecturer in electro-chemistry for the year 1909-10 by the University of Toronto.

MR. C. R. YOUNG, B.A.Sc., has been re-appointed lecturer in Applied Mechanics by the University of Toronto for 1909-10.

MR. FRANK SCOTT, treasurer of the Grand Trunk Railway, has been elected president of the International Association of Railway Financial Officers.

MR. J. GRANT MACGREGOR, formerly of Goderich, Ont., has been appointed chief engineer for the Alberta Central Railway Co., with head offices at Red Deer, Alberta.

MR. W. W. POPE, K.C., for twenty years connected with the solicitor's office of the G. T. R., was recently appointed Secretary to the Hydro-electric Power Commission.

ALDERMEN CROWE, MORTON and MacMILLAN, of Vancouver, B.C., accompanied by Building Inspector Jarrett, will visit Seattle, St. Joseph, Mo., Chicago, and other cities to inspect the newer methods of paving, incinerator plants, building conditions, etc. They left this week on their mission.

MR. JAMES H. NORRIS, for the past nine years business manager of the John F. Allen Riveting Machine Company, 370-372 Gerard Avenue, New York City, has resigned to take a rest of about two months, part of which is to be spent on an extended trip. He has not yet formed any definite future connection, but has several positions under consideration.

MESSRS. SMITH, KERRY & CHACE, engineers; head office, Toronto; have just opened a branch at 71 Fairfield Building, Vancouver, B.C., where they will carry on British Columbia and Pacific Coast work. Mr. H. J. Haffner, McGill, 1904, who is in charge, is experienced in railway, municipal and irrigation engineering. It is proposed to do general business, including, in particular, water-power electrical development. Considerable irrigation and hydro-electric work will be handled.

OBITUARY.

MR. WILLIAM T. GELL, who was appointed master mechanic of the G.T.P. at Rivers, Man., in February, 1908, died at the home of his mother, in Stratford, Ont., on Thursday, September 9th. Mr. Gell was well known in railway circles.

THE

Sanitary Review

SEWERAGE, SEWAGE DISPOSAL, WATER SUPPLY AND WATER PURIFICATION

STREAM POLLUTION.

Each season brings its own problems. The wet season, drainage, the winter months, snow removal, the spring time, refuse cleaning, and the continued dry weather throughout many districts forces upon many municipalities consideration of the sewerage and sewage problem.

Streams that are usually large enough to dilute the sewage have become polluted, and in the immediate vicinity of the outlets of trunk sewers there is a considerable area of grossly polluted ground. The lake levels have dropped a foot or so, and the shore line in some localities is strewn with the waste from our sewers. In some cases our water supply has become contaminated to a dangerous degree.

All this brings our municipalities face to face with the question of installing sewage disposal works. Sooner or later it must come. Those municipalities that have the foresight and courage to undertake such works will effect great savings, for they will prevent the outbreak of epidemics in the town that cost far more than do properly installed refuse and sewage disposal works.

An outbreak of typhoid may be necessary before some people can see their whole duty—but it is a very expensive reminder.

SEWAGE DISPOSAL.

REMOVAL OF PUTRESCIBILITY*

CHAPTER V.

Contact Beds (Continued).

In the previous chapter dealing with the subject of contact beds and their power to remove putrescibility from sewage, we have demonstrated that, (a) A contact bed is something more than a mere filter, a filter being generally understood to remove undissolved matters by the mechanical action of straining, whereas a contact bed has the power of retaining and absorbing not only undissolved matters, but also organic matters in solution which are incapable of being affected by the mere process of straining; (b) The dissolved organic matters are drawn from the sewage to the surface of the filtering material of the contact bed, which becomes coated with a gelatinous film of great absorbing and suction power, and that this absorption takes place during the period when the bed is full of sewage; (c) The final process of nitrification or oxidation of the absorbed organic matters takes place, only after the liquid has been withdrawn from the bed, and a supply of air is admitted to the pores of the filter.

A certain amount (but very little) decomposition of organic matter takes place with the production of carbon dioxide, analogous to the decomposition in a septic tank, during the period of contact. This form of decomposition which is sometimes called anaerobic is not the aim in contact bed treatment.

In order to maintain contact beds at equilibrium, it is obvious that the relations between the processes (b) and (c) must be closely studied. It is necessary to know the length of time necessary for contact, so that sufficient of the organic matters are absorbed to produce a non-putrescible effluent, and again it is necessary to know the length of time necessary for rest or aeration, so that ample opportunity is given for nitrification to take place with the absorption, and produce a numeralized effluent, capable of only absorbing further oxygen to the amount allowed in connection with non-putrescibility.

The above factors and their comparative relations depend largely upon the nature and strength of the sewage under treatment, and no absolute rules can be laid down. Further, the preliminary treatment adopted with reference to the renewal of solids, either by ordinary sedimentation, septic tank sedimentation, or chemical precipitation has a direct bearing upon the efficient working of contact beds.

For example, Dunbar found that with the Hamburg sewage, contact beds could be filled six times a day with fresh sewage without yielding an unsatisfactory effluent. Whereas they would only take septic sewage twice a day. (See Principals of Sewage Treatment, page 87.)

Absolute data for the proper working of contact beds can only be obtained by a close investigation of the particular plant in question. Any upsetting of the equilibrium soon makes itself evident to the works manager, caused either by over-dosing or insufficient aeration, as the bed becomes spongy and clogged and its water containing capacity falls to zero.

There exist, however, certain general data and laws, which in the above relation it will be well to give some detailed attention to.

It has been noted that during the period of contact, a septic action of decomposition takes place with the production of carbon dioxide. It is very probable that if this contact period is too prolonged, that this septic decomposition may have an inhibitive action on the nitrifying organisms contained in the absorptive film. Wollny, in relation to agricultural chemistry, demonstrates that the production of carbon dioxide is in proportion to the amount of organic compounds added to the soil, and that an accumulation of carbon dioxide has the eventual effect of stopping further decomposition even if oxygen is present. This anaerobic period of contact, which is an essential to the contact bed, is the chief objection to the process, and also provides the reason why the system is not so efficient as that of the percolating filter, which at no period provides anaerobic conditions.

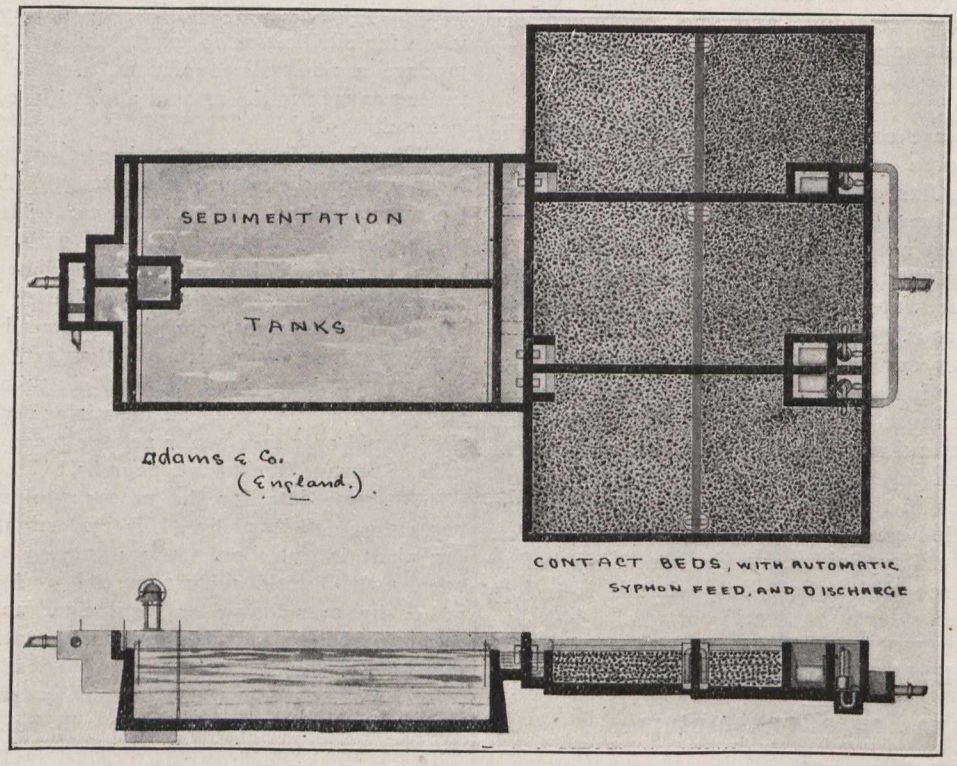
With reference to the period of contact the Royal Commission state (page 54, par. 106), "The evidence shows that two hours' contact and four hours' rest have generally been found to give the best results in practical working, where the beds are filled three times a day, but no rule can be laid down which is of universal application.

Dr. Fowler with reference to his Manchester (England) experience states as follows: "The periods depend almost entirely on the age of the bed and the dilution of the sewage. In the initial stages of working, long contacts (e. g., twenty-four hours) have been found advantageous, their effect being to facilitate the formatinon of a slimy layer of colloidal matter on the medium, in which the real biological action begins. As this layer increases, the absorptive effect increases also, and less time of contact is required. Moreover, a greater

*These articles are specially prepared for this Review by Mr. T. Aird Murray, Consulting Engineer, Toronto.

quantity of water is held up in a bed, and the quantity of draining increases, till with a bed in long use a very short contact, say, a quarter of an hour is all that is required. With increase in dilution of the tank effluent, due, e. g., to storm water, the period of contact may be reduced to a minimum. In general, after the bed is once mature, the period of rest is more important than the period of contact, and the total time occupied in twenty-four hours in filling, standing full, and emptying should not exceed the total of the period of rest. Thus, with ferquent fillings, the time of contact should be shortened. If the bed takes long to fill, the extra time in filling should be taken from the time of contact."

The above is quoted as it represents fairly accurately English practice, which has given great attention to the practical working of this system. Dunbar in his Hamburg experiments practically substantiates English practice in this



direction. In order to test the amount of purification effected and absorption at various periods of contact, six filters were constructed of exactly similar size and of the same material, and they were charged simultaneously every day with the same sewage. The first filter was discharged after standing full for half an hour, the second after an hour, and so on. The results are shown in the following table:—

Reduction in oxygen absorbed effected by Contact Bed.*

	Time Bed Standing full (hours)	Oxygen absorbed (parts per 100,000) Day. 1st.	2nd.	4th.	6th.	Percentage Reduction in Oxygen abs'bed on 6th dy.
Crude sewage, str'ned	....	9.07	12.30	9.30	11.42	.....
Effluent from Bed	1	0.5	5.85	4.10	4.37	3.57	68.73
" " "	2	1.0	3.52	3.67	4.07	3.15	72.43
" " "	3	2.0	3.22	3.07	2.62	2.27	80.09
" " "	4	4.0	2.87	2.77	2.47	2.00	82.49
" " "	5	6.0	....	2.92	2.32	1.85	83.81
" " "	6	12.0	2.77	1.75	1.75	1.57	86.21

The table shows clearly that the reduction on the oxygen absorbed, which may be taken as a measure of the changes which have occurred is not so great on the first as on the following day. On the sixth day the filters were so far matured that they effected a considerable reduction in the oxygen absorbed. Even with only half an hour's contact the oxygen was reduced from 11.42 to 3.57, i. e., by 68.73 per cent., and the effluent was non-putrescible. By a longer contact the oxygen absorbed was further reduced, but not by any means at the same rate. The main portion of the purification had taken place, therefore, during the first half hour. The experiment was repeated, allowing the first filter to stand full of sewage for five minutes, the second for thirty minutes, and so on. The filters were now more mature, and within the first five minutes the oxygen absorbed was reduced from 13.87 to 2.34, i. e., by 83.2 per cent. The main portion of the purification had thus been achieved during the first five minutes. Dunbar, therefore, points out what must be apparent, that the separation of the putrescible matters in solution does not occur gradually, requiring prolonged periods of contact, as would be the case if it were due to the direct decomposing action of bacteria during the time of contact.

We must conclude that the time of contact or period when the beds stand full is useful only as far as the question of absorption is concerned, and that as the absorbing power of the filter increases, the time of contact may be cut down to minutes, and that no benefit in extra nitrification is obtained by allowing longer periods of contact than are necessary for the process of absorption.

Referring to the period of rest or aeration, which is generally now acknowledged as the most important phase in the contact cycle process. During this period, when the liquid sewage is drawn off, the bed uses up not only the oxygen which is immediately drawn into the pores of the filter taking the place of the space volume lately occupied by the liquid, but continues with great energy to attract oxygen from the surrounding atmosphere. This has led to many experiments with a view to forcing atmosphere into the filter beds under pressure, such, however, have not been successful in practice. It is agreed that a well constructed bed supplied with aerating pipes, the filtering material being of a size allowing ample air space, can obtain by ordinary methods all the oxygen it requires. It is a question, however, whether in the case of using very fine material, or where beds have to be protected from the frost, a greater efficiency can not be obtained by introducing warmed air into the base of the filter during winter months especially.

In the case of a very fine material especially when the beds are fairly deep, such as 6 feet for instance, the air containing space being proportionately small, the oxygen may be used up at a higher rate than it can be supplied. We have several examples of such beds on record, where undesirable septic decomposition has been set up, the effluents showing discoloration, caused by sulphide of iron, as well as giving off strong odors of sulphuretted hydrogen.

The main reason why a contact bed will deal with such large quantities of sewage, remains in the fact that the gen-

*Principals of Sewage Treatment, page 159 (English Edition.)

eral construction of the bed allows a complete aeration, whereas with soil the atmosphere has great difficulty in penetrating to depths of over 2 feet.

During the period of aeration, when nitrification is taking place, the contact bed is practically a breathing thing, taking in oxygen and expiring carbon dioxide. That this action is biological, there is practically no doubt. If a well matured bed be treated with chloroform or mercuric chloride, nitrification at once ceases, although for a time the film will continue to absorb oxygen and produce carbon dioxide, proving that this action is due to chemical causes and not to micro-organisms, or possible to a decomposition brought about by enzymes, as in the case of a septic tank.

Loss of capacity and clogging are the great drawbacks to contact beds. The Royal Commission (Fifth Report) give the following factors as chiefly responsible for failure:

(1) Disintegration of the filtering material.
(2) Consolidation of the filtering material.
(3) Deposition of colloidal matter.
(4) Growth of organisms.
(5) The volume of liquid passed on to the bed.
(6) Insufficient rest.
(7) Inefficient drainage.
(8) The amount of suspended matter passed on to the bed.

A very brief consideration of the above factors will convince anyone that they can all be guarded against by proper construction and careful working.

Nos. 1 and 2 may be taken together and they point to the necessity of choosing a filtering material which will not disintegrate either by contact with the liquid or by frost. The material must, primarily, be hard and insoluble, and of such a character and size that it will build itself up in the bed without crushing or settlement. Soft sandstones producing grit silt are useless, and the same may be said of certain soft and unwashed furnace clinkers, although well burnt hard furnace makes an ideal filtering material. Nos. 3 and 4 can be reduced by flushing and rest. Nos. 5, 6, 7 and 8 are all matters which should be primarily attended to in construction and design of the work.

With reference to the size of material, from 3/8th to 5/8th inch diameter is suitable for sewages from which about 60 per cent. of the original solids in suspension have been removed

THE DURHAM MAIN SEWERAGE WORKS.*

By H. W. Taylor, A.M.Inst.C.E.

As is well known, the city of Durham is a very old town, and dates for many centuries back, and consequently the drainage and sewerage arrangements, such as they were, date from these times. The houses and streets were no doubt originally drained by old stone culverts and drains (many of which are in evidence to-day), discharging into the river.

The first attempt at systematically sewering the town was about the year 1853, when Mr. Hawkesley, of London, designed and carried out a system of what he termed "pot-pipe sewers," picking up the drains of the houses and discharging the sewage into the river at about 33 points.

The city of Durham is situated on both banks of the river Wear, this river having a very tortuous course through the city and dividing the town roughly into three parts—namely, the North-road and Western Hill districts in the west, the Cathedral, Claypath and Gilesgate district in the centre and north-east, and the Elvet district in the south-cast

Generally speaking, the town slopes steeply to the river which is the natural outlet for the sewage. There are two dams across the river in its course through the city—namely, near Framwellgate Bridge and near Prebends Bridge. These dams impound the water, and consequently sewage matter remains in them for long times at a stretch, the only flushing possible being by means of floods. The fall in the river is not very great, and consequently the difficulty of drainage is thus increased when one bears in mind the very roundabout and tortuous course of the river.

Original Scheme.—The original scheme adopted by the Council about 1898 was to lay gravitating sewers following the course of the river on both sides to a point opposite Sands House, where the sewage was to be raised by large gas engines and centrifugal pumps from a pump well into chemical precipitation tanks. Thence the sewage was to pass through filters and ultimately over about 8 acres of land.

Intercepting Sewers.—It will be readily seen that with this system the gradients of the sewers were necessarily extremely flat, the flattest one having an inclination of about 1 in 872, while others were of 1 in 670 and 633. This was an important point in the drainage system, as these gradients necessarily were not self-cleansing and the Council feared deposit taking place in the pipes, which fear the author shared. The alternative of this was to bring the sewage from the Elvet district by means of a tunnel under Claypath to the Sands. Great difficulties and dangers were prophesied, and it was stated that if an attempt were made to drive this tunnel terribly bad ground would be encountered and the cost would be enormous. The Council, however, acting upon the advice of the engineer, had a series of bore-holes sunk along the line of the intended tunnel which showed the ground to be very much better than the prophets foretold, with the result that the tunnel was successfully driven without incurring any exceptional trouble or expense.

The result of this tunnel is that the gradients of the sewers have been greatly improved, the flattest one being 1 in 300, as compared with 1 in 872, for the circuitous route following the river banks. It is also interesting to note that by this means one river crossing was avoided.

Some of the intercepting sewers had to be constructed upon piles in the river, and this was carried out in the following manner. Rolled steel joists were driven to a solid foundation, the soil was excavated to well below water level, the joist was then encased in a sanitary pipe filled with cement concrete. The result of this is that the work has been very satisfactorily done at a very reasonable cost. Flushing chambers are provided where necessary at the heads of the sewers, and a system of ventilation chiefly by shafts near the houses and ventilating manhole covers in the fields will be shortly installed.

Scheme Finally Adopted.—The disposal works finally adopted by the Council are as follows: The sewage upon arriving at the pump well will be raised by (a) small gas engines and centrifugal pumps dealing with the dry-weather flow, or (b) large gas engines and pumps dealing with the greatly increased flow in times of heavy rains into (c) detritus tanks, then passing through (d) storm overflows into (e) hydrolytic tank, thence through (f) rectangular percolating filters, the effluent from which will, by a series of carriers, gravitate over (g) about 12 acres of land, and, passing into the underdrains, will ultimately reach the river in a thoroughly purified state. The excess flows from the storm overflows will discharge respectively into the river and on to storm-water percolating filter-beds, so that the system of purification will be very thorough.

