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WEEKLY

ESTABLISHED 1893

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The Canadian Engineer

ESTABLISHED 1893.

Issued Weekly in the interests of the

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

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NOTICE TO ADVERTISERS

Changes of advertisement copy should reach the Head Office by 10 a. m. Monday preceding the date of publication, except the first issue of the month for which changes of copy should be received at least two weeks prior to publication date.

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TORONTO, CANADA, JULY 23, 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 RAILWAY AND THE STATE.

"If the State cannot control the railways, the railways will control the State," was an Englishman's way of expressing the relation of the railway and the State.

Railways are for public service, and it is right that they should be operated in the public interests, but it is yet to be proven that public ownership of railways, which in theory is good, is for the general good. Public servants have allowed public works and public franchises to be run, not in the interest of the country at large, but in the interest of those sections or communities which could bring the greatest pressure to bear.

The history of the railway situation in various lands is not without lessons.

In Australia all the railways are State-owned, built by the different State Governments. In some instances they were not a success under State control, but when placed under a commission they became successful financial ventures, and public sentiment is so strong for public-owned roads that it is not likely that there will be any serious development of private lines.

Belgian railways were State-built because the nation feared foreign capital would control the transportation highways.

Switzerland nationalized her railways in a fit of patriotism, French and German capital having controlled the Swiss railways for years.

Italy, after the union of 1870, acquired the railways and leased them to three companies to operate. But the trouble over capital for new lines, extensions and betterments became so acute that they were compelled to cancel the lease, and now Italy has Government-operated lines.

Holland bought up the private railways, unified the systems, and then leased them to two companies, whose lines have access to all the principal towns and ports.

Each country appears to have developed a system to suit its own particular fancy, but the history of railway operation does not appear to point to any great tendency towards absolute State ownership and State control.

DANGEROUS STRUCTURES.

In many municipalities the city engineer and his department are responsible for building permits, and for this reason we feel that a discussion of the matter is justified in these columns.

There are two classes of persons to be considered—the occupants of the building and those who, while not occupants, are within the danger zone. Both must be protected. In some cases those in the first class feel they are being protected against themselves. This is necessary.

It is not intended that this article should deal with safe design of new buildings, but rather to call attention to some of the danger points of completed and long-standing buildings that should be examined.

Street signs are a frequent source of danger, and their size and condition should be more carefully regulated than is the case in many municipalities. If overhanging street signs were prohibited, no great hardship would result. There are so many safer and saner methods of advertising than hanging out signs of crude

design that shut off the view and make the street line unsightly.

In the same class may be placed the overhanging balconies. Frequently, they are built of wood, and when they become old are dangerous to those who occupy them and to those who pass under. Their position—commanding a good view of the street line—results in their being frequently loaded to the danger point.

Now that our banks, trust and land companies, and even our large stores are using overhanging cornices and coping stones as a means of exterior decoration they should be carefully inspected. The action of rain and frost tends to chip off sections, and even to move the large blocks from their setting.

UNION OF CANADIAN MUNICIPALITIES.

The Union of Canadian Municipalities will hold their annual meeting this year at Medicine Hat, Alta., on July 26th, 27th and 28th.

The first day will be taken up with addresses of welcome and replies, and reports from officers and committees.

The second and third days will be devoted to discussions on Public Utility Commissions, Western Municipal Development, the Juvenile Delinquents' Act, Methods of Street Widening, and Water Filtration and Sewage Disposal Works.

THE PRESERVATION OF IRON AND STEEL.

Associations have been organized, having for their object the preservation of our forests and water powers, and in our zeal for the "preservation of natural resources" we have neglected certain other material just as valuable, just as much used, and subject to as great a monetary loss.

It is a wonder more attention has not been given to the preservation of iron and steel. The annual production of pig-iron alone amounts to, in America, almost 250 million dollars, and the finished steel to many times this.

Such a vast outlay as is annually made for iron and steel should encourage study of methods of protection.

The corrosion of iron may be prevented by the manufacture of a metal which has a high resistance to corrosion; by applying protective coatings, which may be other metals, paints and oil, or bituminous materials, or by specially preparing and treating the surface.

The question is worthy of more study than it has been given.

MR. LUMSDEN RETIRES.

Six years of work and worry, of exacting, hard work, and at times of thankless service, have led to the retirement of Mr. H. D. Lumsden, Chief Engineer of the eastern division of the National Transcontinental Railway.

Mr. Lumsden was a railway engineer of long and varied experience, having been one of the staff of engineers, who, under Sir Sanford Fleming, located the C.P.R. through the Yellow Head Pass some thirty years ago. Since then he has had to do with most of the important railway surveys of this country.

Mr. Gordon Grant, Mr. Lumsden's successor, is a member of the Canadian Society of Civil Engineers, and has had a long experience on railway work.

For the past few years he has been Inspecting Engineer for the Transcontinental Commission, and no man is in closer touch with the work on the grade, nor understands the condition of the various sections better than Mr. Grant.

His is a great honor, but the responsibility is also great. To take up an uncompleted task, to assume responsibility for work under way, and to avoid becoming the theme of parliamentary discussion will require great tact and tireless effort.

EDITORIAL NOTES.

The railways have submitted a new freight tariff on coal to non-competitive points in Western Canada. This new schedule was prepared in response to the demands of the Associated Boards of Trade, but it is unsatisfactory, and opposition will be offered when the tariff is up for sanction before the Railway Board.

* * * *

The Canadian Civil Service Commissioners are now in charge of examinations and the appointments to certain Government positions. It remains to be seen whether difficult examinations and small pay will build up a more efficient civil service than the old method.

* * * *

A thoughtful critic, of long commercial experience in New York city, says: "The stock market has lately lost much of its reputation as a barometer. Formerly, it was the expression of thousands of the most bright and alert minds and their profoundest judgment as to coming events; lately it has been the expression of the opinions and desires of a few financial cliques and the brute financial force that they are able to exert, backed by a mob of followers more intent on their leaders' operations and the next move to be made by them than on the actual conditions, present or prospective."

Our supply of copies of the Canadian Engineer ofr March 19th, 1909, is exhausted. We will extend one month the subscription of any reader forwarding a copy to our Toronto office.

EXHIBITORS AT WINNIPEG EXHIBITION.

The Brydges Engineering and Supply Company, had a most interesting display of internal combustion engines at the Winnipeg Industrial Exhibition last week. The plants on exhibition were a 6½ horse-power gasoline engine driving a patent high-speed pump, and a 6½ B. horse-power suction gas plant and engine, driving a Westinghouse dynamo. The suction plant is the smallest ever exhibited in America, and is creating general interest. It represents the latest development in English gas engine practice, and demonstrates the practical utility of this form of power even in the smallest sizes. The noticeable feature of this type of plant is the complete absence of smoke, everything combustible in the coal being turned into gas. Water troubles such as are found in steam boilers, are entirely eliminated. Producer gas is made by passing steam and air through a bed of incandescent fuel. In the suction plant all this is done by the engine itself, and the quantity of gas made is automatically regulated according to the varying load which is put on the engine. The outfit requires little attention, it being necessary to coal only once in three or four hours, and this operation is very simple, and only takes two or three minutes' time. As an evidence of the economical working of gas plants, it may be stated that the one on exhibition when running at full load, uses less than 6 lbs. of coal per hour. Under certain conditions the gas plant and engine is undoubtedly the cheapest form of power that can possibly be obtained. The excellent finish and massive design of the engines is a matter of general comment amongst the spectators.

(Continued on Page 87.)