Sewage Flow.—The population of Durham has slowly increased during the past twenty or thirty years, but the chief increase took place at Western Hill. Up to 1906 this district was outside the boundaries of the borough, but since then the boundaries have been extended, and the population increased accordingly from about 14,000 up to 18,000. The system of sewers will easily convey the sewage from at least 30,000 population, while the sewage disposal wroks are designed for 18,000 population, but it should be noted that the system adopted is essentially elastic.

Pumping Machinery.—The pumping arrangements consist of two distinct sets of engines and pumps for dealing

*Paper read at the first annual general meeting of the Institution of Municipal Engineers.

with the dry-weather flow and storm flow respectively: The smaller set consists of 4 and 8 horse-power gas engines, driving centrifugal pumps, and designed to deal with the varying rate of flow, the larger engine and pump dealing with the day flow, and the smaller one with the night flow. These engines and pumps will be fixed in the small underground pumping station. The larger set consists of two 30 horse-power gas engines, driving centrifugal pumps, and designed to deal with the sewage flow during times of exceptional rains, under which conditions the sewage will probably exceed the dry-weather flow many times. (It should be noted that the system of sewers is on the "combined" system, that is to say, the sewage and storm-water discharge into the same system of pipes, although it is ultimately intended to exclude as much storm water as possible, where this is feasible).

Detritus Tanks.—The detritus tanks are of the deep Dortmund type, having conical bottoms. This is intentionally arranged so that the detritus can be discharged from the bottom of the tank by opening a valve without having to empty the tank, such as is necessary with the shallow type. The author considers the Dortmund type of detritus tank to be one of the most efficient at present known.

Hydrolytic Tanks.—The type of tank adopted is quite different from the ordinary hollow rectangular or septic tank. It will be built of ferro-concrete. It is a very great improvement on the septic tank, as it really separates the sludge from the liquid in a very much more efficient and satisfactory manner than has yet been obtained with any other kind of tank the author is aware of up to this date. The sewage passes through this tank, and in its passage it is freed of nearly all its solid matters and some portion of its colloids also. Valves are arranged in the bottom of the hydrolytic tank so that the sludge can be run off without emptying the tank, and this is a feature of the type. The tank is the subject of a patent.

Percolating Filter.—The sewage after leaving the hydrolytic tank will flow into a centre feed channel between two rectangular filters, over which it will be evenly distributed by means of rectangular distributors. These filters are provided with false floors so as to afford efficient aëration and drainage, and are filled with suitable media (preferably clinker) graded in size. The floors have a cross fall, and the effluent is collected in channels at the sides along which it runs to a sump at the lower end, where the humus passing out of the filters with the effluent will be caught.

Land.—The total area of the land purchased by the corporation consists of 19 acres. Of this the cottage, pumping station, cart road and other walks, tanks and filters occupy about 7 acres, leaving a net area for irrigation of about 12 acres. The ground has been divided into plots and levelled, the surface being formed into ridges and furrows. The land is, generally speaking, of a sandy loam, with little or no gravel, and clay was encountered in one or two places. Underdrains have been laid under the barrow paths and walks, into which the effluent will percolate, ultimately discharging into the river in a purified state through three outlets.

Sludge Disposal.—The arrangement for disposing of the detritus from the detritus tanks and the sludge from the hydrolytic tank is by burial in the land. Trenches will be cut about 1 ft. or 15 in. deep in the land, into which sludge will gravitate. It will then be immediately covered over, and thus aërial nuisance is reduced to a minimum. The matters raised by the rakes from the screen in the pump well will also be dealt with in a similar manner.

Storm-Water Filter.—The storm-water filter is constructed in a somewhat similar way to the percolating filters, except that it is only 3 ft. deep, and the media is of larger size. The storm-water will be roughly distributed over its surface by means of half-pipes or wooden troughs. This filter is also provided with floor tiles to afford the necessary aëration and drainage.

Cost.—The estimated cost of the entire scheme, including land, disposal works, and intercepting sewers, is about $215,000, and it is expected that the works will be carried out for a little less than this amount.

IMPROVEMENT NAVIGATION ASSOCIATION.

The Great Lakes and St. Lawrence.

The Great Lakes and St. Lawrence Improvement Navigation Association, organized at Toronto on September 9th. They decided to wait on the Dominion Government at an early date to urge the advisability of deepening the Welland Canal. In the meantime a circular setting forth the necessity of the improvement will be printed and circulated among the various municipalities. The following officers were elected: —

President, H. W. Richardson. Kingston; Vice-presidents, H. Champ, Hamilton, Thomas Conlin, Thorold, Thomas L. Church, Toronto, Thomas King, K.C., Kingston, A. E. Kemp, Toronto, Mayor J. S. Campbell, St. Catharines, Colonel Ponton, Belleville, A. A. McKay, Hamilton, J. B. Miller, Toronto, L. L. Henderson, Montreal, Mayor L. H. Daniels, Prescott.

NOVA SCOTIA SOCIETY OF ENGINEERS.*

The election of officers for 1909 resulted as follows:

President, S. Fenn; First Vice-President, J. A. Stairs; Second Vice-President, J. W. Mackenzie; Secretary, J. Lorne Allan; Council, Prof. R. R. Keeley, A. R. McClean, H. C. Burchell, D. McD. Campbell, J. G. McKenzie, A. G. Robb, G. M. Archibald and W. G. Yorston.

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

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

7881—August 27—Covering regulation adopted by the Board for the carriage of explosives by railways subject to its jurisdiction.

7882—August 24—Approving of change of location of the G. T. P. Railway from the East line of Section 1, Township 52, Range 24, West of 5th Meridian, District of North Alberta, Province of Alberta, mileage 43.56 to mileage 55.15.

7883—August 24—Approving location of G. T. P. branch line, Melville-Regina Branch, Section 31, Township 22, Range 6, to Section 13, Township 21, Range 12, West 2nd Meridian, mileage 0 to mileage 33, District of Assiniboia, Saskatchewan.

7884—August 24—Recommendation to the Governor in Council for approval of By-law of the Oshawa Railway Company in re-spitting and smoking on Railway premises.

7885—August 24—Recommendation to the Governor in Council for approval of By-law of the Thousand Islands Railway Company in re-spitting and smoking on railway premises.

7886—August 24—Authorizng the Alberta Government Telephones to erect wires across the tracks of the C.P.R. at Sullivan Street, Camrose, Alberta.

7887—August 25—Authorizing the City of Hamilton to erect lay water pipe under tracks of G.T.R. at the intersection of Hillyar Street and the Northern and North Western Branch of the Railway.

7888—August 27—Authorizing the Canadian Northern Ontario Railway to construct joint section of C.P.R. and C.N.O.R., Parry Sound Spur, under the tracks of the C.P.R. at Parry Sound, Ontario.

7889—August 27—Approving By-law of the New Brunswick Southern Railway Company authorizing H. W. Newnham

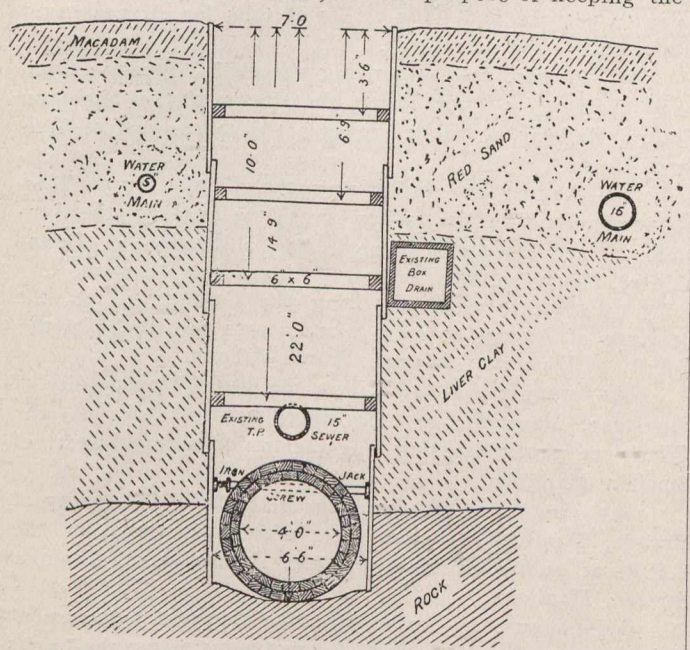
(Continued on Page 320).

*Continued from page 279 Vol. XVIII.

A PAGE OF COSTS
ACTUAL, ESTIMATED and CONTRACTED

COST OF BRICK SEWER.*

On the 26th June, 1908, work was commenced on the construction of the Kent St. Relief Sewer, and which was carried out by the city (day labor). Starting at a point on the Ottawa River, it extends in a southerly direction. This sewer is for the purpose of relieving a system of small tile pipe sewers and a 2′ 8″ x 4′ Brick sewer, which becomes badly surcharged after every rain storm, in the vicinity of Laurier Ave. W. From the outlet on the Ottawa River to the 6 foot by 6 foot inspection chamber at the top of the cliff the sewer is of steel pipe, 24 inches in diameter, in six sections flanged and bolted together. The total length is 146 feet 6 inches, on a 70 per cent. grade, and the last two pipes at the flanges are bedded on a rock foundation in a mass of concrete 7 ft. by 9 feet by 3 feet 9 inches. From the inspection chamber the sewer is circular, 48 inches in diameter, and built of brick 8 inches in thickness. The brick sewer is constructed in open cut throughout, and the trench is directly on the line of the old 15 inch tile pipe sewer. At first, considerable difficulty was experienced in getting rid of the water from the old tile pipe, for the purpose of keeping the



trench dry in the drilling of the rock-bed and the building of the brickwork. A 5-inch electric centrifugal pump was used, but proved expensive, and unsatisfactory for moving, as the work proceeded. Finally, iron troughs were substituted, connecting the old work and the new, and found of great service, as they were light, not bulky, of sufficient carrying capacity, and allowed the workmen perfect freedom to carry on their duties. At the inspection chamber the sewer has a rise of 2 ft. with a ramp, after which there is a grade of 0.291% till Vittoria St. is reached, and another rise of 3.44 feet is made with a ramp. From this point to north building line of Wellington St. the grade is much steeper at 2.05% until it again changes back to 0.291% and Queen St. is reached. From Cliff St. to Wellington St. the rock averaged 9 feet deep and was of a hard, tough nature. The Ingersoll-Sergeant steam drill has been used all the time, with steam at 90 lbs. pressure, supplied from the boiler of the traveller, and has given very satisfactory results. Very great care had to be taken with the timbering of the trench, which was close sheeted in two to four settings, all through from roadway level to rock level. The strata above the rock were of a varying nature, from red sand to hard pan and liverclay, while between Wellington and Sparks St. the strata were particularly bad, for under the liverclay was a bed of pure running sand. Work was carried on by two gangs working day and night until the crossing was made. A 5-inch water main on the one side, a 15-inch on the other, gas and Bell Telephone cables and an old 30-inch box drain to make the work of construction difficult. In the blasting of the rock, care had also to be taken on account of the danger of vibration and concussion to the surrounding property, including St. Andrews Presbyterian Church, the British American Bank Note Co. and other buildings, with the possibility of a cave-in of the whole sewer trench, which at this section is 22 feet deep. (See diagram.) It is a matter for congratulation that the work was caried out in winter and not in summer, otherwise there would be more serious danger. In winter the liverclay and running sand were in a frozen state, and so until tampered with and exposed to the atmosphere has some stability of its own. The traveller which weighs about 2 tons was carried directly over the bench on rails 7 ft. 6 inches gauge, and handles all the material expeditiously in buckets holding ⅔ of a cubic yard. Construction is proceeding as fast as it is possible to proceed with under the circumstances, and in the face of the peculiar difficulties that have presented themselves as far as is consistent with good workmanship and public safety. The length of the sewer constucted, for the estimate, was 860 feet or 0.16 miles, and the cost of construction $18,097.41.

The detail cost of the 48-inch brick circular sewer is as follows:—

	Actual Cost per foot.	Estimated Cost per foot.
Brickwork	$1.93	
Bricklaying	1.66	
Sand	0.23	
Cement	0.72	
	$4.54	$4.95

*Adapted from a report of W. H. Carson, C. E., to Mr. N. J. Ker, City Engineer, Ottawa.

FAIR RATES OF RENTAL FOR MACHINERY ON MUNICIPAL WORK.

In their recently published report to the Boston Finance Commission, Metcalf & Eddy, of Boston, consulting civil engineers, discuss in some detail the fair rates of rental for machinery on municipal work, particularly with relation to conditions heretofore existing in the Sewer Department of Boston, when over $32,000 was paid in machinery rentals during a period of nineteen months.

It was found that the prices paid for such rentals were very much higher than the market prices and than were reasonable. Had the city rented its machinery at a monthly rate of 5 per cent. of the first cost of the machinery, a material saving would have been effected. If the city should continue to do work by day labor, which the engineers do not recommend, however, they indicate that it would seem wise for it to purchase and own its machinery, in which case the rental, including interest, would be materially less than 5 per cent. per month. During the period of nineteen months nearly enough money was paid for rentals to pay the first cost of an equipment sufficient to meet the requirements of the department.

"It is somewhat difficult," so state the engineers, "to determine what is a fair rental for machinery upon this class of work. It not infrequently happens that much machinery is abused by those operating it, and it is also at times injured when being moved, and in cold weather it is liable to be damaged by freezing of water in pipes and boilers. The owner must take all of these conditions into consideration in fixing his price. There are, however, a few firms which make a business of building and renting ma-

chines, and in fixing the fair rental prices herein presented, the charges made by some of these companies have been taken into consideration. In view of all the circumstances, it does not appear that a rental amounting to 5 per cent. of the first cost of the machine for each month's use is unreasonable, although at first glance it appears to be very high.

For purposes of comparison in this report Metcalf & Eddy used the cost of new machinery, as given in the accompanying table, and calculated the fair rental per month on a basis of 5 per cent. of first cost as given therein:—

Cost Prices of Machinery Rented by Sewer Department.

	Cost	Fair rental per month
Six-bucket Carson trench machine, including engine delivered on street and erected	$3,300	$165.00
Carson cable machine, including 30 horse-power reversible, link motion engine, delivered and erected upon the street....	3,250	162.50
Hoisting engine and boiler, 20 horse-power (Bond) $1,656, less 30 per cent. (including swinging gear)	1,200	60.00
Fifty-foot boom derrick, fully equipped, ready to run, with bull wheel (Bond) exclusive of engine	500	25.00
Tubs and buckets, 12 cubic feet, No. 6,536, D. F. & M. Company (Bond) 50 per cent. discount	28	1.40
Scale boxes, ½ yard, 12 cubic feet, No. 6,518 D. F. & M. Company (Bond) 30 per cent. discount	98	4.90
Portable boiler for pumping engine.....	450	22.50
Pumping engine without boiler and pump..	275	13.75
Six-inch centrifugal pump, with extra pipe, hose, strainer, etc.	350	17.50
Four-inch pulsometer and fittings	350	17.50

COST OF WATER POWER PLANT.

The accompanying table of estimated costs per horse-power of water power plants was prepared by Charles T. Main, mill engineer and architect, Boston, Mass., and gives approximate figures for ordinary conditions and should be useful in making rough preliminary estimates. It is to be noted that the costs of dam, canal, and buildings are not included for these of necessity will vary greatly with the locality.

TABLE OF ESTIMATED COSTS PER HORSE-POWER OF WATER POWER PLANTS.

Having Horizontal Turbines, Steel Penstocks, and Walled Tailraces—Dam and Buildings not included.

	"L."	10ft. fall	20ft. fall	30ft. fall	40ft. fall
	200 feet	$71.91	$32.84	$21.70	$16.38
1,000 h.p.	.....400 "	85.43	39.77	26.32	19.35
	600 "	93.96	46.69	30.94	23.53
	200 "	72.22	33.12	21.98	16.78
800 h.p.	.....400 "	85.70	40.04	26.56	20.35
	600 "	99.15	46.98	31.17	23.93
	200 "	72.64	33.49	22.34	17.20
600 h.p.	.....400 "	86.20	40.45	26.95	20.87
	600 "	99.76	47.42	31.57	24.54
	200 "	73.16	34.05	23.10	17.82
400 h.p.	.....400 "	86.90	41.03	27.73	21.45
	600 "	100.65	48.03	32.35	25.08
	200 "	75.35	35.97	24.97	19.47
200 h.p.	.....400 "	89.10	43.56	29.70	23.21
	600 "	102.85	50.60	34.43	26.95

STREET SPRINKLING.

The mileage of streets sprinkled in Ottawa during 1908 was 52.42, and the average cost per mile was $353.23.

COST OF CEMENT WALKS AND CURBS IN HAMILTON, ONTARIO, 1908.

	Length lin. ft.	Area sq. ft.	Total cost.	Cost per sq. ft.
Cement walks.	42,568	263,080	$37,035.16	14 1-10c
Cement curbs.	569	.....	253.73	44 5-10 per lin. ft

COST OF SNOW CLEANING.

During 1908 Ottawa paid for snow cleaning as follows: For 140.52 miles of street $20,432.34 or 145.40 per mile. Adding 759.37 for plant, repairs, etc., it cost $150.81 per mile.

The snow fall during that period amounted to 115 inches and the work was done by day labor.

RAILWAY ORDERS.

(Continued from Page 318).

to prepare and issue tariffs of tolls to be charged for freight traffic on its line of railway.

7890—August 27—Approving By-law of the New Brunswick Southern Railway Company authorizing Hugh H. McLean to prepare and issue tariffs of tolls for all passenger traffic on its line of railway.

7891—August 27—Authorizing the Bell Telephone Company to erect its wires across the tracks of the Michigan Central Railway at public crossing 1¼ miles west of Welland, Ontario.

7892—August 27—Authorizing the Condie Rural Telephone Company to erect wires across the tracks of the Canadian Northern Railway in north half of Section 30, Township 18, Range 20, West of 2nd Meridan, Saskatchewan.

7893—August 27—Authorizing the Government of the Province of Alberta to erect wires across the tracks of the C.P.R. at Dominion Avenue, Frank, Alberta.

7894—August 27—Authorizing the Rural Municipality of Pipestone, Manitoba, to erect wires across tracks of the C.P.R. at public crossing one-quarter of a mile west of Sinclair, Manitoba.

7895—August 27—Authorizing the Rural Municipality of Branda, Manitoba, to erect wires across the tracks of the C.P.R. at public crossing 300 feet north-east of Napinka Station, Manitoba.

7896—August 27—Authorizing the Manitoba Government Telephones under Section 246, to erect wires across the tracks of the C.P.R. at Strathclair, Manitoba.