GRAPHIC SOLUTION OF KUTTER'S FROMULA.

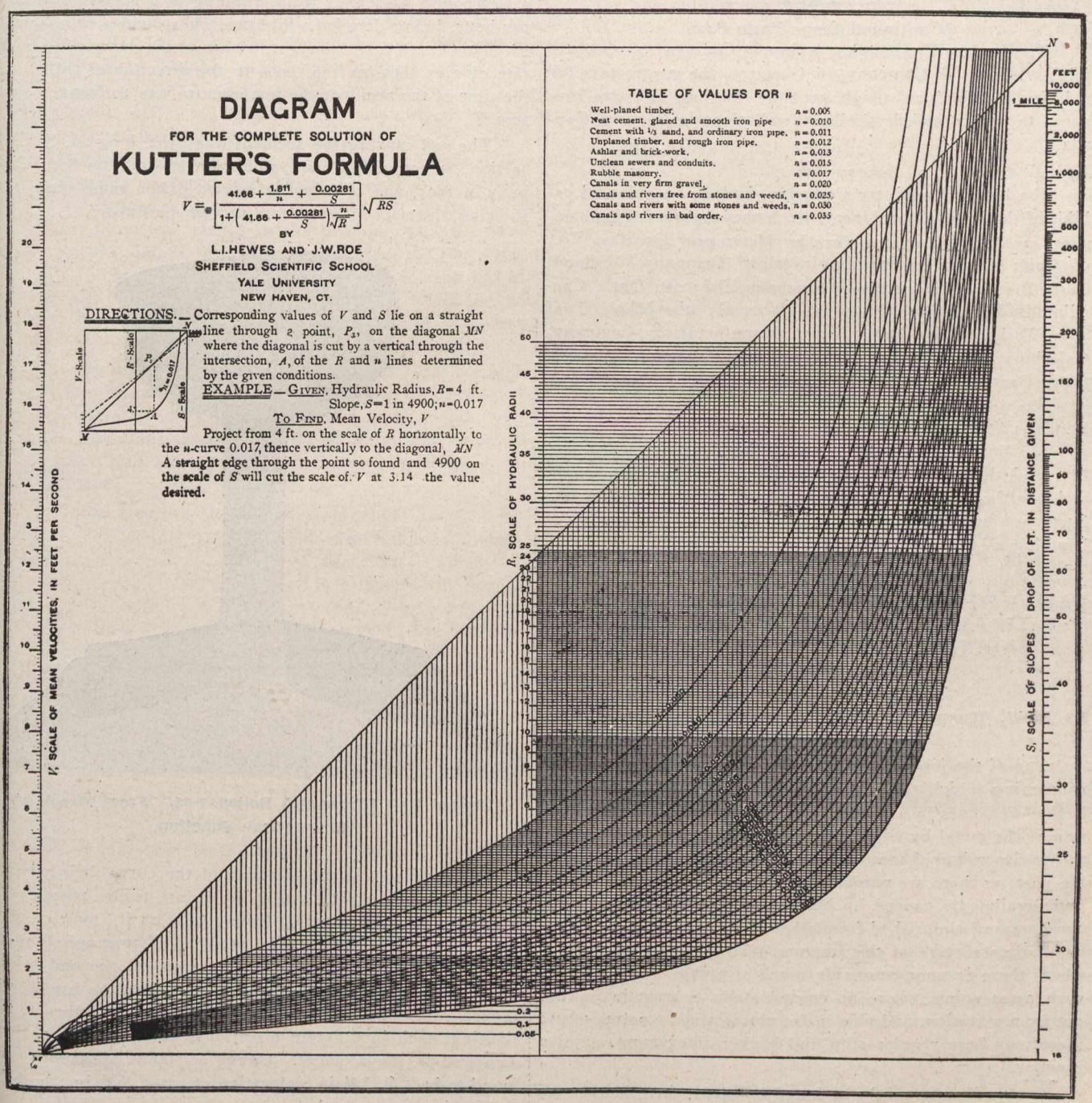
By L. I. Hewes and Joseph W. Roe.*

A graphic solution of Kutter's formula for the flow of water has been worked out by Dr. L. I. Hewes in connection with his course in graphic computations, given in the Sheffield Scientific School, Yale University, which may be of interest to those who deal with canals, flumes and streams.

Kutter's formula, $$V=\left[\frac{41.66+\frac{1.811}{n}+\frac{0.00281}{S}}{1+\left(41.76+\frac{0.00281}{S}\right)\frac{n}{\sqrt{R}}}\right]\sqrt{RS}$$

is probably the most accurate of those proposed determining the flow of water. But it is extremely cumbersome, and if many calculations are to be made their solution becomes drudgery. The purpose of this chart, Fig. 1, is to furnish a rapid solution, sufficiently accurate to be well within the limits of the observed data.

The chart consists essentially of three parallel scales, one for the mean velocity, V, one for the hydraulic radius, R, and one for the slope; a diagonal line, not graduated; and set of curves for the various values of n, the factor which involves the nature and condition of the bottom. Usually, R and S have been determined; n, assumed, and it is desired to calculate V. In this case the diagram is read as follows: From the given value of R on the middle scale project horizontally to the curve of the n-value assumed; thence project vertically to the diagonal. A straight-edge through the point on the diagonal so found and the point on the S-scale determined by the given conditions will cut the V-scale at the required mean velocity. The chart furnishes a means of determining any one of the four factors, the other three being known. This would be especially useful where it is desired to find a coefficient, n, corresponding to a given set of conditions, as the solution of Kutter's formula for this factor is especially troublesome.



The range of values covers all but the most extraordinary conditions. The graduations on the V-scale range from 0 to 25, far beyond any velocity encountered in practice; the scale of hydraulic radii ranges from 0 to 50 ft.; the slopes range from 1 in 16 to 1 in two miles; and the n-curves cover all the values given in any of the books of reference.

The accuracy of the chart is about uniform for the various conditions encountered. Where the n-curves are acute to the R-scale, the scale itself is very coarse, thus compensating for any error due to the obliquity of the curves. Opposite the upper end of the R-scale, where its graduations are finer, the n-curves have turned and are nearly parallel to it, so that an error

*Paper read before New Haven meeting Am. Inst. M. E.

in reading the R-scale has but little effect on the location of the pivot-point on the diagonal. Each of the curves has been checked by calculations, and the mean error of the total readings was only 0.53 per cent. The V-scale, on which the results are usually sought, with reasonable care in reading, will give results correct to within two or three units in the third significant figure, an accuracy well within that of the original data. The selection of n, for instance, is an element which introduces an uncertainty largely in excess of this.

Other graphic solutions of this formula have been worked out, but they nearly all involve a set of diagrams, one for each value of n. So far as we know, there have been none where the entire range of all factors has been included as conveniently in one diagram.

(Continued from Page 84.)

The Brydges Engineering & Supply Company, are agents for Wm. Jacks & Company, of Glasgow, the contractors for the city at Winnipeg's high pressure station, and are prepared to design and fit similar installations in Western Canada.

The Stuart Machinery Company, had also a splendid exhibit of the lines of machinery which they handle. This company are Western agents for the McGregor Gourlay Co., of Galt; Georgian Bay Engineering Company, Midland, Ont.; Prescott Emery Wheel Company, Prescott, Ont.; Canadian Buffalo Forge Company, Montreal; the Maple Leaf Saw Works, Galt, Ont.; Frost Manufacturing Company, Galesburg, Ill.; Dodge Manufacturing Company, Toronto, Ont.; Canton Hughes Pump Company, Canton, Ohio; Beardmore Belting Co., Toronto, Electrical Construction Company, London; Stratford Mill Building Company.