7897—August 10—Dismissing complaint of the Plymouth Cordage Company, North Plymouth, Mass., in re-rates on binder twine; and authorizing the Michigan Central Railroad Company to refund to the Plymouth Cordage Company the sum of two cents per 100 pounds in respect of the four carloads of binder twine shipped by the Plymouth Cordage Company to Wallaceburg, Dresden and Wheatley, making a difference between the legal rate of 18c. per 100 pounds and the rate of 20c. per 100 pounds charged and collected by the Railway Company on said shipments.

7898—August 27—Approving of the proposed deviation of the Hamilton, Waterloo and Guelph Railway from the Village of Sheffield to and into the Town of Galt, Ontario.

7899—August 30—Extending until the 25th day of September 1909, the time in which the City of Montreal shall put in proper repair the bridge known as Bridge No. 1.65, being a steel viaduct carrying St. Catharine Street over the track of the C.P.R. and ordering that the City of Montreal be liable to a penalty of $25.00, per day, for every day after September 25th, 1909, that the work required to be done shall remain uncompleted.

7900—August 27—Granting leave to the Tilbury Telephone Company to place its wires across the track of the

(Continued on Page 328).

GREAT ENGINEERING WORKS ON THE CANADIAN PACIFIC RAILWAY.*

By J. E. Schwitzer, Assistant Chief Engineer, Western Lines.

The Huge Lethbridge Viaduct in Southern Alberta and the Grade Reduction in the Canadian Rockies.

Two great engineering triumphs have been achieved this year by the Canadian Pacific Railway Company, in the construction of a huge viaduct on its Crow's Nest branch, and the reduction of the steep grade in the Canadian Rockies. Both are works of considerable magnitude, and both have been successfully completed in a remarkably short time. Although only separated by less than 200 miles as the crow flies, these engineering feats are essentially different in every aspect, even in their surroundings and conditions, the one being located in mountain recesses, and the other on the broad planes of a ranching and grain-growing region.

The Lethbridge Viaduct.

The Crow's Nest line of the Canadian Pacific Railway branches off the main transcontinental road at Medicine Hat, and parallels it through the mountains a hundred miles to the south, to give easy access from the east to the rich mining regions of southern British Columbia.

General.—The present line between Lethbridge Junction and MacLeod is 37 miles in length, the distance from Lethbridge, which is situated on a spur track, to Lethbridge Junction is 1.5 miles. The total distance from Lethbridge to MacLeod being 38.5 miles. The present line is constructed with curves as sharp as 7 deg. (819 feet radius) and with a grade of actual 1 per cent. (52.8 feet per mile), no compensation being allowed for curvature, so that in the estimates for new location the ruling gradient on this line was calculated to be equal to a virtual 1.2 per cent. grade (63.4 feet per mile).

On the above line, which was constructed in 1897 and 1898, are the following wooden deck bridges:—

Bridge	Length	Height from Ground to Base of Rail
108.7	406	110
112.2	476	105
112.4	420	94
112.8	463	87
113.1	674	67
113.5	503	102
113.8	405	77
114	569	84
114.3	569	74
114.8	473	62
115.2	317	41
115.6	419	39
116	2933	65
117.5	707	117
119.6	449	73
120	567	117
120.2	313	53
121.1	629	113
131.8	755	24
132.5	16	9

A total of twenty bridges, with a total length of 12,063 feet, or 2.8 miles, 1,450 feet of this length being Howe truss spans, varying in length from 100 feet to 150 feet. In the majority of cases these bridges cross streams and ravines with very steep-cut banks, which, on account of the nature of the soil, require constant watching, especially in the spring and during high water. The worst of these crossings are those at St. Mary's and Belly Rivers.

On account of the life of these bridges being very nearly expired, they would require, during the present year, heavy repairs, or practically rebuilding. The estimated cost of permanent bridges to replace these wooden bridges is $1,065,000. Owing to the necessity of rebuilding these bridges, and to the rapid increase of traffic, and the fact that the original charter for the Crow's Nest branch required the construction of a line to start from Lethbridge, it was therefore decided to have surveys made and ascertain if it were possible to secure a low grade line with better alignment. With this object in view extensive surveys were made in 1904 and 1905, the line which was finally adopted being as shown on small scale plan attached, marked "A." This line gives a maximum virtual grade of four-tenths of 1 per cent. (21.12 feet per mile) with a maximum curvature of 3 degrees (1,910 feet radius).

As already noted, the town of Lethbridge is on a spur track of the Crow's Nest Pass Railway, 1.5 miles long, which necessitates practically all trains running into Lethbridge and backing out, being a loss of three miles, which will be saved when the new line is placed in operation.

The saving effected by the new location as compared with the old is as follows:

5.26 miles of line, 1,735 degrees less curvature, thirty-seven fewer curves, and 401.5 feet less rise and fall, besides securing the 0.4 per cent. grade, as compared with a virtual 1.2 per cent. on the old line. These changes should so reduce operating expenses that the saving with an increase of 20 per cent. in traffic above what it was last year would pay an interest at the rate of 4 per cent. on an investment of $3,625,000, besides which it would cost to replace the old bridges with permanent structures $1,065,000. The total capital expenditure which would therefore be justified would be $4,690,000, while the estimated cost of the change of the line is $2,048,700. On this new line there are only two bridges, both large viaducts, one over the Belly River at Lethbridge, 5,327.6 feet in length, with a maximum height of 314 feet from the bed of the river. This viaduct is the subject of this article. The second bridge over the Old Man River, is 1,900 feet in length and 146 feet in height from the bed of the river.

Location.—The east end of the viaduct is 3,800 feet west of Lethbridge Station, being somewhat west of the centre of the town. Lethbridge is the centre of a large irrigation track and of an important coal-mining district, is a divisional point of the Crow's Nest branch of the Canadian Pacific Railway and the Alberta Railway and Irrigation Company, and has at the present time a population of about six thousand. It is located in the Province of Alberta, 759 miles west of Winnipeg, 2,174 miles west of Montreal, and is the centre of a rapidly developing territory.

Site.—The site of the bridge is the best for a high-level crossing in the immediate vicinity of the town. The slopes are fairly uniform for a distance of 1,000 feet from the prairie level, then drop more abruptly for 800 feet to the flat, which is flooded in extreme high water, then runs on an approximate level for a distance of 1,800 feet to the edge of the river, which is 300 feet wide. On the west side of the river it rises rapidly to prairie level in a distance of 1,300 feet.

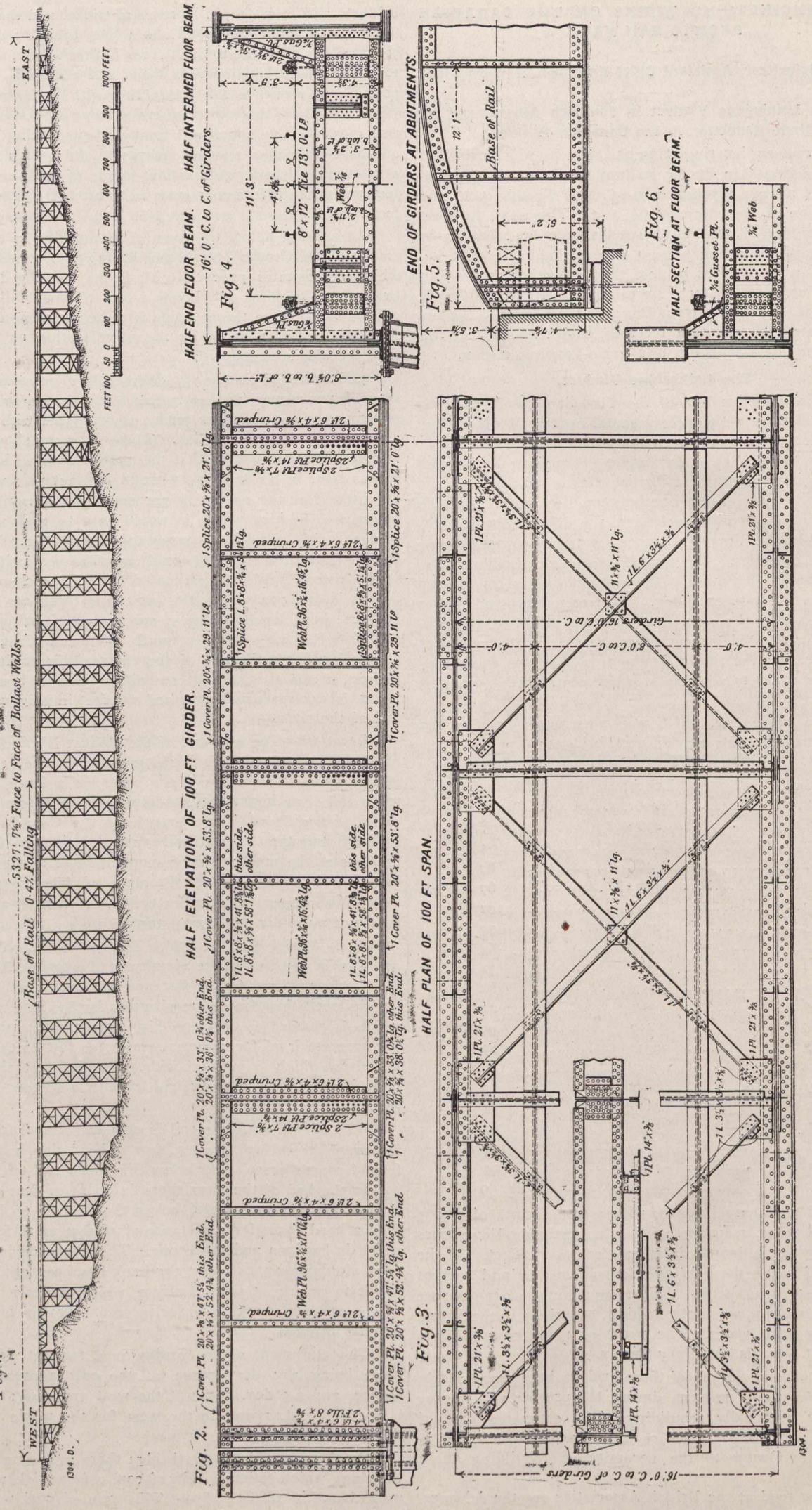
On the east bank the soil is clay and gravel for about 6 feet from the surface, then 50 feet of hard clay, 12 feet to 20 feet of coarse gravel, and below this shale and coal.

In the bed of the river there is about 20 feet of gravel, then 20 feet of coal-shale, below that 2 feet of blue clay, then a hard shale for a distance of 16 feet to 18 feet, below which is hardpan and sandstone. The west side is of somewhat similar formation, but the bank has been eroded, causing it to cave in at several points, which makes it necessary to do extensive work in order to secure proper foundations for the bridge.

The alignment of the bridge is a tangent throughout, there being a 1 deg. curve. at the east approach of the bridge, and a 3 deg. curve at the west approach; the grade is 0.4 per cent. rising to the west for the whole length of the bridge.

On the east side of the bridge there are some old mine workings which follow a vein of coal 7 feet thick which was worked out in 1888 to 1890. This vein of coal was practically horizontal and level with the flat at the river, varying

* Paper read at the British Association for the Advancement of Science, Winnipeg, Man., 1909.


GENERAL ELEVATION.
5327' 7½" Face to Face of Ballast Walls
Base of Rail 0·4% Falling
WEST
EAST
1304.0.
FEET 100 50 0 100 200 300 400 500 600 700 800 900 1000 FEET
Fig. 1.
HALF END FLOOR BEAM. HALF INTERMED FLOOR BEAM.
16'. 0" C. to C. of Girders
Fig. 4.
END OF GIRDERS AT ABUTMENTS.
Base of Rail
Fig. 5.
HALF SECTION AT FLOOR BEAM.
Fig. 6.
HALF ELEVATION OF 100 FT. GIRDER.
Fig. 2.
HALF PLAN OF 100 FT. SPAN.
Fig. 3.
16'. 0" C. to C. of Girders

from about 25 feet at bent No. 23 to 150 feet below the surface at the east end of the bridge.

The work of finally laying out the centre line and locating the position of the pedestals for the viaduct was commenced during the first week of December, 1907.

Excavation.—The contract for the excavation and substructure of the bridge was awarded to J. Gunn & Sons, of the City of Winnipeg, the work to be completed by March 1, 1908. The excavation work was started in October, 1907, and the concreting was commenced in November, 1907, and carried on continuously, being completed in February, 1909.

Before excavation was started borings were made at various points along the bridge site; results of these are shown in the profile which is marked "B" hereto attached. In addition to this several test-pits were sunk and test-piles were driven. These several test-piles consisted of fir piles about 11 inches in diameter, and were driven to a depth of 24 feet to refusal, and were afterwards loaded with a 30-ton load and showed no settlement.

In order to make absolutely sure of the foundations near pier 23 a shaft was sunk to the old mine workings. In the sinking of this shaft we met with a couple of fatalities by men going in and being overcome with the accumulation of gas. They went down to rescue a small boy who was playing in the shaft after being repeatedly warned not to go near the place.

Considerable difficulty was experienced with the river piers, as it was found necessary to go down through the gravel and shale, making it very difficult to get tight cofferdams. In June, 1908, before the excavation for these piers was completed, there was a flood, during which the water rose to a higher level than had ever been known at this point, being 1 foot higher than previous extreme high water, which occurred in June, 1902. These levels are shown on the profile attached, which is marked C. This high water completely submerged the cofferdam, carrying enough silt to fill them, besides which it carried away some of the contractors' plant, causing delay in the completion of the work.

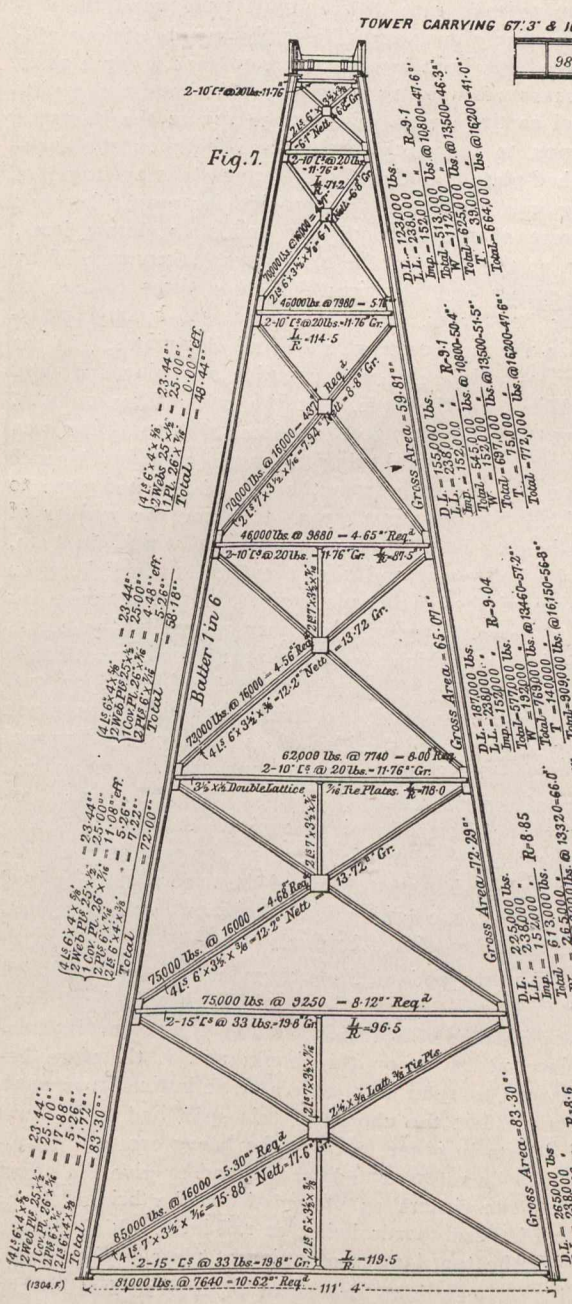


Fig. 7.

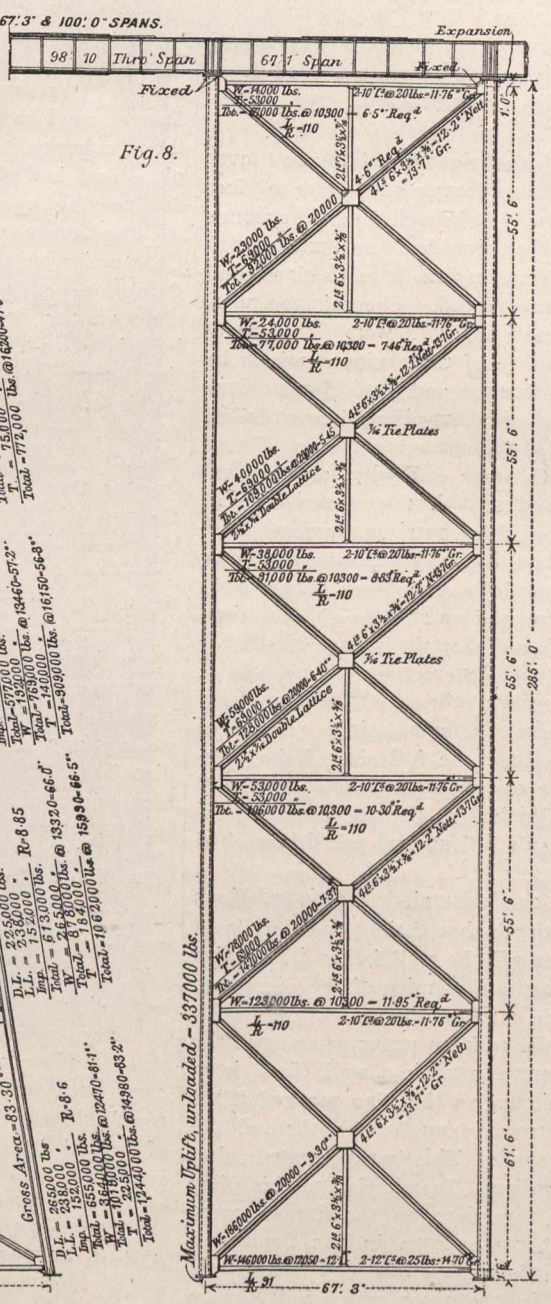


Fig. 8.