The Stuart Machinery Company, not long ago had a bad fire, and their present accommodation is entirely too small, and it is the intention of the firm to erect in the near future a four-story building with all the modern conveniences for handling a large stock of machinery.

RAIL FAILURES DUE TO BURNS AND CRYSTALLIZATION, CAUSED BY SLIPPING OF ENGINE DRIVERS, BALTIMORE AND OHIO RAILROAD.*

By A. W. Thompson, Chief Engineer Maintenance of Way.

One of the less frequent causes of rail failures, and one concerning which there is very little published information, is that weakness in a rail due to the burning and crystallization of the metal by slipping of engine drivers. Undoubtedly this is deserving of more attention than it has been given in the past, as there are numerous instances on record of wrecks and derailments caused by broken rails of this class. The breaks are distinguished from other kinds and show very characteristic structure of the fracture. They occur in localities where there is unquestionably much slipping of the drivers, such as at points where an engine starts a train in pulling out from a station, and also in freight service at points where there may be a regular stop and back-up movement, as at a junction.

Such rails also might be found in yards where heavy cuts of cars are handled by a single switching engine. A probable cause for the scarcity of the latter class is the lighter weight of the switching engines in comparison with the weight of the usual road engine. The recent rapid advance in the loads on driving wheels of switching engines, particularly in the larger and better equipped yards, may result in more failed rails from this cause, especially in that part of the yard in which the push and pull method of operation may be used.

In the text of papers written upon other subjects allied to the rail question, casual mention has been quite often made of specific instances of rail which has failed from crystallization of the metal, but these discussions and records have never been isolated or carried to any definite conclusion concerning this particular subject. There must be records of this kind in the files of every railroad, and interest should be taken toward making these available to the American Railway Engineering and Maintenance of Way Association, and compiling them into comparative and intelligible form.

To furnish a beginning upon which to build, the following instances, taken from the experience of the Baltimore & Ohio Railroad, are compiled in concise form, these being selected because test of the physical and chemical properties was made of the broken rail in question. The first instance which has come to the writer's notice occurred at Salisbury Junction; a westbound passenger train, running at a speed of 40 miles per hour, being derailed while passing around a 6° 30′ curve.

This curve is to the right, with a grade descending at the rate of 1.25 feet per 100, both in the direction of traffic. At the time of the accident the temperature was 10 degrees above zero.

The rail causing the accident was 33 ft. long, A. S. C. E. section, 85 pounds per yard, rolled by the Cambria Steel Company in 1905, and laid during August of the same year; thus showing a service of about two and one-half years.

Failed Rail (Carnegie) Rolled 7-96. From Wreck at Shenandoah Junction.

The rail was in the low side of the curve, being jointed with a four-hole splice, and it broke into twelve pieces. The lengths of the pieces varied from 3 in to 24 ft., most of which were over 1½ ft. long. The attached photographs show a view of these pieces with the exception of the end pieces, which remained in the splice. At two points the breaks were square, as if sawed, but in the other cases the breaks were slanting, each in different directions. This was the only rail damaged in the accident. Gauge at point of accident was found to be 4 ft. 8⅞ in.; elevation of curve, 6¼ in.; both line and surface were good.

Microscopical tests of the rail later developed the fact that slight cracks existed in the base of the rail before the accident occurred, but these cracks were entirely too small to have been detected by even close examination with the eye before the rail became separated. The rail was inspected by track walker only a short time before the derailment took place.

The rail showed very little wear and the only marks which could be detected were those made by the slipping of the drivers of the engine. The frequency with which these marks occurred on this one rail was due to the fact that westbound freight engines stop nearly always in about this spot to back

*From Bulletin No. 111 of the American Railway, Engineering and Maintenance of Way Association.

(Continued from Page 84.)

up and set off empties on the Salisbury Branch, and in considering the failure of this rail this point should be carefully borne in mind.

The pieces were not carried any distance, with the exception of the longer ones, and this condition would naturally lead to the conclusion that the breaks were caused by the downward pressure of the engine passing over the rail ends.

A chemical analysis of the rail showed the following:

	Chemical Analysis.	Specifications Called for.
Carbon	.48	.43 to .53
Sulphur	.77	.....
Phosphorus	.108	Not to exceed .10
Manganese	1.10	.80

This analysis shows the composition to be rather high in phosphorus, with manganese closely approaching the upper allowable limit. While either one in itself would not be a serious matter, the combination would tend to make a somewhat brittle rail, even though the phosphorus is no higher than is found in many good rails.

In making physical tests of this rail a weight of tup of 1,640 pounds was used, this being the only drop available in the Test Bureau. Supports were placed 3 ft. apart, and when the test piece was placed in the machine with the head up the tup was allowed to fall 10 ft., and when the test piece was placed in the machine with the head down, the tup was allowed to fall 8 ft. It was the intention to so select the height of the drop that the number of blows would show a comparison of the different rails; that is, it was so arranged that the drop would not break a rail which had been in service and was not defective, while it might break a rail which was burnt. under these conditions the following results were secured. These conditions do not conform to those usually specified, but other rails were tested under same conditions in direct comparison:

Rail Causing Derailment at Salisbury Junction.

	—Deflection in Inches— Head Up in Supports 10-ft. Drop.	Head Down in Supports 8-ft. Drop.
1st Blow	.65	broke
2nd Blow	1.20	.....
3rd Blow	1.80	.....
4th Blow	2.25	.....
5th Blow	2.75	.....
6th Blow	broke	.....

The rail placed with head up broke with fine crystalline fracture, near supports. Rail with head down broke near center, on first blow, with a fine crystalline fracture.

Rail of Maryland Steel Company Tested for Comparison With Above.

	—Deflection in Inches— Head Up in Supports 10-ft. Drop.	Head Down in Supports 8-ft. Drop.
1st Blow	.61	.62
2nd Blow	1.30	1.06
3rd Blow	1.80	1.44
4th Blow	2.22	broke
5th Blow	2.75	.....
6th Blow	3.25	.....
7th Blow	broke	.....

This rail was perfect so far as known, but had seen service in track. With head up the test piece broke near support with a fine crystalline fracture. With head down it broke near the center with similar surface appearance.

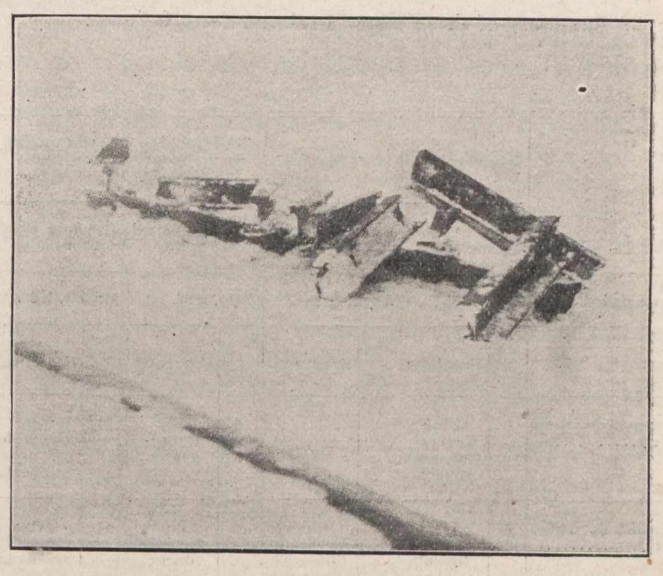
A further comparative test of rail of the Cambria Steel Company's manufacture showed the following:

	Head Down in Supports 8-ft. Drop.
1st Blow	.73
2nd Blow	1.28
3rd Blow	1.74
4th Blow	2.22
5th Blow	2.58
6th Blow	broke

This rail also broke near center with fine crystalline fracture. A common and noticeable feature of all these breaks is that with head up they break near supports, while with head down they break near the center, but the burnt rail broke under a much less number of blows whichever way it was placed, and with a very much less final deflection.