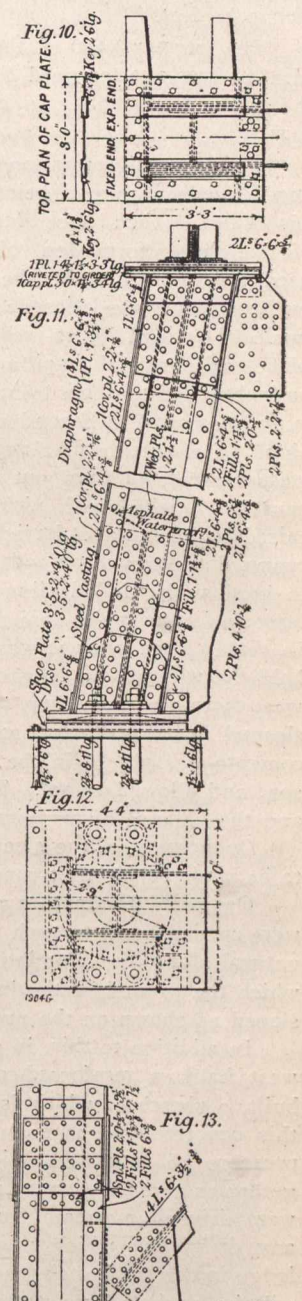



Fig. 14

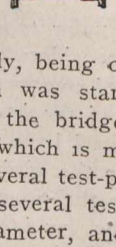


Fig. 15.

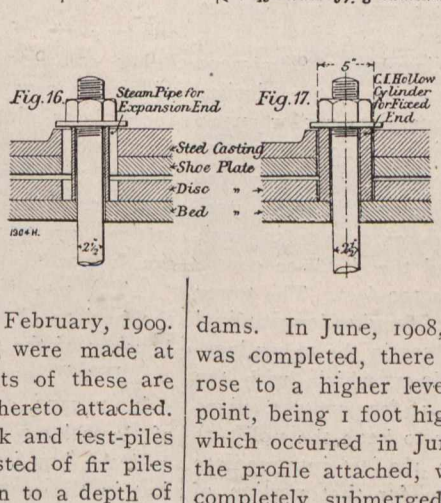


Fig. 16. Fig. 17.

All the pedestals and foundations on the land were completed by August 31, 1908.

Foundations.—For the foundations of the bridge various estimates were made in connection with the cost of timber piles with concrete pedestals and concrete piles, with the concrete pedestals on top. It was finally decided to adopt concrete piles and concrete pedestals, and a contract was let on this basis. All the land piers, with the exception of six, were built on concrete piles, the excavation for the same averaging 7 feet deep, but in some cases running as deep as 18 feet. The length of the concrete piles varied from 12 feet to 20 feet.

The greater part of the concrete for piers was mixed with a three-quarter yard Smith mixer, and conveyed from the mixer to the piers in ordinary contractors' iron dump-cars.

The general formation of the river-bed is gravel over hard shale, there being an average of 10 feet of water, then 10 feet of gravel. On account of the hard formation of the river-bed no piles were used, the excavation for the piers was made with clam-shell buckets before the caissons were placed. The caissons were made of 10-inch by 10-inch material, and were floated into place and sunk; sheet-piling made of three pieces 2 inch by 10 inch nailed together to form tongue and groove was driven outside caisson, a second row of sheet-piling being driven about 3 feet outside the first to leave space for puddle. These caissons were pumped out with some difficulty, and the excavation finished with pick and shovel, the material being raised by bucket and derrick. Three centrifugal pumps were required to keep the foundations dry, excavations were made to hard shale, and drillings made to a further depth of at least 20 feet to make sure there was no change of formation. In three of the piers it was found that the pumps could not hold the water down long enough to erect the forms, and it was therefore necessary to have the bottoms carefully cleaned by divers before concrete was deposited; 4 feet of concrete was placed in the bottom, the full size of the caisson, and allowed to set. The caisson was then pumped out and the balance of the pier finished as usual.

On account of the steep side hill special pile-drivers had to be made for driving concrete piles.

Owing to the nature of the west slope all foundations were carried down to such a depth that if the ground takes a natural slope, the foundations will be well below it, besides which the ground in the immediate vicinity of the piers was sloped as shown on the profile marked "B" attached.

In addition to this, in order to keep water away from the west bank a reinforced-concrete retaining wall has been built, a sketch of which is shown on the plan marked "B," this concrete wall is built strong enough to withstand the pressure of saturated quicksand. This was adopted altogether as a precautionary measure. In addition to this piles were driven up-stream from the piers on the flat to catch any drift-wood which might come down in the flood and lodge in the steel-work, and it is further intended that booms will be anchored up-stream in the river which will deflect any débris through the 100-feet openings.

Details of Design.—Numerous preliminary studies were made in connection with this structure, and the design finally decided upon consists of forty-four plate girder spans 67 feet 1 inch long, twenty-two plate girder spans 98 feet 10 inches long, and one riveted deck lattice truss span 167 feet long, carried on thirty-three rigidly braced riveted steel towers. The distance centre to centre of towers in each column was made 67 feet 3 inches, and the distance centre to centre of columns in adjacent towers 100 feet. The tower spans were made 67 feet long, in order to give longitudinal stiffness to the towers, and reduce stresses in the tower legs. A batter of 1 in 6 was given to the legs, which, with the spacing of the girders of the spans at 16-feet centres, gives ample spread at the base of the towers to keep the uplift at the piers within a reasonable amount; 100-feet intermediate spans between towers were decided on for that portion of the structure over 125 feet high, these spans being the longest thought feasible to handle, from an erection standpoint, although theoretical economy would call for still longer intermediate spans. On account of the severe winds experienced in this region, and considering the great height of the structure, it was decided to use through plate girder spans instead of decks on this viaduct, so as to render it practically impossible for cars to leave the deck from derailment or wind, and give greater security to the viaduct, since a derailed car might fall and knock out tower legs and bracing, on account of the great batter of the bents, and cause great delay to traffic. This type of span has since been adopted for a similar high viaduct in New Brunswick.

In order to take care of the uplift from wind the columns were securely anchored to piers by means of four 2½-inch diameter bolts built into the piers to such a depth as to engage a mass of masonry weighing 1½ times the uplift. Special steel castings were designed to secure the bases of these columns to the anchor-bolts, and between the shoe-plate and bed-plate the Canadian Pacific Railway standard disc-bearing was used, so as to provide for proper bearing in the event of the masonry not being absolutely level. Contraction at the base of the towers was taken care of by fixing one corner and allowing the other three corners to slide on the bed-plates. This was arranged by making 5-inch holes in the steel casting, shoe and disc-plates. At the fixed corner a hollow cast-iron cylinder was placed around the bolt, filling up the hole. At the other three corners, where movement takes place, a piece of steam-pipe was placed around the bolts, having a length of about ⅛ inch greater than the distance from the top of the bed-plate to the top of the steel casting, so as to allow the washer of the anchor-bolt to bear tight on this filler, which, in turn, bears on the bed-plate, and allows sufficient slack between the underside of the washer-plate and the steel casting for the latter to move. Dry graphite was placed in the recess of the bed-plates in which the disc-plates rested, to act as a lubricant. Tongues were made on the bed-plates at two corners of the towers, and the fourth bed-plate was made without any tongue, with the idea of its moving in a diagonal direction. Details of this arrangement are shown on the blue-prints of typical details, Nos. $36,542_1$ and $36,542_2$ attached. On the latter drawing typical details are also shown of the 100-feet plate-girder spans, as well as a stress-sheet and material diagram of one of the towers, the live-load diagram to which the bridge was designed, and a general small-scale elevation of the bridge.

At the western end of the bridge a high cut bank of hard clay had to be crossed, and although this bank was cut down to a slope of 1½ to 1, it was considered inadvisable to place pedestals on this bank, and it therefore became necessary to span this with a deck lattice truss span 167 feet long. The top chords of this span had to be built of special design in order to carry the heavy erection traveller, which will be referred to later on, and to give the effect of through plate-girders as viewed from the bridge floor; the bottom of these chords being at rail-level, while the top is flush with the top flanges of adjacent plate-girder spans.

As will be seen from the sheet of typical details, the columns are of very liberal dimensions, the bottom sections being composed of six angles, two web-plates 25 inches wide, one cover-plate 26 inches wide, in addition to two 6-inch plates placed in the inside of the columns. Longitudinal and transverse bracing is composed of angles laced together, the diagonal bracing being figured for tension only, and struts composed of channels placed back to back and latticed, are used to take compression stresses. Long struts are supported in the centre.

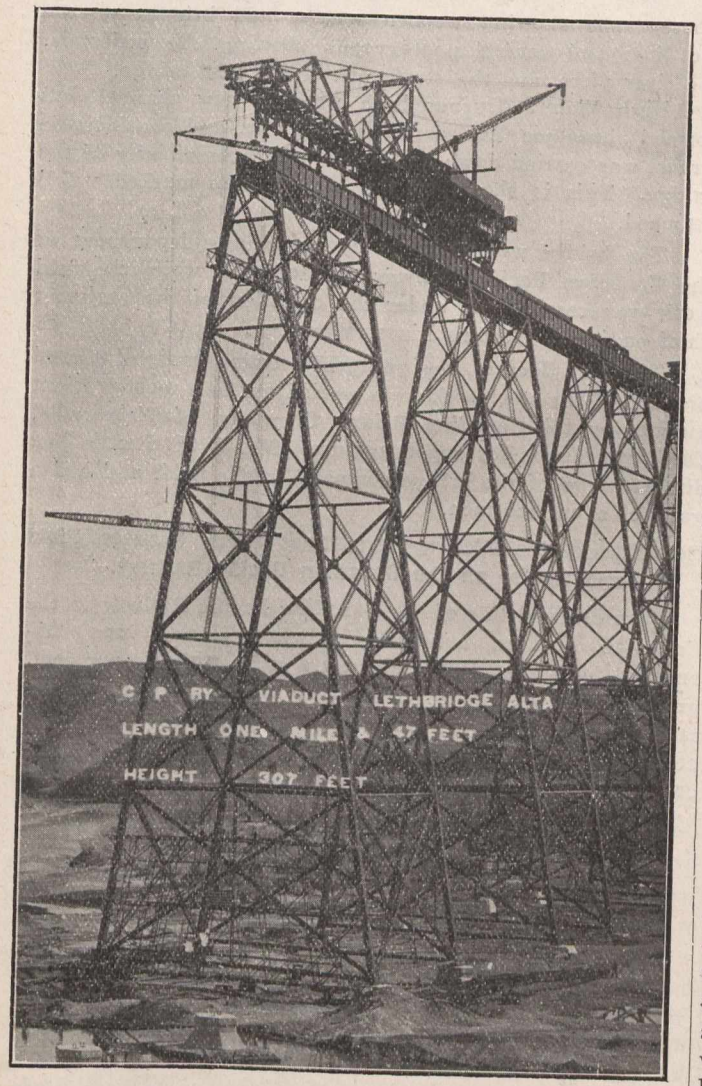
The use of double triangular type of bracing (without the horizontal struts) was considered, but was not used because of the great length of compression diagonals.

Details are also shown of the bearing of the spans on column caps, consisting of steel keys set in slots in the cap of the column and riveted to the girder shoe. In the fixed end the key is a neat fit in the groove of the column cap, but in the expansion end the key is made narrow so as to provide clearance on either side for movement of key in the slot. The underside of these keys is bevelled at the edges

to provide against their binding in the cap-plates. Details are also shown of the shore end of the flanking spans which show how the top flanges are curved.

Erection.

Unloading Traveller.—A material yard was located a short distance east of the eastern end of the bridge, over which was erected a travelling crane, consisting of a standard 125 feet highway span, provided with end wheels, two of which at each end are connected up by gearing and shaft-



ing to standard two-drum hoisting-engine, thus providing for its travelling along the runway. Each end of the crane is provided with a 5-ton 42-foot boom derrick commanding the additional storage area of 40 feet wide by the length of the runway for the storage of lighter class of material, the main area between the crane and the runways being utilized for the storage of girders and heavy columns. The length of the crane runway is 240 feet, and the height 37½ feet.

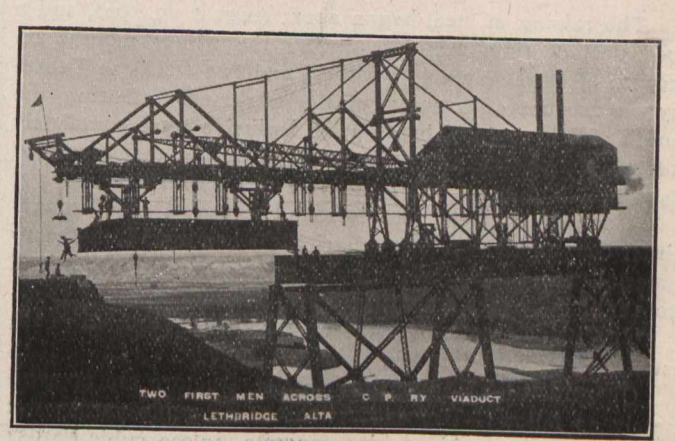
For lifting 100-feet girders, which weigh about 30 tons each, two sets of three-sheave steel blocks rigged with ⅝-inch line were provided, with a capacity of 17 tons each, connected up to a standard double-drum hoisting-engine. Turning of the 100-feet girders end for end is provided for by hooks and beams arranged to swivel on the centre floor beam of a 125-foot crane, such arrangement being desirable in the event of girders reaching the work wrong end first.

For the purpose of transporting material from the storage yard to the front the contractor is provided with constant use of locomotive and ten flat cars. To facilitate the work of erection a regular programme for the loading of material was arrranged. Drawing 637-14 shows the method of loading a pair of 100-foot girders, with their accompanying floor-beams and stringers on two 80,000 lb. capacity 40-feet long flat cars, the girders being loaded at a height to suit convenient picking up by the erection traveller. The 67-ft. 1-inch girders, weighing about 30,000 lb. each, were loaded in a similar manner, as will be seen from drawing 637-15. The columns were loaded on flat cars with corbels of convenient height for lifting off by the erection traveller.

The main traveller for the erection of this viaduct is a very ponderous machine, built entirely of steel, except for some minor parts, such as the engine-house, and various platforms. (See illustration). It was designed with two principal trusses 207 feet in length, spaced 16 feet apart centre to centre, to suit the spacing of the main girders of the viaduct spans. The cantilever portion of the trusses have a reach of 116 feet, the balancing portion of the trusses being 91 feet in length. The rear end of each balancing truss is carried on a truck with three 24-inch cast-steel wheels, and the forward end is supported on four similar wheels. The rear end of the traveller is counterweighted with 46 tons of steel rails, in addition to the weight of the engine-house, platforms and hoisting machinery contained thereon. The traveller runs on 80-lb. rails on oak planking along the top flanges of the girders, the rails and oak planking being bolted together in sections, so as to facilitate its placing and removal with each movement of the traveller. The weight of the traveller in working condition is 712,000 lb. The clearance under the deck of the traveller was made sufficient to permit the running of flat cars loaded with girders under it. The strains of the traveller were carefully calculated for conditions shown on drawing A-76°, special attention being paid to the matter of wind stresses on account of the very high winds certain to occur during the time of erection, which was estimated to be one year.

A stress-sheet was made up on the expectation that it might be necessary to carry the entire weight of the bottom storey of the bent suspended from the end of the traveller, which would make a total load of 90,000 lb. at the end of the traveller. This estimation is due to the expectation of assembling such bottom storey flat on the ground and then lifting it vertically into position on the piers. This method was later abandoned in favor of placing each item in the bent directly in its final position. To carry out this latter plan it was found desirable to suspend from the end of the traveller the assembling cage indicated on plan 637-23.

The erection traveller is hung with four trolleys hung on two trucks 8 feet apart centre to centre, which trucks extend the whole length of the traveller arm and about two-thirds of the balancing arm. All of the material is taken directly from flat cars run under the rear end of the traveller and handled by these trolleys, each one of which is provided with a 40-ton hydraulic jack of 18-inch stroke, these jacks being used to lift the girders from the cars, as it was undesirable to set the traveller high enough to give head room for block and tackle for this purpose.



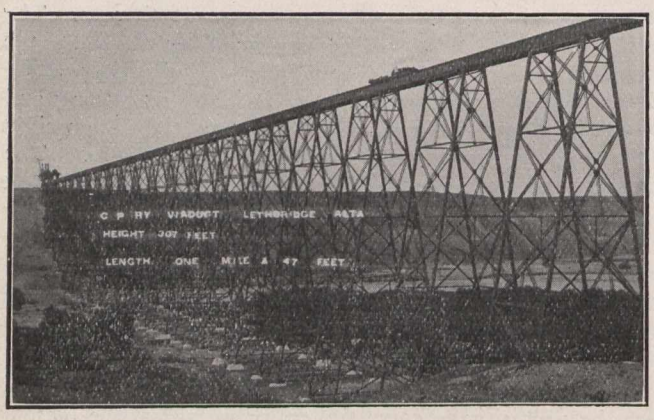
Traveller Placing Girder.

Girders were run out on flat cars under the traveller, and when transferred to these trolleys they were pulled forward on to the cantilever-arm of the traveller until in a proper position for lowering into place. Lighter material, such as longitudinal bracing, were lowered direct to the ground by wire-rope tackles, and were raised to position in the structure by special 85-ft. swinging booms of 5 tons capacity each, attached to the traveller.

In erecting the bents the traveller is moved to position to bring the hoisting tackle at the end of the traveller directly over the centre line of the bent to be erected, the overhang of the traveller being sufficient to span the maximum space of 100 feet made by the length of the intermediate girder span.

On completion of the lower storey of a bent supporting 100 ft. spans its top is braced back to previously-completed work by an erection strut, and similar struts are placed at each storey of the bent as it is erected, and when the bent is completed the 100-ft. span is put in place, the traveller moved forward, and the remainder of the tower completed, and the tower-span put in place.

All of the transverse connections and splices requiring to be field-bolted were rendered readily accessible to the



Height, 307 feet; length, 1 mile and 40 feet.

workmen by means of a cage suspended from the end of the traveller. On this erection traveller were placed six hoisting-engines, and a system of telephones was installed to establish communication between the men engaged in erecting material and those in charge of the hoisting-engines. The riveting of this bridge was carried on as quickly as possible after the material was put in place, and a separate traveller was used for this purpose, moving along the same track as the erection traveller.

The riveting traveller was built of timber, and high enough to permit of the passage of loaded flat cars beneath it. Riveting platforms were suspended on the sides from this traveller. All the riveting was done by pneumatic hammers. Compressed air of 100 lb. pressure was piped out on the bridge from the air-compressor plant placed on the ground near the Lethbridge abutment.

General.

The raising of steel began about August 15, 1908, and a good deal of time was lost during the winter months on account of extremely cold weather, and two weeks in February on account of a strike of the workmen. During the month of March 1909, bents 37-46 inclusive were completely erected, comprising a tonnage handled during that month of 2,300 tons and about 735 lineal feet of structure.

A serious accident was averted because of the through-girder construction; a heavy derrick car handling some heavy material was accidentally tipped over, but was restrained from falling by the through girders.

The 167-feet span over the west bank was erected in the usual manner by falsework.