The second instance in which any extended test was made of the chemical and physical properties of the failed rail occurred at Shenandoah Junction, as a westbound passenger train was pulling out from the station. This rail broke into five pieces and had been, evidently, badly burnt by slipping of the drivers as the engine started the train up a quite heavy grade from the station. The brittleness of this rail was further indicated by its breaking at one point while it was being cut at another by the section foreman.

This rail was rolled by the Carnegie Steel Company in 1896, of A. S. C. E. section, 85 pounds per yard. There was no surface indication of defect in the rail, and roadbed conditions were good and not contributary causes to this failure. Track was fully ballasted with stone and had good drainage, and the ties were in good condition and properly spaced. No undue strains were brought to bear on the rail by longer supports between ties or by any unusually flexible ballast.



Views Showing Pieces of Rail which Broke at Salisbury Junction.

The curve at this point was 4° 30′ and had an elevation of 3½ in., with gauge ¾-in. wide at the point of failure, caused by wear of rail over the standard gauge of 4 ft. 8½ in. on this degree of curvature. The grade was 0.75 per cent. ascending, westbound. The chemical analysis of this rail showed the following:

Rail Causing Derailment at Shenandoah Junction.

	Chemical Analysis.	Specifications Called for.
Carbon	.48	.43 to .53
Sulphur	.027	.....
Phosphorus	.095	Not to exceed .10
Manganese	.76	.80

The chemical composition of this rail is apparently good, but microscopical examination showed small cracks in the head, which may have been produced by slipping of the drivers, since these surfaces of the metal at the crack showed the characteristic blue color due to heating.

The drop test of this rail, made under the same conditions as those above, showed the following:

	—Deflection in Inches— Head Up in Supports 10-ft. Drop.	Head Down in Supports 8-ft. Drop.
1st Blow	.25	broke
2nd Blow	1.90	.....
3rd Blow	2.50	.....
4th Blow	3.35	.....
5th Blow	4.10	.....
6th Blow	broke	.....

Again in this test do we find the break near the supports when the head was placed up, and at the center when the head was placed down, each with a fine crystalline fracture.

In making the above test with the head up, a piece one foot long was snapped off of the end of the test piece where it projected over the supports, the fracture of which showed about 60 per cent. of an old defect in the head and 40 per cent. in the web. The attached photograph of this section shows plainly the burnt and crystallized condition of the metal and the different color of the injured portion. It also discloses a small pipe near the base of the rail.

After the piece with head down had been tested, a further test was made of a piece of this same rail 10 in. in length, which was broken off with a sledge-hammer, and clearly showed a burnt spot in the head ¾-in. long by 5/16-in. deep.

A summary of these tests in tabular form follows:

	Standard Rail after Service.				Rail Causing Shenandoah Jct. Wreck.		Rail Causing Salisbury Wreck	
Manufacturer....	Maryland Steel Company		Cambria Steel Company		Carnegie Steel Company		Cambria Steel Company	
Date rolled	July, 1905.		April, 1907.		July, 1896.		March, 1905.	
	No. of Blows	Fracture	No. of Blows	Fracture.	No. of Blows	Fracture.	No. of Blows	Fracture.
Drop 10 ft. Head up.....	7	Fine Crystalline near Support.			6	See Photograph.	6	Fine Crystalline near Support.
Drop 8 ft. Head down	4	Fine Crystalline at Centre.	6	Fine Crystalline near Centre.	1	Near Centre burnt spot.	1	Fine Crystalline near Centre.

An examination of this table, keeping in mind the chemical analysis, indicates clearly the weakening effect due to the burn.

All these failures correspond in location and when the test pieces were turned with head down one blow broke such rails as were burned, whereas rails which had seen service in track, but were not defective, required four to six blows to cause a break. The burnt rail of the Carnegie Steel Company being of fair chemical composition, shows conclusively that failure was due to burns. There is a possibility that in the case of the Cambria Steel Company's rail the chemical composition had something to do with the failure, as the rail only showed a service in track of 2½ years. While both of these rails were marked with burns due to slipping, and in all probability failed from that cause, yet the term of service was so different, as well as other conditions, that no definite conclusions should be drawn from these two instances alone.

Such a failure as that at Salisbury Junction might have been the sooner induced because of the greater vibration and impact from the momentum of the passenger engines, with their higher speed, together with the blow from the reciprocating parts and the wheel balance, and in those tests made with the heads down, this very metal which has been burnt and weakened by crystallization is subjected to the greatest tensile stress. With the head up the same metal is on the compression side of the neutral axis, and under such conditions naturally would not fail as quickly, this being borne out by the records of the tests.

These rails were called upon to withstand heavy traffic, both freight and passenger, on curves and grades somewhat above the average, but these records are not complete or conclusive, and are interesting only as being specialized on failures due to a change in strength of metal from burning. Further records are needed, not alone to determine the effect upon the rail itself, but to tabulate the loss and damage in wreck from this particular cause, that the importance of this subject may be brought clearly to the attention of the officers of all roads, to the end that steps may be taken to prevent such practice in so far as it is possible.

(Continued from Page 89.)

and a ten-inch board firmly nailed to the bottom of the posts to prevent snow from blowing off the elevated roadway, be constructed on each side of every approach to a rural railway crossing where the height is six feet or more above the level of the adjacent ground, leaving always a clear road-surface twenty feet wide.

3. That the width of approaches to rural railway crossings made in cuttings be not less than twenty feet clear from bank to bank.

4. That, unless otherwise ordered by the Board, the planking or paving blocks, or broken stone topped with crushed rock screenings, on rural railway crossings over highways (between the rails and for a width of at least eight inches on the outer sides thereof) be **twenty feet** long on concession and main roads, and **sixteen feet** on side and bush roads.

10. Leave may be reserved to each of the railway companies affected by this order to move to extend the time for compliance therewith.

RAILWAY EARNINGS AND STOCK QUOTATIONS

NAME OF COMPANY	Mileage Operated	Capital in Thousands	Par Value	EARNINGS Week of July 14		STOCK QUOTATIONS TORONTO				MONTREAL			
				1909	1908	Price July 16 '08	Price July 8 '09	Price July 15 '09	Sales Week End'd July15	Price July 16 '08	Price July 15 '09	Price July 15 '09	Sales Week End'd July15
Canadian Pacific Railway	8,920.6	$150,000	$100	1,621,000	1,407,000	168 167½	183	186 184½	235	167½ 167¼	183⅝ 182¾	185 184⅝	2685
Canadian Northern Railway	2,986.9	.....	.....	191,300	177,500	.....	.....	.....	.....	.....	.....	.....	.....
*Grand Trunk Railway	3,536	226,000	100	789,746	749,015	.....	.....	*1st. pref.105½, 3rd pref. 56⅜, ordinary 23½		.....	.....	.....	.....
T. & N. O.	334	(Gov. Road)	.....	30,190	17,544	.....	.....	.....	.....	.....	.....	.....	.....
Montreal Street Railway	138.3	18,000	100	77,196	70,225	.....	.....	.....	.....	174 172½	218 217	216 215¾	285
Toronto Street Railway	114	8,000	100	75,242	65,913	98¾	124½	125	24	97¼ 97	124 123¾	124 123¾	387
Winnipeg Electric	70	6,000	100	.....	.....	158	186 185¾	187½	85	.....	185¾	.....	25

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

RAILWAY EARNINGS.