Quantities.—The quantities in the structure are approximately as follow:—Dry excavation, 18,110 cubic yards; wet excavation, 4,870 cubic yards; concrete, 17,090 cubic yards; concrete piling, 1,676 piles; riprap, 339 cubic yards; steel, 12,200 tons.

It required 645 cars to transport the steel actually used in the erection of the bridge to the bridge site. Contractor's plant amounted to about forty cars, tie and guard rail fifty-three cars, besides which there would be an additional number of cars for coal used on the work, which would make the total about 900 cars.

It is estimated that in order to give the bridge two coats of paint about 7,600 gallons will be required.

Records. — Throughout the work careful records were kept of all measurements, triangulations, and all other work, the note-books being carefully indexed. In addition to this, weather records were kept, together with notes as to the wind, as on many occasions the wind was so strong that men could not work on the erection of the bridge. In addition to this, records were kept showing progress of work in accordance with form, which is attached. These were sent into the head office twice a month in order that a check might be kept on the progress of the work. Attached are several photographs showing wooden trestles and bridges on the old line, and several photographs showing the pedestals, the river piers, and the steel-work of the new bridge.

High Water.—During high water a new channel was formed about 300 feet east of the old one, and considerable gravel was carried down and deposited in the vicinity of the bridge. This is shown on the counter map marked "C" attached.

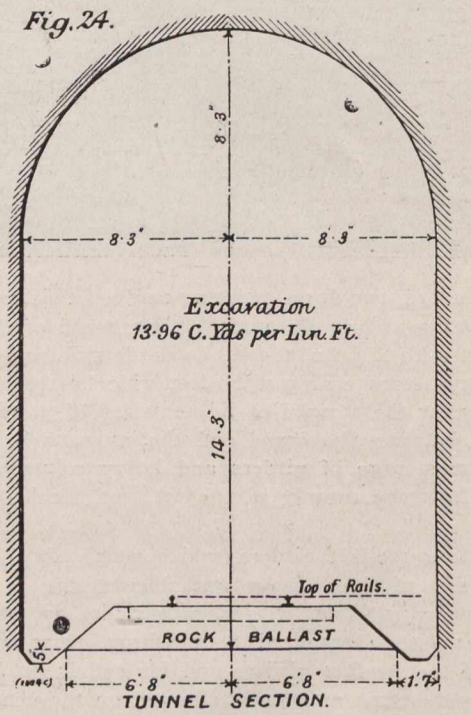
The bridge was designed by the bridge department of the Canadian Pacific Railway at Montreal, while the field work was carried out under the direction of the assistant chief engineer, Western Lines, Winnipeg.

The manufacture, designing of erection equipment, and erection of the steel-work were carried out in a most efficient manner by the Canadian Bridge Company, of Walkerville, Ont., contractors for superstructure. Mr. C. F. Prettie had direct charge of the bridge company in the field, and had a gang of about 100 men.

Reduction of the Kicking-Horse Pass Grade Between Field and Hector on the Canadian Pacific Railway.

The original line of the Canadian Pacific Railway in the Canadian Rockies, between Field and Hector, was constructed for a distance of about 4.1 miles with 4.5 per cent. grade, which was the heaviest grade on the main line of the railway; this, however, answered all purposes until the increasing traffic during the past few years necessitated the consideration of a grade revision at this point, more especi-

Fig. 24.



ally owing to the large amount of passenger traffic and the danger of operating this 4.5 per cent. grade, although on this gradient there were three safety switches, one at mile 10.2, one at mile 11, and the other at mile 12.3. Before passing any of these switches going west on the down grade, all trains had to come to a stop, when a man threw the switch for the main line, allowing trains to proceed. Under an agreement with the Government, this gradient had to be reduced.

Special surveys were made in the years 1902 and 1905 of alternative routes. The different propositions finally resolved themselves into the consideration of three lines, as

shown in the plan, Fig. 21, page 327. The line which is marked "A" required the abandoning of Field and moving the terminal at this point, besides being very expensive work, running into a series of slides. From the appearance of the ground, the Yoho Valley, or the north branch of the Kicking Horse River, appears to lend itself readily to a location in this direction; but on account of the exceedingly steep banks, and a large number of snow and rock slides, this line was abandoned. It therefore necessitated the consideration of the lines shown in dot-and-dash line and dotted line on the plan (fig. 21). The dot-and-dash line required running parallel to the bed of the river at several points in order to secure the gradient; this would require the railway and the river to be carried through the same cuts, and on account of the danger of ice blocking the river, besides being a very expensive project to divert the river, this line was abandoned, and the dotted line adopted as a general location.

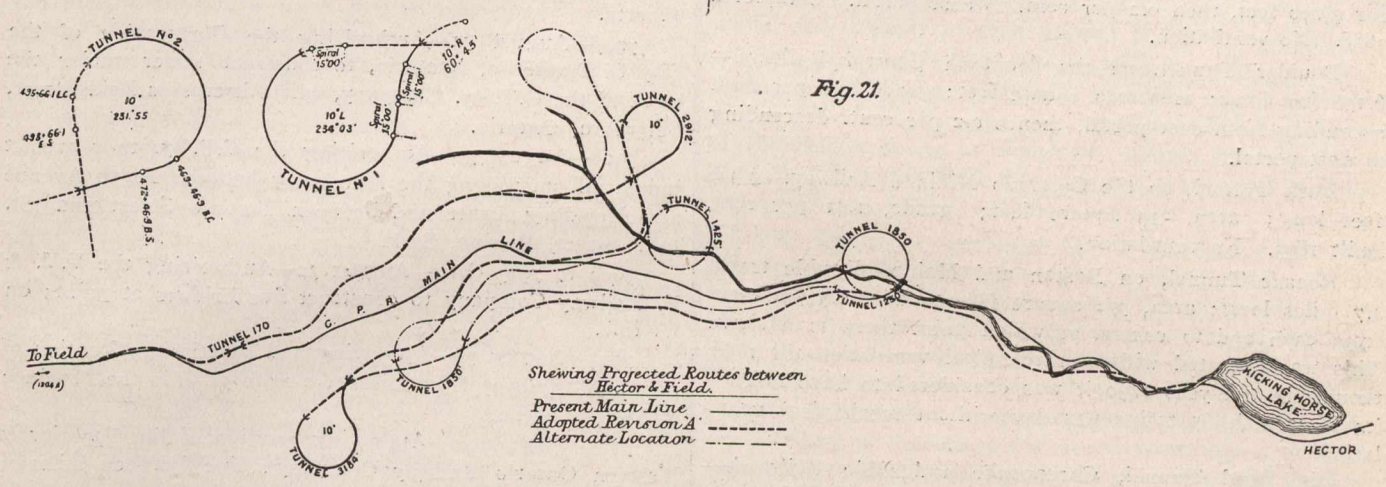


Fig. 21.

After having further surveys made, and in order to save length of tunnel, this was changed to the line shown in dot and dash; while this increased the curvature by 102 degrees and lengthened the line by 362 feet, the tunnel was shortened by 1,000 feet, and on account of the cost of the tunnel work it was decided to adopt this line.

Before actually starting the work on this line, further investigations were made up the Yoho Valley, and it was decided that it was impracticable to build a line up the valley, as, for a distance of two miles or more, it would be on the face of perpendicular rock-slides, ranging from 3,000 feet to 5,000 feet, besides which there would be several snow-slides to contend with, which would endanger the operation of the line. It was decided by the management to undertake this work in 1907, the contract being let to Messrs. McDonnel and Gzowski for the construction work.

There was no work of any particular interest outside of the ordinary grading except the tunnels. The tunnel known as No. 1 is 3,184 feet long, on a revrese curve shown on plan marked "A"; Tunnel No. 2, 2,912 feet long, being partly on a 10 degree curve radius 573.7 and partly on a tangent. Each of these curves have 300 feet of spiral at each end. The grade is 2.2 per cent., compensated at 0.04 per degree of curvature throughout, except in the tunnel, where 0.06 is used, and on the tangents in the tunnels an allowance of 0.02 was made for slippery rails.

As already stated, the maximum grade on the present line is 4½ per cent. for a distance of 3.71 miles, and the balance of 0.2 mile varies from 3.5 to 4 per cent. At the present time it requires four engines to handle a train of 700 tons over this grade, while it is estimated that with two engines of the same class the company will be able to haul 982 tons. The engines used in operating over this grade are what are known as 180 per cent. engines, having a total tractive force of 46,900 lb., the weight on the drivers being 173,700 lb., the total weight of the engine and tender loaded being 154 tons.

The amount saved on account of reducing this grade at the time the estimate was prepared was not in itself sufficient to warrant the expenditure; but, taking into account the question of handling passenger traffic so much more safely, as well as allowing longer trains to be operated, besides doing away with the terminal at Laggan, the terminal of the Western division being moved to Field, it was decided to go on with the work.

The work was started on this grade revision in September 1907, and it is estimated that it will be finished by August 15 of the present year.

The work on the tunnels was started from both ends, the contractor at first using an old-style Jumbo, but steam-shovels were later substituted in these tunnels, and the work progressed a little quicker. No great difficulty was experienced in the tunnel work, as it is through medium hard limestone, with a dip of about 20 degrees. A large quantity of timber was required in both the large tunnels on account of striking slides in the rock, and a little trouble was experienced from water, but this was kept under control at the upper ends with two small steam-pumps. The two headings in the tunnels met on May 22, the levels checking in Tunnel No. 1 within two-hundredths of a foot, and Tunnel No. 2 within one-hundredth of a foot.

The question of ventilation was investigated, but it was not considered that any would be required in either of these tunnels until the traffic increases to such a degree that it will be necessary to double track outside the present tunnels. On account of the tunnels being on a spiral, and the portals being in such close proximity to each other, there will practically be the same atmospheric conditions at the portals of each of the tunnels, and the tunnel should have a complete change of air in about 2½ minutes.

On account of the nature of the rock, which appears to slack after being exposed to the air for some little time, the greater part of the tunnels were taken out, so that they might be lined with concrete when that may be necessary. This will give a maximum grade of 2.2 per cent. through the mountains, of which there will be 12.7 miles east bound and 5.1 miles west bound.

As a comparison between other tunnels it might be stated that the present tunnels would have an area of 376.9

Fig. 22.

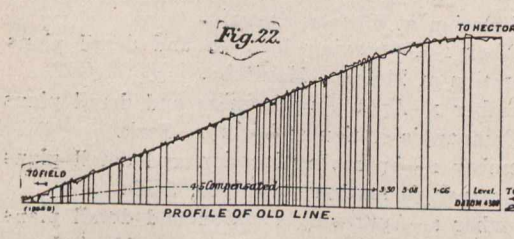
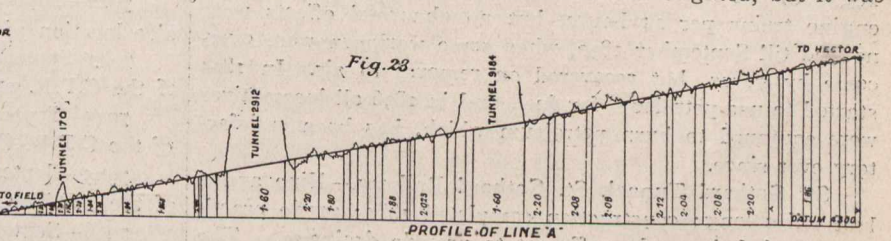


Fig. 23.



square feet of section through the longest tunnel, the actual grade being 1.6 per cent.

The Elkhorn Tunnel, on the Norfolk and Western Railroad, is 3,000 feet long, with an area of 235 square feet, and a grade of 2 and 1.4 per cent. It was found necessary to install a ventilating plant in this tunnel, as the train movements were about 100 per 24 hours.

The Cascade Tunnel, on the Great Northern Railway.—Length, 13,280 feet; grade, 1.74 per cent. Up to the present there has been no ventilating plant used at this point, and it is proposed to operate this by electricity, the installation for which was to be completed about the end of June of the present year.

Stampede Tunnel, on the Northern Pacific Railroad.—9,844 feet long; area, 333.7 square feet; grade, 0.74 per cent. for 5,000 feet, then 0.2 per cent. to east portal. Completed 1888. No ventilation.

Boulder Tunnel, on the Montana Central Railway.—6,130 feet long; area, 239 square feet; grade, 0.6 per cent. ascending from east portal, thence 0.2 per cent. descending to west portal.

Busk Tunnel, on the Colorado Midland Railway.—9,400 feet long; area, 275 square feet; grade, 1.41 per cent. Built 1893. No ventilation.

Hoosac Tunnel, on Boston and Maine.—Double track, 4.7 miles long; area, 572 square feet; grade, 0.5 per cent. from each end to centre, at which point there is a shaft. This was operated without mechanical ventilation till 1899, though in the year 1890 it was considered to have reached its limit with 65 trains per day without mechanical ventilation.

Big Bend Tunnel, Chesapeake and Ohio Railroad.—6,500 feet long; area, 250 square feet; grade, ascending, 0.4 per cent. for 4,300 feet, thence, descending, 0.08 per cent. for balance. It was divided in three sections of about 2,000 feet by two shafts. These were found to be insufficient for proper ventilation when traffic reached 45 trains per day.

St. Clair Tunnel, Grand Trunk Railway.—Built 1901; 6,000 feet long; grades 2 per cent., descending, each way to centre of section of 2,000 feet, which is on 1 per cent. grade. Area, 300 square feet. No ventilating plant installed till at least 1904, when train movement became so heavy that it was necessary to install electric locomotives.

Arlberg Tunnel, on Arlberg Railway.—Completed 1883; 6.4 miles long; area, 442.6 square feet; double track; grade, 0.2 per cent. for 2.6 miles, ascending from east end, thence 1.5 per cent. descending to west end. Owing to increased traffic it began to give trouble in 1885, when the company began to use coke. In 1888 the traffic increased to 31 two-engine trains per 24 hours, but no abnormal effects were noticed till September 1890, when some workmen were overcome by gases, but recovered on removal to air. In 1894 started to use petroleum for fuel, and in 1896 all locomotives were equipped to burn petroleum which, has been satisfactory ever since.

St. Gothard Tunnel, St. Gothard Railway.—Nine and a half miles long; construction completed 1882; grade practically level, being only sufficient to provide drainage. The ventilation was natural till about 1899, when Saccardo system was installed. At this time the traffic was 61 trains per day.

The approach to the St. Gothard has seven spiral tunnels of the following lengths: 5,000 feet, 3,670 feet, 3,605 feet, 5,100 feet, 5,090 feet, 4,000 feet, and 5,010 feet, with grades of 2.5 per cent., with natural ventilation only; besides a straight tunnel of 5,150 feet.

Tangevand Tunnel, on Bergen and Christiania Railway.—Length about 5 miles; no ventilation; grade, about 1.5 per cent.

Khojak Tunnel, India.—Double track, three miles long. Was originally divided into three sections by two shafts, but on account of these shafts it was found that there was a dead section between the two shafts. These were then closed up, and till 1901 it was not found necessary to ventilate same.

RAILWAY ORDERS.

(Continued from Page 320).

P.M.R.R. at P. C. west side of highway ¾ mile east of Glenwood Station, Ontario.

7901—August 31—Granting leave to the Princeton & Drumbo Telephone Company, to place its wires across the track of the G. T. Ry. at 6th Concession of Blenheim Township east of the middle townline, Ontario.

7902—August 31—Granting leave to the Bell Telephone Company to place its wires across the track of the C.P.Ry. between Wallace Avenue and Dundas Street, Toronto, Ont.

7903 to 7906, Inc.—August 31—Granting leave to the Alberta Government Telephones to place its wires across the track of the C.N.Ry. at four points in the Province of Alberta.

7907—August 31—Authorizing the Corporation of the City of Peterboro, Ontario, to construct sewer under the track of the G.T.Ry. Company, where it crosses Reid Street, Peterboro, Ontario.

7908—August 31—Authorizing the C.P.Ry. to construct industrial spur along the lane lying between Eigth Avenue and Dewdney Street and between Toronto Street and St. John Street, Regina, Sask.

7909 to 7913, Inc.—August 30—Authorizing the V.V. & E. Railway Company to construct five bridges at points on its line.

7914—August 30—Approving and sanctioning location of the C. N. Railway from mileage 0.00 to 51.50 in the Province of Saskatchewan.

7915—August 30—Approving location of the Superior & Western Ontario Railway Company's line between mileage 0 to 6.415.

7916—August 31—Sanctioning and approving location of the G.T.P. Railway Company's line from mile 100 to 150, British columbia.

7917—August 31—Authorizing the V.V. & E. Railway to construct bridge No. 409, at mileage 24.1 of its line.

7918—August 31—Authorizing the G.T.Ry. Company to reconstruct bridge to carry its tracks across the C.P.Ry. just west of Brockville, Ontario.

7919—August 27—Approving the location of the C.P.R. Company's station at Fort William, Ontario.

7920—September 1—Authorizing the C.P.R. to open for the carriage of traffic, the portion of the Mountain Section of its line between Hector, B.C., and Field, B.C.

7921—August 31—Authorizing the C.P.R. to construct overhead crossings at 6th Avenue at Moose Jaw, Sask.

7922—September 1—Approving detail plans of the C.P.R. also location of station at Upsala, Ontario.

7923 September 1—Approving location and detail plans of the C.P.R. station at Molson, Manitoba.

7924—September 1—Approving location and detail plans of the C.P.R. Company's station at Welwyn, Sask.

7925—September 1—Approving location and detail plans of the C.P.R. Company's station at Bulyea, Sask.

7926—September 1—Approving location and detail plans of the C.P.R. Company's station at Glenboro, Manitoba.

7927 to 7930, Inc.—September 1—Granting leave to the Bell Telephone Company to cross the tracks of the C.P.R. at four points in the Province of Ontario.

7931—September 1—Approving deviation of the location of portion of the C.P.R. from a point on the revision of the Crow's Nest Pass Branch to a point on the Calgary & Edmonton Railway in the Province of Alberta.

7932—August 31—Extending until October 15, 1909, the time within which the C.P.R. are required to complete the work on the Richmond Road viaduct, Ottawa, Ontario.

7933—August 30—Granting leave to the Superior & Western Ontario Railway, to open for the carriage of freight traffic, that portion of its line from the junction on the G.T.P.R. Company's Lake Superior Branch near mile 154, to the head of Sturgeon Lake, at O'Brien, a distance of seven miles.

7934—August 24—Granting leave to the G.T.P.R. to construct its railway across Norton Street, Edmonton, Alta.

7935—September 1—Authorizing the G.T.R. Company to construct six bridges on its Ottawa Division.

7936 to 7937—August 31—Authorizing the V.V. & E. Railway to construct bridges No. 437 and 400 on its line of railway over Twenty Mile Creek, and Similkameen River.

7938 to 7941, Inc.—September 1—Approving detail plan and location of the C.P.R. Company's stations at Redvers, Sask., Little Qualicum River, Graydon, Sask., and Goodlands, Manitoba.