United States railroads for the first week of July show total gross earnings of $6,536,143, an increase of 6.3 per cent. over last year and a loss of only 0.8 per cent. compared with the corresponding period in 1907. In the following table are given earnings of United States roads reporting for the first week of July and the same roads for a like period in June; also the more complete reports for June and the two preceding months:

Gross Earnings.

	1909.	Gain.	Per Cent.
July, one week ..	$ 6,536,143	$ 386,644	6.3
June, one week..	6,527,303	657,716	8.0
June	37,769,725	3,251,844	9.4
May	43,097,449	5,367,794	14.2
April	42,473,864	4,786,961	12.7

The preliminary report for June of all United States roads included shows total gross earnings of $37,769,725, a gain of 9.4 per cent. Compared with June, 1907, there is a loss of 8.8 per cent. Railroads continue to make a better showing each month, compared with 1907. In the comparison with 1908 there is a considerable increase on the Pacific systems; also on the Southwestern roads. The Western Trunk lines show a gain of 4.2 per cent. and the Central Western a gain of 3.6 per cent. Southern roads report an increase of 7.5 per cent. The statement is printed below:

	1909. Gross Earnings.	Gain.	Per Cent.
Trunk West	$ 5,805,628	$237,303	4.2
Central West ...	6,166,643	214,618	3.6
Southern	12,200,568	855,982	7.5
Southwestern	8,959,133	963,370	12.0
Pacific	4,637,753	980,570	26.8
U. S. roads	$37,769,725	$3,251,844	9.4
Canadian	6,354,000	896,000	16.4
Mexican	4,795,561	236,109	5.1
Total..	$48,919,286	$4,383,953	9.8

SOO EARNINGS.

The following figures relate to the "Soo" Railway for the eleven months ended May 31st:—

	1909.	1908.
Gross Earnings	$11,536,678	$10,589,104
Operating Expense	6,503,100	6,572,275
Net Earnings	5,933,571	4,016,889

FENCING OF RAILWAYS.

An order of the Board of Railway Commissioners for Canada, dated May 4th, 1909, orders that all railway companies subject to the jurisdiction of this Board, shall, as to all railway lines completed, owned, or operated by them, where the lands on either side of the railway are not enclosed, settled, or improved:—

1. On or before January 1st, 1911, erect and maintain, on each side of the right of way (1) fences of a minimum height of four feet six inches, with swing gates, at farm crossings, with minimum height aforesaid, with proper hinges or fastenings; (2) cattle guards on each side of the highway at every highway crossing, at rail level: Provided that sliding or hurdle gates, constructed before the 1st day of February, 1904, may be maintained.

2. The railway fences at every highway crossing shall be turned into the respective cattle guards on each side of the highway.

3. All fences, gates, and cattle guards shall be suitable and sufficient to prevent cattle and other animals from getting on the railway.

4. As to lines not yet completed or opened for traffic, or in course of construction, all such companies shall—

(1) Erect fences, gates, and cattle guards as aforesaid as the rails are laid.

(2) If not yet opened for traffic, then such fences, gates and cattle guards as aforesaid shall be erected and maintained before such railway shall be opened for traffic.

(3) Where the railway is being constructed through enclosed lands, it shall be the duty of the railway company to at once construct such fences or take such other steps that will prevent cattle and other animals escaping from such enclosed lands.

5. As to all railway lines completed, owned, or operated, where the lands on either side of the railway are enclosed, settled or improved, such company shall erect and maintain such fences, gates and cattle guards, and in all respects comply with Section 254 of the Railway Act, on or before the 15th day of October, 1909.

6. Where it shall be made to appear to the Board that no necessity exists for the fencing or other works hereinbefore directed, the company or companies may apply to the Board for exemption from fencing, and other works, and such exemptions may be made as the Board deems proper.

7. All railways now in operation shall, within the time aforesaid, construct and maintain suitable and proper highway crossings, except such as may have already been covered by previous orders apportioning cost or providing for liability for maintenance, at all such as are being used for travel, and additional ones at once upon such highways being from time to time opened and used for travel.

8. All railways not yet opened for traffic, or hereafter constructed, shall, before the same are opened for traffic, construct and maintain suitable and proper highway crossings at all such as are being used for travel, and additional ones at once upon such highways being from time to time opened and used for travel.

9. All such crossings shall comply with the standard conditions of the Board, in so far as the same may be applicable, which are as follows:—

1. That, unless otherwise ordered by the Board, **the width of approaches to rural railway crossings over highways be twenty feet** road surface on concession and main roads and sixteen feet on side and bush roads.

2. That a strong, substantial fence or railing, four feet six inches high, with a good post-cap (four inches by four inches), a middle piece of timber (1½ inches by 6 inches),

(Continued on Page 88.)

THE
Sanitary Review
SEWERAGE, SEWAGE DISPOSAL, WATER SUPPLY AND WATER PURIFICATION

LINDSAY'S WATER SUPPLY AND OZONE PURIFICATION.

The town council of Lindsay, Ont., have taken over the ozone plant recently installed by a company, and have accepted the plant as efficient and generally in accordance with the specified undertakings.

The plant has not yet received the approval of the Ontario Provincial Board of Health; in fact, has not yet been examined by that authority. The minutes of the Board of the last meeting instruct the chairman, Dr. Sheard, along with Dr. Hodgetts, to visit the plant, and report what measures should be taken as to amount of time required, etc., in order to make a proper report and analyses of the water, so that the Board may determine upon the efficiency or otherwise of this plant, which is new to Canada. This minute is not yet carried out.

Ozone treatment is not a new thing as applied to water purification processes. It is new to Canada. If ozone treatment can be made to work efficiently and economically in Canada, it must be welcomed, as its very compactness makes it easily protected from frost as against the difficulty of protecting large, slow, sand filtration areas.

Town engineers, health officers and sanitarians generally look to the Provincial Board of Health to give some definite pronouncement on the Lindsay plant, such a pronouncement to be based upon accurate data.

The Sanitary Review of April 9th last contained an article dealing with this subject, and it was there stated that it was understood that the works were being installed subject to the approval of the Provincial Board, represented by their bacteriologist, who, of course, is the officer capable of forming an exact opinion, based on the requisite data of analyses.

Why the town council have relieved the contractors of this responsibility without this approval we are at an entire loss to know.

A private report and analysis tests have been obtained apart from the Board of Health. These we publish in this issue. The town council evidently are content, and do not think it necessary to await the authoritative decision of the Ontario Health Central Authority.

We have given some attention to the report and analyses made, and, although interesting, we must confess that we cannot enthuse over the results to the extent either of the town council or the local papers. As far as the town of Lindsay is concerned, we cannot yet accept its ozone treatment as satisfactory.

Let us briefly examine this report and analyses tests made by Dr. Archibald, of Toronto University.

The doctor, in the letter accompanying the report, states that the plant is entirely satisfactory, and then goes on to say that the electric current is not sufficient, in his opinion, and recommends that the current should be increased and the pressure made constant.

We must be excused from attempting to blend these two statements: the one which says the plant is efficient; the other, which says it is not.

The report states, further: "It is rather unfortunate that, at the time these tests were made, the raw river water should have been so pure, from a bacteriological standpoint, as it is hardly a fair criterion from which to judge of the efficiency of the plant." This can only mean that the bacterial count was so small that it was beneath the pride of the ozone to stoop to conquer. One would, however, have almost expected that with such a powerful sterilizing agent as ozone is said to be that the few bacteria in the raw water would have been immediately blasted out of existence. Such, however, is not the case; in fact, the percentage removal falls far short of what is even guaranteed by ordinary mechanical filters, to say nothing of the more perfect process of slow sand filtration.

The analyses show the numbers of bacteria in the raw water, the number in the filtered water, and the number in the ozone sterilized water. This plant consists of a combined system of, first, filtration, and second, ozonization. The percentage removals of bacteria due to each process are of interest, and we have worked them out. No account is taken of test No. 5, which shows an enormous increase in bacteria after ozonization. Test No. 9 is also ignored, as there is apparently no bacteria in the raw water per c.c. This leaves us altogether nine tests from which to deduct averages of percentage removals.

	Per cent.
Removal of bacteria due to filtration.....	67
Removal of bacteria due to ozone.....	59
Total percentage removal of bacteria due to combined processes	89

From the above it will be at once seen that filtration has proved a more efficient means of bacteria removal than ozone. Further, that the total removal is far below the percentage required either from mechanical or slow sand filtration.

The ordinary guarantee required by the United States Board of Health for mechanical filters is as follows: "That the filtered water shall be bright and clear, and free from suspended matter visible to the naked eye; that there shall be an average bacterial reduction of 97 per cent." With slow sand filtration it is a poor efficiency removal when the removal is under 99 per cent.

With sterilization we must look for better results than are even obtained by either mechanical or slow sand filtration. Slow sand filtration, if properly worked, is nearly perfect. Only absolute sterilization can beat it. Lindsay has not yet succeeded, according to the reported analyses, of by any means reaching either the efficiencies expected by mechanical or slow sand filtration, nor has it approached sterilization.

On the question of the efficiency of the Lindsay plant we are content to keep an open mind for the present. We desire its complete and entire success. We look to Dr. Sheard, the chairman of the Provincial Board of Health, assisted by his able lieutenants, to make such an examination and present such a report upon the efficiency of this plant, which is on its trial in Canada, that we may be able to form some definite conclusion on the matter.

LINDSAY FILTRATION PLANT.

Several months ago the town to Lindsay, Ont., made a contract with Mr. J. Howard Bridge for an ozonization plant. The building and apparatus have been completed, and Dr. T. D. Archibald, of Toronto, made tests, and upon his report the municipality accepted the plant.

Dr. Archibald's letter of transmission is given with his report, as they must be read together before one can obtain a true idea of the conditions attending the test and the value of the conclusions arrived at.

University of Toronto,
Pathological Department,
Toronto, Canada, July 11th, 1909.

My dear Mr. Ray,—

I enclose the following report which seems to prove, as you will see by the figures, that the plant is entirely satisfactory under ordinary conditions. Should there be anything which you do not understand, or any point on which you wish further information, I would be very pleased to have you let me know as soon as possible, when I will endeavor to give you further light on the matter.

Although outside of the scope of my examination, I should think that attention should be paid to the electric current which is available for the running of the pump and the ozonizing of the water, that is to say that sufficient electricity should be furnished and the amount of current and pressure should be constant. However, that question is one with which an engineer should deal.

I handed over the specimen of water which you gave me to the Board of Health.

Yours truly,

T. D. Archibald.

July 10th, 1909.

The Board of Water Commissioners, Lindsay, Ontario.

Sirs,—I beg to submit the following report on the analysis made by me as to the efficiency of the plant installed in your town by Mr. J. Howard Bridge for removing bacteria from the raw water supplied by the river.

In all, eleven tests were made under varying conditions, and the results of these are seen in the attached table. The conditions under which the water was obtained and any extraordinary circumstances that arose during the tests are likewise noted. It is rather unfortunate that, at the time these tests were made the raw river water should have been so pure from a bacteriological standpoint as it is hardly a fair criterion from which to judge of the efficiency of the plant. There is one instance, however, test No. 10 which seems to prove most definitely that the ozonization of the water has a very marked destructive power on the bacteria present.

No. of tests.	Number of Colonies.					
	Ozonized water.		Filtered water.		Raw water.	
	1 c.c.	1-10 c.c	1 c.c.	1-10 c.c.	1 c.c.	1-10 c.c.
1	18	1	46	4	97	9
2	21	0	22	4	102	14
3	27	3	113	5	400	34
4	4	0	14	2	34	2
5	229	22	42	8	70	5
6	2	1	19	1	63	6
7	7	0	15	2	42	5
8	18	4	31	3	1,200	128
9	48	5	212	12	.....	15
10	12	2	567	33	1,500	38
11	27	1	48	6	193	11

Examination for pathogenic bacteria.

Raw water .....colon bacilli present.
Filtered water .....colon bacilli present.
Ozonized water .....colon bacilli absent.

All the plate cultures were made under the same conditions, the temperature of the medium being 46° C., and a beef broth agar, 15 acid to phenolphthalein being used.

Conditions under which the water was obtained:—

In all cases the ozonized water was taken where it makes its entrance into the tank.

The filtered water was drawn from the receptacle into which the filters drain.

The raw water was taken from different sources as follows:—

In tests 1, 2 and 3 from the edge of the river.
Test 4 from the square filter.
Test 5 from the round filter.
Test 6 from the square filter.
Test 7 and 8 from the square filter.
Test 9 and 10 from the round filter.
Test 11 from the square filter.

All the tests, except No. 5, show diminution in the number of bacteria, from the raw water to the filtered water, and from the filtered water to the ozonized water. In test No. 5 a very peculiar condition arises, as is seen by the number of colonies on the plates. There is a diminution from 70 colonies in the raw water to 42 colonies in the filtered water. In the ozonized water, however, there was an increase to 229 colonies. The only explanation that occurs to me for this deviation from the results of all the other tests is; that a few minutes prior to the taking of the sample of ozonized water, a fire broke out in the town and a telephone message was sent to the pumphouse for immediate increased pressure. The electric pump was run at its maximum speed thus causing a rapid lowering of the water in the chamber containing the ozonized water; from that a rapid lowering of the level of the filtered water, with the result that the raw water would gravitate with unusual rapidity through the filter beds, and draw with it large numbers of bacteria which had been caught in the beds. The fact that the number of bacteria was lower in the filtered water than in the raw water, and that there was a large increase in the ozonized water, might be explained by the filtered water having been drawn from the surface water which was contained in the chamber, while the increased suction caused by the high pressure pumping would draw the fresh filtered water directly towards the pipes where it mixes with the ozone and passes into the chamber containing the ozonized water;—and the ozone failing to do its work thoroughly.

In case of test No. 8 the water in the square filter was very turbid, having been disturbed from some cause which I was unable to ascertain.

Test No. 10 was made 40 minutes after washing the filter beds, the plant having been run at usual speed during this period. The raw water contained, roughly, 1,500 colonies, the filtered water 567, while the ozonized contained only 12. In the case of this test sufficient time had elapsed for the raw water to have found its way into the filters, from the filters through the ozonizing plant before the samples were taken. This test seems to prove definitely the efficiency of the ozonization of the water as having the desired effect of destroying bacteria, even when present in large numbers, provided that the plant is working under ordinary conditions.