7942—September 1—Authorizing the C.P.R. to construct spur to the premises of the Rocky Mountain Cement Company, Blairmore, Alberta.

7943—September 1—Extending until September 14th, the time within which the C.N.Q.R. may operate its trains for the carriage of traffic portion of its line connecting with the Quebec & Lake St. John Railway, in the City of Quebec to Garneau Junction, P.Q.

7944—September 2—Approving stress sheets of the G.T.R. for the Port Hope viaduct, Ontario.

7945—September 2—Approving strain sheets for bridge over Rideau River, at mileage 56.9, west from Hawkesbury on the Ottawa-Hawkesbury line of the C.N.O.R.

7946—September 1—Extending for a period of thirty days from 26th August 1909, time within which the C.P.R. may be permitted to commence the construction of subway at Iberville Street, Montreal, P.Q.

7947—September 2—Authorizing the N. St. C. & T.R. to construct spur from Fonthill station, Township of Thorold, Ontario, to Railton's Gravel Pit, Ontario.

7948—September 2—Authorizing the T.H. & B.R to construct spur to the premises of Messrs. Easterbrook & Bryan, Hamilton, Ontario.

7949 & 7950—September 1—Granting leave to the Dundurn Rural Telephone Company to place its wires across the track of the C.N.R. at two points in the Province of Saskatchewan.

7951—September 2—Granting leave to the Alberta Government Telephones to cross the track of the C.P.R. between Sections 2 and 3, Township 11, Range 8, west of the 4th Meridian.

7952 to 7955, Inc.—September 2—Granting leave to the Bell Telephone Company to cross the tracks of the G.T.R. at three points in Toronto, and the C.P.R. at Westmount, Montreal, P.Q.

7956 to 7958, Inc.—September 2—Granting leave to the Manitoba Government Telephones to cross the tracks of the C.N.R. at two points and the C.P.R. at one point in the Province of Manitoba.

7959 & 7960—September 1—Granting leave to the Saskatchewan Government Telephones to cross the track of the C.N.R. and the C.P.R. at one point east in the Province of Saskatchewan.

7961—September 1—Granting leave to the Elmwood Rural Telephone Company to cross the track of the G.T.R. Company, at its Elmwood Yards, Elmwood, Ontario.

7962—September 1—Amending order No. 7698, dated August 3rd, 1909, authorizing the C.P.R. to construct spur into the premises of the Wood-McNabb Lumber Company, East Kootenay District; by striking out the figures "1465" and the word "Chains" where these words occur in the recital and operative parts of said Order, and substituting therefor the figures "1465" and the word "feet."

7963—September 1—Authorizing the C.N.R. to alter its existng level crossing on Pembina Street, Winnipeg, Man.

7964—August 31—Authorizng the C.N.R. to use Ticket and Baggage form in use on its lines west of Port Arthur, filed with the Board until the Board shall hereafter otherwise order and determine.

7965—September 2—Authorizing the Corporation of the City of Brantford, Ont., to construct sewer under the track of the G.T.R. on Gilkinson Street, Brantford, Ont.

7966—September 1— Recommending to the Governor-in-Council for sanction by-law of the C.N.R. entitled "A by-law respecting the travelling upon and use of the railway," and rescinding Order of the Board No. 7735, dated the 6th of August, 1909.

7967—September 2—Approving location of the C.N.R. Company's line of railway from a point five miles above Yale on the Fraser River to a point ten miles above Yale, in the Province of British Columbia.

CITY OF WESTMOUNT DESTRUCTOR.

The City of Westmount have recently placed an order for a second refuse destructor which when installed will double the capacity of their present incineration plant.

The destructor will be of the Heenan patent type, consisting of three cells or furnaces arranged in one unit with a common combustion chamber. The complete unit will be of sufficient capacity to completely destroy by reducing to a clinker absolutely free from organic matter not less than 50 tons of refuse per twenty-four hours.

The destructor generally is in accordance with the British type which has proved so uniformly successful in many different parts of the world. The cells will be fed from the top. The charging will be considerably facilitated by a new and important improvement introduced by the builders which enables each cell to be charged instantaneously. Instead of two men occupying five to ten minutes in shovelling in the refuse and at the same time a very considerable inrush of cold air taking place through the open charging door, the new Heenan system enables one man to handle the charging of the three cells. On the top of each cell will be a container holding sufficient refuse for one charge. When each container is filled, a door on the top is closed and a charging door at the bottom of the container is mechanically opened, and the charge drops down to the drying hearth inside of the destructor.

After remaining on the drying hearth for whatever time may be necessary, the charges are pushed forward on to the grates through poking doors which are provided in the back of the destructor for this purpose.

The air for the combustion of the refuse is preheated in a regenerator through which the hot gases pass after leaving the boiler. The air travels the full length of the regenerator outside the tubes, the flue gases passing through the tubes. The heated air for combustion is forced through the grate bars by a Heenan centrifugal fan operated by specially designed Heenan vertical, high speed, enclosed, self-lubricating engine.

Another important feature in connection with the installation will be the very efficient method of ventilating the incineration building, as the air supply to the forced draft fan is drawn by a duct from the upper portion of the building, inside thus effectively disposing of any dust and heat that may be present.

The heat generated in the combustion of the refuse will be utilized for the production of steam. The hot gases pass immediately from the combustion chamber of the destructor to a Babcock & Wilcox boiler in which a guaranteed evaporation of not less than 1¼ lbs. per lb. of refuse from and at 212 degrees will be obtained.

The new Westmount destructor will be similar to that installed by Heenan & Froude, for the Borough of Richmond, New York, the operation of which has been watched with the greatest interest by engineers in the United States, and concerning which data of considerable valuable have been published from time to time. The only other Heenan destructor in Canada is that at Vancouver.

The contract for this destuctor has been placed with Messrs. Heenan & Froude of Manchester, through their Montreal agents, Messrs. Laurie & Lamb, Engineers.

ENGINEERING SOCIETIES.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—413 Dorchester Street West, Montreal. President, Geo. A. Mountain; Secretary, Prof. C. H. McLeod.

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

TORONTO BRANCH—
96 King Street West, Toronto. Chairman, J. G. G. Kerry; Secretary, E. A. James, 62 Church Street, Toronto.

MANITOBA BRANCH—
Chairman, H. N. Ruttan; 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 College.

OTTAWA BRANCH—
Chairman, C. R. Coutlee, Box 560, Ottawa; S. J. Chapleau, Box 203.

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

UNION OF SASKATCHEWAN MUNICIPALITIES.—President, Mayor Hopkins, Saskatoon; Secretary, Mr. J. Kelso Hunter, City Clerk, Regina, Sask.

ALBERTA ASSOCIATION OF ARCHITECTS.—President, R. Percy Barnes, Edmonton; Secretary, H. M. Widdington, Strathcona, Alberta.

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

AMERICAN MINING CONGRESS.—President, J. H. Richards; Secretary, James F. Callbreath, Jr., Denver, Colorado.

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

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE OF WAY ASSOCIATION.—President, Wm. McNab, Principal Assistant Engineer, G.T.R., Montreal, Que.; 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, Geo. W. Jackson, contractor, Chicago; Secretary, Daniel J. Haner, Park Row Building, New York.

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

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.—President, E. Grandbois, 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, Alfred E. Uren, 62 Church Street, Toronto.

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

CANADIAN FORESTRY ASSOCIATION. — President, Thomas Southworth; Secretary-Treasurer, King Radiator Co., Toronto; Secretary, James Lawler, 11 Queen's Park, Toronto.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, Dr. W. Doan, Harrietsville, Ont.; Secretary, F. Page Wilson, Toronto.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President, W. G. Miller, Toronto; Secretary, H. Mortimer-Lamb, Montreal.

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

CANADIAN STREET RAILWAY ASSOCIATION.—President, D. McDonald, Manager, Montreal Street Railway; Secretary, Acton Burrows, 157 Bay Street, Toronto.

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

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

DOMINION LAND SURVEYORS.—Ottawa, Ont. Secretary, T. Nash.

EDMONTON ENGINEERING SOCIETY.—President, Dr. Martin Murphy; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alta.

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

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

INTERNAL COMBUSTION ENGINEERS' ASSOCIATION.—Homer R. Linn, President; Walter A. Sittig, Secretary, 61 Ward Street, Chicago, Ill.

MANITOBA LAND SURVEYORS.—President, Geo. McPhillips; Secretary-Treasurer, C. C. Chataway, Winnipeg, Man.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, J. H. Winfield; Secretary, S. Fenn, Bedford Row, Halifax, N.S.

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

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, Louis Bolton; Secretary, Killaly Gamble, 703 Temple Building, Toronto.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—President, A. F. Dunlop, R.C.A., Montreal, Que., Secretary, Alcide Chaussé, P.O. Box 259, Montreal, Que.

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.

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

COMING MEETINGS.

American Railway Bridge and Building Association.—October 19-21. Nineteenth annual convention at Jacksonville, Florida. Secretary, S. F. Patterson, Boston & Maine Railway, Concord, N.H.

American Society of Municipal Improvements.—November 9-11. Annual convention at Little Rock, Ark., U.S.A. A. Prescott Folwell, Secretary, 241 W. 39th St., New York City.

Royal Architectural Institute of Canada.—October 5-7, at Toronto, general annual assembly. Secretary, Alcide Chaussé R.S.A.; P.O. Box 259, Montreal, Que.

National Gas and Gasoline Engine Trades Association. Harry T. Wilson, treasurer, Middleton, Ohio; Albert Stritmatter, Cincinnati, Ohio. Next meeting November 30, December 1, 2, 1909, at Chicago, Ill.

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.

Quebec.

MONTREAL.—Tenders will be received until Thursday, 23rd September, for the construction of a 2 feet x 3 feet brick sewer. John R. Barlow, city surveyor.

NOTRE DAME DE GRACE.—Tenders will be received until 20 September for construction of sewer. The Town Engineer, 335 Decarie Avenue, has plans.

QUEBEC.—Tenders for alterations to the Post Office Building will be received until Friday, September 24. Albert R. Decary, District Engineer, Quebec Post Office Building. Napoleon Tessier, secretary, Department of Public Works, Ottawa.

QUEBEC.—Tenders will be received until Thursday, October 7, for the construction of a dam on Kipawa River, County of Pontiac. Plans may be seen at the offices of J. G. Sing, resident engineer, Toronto; J. L. Michaud, Merchants Bank Building, St. James Street, Montreal, and at the Department of Public Works, Ottawa. Napoleon Tessier, secretary.

THREE RIVERS.—Tenders will be received until Thursday, Sept. 16th, for supplying and installing pressure filters with a capacity of two million gallons per 24 hours. L. T. Desaulniers, Secretary-treasurer.

JOLIETTE.—Tenders for electric light wiring and fittings for the Armory will be received until Friday, September 24. A. Durand, Clerk of Works, Joliette. Napoleon Tessier, secretary, Department of Public Works, Ottawa.

Ontario.

PARKHILL. — Tenders for hot water heating system will be received until September 27. Plans may be seen on application to Mr. James Phelan, Clerk of Works, Parkhill, and at the Department of Public Works, Ottawa. Napoleon Tessier, secretary.

KINGSTON. — Tenders for heating apparatus, stable establishment, R.M.C., Kingston, will be received until Friday, September 24. H. P. Smith, architect, Kingston. Napoleon Tessier, secretary, Department of Public Works, Ottawa.

GLENCOE.—Tenders for Post Office, Customs and Inland Revenue fittings will be received until Monday, September 27. J. E. Hull, Clerk of Works, Glencoe; T. A. Hastings, Clerk of Works, Toronto. Napoleon Tessier, secretary, Department of Public Works, Ottawa.

OTTAWA.—Tenders will be received until 28th September, 1909, for the construction of steel superstructures and floor systems for bridges at the points named below:

District "A."

Mile	Bridge	Date of Completion
82.0	Cains River	December 1, 1909
124.5	South-West Maramichi, N.B.	March 15, 1910
133.0	South-West Maramichi, N.B.	March 15, 1910
134.07	Juniper Brook	April 1, 1910
1.42.0	Odell Brook	April 1, 1910

District "D."

62.25	Circle River	July 1, 1910
62.5	Low Brush River	June 1, 1910
99.0	Brule Creek	April 1, 1910
109.29	Frederichouse River	April 1, 1910
113.48	Buskegow River	April 15, 1910
123.5	Driftwood River	May 1, 1910
135.0	Mattagama River	June 1, 1910

Plans and profiles may be seen at the office of the Chief Engineer at Ottawa. P. E. Ryan, secretary.

FLESHERTON.—Tenders will be received up to September 20th for building a concrete bridge, 10 feet span, on the township boundary line between Glenelg and Artemesia. John A. Boyd, Reeve, Artemesia, Flesherton.

ORANGEVILLE.—Tenders will be received up to Tuesday, September 14th for supplying material, construction and erection of a steel highway bridge (75 feet span) over the Credit River. C. R. Wheelock, engineer, Peel County.

TORONTO.—Tenders will be received until Thursday, October 28, for turbine pumps. Further particulars may be had from the city engineer. (Advertised in the Canadian Engineer.)

TORONTO.—Tenders will be received until Thursday, October 28, for electric motors. Further particulars may be had from the city engineer. (Advertised in the Canadian Engineer.)

TORONTO.—Tenders are invited until 5th October by the City of Toronto for 16-inch cast iron pipe and valves. Joseph Oliver (Mayor), Chairman Board of Control. (Advertised in Canadian Engineer).

TORONTO.—Tenders will be received until Monday, September 20th, for the cut stone, brick and carpenter work in connection with the erection and reconstruction of the portions of the Ontario Parliament Buildings, recently destroyed by fire. F. Cochrane, Acting Minister of Public Works, Toronto.

TORONTO.—Tenders will be received until September 21st for construction of pavements, concrete sidewalks and sewers. Joseph Oliver (Mayor), Chairman Board of Control. (Advertised in Canadian Engineer).

Manitoba.

WINNIPEG.—Tenders for supply of cast iron water pipe of the following quantities and sizes, delivered f.o.b. cars, Winnipeg, namely, 20,000 feet of 8-in. pipe, 6,000 feet of 10-in. pipe, 6,000 feet of 18-in. pipe, will be received up to September 29. M. Peterson, Secretary Board of Control.

WINNIPEG.—Tenders will be received up to Monday, November 1, for supply of one motor hose wagon for the Fire Department capable of carrying 2,000 feet of 2½-in. cotton, rubber lined, fire hose, approximate weight, 2,200 lbs., and six men, approximate weight, 1,020 lbs. M. Peterson, Secretary Board of Control.

Saskatchewan.

YORKTON.—Tenders will be received until Tuesday, September 28th, for cast iron pipe and laying of mains. F. T. McArthur, B. Sc., Town Engineer. (Advertised in the Canadian Engineer).

British Columbia.

VICTORIA.—Tenders will be received until Monday, October 11th, for 2,500 feet of 12-inch pipe; 15,000 feet of 8-inch; 20,000 feet of 6-inch and must be delivered in 30-feet lengths, covered with jute and double coated, inside and out, with asphalt solution. Delivery must be made by March 15th next. W. W. Northcott, purchasing agent.

CONTRACTS AWARDED.

New Brunswick.

MONCTON.—Tenders were received at the last council meeting for two 12-inch, two 8-inch, and eight 6-inch valves, as follows:—Canadian Fairbanks Company, $227.60; Sumner Company, $213.42; Coffin Valve Company, Boston, $232.20; Glenfield and Kennedy Company, Montreal, $241.90. The Sumner Company's tender was accepted. Tenders for two 4-K.W., and two 3-K.W. transformers were as follows:—Packard Electric Company, $173.18; Canadian General Electric Company, $191; Canadian Westinghouse, $208.72. That of Packard Electric Company was accepted. Tenders for 1½ dozen 5 amp. and ½ dozen 10 amp. electric meters were as follows:—Packard Company, $277.80; Canadian Westinghouse Company, $294; Ferranti, $253.36. The

Packard Company tender was accepted. The Sumner Company's tender, being the lowest for galvanized pipe, tees, valves and elbows, was accepted.

Quebec.

MONTREAL.—Gaudreau Freres have been given a contract for repairing the roof of St. Lawrence Market at $1,140.

Ontario.

COLLINGWOOD.—Wm. Simpson, of Collingwood, received the contract for sewer extensions at $6,790, the corporation to furnish two steam drills, two pumps and a steam boiler. Other tenders were Wm. McIllwraith, Collingwood, $7,200, town engineer, by day labor, $7,500 (including purchase of necessary plant.)

THOROLD.—This municipality recently invited tenders for the construction of 1,290 feet of 18-inch tile sewer and all appurtenances. The tenders follow:—

*Peter Lorenzo, Niagara Falls	$3,277
Daniel Oates, Thorold	4,448
David Walker, Thorold	3,700

*Accepted.

TORONTO.—The Gutta Percha and Rubber Company, of Toronto, will be given a contract by the city for 7,000 feet of 2½-inch "Paragon" hose at 95 cents a foot.

TORONTO.—The following tenders were accepted for the erection of the new Parkdale Public School:—Masonry, H. Needham, $24,800; carpentry, Crocker & Le Drew, $13,500; plastering, T. Blackburn & Sons, $3,700; painting, J. Phinnemore, $1,525; plumbing, Fred. Armstrong Company, $1,880; roof and tinsmithing, A. B. Ormsby & Company, $1,807; heating and ventilating, J. R. Seager, $3,625; heat regulating, Johnston Temperature Regulating Company, $695. The total, $51,532, is well below the appropriation of $65,000.

Manitoba.

WINNIPEG.—The Canadian Westinghouse Company will probably receive the contract for supplying the city with 50 arc lamps and cut offs, for $1,637.50. Several other firms tendered, and their prices were identically the same.

WINNIPEG.—D. D. Wood will probably receive the contract for additions to the city hall annex. His tender is $17,500.

WINNIPEG.—The Brydges Engineering & Supply Company, Limited, have been awarded the contract for supplying a duplicate pumping plant to the Canadian Northern Railway, in two complete units, each one consisting of a gas engine, a Sutton gas producer plant and a Daniels high-speed pump. Each unit will be capable of pumping 500,000 gallons of water in twenty-four hours, and the plant will be installed in the pump house on the bank of the Red River, in place of the steam pumps at present in use. They will furnish water to the Canadian Northern shops and yards in Fort Rouge.

British Columbia.

NELSON.—The contract for the erection of the Y. M. C. A. building, was awarded to Thomas H. Waters and W. Pascoe. The cost will be $22,900.

VICTORIA.—The contract for 20 tons of pig lead will be given to the Robertson, Godson Company.