The analysis was made at a time when the raw river water was least liable to contain many or harmful bacteria because there had been a long period drought, and consequently no liability to contamination by surface washings, from soil, manure heaps or sewage, a condition which must inevitably occur in the spring and autumn during freshets and heavy rains. The examination would be most satisfactory had the raw water been at its worst instead of its best. From the tests made, however, one should draw the following conclusions:—

1. The plant when working under ordinary conditions furnishes a water perfectly safe for drinking purposes from a sanitary and public health standpoint as it contained very few bacteria. (The maximum number being 48 and the minimum 2 per c.c.)

2. Regarding the presence of harmful organisms, both the raw water and the filtered water contained colon bacilli, while the ozonized water showed entire absence of these organisms.

3. When working under abnormal conditions such as in the case of fire, when there is a sudden rapid filtration, the ozonizer apparently failed to do its work as seen by the figures in test No. 5. I understand that the capacity of the electric pump is 1,200 gallons per minute, while the capacity of the ozonizing plant is only 700 gallons per minute. It would, therefore, seem that were the ozonizing plant of sufficient capacity to treat all the water passing through it, that a satisfactory result would be obtained.

I have the honor to be,

Sirs,

Yours faithfully,

T. D. Archibald.

A COMPARISON OF CONTACT BEDS AND PERCOLATING FILTERS.*

By John E. Farmer, F.C.S., Chemist, Croydon Corporation Sewage Works.

It is difficult to give an accurate comparative cost of construction, as there are so many details affecting the cost of both methods. In this paper I have confined myself to results only, these having been obtained by the treatment of the same sewage, but not concurrently, by both methods.

The principles of the methods are identical, the application and the use of them being the difference. The principles briefly are:—(1) Exposing the liquid to be treated to a large surface area covered with living purifying agencies; (2) keeping a vast number of bacteria in prime working condition.

In the contact method, the liquid is presented to the bacteria "in bulk," all the air between the particles composing the bed being replaced by the liquid. The bacteria are allowed a period in which to act on the liquid, which is then removed, carrying away with it the products of the bacteria. The next operation consists in giving the bacteria an air supply, by allowing a period of air contact.

—	Ammonia, parts per million		Oxygen absorbed 4 hours.	Grains per gallon.		Dissolved oxygen C C S per	
	Free.	Albuminoid		Chlorine.	Ammonias, nitrites and nitrates.	Nitrites.	Litre.
Tanks effluent ..	60 88	5.01	2 50	6.2	——	——	——
half ,, ..	1.15	0.52	0.30	6 2	3.010	0.0 3	6.3
7 ft ,, ,, ..	1 77	0.76	0.46	6.0	3.010	0.028	5.7

In the percolating method the first principle is effected by allowing the liquid to run in a fine stream over the particles covered with the bacteria, but not filling the air space, the remaining space acting as a continuous "air contact," and so allowing the process to go on for days together.

The feeding of the bacteria and the supply of oxygen proceeded simultaneously, and are not separate operations as in the contact method. The unit taken for the contact method is quantity treated per cube yard of material comprising the bed, the quantity that can be treated depending upon the available water volume left between the particles, which is found in practice, after periods of working, to decrease in some cases to a great amount.

With the percolating system the same unit is used by many, including the Local Government Board. This would make a true comparison if the modes of presenting the liquid to the purifying agencies were identical, and the volume of liquid that could be treated by percolating filters depended upon the air space between the particles; but as the liquid has to run in a stream over them the quantity that can be treated is independent of this space.

The best unit to use for percolating filters is the volume treated per square yard or per acre in twenty-four hours, especially as the depth or the cubic capacity is no criterion as to the volume which can be treated. In proof of this I give the following results of a filter constructed in two halves, and fed by a revolving sprinkler, each half having exactly the same quantities to deal with. One-half is 7 feet deep, composed of 5 feet of gravel and 2 feet of clinker, the other half being 4 feet deep, and composed of 6 inches of gravel and 3 feet 6 inches of clinker.

The average results of twenty-one samples of each half taken during a period of eleven months are given below.

It will be seen that although one-half has 75 per cent. more depth, it does not give as good a result as the other half; and taking it on the cube yard unit it should treat 75 per cent. more liquid than the lesser depth, or in other words, the 4-foot side does in proportion to the cube yard unit 75 per cent. more work with better results.

The following gives the comparison between "contact" and "percolating," as regards volume treated on the same gross superficial area, volume per cube yard unit, and the results obtained. The figures for "contact" are the total quantities dealt with and the average results for four years, those for percolating filters being for two years, so that comparison may be on the volume treated rather than on the period of working. The percolating filters were constructed on the same site as the contact beds, by converting each contact bed into four circular percolating filters, which accounts for the less nett available area of the latter. The nett available area of each method was:—"Contact," 10,019 square yards, or 13.258 cubic yards; "percolating," 7,599 square yards, or 12.664 cubic yards. The contact beds were 4 feet deep, and the percolating filters 5 feet deep.

	Contact beds, (4 years). Gallons.	Percolating filters (2 years.) Gallons.
Total volume treated	892,228,000	962,496,000
Average volume treated each square yard per day	61	173
Average volume treated each cube yard per day	46	104

	Average reduction on sewage. Contact beds, (4 years). Per cent.	Percolating filters (2 years.) Per cent.
Oxygen absorbed, 4 hours	47.3	76.8
Albuminoid ammonia	40.6	73.8

During the four years the contact beds were working they lost in water capacity 62 per cent., and at the end there was no reserve whatever, and only 68 per cent. of the sewage for which they were originally constructed could be treated.

In the case of the percolating filters, as will be seen from the above figures, they have treated during two years a greater total volume, and a greater volume per square yard, and per cube yard, this being done on a smaller total available area, and with more than one-eighth of the area resting at a time. The volume treated per day after two years' working is the same as at the commencement. The labor required for percolating filters taken on the volume treated is about one-half of that required for contact beds, the cleaning of the material not being taken into account.

One method may be better than the other to adopt according to circumstances, but many details must be considered before one can say definitely which will give the best results at the least expense.

*Paper read at the Association of Managers of Sewage Disposal Works.

EFFICIENCY OF DAY LABOR IN THE LAYING OF MAIN WATER PIPES.

When Metcalf & Eddy, of Boston, consulting civil engineers to the Boston Finance Commission, began their investigation for that body, they found that the City Engineer had, for a number of years, kept a record of the average cost of pipe laying work performed by the Boston Water Department on jobs of similar character (that is, involving no special difficulties and no rock excavations) plotted in the form of a diagram to show progressive changes in this cost.