VICTORIA.—Tenders for 2-inch galvanized water pipe were received from the following: Colbert Plumbing & Heating Co., per 100 feet, $16.90; Hickman Tye Hardware Co., $18.91; Bonass Bownass & Co., $17.70; E. G. Prior & Co., $19.50; B. C. Hardware Co., $19.30; C. M. Cookson, $16; Walter Fraser & Co., $19.30; Andrew Sheret, $18.20. The tenders were referred to the purchasing agent.

VICTORIA.—Recently tenders were called by the city for the local improvement work on Cowan and Hulton Streets. The tenders for the Cowan Street work were as follows:—City Engineer, $2,422.80; F. Stedham, $2,765.20; A. Pike, $2,926.50. For Hulton Street the tenders were:—City Engineer, $4,725.60; F. Stedham, $5,208; A. Pike, $5,477. The city engineer was given the contract.

VICTORIA.—The city will purchase a new steam roller at a cost of $3,362, from the Waterous Engine Works Company, of Brantford, Ontario.

RAILWAYS—STEAM AND ELECTRIC.

Quebec.

MONTREAL.—It is expected that the cars of the Montreal and Southern Counties Railway will be operating between Montreal and St. Lambert before the end of October. Save for about 400 feet of concrete wall, the tracks from the terminus in Montreal to Victoria Bridge have now been completed. The overhead work on the bridge has also been completed and the flooring and tracking is now being commenced. The work on the St. Lambert side, down to Longueuil, is being laid out, and tenders for the construction of this section will close on the 17th instant. The length of this section will be about four and one-half miles, and it is hoped to have the rails laid before the winter. The delivery of new cars will commence about the beginning of October. They will be of the vestibule type, with smoking compartment in rear, and with a capacity of sixty-five persons. The steam plant for the generation of the power used by the company is being installed by the Canadian Westinghouse Company.

MONTREAL.—At the last meeting of the Council of Longueuil, Mayor Geoffrion authorized the town engineer to establish the levels for the street tracks of the Southern Counties Railway, conjointly with the company's engineer. It is expected that the laying of the tracks will begin immediately and the work pushed ahead vigorously so that the cars may be running before the winter sets in.

VAL BARRETTE.—The C.P.R. have just completed a handsome No. 4 station at this point, which is on the Nominingue extension.

Mr. G. A. Mountain, C. E., Chief Engineer of the Dominion Railway Commission, accompanied by Mr. McCulloch, C. E., Division Engineer C.P.R., and Mr. Murphy of the traffic bureau, C.P.R., inspected the Nominingue extension on Friday, the 10th September. A service of trains began on Wednesday, the 15th September. The station at Mile 35, near the village of Rapidé L 'Originale is completed and operations have been commenced on round house near by. The buildings on this extension were erected by Mr. C. E. Deakin, of Montreal; the engineer in charge of the entire extension was Mr. H. M. Dibblee, C. E., Nominingue, and the building inspector Mr. M. M. Campbell, C. E., of Ottawa. The track engineer was Mr. Wm. Patterson, C. E., of Carleton Place.

Ontario

PORT ARTHUR.—The City Council, Board of Trade, and Railway Commission are moving with the Townships of Oliver and Shuniah toward the organization of a company to construct twenty miles of rural tram lines to facilitate communication between the townships and the city. The city will likely assume sixty per cent. of the burden by guaranteeing its bonds while the townships will assist in a similar way to a smaller extent.

TORONTO.—It is understood that the C.N.R. will shortly invite tenders for the construction of the first 130 miles of the proposed Toronto-Ottawa line.

TORONTO.—The Grand Trunk Pacific have just placed an order for 22,000 tons of steel rails with the Algoma Steel Company. The Standard Inspection Bureau, of Toronto, have been retained as inspection engineers.

Alberta.

EDMONTON.—After an absence of seven months, William R. Clarke, financial manager af the Alberta and Great Waterways Railway Co., which holds a charter to build from Edmonton to Fort McMurray, and also holds a Provincial guarantee to bonds for the line, has returned to the city, and announces that he is prepared to commence immediate contruction of the road. Mr. Clarke is accompanied by his entire staff of chief officials, including E. A. James, gen. man., who was formerly manager of the Canadian Northern Railway; Dr. Wadell, chief consulting engineer, and G. W. Minty, solicitor. Close upon fourteen millions of money was brought back from Europe by Mr. Clarke. Of this $7,400,000 is in stock, and $7,000,000 in bonds sold at a good figure.

The majority of the money is French capital, secured on the money market of Paris.

British Columbia.

NELSON.—A company with a capital of $50,000 has been formed in Nelson to operate a tramway system. The city council have practically agreed to guarantee a bond issue of $25,000; and a by-law will shortly be submitted to the ratepayers, judging from present indications.

VICTORIA.—The new line of the British Columbia Electric Railway from New Westminster to Eburne is rapidly nearing completion.

FINANCING PUBLIC WORKS.

The following particulars refer to recent debenture issues:—

CHATHAM, N.B.—$25,000, to J. M. Robinson & Sons, St. John, N.B.

AMULREE, ONT.—$3,695.40, drainage, to G. A. Stimson & Company, Toronto.

TABER, ALTA.—$55,000, to W. A. Mackenzie & Co., Toronto.

NANTON, ALTA.—$5,000, to Nay & James,, Regina.

MAGRATH, ALTA.—$14,000, to Nay & James, Regina.

WHITEWOOD, SASK.—$4,000, to Nay & James.

KILLARNEY, MAN.—$10,000, to Nay & James.

MELVILLE, SASK.—$6,000, to Nay & James.

NORTH EASTHOPE, ONT.—$3,695, to Geo. A. Stimson & Co., Toronto.

ALAMEDA, SASK.—$15,000, town hall debentures, to Hawkey, Somerville & Company,

STRATFORD, ONT.—$12,000, for water works, $18,000 for public schools and $17,000 for collegiate institute, to the Ontario Securities Co., Toronto.

WINDSOR, ONT.—$20,000, macadam pavement debentures, to Messrs. Aemilius Jarvis & Co., Toronto.

The following debentures were purchased by Messrs. Brent, Noxon & Co., of Toronto:—

VERMILION, ALTA.—$6,500.

DRESDEN, ONT.—$20,000.

CLINTON, ONT.—$26,000, waterworks.

THURLOW TOWNSHIP, ONT.—$6,500, school purposes.

TAY TOWNSHIP, ONT.—$4,500, schools.

INNISFIL TOWNSHIP, ONT.—$1,000, schools.

NEELON AND GARSON TOWNSHIPS, ONT.—$5,000, good roads.

STREETSVILLE, ONT.—$5,500 (guaranteed by County of Peel), for local improvements.

Quebec.

VERDUN.—This municipality has just completed its sale of 5 per cent. bonds amounting to $150,000. The purchasers were Messrs. St. Cyr, Gauthier and Frigon, at 106.06.

Ontario.

GODERICH.—The road machinery by-law of $10,000 was carried by the ratepayers on September 11th by a majority of 410..

TORONTO.—The City Council are considering the advisability of a by-law authorizing the expenditure of $500,000 on new buildings for the Exhibition.

Manitoba.

UNITY.—J. K. Hall, overseer, offers for sale $8,000 5½ per cent. 15-year fire and local improvement debentures.

Saskatchewan.

ARCOLA.—The waterworks debentures, amounting to $15,000, have been sold to Nay & James, of Regina.

British Columbia.

NELSON.—A company recently formed to operate a tramway system here have asked the city council to guarantee a bond issue of $25,000. A by-law will probably be submitted to the ratepayers at an early date.

VANCOUVER.—The ratepayers have passed the following money by-laws:—Waterworks extensions, $234,000; street improvements, $104,000; hospital, $30,000; incinerator, $20,000; jail and police court, $6,000; advertising, $4,000.

LIGHT, HEAT, AND POWER.

Quebec.

VERDUN.—Mr. Charles Brandeis, consulting electrical engineer, of Montreal, has been retained by the municipality in connection with the proposed extensions to the electric light plant.

Ontario.

ST. CATHARINES.—The Welland Electric Co. expects to have its line to Thorold nearly completed in two weeks.

TORONTO.—The Board of Control have decided to lease to the Hydro-Electric Commission the site necessary for the local transformer station. The erection of the station will be begun at once.

TORONTO.—The work of constructing the Toronto transformer station in connection with the Hydro-electric power transmission line was commenced on Monday on Garrison common, near Strachan Avenue. All the stations along the line are now under way, and the commission is hastening the work as much as possible with a view to completion before the end of the year.

WELLAND,—Stamford Township Council refused permission for the Hydro-electric Power Commission to erect poles on the highways of the township.

Saskatchewan.

PRINCE ALBERT.—Mr. Charles H. Mitchell, of Toronto, who recently paid a visit to Lacolle Falls, thinks they are capable of developing 10,000 horsepower.

British Columbia.

FERNIE.—The new power house for the electric light plant is rapidly nearing completion and will be ready for the installation of the machinery in a few days. The special boilers have not yet arrived, however, and it will probably be a month or more before the system is in working order. The town has been without a lighting plant ever since the fire and the completion of the new system will be heartily welcomed.

LADYSMITH.—The pole line for the electric lighting of the city is now complete and work has been started on the power house.

SEWERAGE AND WATERWORKS.

Quebec.

QUEBEC.—The Council have voted $2,500 to the Waterworks Committee for extensions in St. Malo Ward.

Ontario.

LONDON.—The city has signed a contract with the Hon. Adam Beck whereby an adequate supply of water will be obtained. The contractor will sink a number of artesian wells capable of a pumping capacity of 4,500,000 gallons, an economic supply of 2,000,000 gallons, and a visible supply of 3,000,000 gallons.

PORT ARTHUR.—John Galt, consulting engineer, Toronto, is here to advise the city regarding the placing of the intake pipe connected with the waterworks, which must be moved to allow the construction of the dry dock.

British Columbia.

FERNIE.—Good progress has been made on the construction of the new pipe line from Fairy creek from where the future water supply of the city is to be drawn. The excavating work has been completed from the Elk River to the Fairy creek falls, though the pipe has not yet been laid. The dam is under construction.

NELSON.—Sewer extensions, to cost $4,693, are being made by this municipality.

VICTORIA.—Mr. Ashcroft estimates the cost of bringing water from Sooke Lake and redistributing it to consumers as over two million dollars. The question will be considered at a special meeting of the council which will be held shortly.

CEMENT—CONCRETE.

Quebec.

ST. LOUIS.—Much concrete work, in which sidewalks will figure largely, is contemplated by this municipality.

Ontario.

PETERBORO.—Messrs. George A. Begy & Company, of St. Catharines, have been awarded the contract for a large reinforced concrete bridge at Peterborough. They propose to start the work immediately.

TORONTO.—A new cement merger which welds into one company a number of important concerns not included in the big merger recently put through at Montreal, was consummated on the 7th September at a meeting of the various companies interested, held at the offices of Mr. J. R. Roaf, who will act as solicitor for the new organization. The company, which will be known as the Independent Portland Cement Company, Limited, will have a capital stock of $10,000,000, the head offices being at Toronto. Immediate application will be made for a charter, and as soon as it is obtained officers will be elected and operations commenced.

The companies which have already agreed to enter the merger, and their authorized capitalization, are as follows:—Brant Portland Cement Co., Limited, of Brantford, $500,000; Colonial Portland Cement Co., Limited, of Wiarton, $800,000; Hanover Portland Cement Co., Limited, of Hanover, $500,000; Imperial Cement Co., Limited, of Owen Sound, $300,000; Ontario Portland Cement Co., Limited, of Paris, $450,000; Bell's Lake Cement Co., Limited, of Markdale, $500,000; Superior Cement Co., Limited, of Orangeville, $500,000; Western Ontario Portland Cement Co., of Atwood, $500,000, and St. Mary's Portland Cement Co., Limited, of St. Mary's, $500,000. In addition to these companies, several other concerns are expected to join the merger.

As will be seen, all these companies are located in Western Ontario.

Foreign.

BOSTON, MASS.—The Hood Rubber Co. have placed the contract for their new building at West Watertown, Mass., with the Aberthaw Construction Co., of Boston. It is to be built of reinforced concrete, 96 x 80 feet, three stories high. Provision will be made for future additional stories.

For late construction news see page 314.

MARKET CONDITIONS.

Montreal, September 15th, 1909.

According to all accounts, conditions throughout the United States continue to improve, not alone in the markets for pig-iron, but for steel and for the various products thereof. The price has shown a gradual advance for some time past, and is now firm at the top point, for prompt delivery, and also for next year's delivery. The active buying of railway material continues to be a feature of the situation. The production during the month of August has seldom been exceeded in the past, and any considerable increase during the coming few months would give a volume which would break all previous records. Under the circumstances, with good crops now assured, and with the purchase and production of iron reaching record proportions, and prices gradually advancing, the outlook not only for the iron and steel trade, but for general trade throughout the whole country, is all that was being looked forward to.

In Great Britain, the strongest feature would seem to be the optimism of the United States. There is also the fact that labor troubles, which all season were a bearish factor, have been removed, besides which there is unquestionably a better home demand and a slight picking up of demand from continental sources. Everything considered, the situation in England and Scotland is firm, and producers of pig-iron are able to add a little to prices, from time to time, without limiting the amount of buying but rather adding thereto.

Locally, the situation is unusually promising. The Dominion Iron and Steel, and the Lake Superior Corporation are running their plants at full speed, and the Nova Scotia Steel and Coal Company is in the same situation, having orders booked for a long time in advance. The Dominion Company is experiencing the best year of its history, the Superior Company is now able to make a large expenditure on the improvement to its plant, and the Nova Scotia Company, by virtue of its new financing, is in a strong position and will doubtless be able to begin dividends before the end of the present year. The result of all this is an added feeling of optimism in the future of the iron and steel trade of Canada.

During the past week, prices have continued steady. No changes of consequence have taken place either in pig-iron or in steel, or in any of the lines in which engineers are interested, so that last week's price list is practically repeated:—

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

Bar Iron and Steel.—Prices are steady and trade is quiet. Bar iron, $1.85 per 100 pounds; best refined horseshoe, $2.10; forged iron, $2; mild steel, $1.85; sleigh shoe steel, $1.85 for 1 x ¾-base; tire steel, $1.00 for 1 x ¾-base; toe calk steel, $2.35; machine steel, iron finish, $1.90; imported, $2.20.

Boiler Tubes.—The market is steady, quotations being as follows:—1¼ and 2-inch tubes, 8¼c.; 2½-inch, 10c.; 3-inch, 11¼c.; 3½-inch, 14 1-2c.; 4-inch, 18 1-2c.

Building Paper.—Tar paper, 7, 10, or 16 ounces, $1.80 per 100 pounds; felt paper, $2.75 per 100 pounds; tar sheathing, 40c. per roll of 400 square feet; dry sheathing, No. 1, 30 to 40c. per roll of 400 square feet; tarred fibre, 55c. per roll; dry fibre, 45c. (See Roofing; also Tar and Pitch).

Cement.—Canadian cement is quotable, as follows, in car lots, f.o.b., Montreal:—$1.30 to $1.40 per 350-lb. bbl., in 4 cotton bags, adding 10c. for each bag. Good bags re-purchased at 10c. each. Paper bags cost 2½ cents extra, or 10c. per bbl. weight.

Chain.—Prices are as follows:—¾-inch, $5.10; 5-16-inch, $3.95, ⅜-inch, $3.55; 7-16-inch, $3.35; ½-inch, $3.20; 9-16-inch, $3.05; ⅝-inch, $2.95; ¾-inch, $2.90; ⅞-inch, $2.85; 1-inch, $2.85.

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

Copper.—Prices are strong at 14½ to 14¾c.

Explosives and Accessories.—Dynamite, 50-lb. cases, 40 per cent. proof, 15c. in single case lots, Montreal. Blasting powder, 25-lb. kegs, $2.25 per keg. Special quotations on large lots of dynamite and powder. Detonator caps, case lots, containing 10,000, 75c. per 100; broken lots, $1; electric blasting apparatus:—Batteries, 1 to 10 holes, $15; 1 to 20 holes, $25; 1 to 30 holes, $35; 1 to 40 holes, $50. Wire, leading, 1c. per foot; connecting, 50c. per lb. Fuses, platinum, single strentgh, per 100 fuses:—4-ft. wires, $3; 6-ft. wires, $3.54; 8-ft. wires, $4.08; 10-ft. wires, $5. Double strength fuses, 4-ft., $3.75; 6-ft., $4.29; 8-ft., $4.83; 10-ft., $5.37. Fuses, time, double-tape, $6 per 1,000 feet; explohmeters, fuse and circuit, $7.50 each.

Iron.—Swedish iron, 100 lbs., $4.75 base; sheet, black, 14 to 22 gauge, $3.75; 24-gauge, $3.90; 26-gauge, $4; 28-gauge, $4.10. Galvanized—American, 18 to 20-gauge, $4.40; 22 to 24-gauge, $4.65; 26-gauge, $4.65; 28-gauge, $4.90; 30-gauge, $5.15 per 100 lbs. Queen's Head, 22 to 24-gauge, $4.65; 26-gauge English, or 30-gauge American, $4.90; 30-gauge American, $5.15; Fleur de Lis, 22 to 24-gauge, $4.50; 28-gauge American, $4.75; 30-gauge American, $5.

Galvanized Iron.—The market is steady. Prices, basis, 28-gauge, are:—Queen's Head, $4.40; Comet, $4.25; Gorbal's Best, $4.25; Apollo, 10¾ oz., $4.35. Add 25c. to above figures for less than case lots; 26-gauge is 10c. less than 28-gauge. American 28-gauge and English 26 are equivalents, as are American 10¾ oz., and English 28-gauge.

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

Iron.—The outlook is strong. The following prices are for carload quantities and over, free on dock, Montreal, prompt delivery: No. 1 Summerlee, $20 to $20.50; selected Summerlee, $19.50 to $20; soft Summerlee, $19 to $19.50; Clarence, $17.50 to $17.75; Midland or Hamilton pig is quoted at $20.50 to $21, Montreal. It is said Dominion and Scotia companies are not quoting prompt delivery. Carron special, $19.50 to $20; Carron, soft, $19.25.

Laths.—See Lumber, etc.

Lead.—Prices are about steady, at $3.50 to $3.60.

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

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

Nails.—Demand for nails is better, but prices are steady at $2.30 per keg for cut, and $2.25 for wire, base prices. Wire roofing nails, 5c. lb.

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

Pipe.—Cast Iron.—The market is unsettled and uncertain, as dealers are compelled to meet competition from all sources. Prices are easy and approximately as follows:—$31 for 6 and 8-inch pipe and larger; $32 for 5-inch and 4-inch at the foundry. Pipe, specials, $3 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

Pipe.—Wrought and Galvanized.—Demand is much better and the tone is firm, though prices are steady, moderate-sized lots being: ¼-inch, $5.50 with 63 per cent. off for black, and 48 per cent. off for galvanized; ⅜-inch, $5.50, with 59 per cent. off for black and 44 per cent. off for galvanized; ½-inch, $8.50, with 69 per cent. off for black, and 59 per cent. off for galvanized. The discount on the following is 72½ per cent. off for black, and 62½ per cent. off for galvanized; ¾-inch, $11.50; 1-inch, $16.50; 1¼-inch, $22.50; 1½-nch, $27; 2-inch, $36; 2½-inch, $57.50; 3-inch, $75.50; 3½-inch, $95; 4-inch, $108.

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

Rails.—Quotations on steel rails are necessarily only approximate and depend upon specification, quantity and delivery required. A range of $30.50 to $31 is given for 60-lb. and 70-lb.; 80-lb. and heavier, being $30; rails, per gross ton of 2,240 lbs., f.o.b. mill. Re-laying rails are quoted at $27 to $29 per ton, according to condition of rail and location.

Railway Ties.—See lumber, etc.

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

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

Spikes.—Railway spikes are steady at $2.35 per 100 pounds, base of 5/16 x 9-16. Ship spikes are steady at $2.85 per 100 pounds, base of ⅝ x 10-inch, and ⅝ x 12-inch.

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

Telegraph Poles.—See lumber, etc

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

Tin.—Prices are unchanged, at 33½ to 34c.

Zinc.—The tone is steady, at 5¾ to 6c.

* * * *

Toronto, September 16th, 1909.

Wholesale trade in metals and hardware shows a more active pace, the almost realized prospects of the former making "all hands" more or less buoyant. Builders' materials are in fair demand in Ontario, while in the city bricks and lumber are still moving freely. Cement is not active in Ontario, the market being greatly depressed. Glowing accounts of what the "merger" of plants is to accomplish in the way of economy and stimulus are beginning to appear in the daily papers; but up to date they have not helped the price which is extremely low and unsatisfactory. In camp supplies the only noteworthy feature is an advance of 10c. in sugars.

The following are wholesale prices for Toronto, where not otherwise explained, although for broken quantities higher prices are quoted:—

"QUEEN'S HEAD"
CANADA
Galvanized Iron
The World's Standard for half a Century.
John Lysaght, Limited
Makers, Bristol
A. C. Leslie & Co., Ltd.
Montreal

Antimony.—Demand inactive, market unchanged at $9 per 100 lbs.

Axes.—Standard makes, double bitted, $8 to $10; single bitted, per dozen, $7 to $9.

Bar Iron.—$1.95 to $2, base, per 100 lbs., from stock to wholesale dealer. Market well supplied.

Boiler Plates.—¼-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate.

Boiler Tubes.—Orders continue active. Lap-welded, steel, 1¼-inch, 10c.; 1½-inch, 9c. per foot; 2-inch, $8.50; 2¼-inch, $10; 2½-inch, $10.60; 3-inch, $12.10; 3½-inch, $15; 4-inch, $18.50 to $19 per 100 feet.

Building Paper.—Plain, 30c. per roll; tarred, 40c. per roll. Demand increased within the last fortnight.

Bricks.—Business is very active, price at some yards $9 to $9.50, at others, $9.50 to $10, for common. Don Valley pressed brick move also freely. Red and buff pressed are worth $18 delivered and $17 at works per 1,000.

Broken Stone.—Lime stone, good hard, for roadways or concrete, f.o.b., Schaw station, C.P.R., 60c. per ton of 2,000 lbs., 1-inch, 2-inch, or larger, price all the same. The supply is excessive; hence the lowered price. Broken granite is selling at $3 per ton for good Oshawa.

Cement.—The price continues low, $1.55 per bbl. in car lots, including bags. Demand is slack in Ontario, but some fair lots have been sold for Manitoba and Alberta. Smaller dealers report a fair movement in small lots at $1.40 per barrel in load lots delivered in town, bags extra; in shop, $1.35. In packages, $1.40 to $1.50, including paper bags.

Coal.—Retail price for Pennsylvania hard, $6.75 net, steady. This price applies to grate, egg, stove, and chestnut; only pea coal is cheaper, namely, $5.75. These are all cash, and the quantity purchased does not affect the price. Soft coal is in good supply, American brokers have been 60c.; No. 2 tarred, 62½c.; plain, 56c. covering the ground very fully. In the United States there is an open market for bituminous coal and a great number of qualities exist. We quote. Youghiogheny lump coal on cars here, $3.70 to $3.80; mine run, $3.60 to $3.75; slack, $2.65 to $2.85; lump coal from other districts, $3.40 to $3.70; mine run 10c. less; slack, $2.50 to $2.70; cannel coal plentiful at $7.50 per ton; coke, Solvey foundry, which is largely used here, quotes at from $5.25 to $5.50; Reynoldsville, $4.50 to $4.75; Connellsville, 72-hour coke, $5.25 to $5.50.

Copper Ingot.—The market is very firm, but heavy stocks still act as a drag. We quote as before $13.85 to $14.05 in this market, with a fair movement.

Detonator Caps.—75c. to $1 per 100; case lots, 75c. per 100; broken quantities, $1.

Dynamite, per pound, 21 to 25c., as to quantity.

Roofing Felt.—An improvement in demand of late, no change in price.

Fire Bricks.—English and Scotch, $30 to $35; American, $25 to $35 per 1,000. The demand is steady.

Fuses.—Electric Blasting.—Double strength 4 feet, $4.50; 6 feet, $5; 8 feet, $5.50; 10 feet, $6. Single strength, 4 feet, $3.50; 6 feet, $4; 8 feet, $4.50; 10 feet, $5, per 100 count. Bennett's double tape fuse, $6 per 1,000 feet.

Galvanized Sheets.—Apollo Brand.—Sheets 6 or 8 feet long, 30 or 36 inches wide; 10-gauge, $2.90; 12-14 gauge, $3.00; 16, 18, 20, $3.10; 22-24, $3.25; 26, $3.40; 28, $3.85; 29, $4.15; 10¾, $4.50 per 100 lbs. Fleur de Lis—gauge, $4.50; 26-gauge, $4.25; per 10 lbs. This downward change is the result of dissolution of an agreement between British and U. S. makers. Impossible to say how long it will last.

Iron Chain.—¼-inch, $5.75; 5-16-inch, $5.15; ⅜-inch, $4.15; 7-16-inch, $3.95; ½-inch, $3.75; 9-16-inch, $3.70; ⅝-inch, $3.55; ¾-inch, $3.45; ⅞-inch, $3.40; 1-inch, $3.40, per 100 lbs.

Iron Pipe.—Black, ¼-inch, $2.03; ⅜-inch, $2.26; ½-inch, $2.63; ¾-inch, $3.16; 1-inch, $4.54; 1¼-inch, $6.19; 1½-inch, $7.43; 2-inch, $9.90; 2½-inch, $15.81; 3-inch, $20.76; 3½-inch, $26.13; 4-inch, $29.70; 4½-inch, $38; 5-inch, $43.50; 6-inch, $56. Galvanized, ¼-inch, $2.86; ⅜-inch, $3.08; ½-inch, $3.48; ¾-inch, $4.31; 1-inch, $6.19; 1¼-inch, $8.44; 1½-inch, $10.13; 2-inch, $13.50, per 100 feet. Talk is still heard of an advance, but nothing definite.

Lead.—Prices steady outside. This market is steadier, and demand rather better at $3.75 to $3.85 per 100 lbs.

Lime.—Retail price in city 35c. per 100 lbs. f.o.b., car; in large lots at kilns outside city 22c. per 100 lbs. f.o.b. car. Demand is good.

Lumber.—A fair demand is reported for city trade, not so much from the country. Southern pine is the main item here. Hemlock is steady, but not active. Lath are held stiffly at quotations, and none too plentiful; many are being made up north to go to the States. The 32-inch lath, so long a feature of the market, are nearly all gone. We quote dressing pine, $32 to $35 per M; common stock boards, $26 to $30; cull stocks, $20; cull sidings, $17.50; Southern pine dimension timber from $30 to $45, according to size and grade; finished Southern pine according to thickness and width, $30 to $40. Hemlock in car lots, $16.50 to $17; spruce flooring in car lots, $22; shingles, British Columbia, $3.20; lath, No. 1, $4.25; No. 2, $3.75; for white pine, 48-inch; for 32-inch, $1.60, and very few to be had.

Nails.—Wire, $2.25 base; cut, $2.70; spikes, $3, per keg of 100 lbs.

Pitch and Tar.—Pitch, demand moderate, price so far unchanged at 70c. per 100 lbs. Coal tar fairly active at $3.50 per barrel.

Pig Iron.—There is fair activity and prices are maintained. Clarence quotes at $20.50 for No. 3; Cleveland, $20.50 to $21; in Canadian pig, Hamilton quotes $19.50 to $20 per ton.

Plaster of Paris.—Calcined, New Brunswick, hammer brand, car lots, $2; retail, $2.15 per barrel of 300 lbs.

Putty.—In bladders, strictly pure, per 100 lbs., $2.25; in barrel lots, $2.05. Plasterer's, $2.15 per barrel of three bushels.

Ready Roofing.—An improved request is noted lately, at catalogue prices before quoted.

Roofing Slate.—Most of the slate used in Canada comes now from Pennsylvania or Maine, the Canadian supply being slender and mostly from the Rockland quarries of the Eastern Townships in Quebec. There is a great variety of sizes and qualities, so that it is difficult to indicate prices. But No. 1 Pennsylvania slate 10 x 16 may be quoted at $7.25 per square of 100 square feet, f.o.b., cars, Toronto; seconds, 50c. less. The demand continues active; competent roofers are scarce.

Rope.—Sisal, 9½c. per lb.; pure Manila, 12½c. per lb., Base.

Sewer Pipe.—

	4-in.	6-in.	9-in.	10-in.	12-in.	24-in.
Straight pipe per foot	$0.20	$0.30	$0.65	$0.75	$1.00	$3.25
Single junction, 1 or 2 ft. long	.90	1.35	2.70	3.40	4.50	14.65
Double junctions	1.50	2.50	5.00	....	8.50	.....
Increasers and reducers	....	1.50	2.50	....	4.00	.....
P. traps	2.00	3.50	7.50	....	15.00	.....
H. H. traps	2.50	4.00	8.00	....	15.00	.....

Business steady; price, 73 per cent. off list at factory for car-load lots; 65 per cent. off list retail. Small lots subject to advance.

Steel Beams and Channels.—Quiet. We quote:—$2.50 to $2.75 per 100 lbs., according to size and quantity; if cut, $2.75 to $3 per 100 lbs.; angles, 1¼ by 3-16 and larger, $2.50; tees, $2.80 to $3 per 100 pounds. Extra for smaller sizes of angles and tees.

Steel Rails.—80-lb., $35 to $38 per ton. The following are prices per gross ton, for 500 tons or over: Montreal, 12-lb. $45, 16-lb. $44, 25 and 30-lb. $43.

Sheet Steel.—Market steady, at the former prices; 10-gauge, $2.50; 12-gauge, $2.55; American Bessemer, 14-gauge, $2.35; 17, 18, and 20-gauge, $2.45; 22 and 24-gauge, $2.50; 26-gauge, $2.65; 28-gauge, $2.85. Quite a quantity of light sheets moving.

Tank Plate.—3-16-inch, $2.40 per 100 lbs.

Tool Steel.—Jowett's special pink label, 10½c. Cammel-Laird, 16c. "H.R.D." high speed tool steel, 65c.

Tin.—The feeling in tin is firm, and we quote an advance of ½c., say 31½c. to 32c.

Wheelbarrows.—Navvy, steel wheel, Jewel pattern, knocked down, $21.60 per dozen; set up, $22.60. Pan Canadian, navvy, steel tray, steel wheel, per dozen, $3.30 each; Pan American, steel tray, steel wheel, $4.25 each.

Zinc Spelter.—A very active movement continues, and the market is firm at $5.50 to $5.75.

CAMP SUPPLIES.

Beans.—Hand Picked, $2.60 to $2.70; prime, $2.40 to $2.50; Rangoon, hand-picked. $1.90 to $2.

Cheese.—No old cheese on hand; new cheese, large, 13c.; twins, 13¾c.

Coffee.—Rio, green, 10 to 12½c.; Mocha, 21 to 23c.; Java, 20 to 31c.; Santos, 11 to 15c.

Dried Fruits.—Raisins, Valencia, 6 to 6¾c.; seeded, 1-lb. packets, fancy, 7½ to 8c.; 16-oz. packets, choice, 7 to 7½c.; 12-oz. packets, choice, 7c.; Sultanas, good, 5 to 6c.; fine, 6 to 7c.; choice, 7 to 8c.; fancy, 8 to 9c.; Filiatras currants, 6½ to 7c.; Vostizzas, 8½ to 9c.; uncleaned currants, ¼c. lower than cleaned. California Dried Fruits,—Evaporated apricots, 12 to 15c. per lb.; prunes, 60s to 70s, 7 to 7½c.; 90s to 100s, 6½c.; evaporated apples, 8c.

Eggs.—New laid, 24 to 25c. per dozen, in case lots.

Lard.—Scarce and higher. Tierces, 15¼c.; tub, 15½c.; pails, 15¾c. per lb.

Molasses.—Barbadoes, barrels, 37 to 45c.; Porto Rico, 45 to 60c.; New Orleans, 30 to 33c. for medium.

Pork.—Still advancing. Short cut, $27.50 per barrel; mess, $26.

Potatoes.—Ontario,.

Rice.—B grade, 3½c. per lb.; Patna, 5¼ to 5¾c.; Japan, 5¾ to 6c.

Salmon.—Fraser River, talls, $2; flats, $2; River Inlet, $1.55 to $1.75.

Smoked and Dry Salt Meats.—Long clear bacon, 15c.; firm, tons and cases; hams, large, 14 to 14½c.; small, 15½ to 16c.; rolls, 13¾ to 14c.; breakfast bacon, 17c.; backs (plain), 17½c. to 18c.; backs (peameal), 18c. to 18½c.; shoulder hams, 12c.; green meats out of pickle, 1c. less than smoked.

Spices.—Allspice, 16 to 19c.; nutmegs, 30 to 75c.; cream tartar, 22 to 25c.; compound, 15 to 20c.; pepper, black, pure Singapore, 14 to 17c.; pepper, white, 20 to 30c.

Sugar.—Granulated, $4.85 per 100 lbs. in barrels; Acadia, $4.75; yellow, $4.45; bags, 5c. lower; bright coffee, $4.65; bags, 5c. less.

Syrup.—Corn syrup, special bright, 3½c. per lb.

Teas.—Japans, 20 to 35c. per lb.; Young Hysons, 16 to 35c.; Ceylons, medium, 16 to 45c.

* * * *

Winnipeg, September 14th, 1909.

Business with wholesale houses of Winnipeg is good and becoming better every day, as it is now an assured fact that the West will have a large and abundant crop, and all lines of business are becoming visibly stronger. Country dealers are now ordering heavily, as in a very short time every available car will be in use moving the crop.

All kinds of building and roofing paper are in demand in country orders, and city trade in these lines is also very good with prices steady as quoted. The bar iron trade in Winnipeg and the West is more and more becoming a large faction in the hardware business; and the local bar iron factory have all the orders they can possibly handle, and are this year moving the factory to a more suitable site and doubling its capacity.

Coal is becoming active again, with prices remaining as usual. Cement is still quiet. Lumber also is not so active, the local carpenter's strike not yet being settled.

Winnipeg quotations are as follows:—

Butter.—Dairy prints, 20 to 21c.; creamery rolls, 24 to 25c.

Canned Goods—Peas, 77½ to $1.12½; tomatoes, 2s, 85 to 90c.; tomatoes, 3s, 95c. to $1; pumpkins, 3s, 80 to 85c.; corn, 85 to 95c.; peaches, 2s, white, $1.50 to $1.60; yellow, $1.90 to $1.95; strawberries, 2s, heavy

Cement is again somewhat quiet and prices are pared down very low. A good demand is also noted for a better class of brick this season.

Winnipeg quotations are as follows:—

Anvils.—Per pound, 10 to 12½c.; Buckworth anvils, 80 lbs., and up, 10¾c.; anvil and vice combined, each, $5.50.

Axes.—Chopping axes, per dozen, $6 to $9; double bits, $12.10 per dozen.

Barbed Wire.—4 point and 2 point, common, $3.15 per cwt.; Baker, $3.20; Waukegan, $3.30.

Bar Iron.—$2.50 to $2.60.

Bars.—Crow, $4 per 100 pounds.

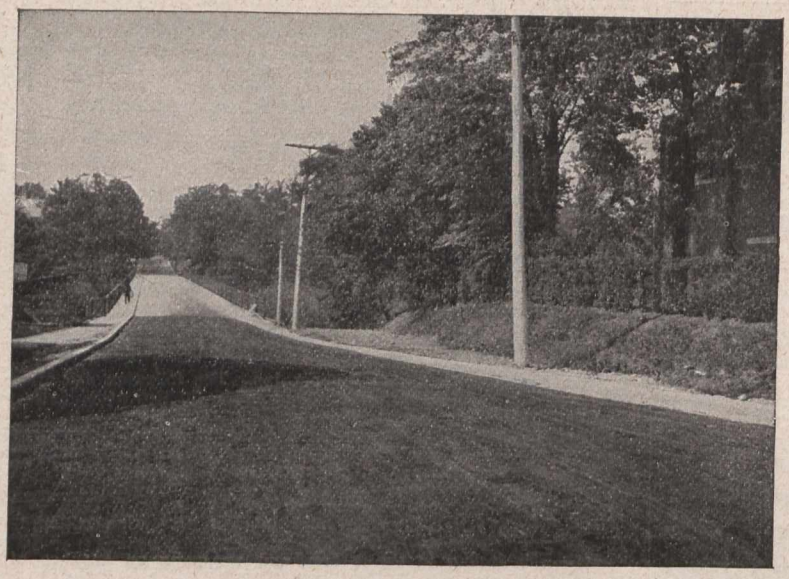
Beams and Channels.—$3 to $3.10 per 100 up to 15-inch.

Boards.—No. 1 Common Pine, 8 in. to 12 in., $38 to $45; siding, No. 2 White Pine, 6 in. $55; cull red or white pine or spruce $24; No. 1 Clear Cedar, 6 in., 8 to 16 ft. $60; Nos. 1 and 2 British Columbia spruce, 4 to 6 in $55; No. 3, $45.

Bricks.—$10, $11, $12 per M, three grades.

Building Paper.—4½ to 7c. per pound. No. 1 tarred, 84c. per roll; plain,

Coal and Coke.—Anthracite, egg, stove or chestnut coal, $9.75 large lots, to $10.50 ton lots, net; Alleghany soft coal; carload lots, basis, Winnipeg, f.o.b., cars, $6 per ton; cannel coal, $10.50 per ton; Galt coal, $8



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