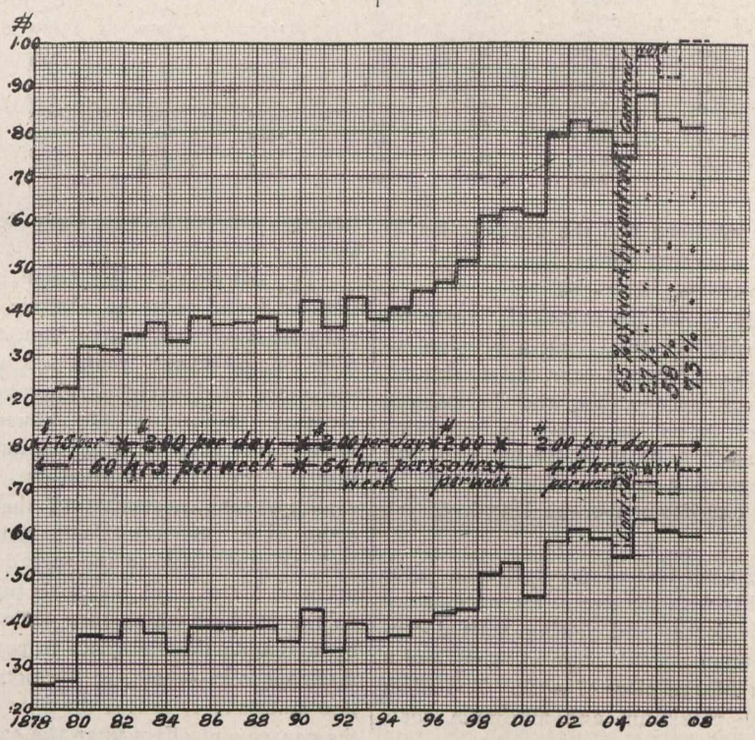
The diagram presented in the recently published report of the engineers and reproduced herewith—is in two parts, the first showing the average actual cost of labor per foot of pipe laid each year from 1878 to June, 1907, inclusive; the second showing the same information reduced to a uniform basis of wages and hours of labor. The basis selected by the City Engineer was $2 per day, and sixty hours per week. In making the reduction it was assumed that the efficiency of labor remained constant,—or in other words, that a laborer would accomplish 0.8 as much in an 8-hour day as in a 10-hour day,—and that the changes in pay had no effect upon the efficiency. If this assumption were incorrect, and, as has often been claimed by the advocates of shorter hours of labor, a man would accomplish as much, or nearly as much, in an 8-hour day is in a 9 or 10-hour day, then the efficiency per hour would evidently be increased with the decreased hours of labor, and in that event the cost per foot when reduced to a uniform basis would be lessened when the hours of labor were reduced. The diagram shows that this is not the case.

Before passing to a detailed discussion of this diagram it should be noted further that nearly all the work covered consists of laying 8-inch pipe; some 6 and 10-inch pipe has been included, and a little 12-inch. Since, however, substantially no change in the dimensions of the trench is involved in this range of pipe sizes, the cost per foot of trench should be directly comparable. In all these cases the trench is 6 feet deep.

It should be further noted that in the last four years covered by the diagram, a portion of the work included in making the averages was done by contract, viz.: in 1904, 65 per cent. was contract work; in 1905, 27 per cent.; in 1906, 58 per cent.; and in 1907 (first six months), 73 per cent. The reason for including this contract work was said to be that the amount of work done by city labor during these years was too small to get a suitable average for comparison with previous years. In these cases, however, the total cost of the contract work was increased by the cost of city labor charged to these same jobs before they were included.

The engineers' examination of the records shows, however, that if the contract work had been entirely omitted, there would still have remained 1,303, 4,168, 6,359, and 1,627 feet, respectively, of pipe laid by city labor in the four years under discussion—enough for a reasonable average which should be substantially comparable with previous years. Omitting the contract work entirely, the diagram would be changed as shown by the dotted lines which have been added. The dotted lines should then be followed, instead of the full lines, for the last four years of the diagram.

A study of the lower line of the diagram shows that up to the end of 1894, although there were considerable fluctuations, the average cost was substantially uniform at about 37 cents or 38 cents per foot. From that time, however, the cost has increased at a generally uniform rate until 1902; in two succeeding years it decreased somewhat, but in 1905 rose to the highest point reached, but has decreased somewhat again in 1906 and 1907. If, however, the contract work be left out of consideration, as it should be in studying efficiency of the city's labor force, the cost is seen to rise at a substantially uniform rate, except for minor fluctuations, from 1893 to the present time.



BOSTON WATER WORKS.
Diagram of Cost of Trench Work in Laying Mains up to 12 Inches.
All work involving special difficulties omitted. Upper table shows what cost would have been if a uniform wage of $2 and a uniform working day of 10 hours had prevailed throughout the entire period.

The average labor cost per foot of pipe laying by city labor during the last three years is seen to be equivalent to about 71 cents per foot upon a basis of $2 per day, and sixty hours per week, as compared with 37 or 38 cents per foot previous to 1893, upon the same basis of wages and hours.

There seems to be no other cause to which this increase in cost can be assigned than a progressive decrease in efficiency of labor. The increase in cost has been so great and the conclusions to be drawn are so radical that the consulting engineers took the greatest care to go back to the records from which the diagram was constructed. Although they did not examine the cost records of each particular job as shown by the Water Department's books, they assumed the total cost and the total length of each job as listed by the City Engineer for this computation to be correct; and checked

TABLE SHOWING THE AVERAGE LABOR COST PER LINEAR FOOT OF LAYING WATER PIPE IN BOSTON EACH YEAR FROM 1878 TO JUNE, 1907, INCLUSIVE.

Year.	Wages per day.	Number of jobs.	Total length of pipe (ft.).	Average length of job (ft.)	Hours per week.	Labor cost per foot in cents.			Average cost reduced to uniform basis of $2 per day, 60 hours per week.	Average cost further reduced to uniform average length of job (500 ft.).
						Max.	Min.	Average actual cost.		
	$					$	$	$	Cents.	Cents.
1878	1.75	9	4,398	489	60	35.4	17.2	22.3	25.5	25.3
1879	1.75	4	3,110	778	60	29.5	17.4	22.7	25.9	26.4
1880	1.75	9	4,258	473	60	74.9	25.0	32.3	36.9	36.6
1881	1.75	2	557	279	60	33.6	29.4	32.0	36.6	32.7
1882	1.75	..	...	...	60	....	....	35.0?	40.0?	....
1883	2.00	15	4,787	319	60	49.6	27.4	37.3	37.3	34.0
1884	2.00	20	8,710	435	60	75.0	22.6	33.1	33.1	32.1
1885	2.00	14	3,065	219	60	79.1	21.4	38.8	38.8	33.7
1886	2.00	29	7,056	243	60	141.6	21.0	37.1	37.1	32.5
1887	2.00	38	13,943	367	60	104.2	21.9	37.2	37.2	34.8
1888	2.00	38	11,203	295	60	119.7	19.5	38.9	38.9	35.0
1889	2.00	48	14,215	296	60	105.94	13.63	35.26	35.26	31.8
1890	2.00	30	6,306	210	60	105.0	15.52	43.05	43.05	37.1
1891	2.00	74	20,428	276	54	94.83	16.32	36.82	33.1	29.6
1892	2.00	59	16,527	280	54	242.4	24.0	43.7	39.3	35.0
1893	2.00	23	7,593	330	54	63.6	20.4	37.2	33.5	30.7
1894	2.00	45	19,037	423	54	215.3	11.5	41.3	37.2	36.8
1895	2.00	36	17,353	482	54	88.6	18.8	44.6	40.1	39.8
1896	2.00	39	13,975	358	54	282.6	16.7	47.3	42.6	39.6
1897	2.00	21	9,613	458	50	112.5	21.1	51.5	42.9	42.0
1898	2.00	22	10,628	483	50	95.8	36.4	61.3	51.1	50.6
1899	2.00	31	11,685	377	50	149.3	32.9	64.1	53.4	50.4
1900	2.00	19	8,502	447	44	99.6	28.2	63.1	46.3	44.9
1901	2.00	11	3,478	316	44	130.5	47.2	81.8	60.0	54.6
1902	2.00	14	8,789	628	44	185.6	60.1	83.4	61.2	65.1
1903	2.00	9	3,765	418	44	121.6	43.4	80.7	59.2	56.9
1904	2.00	9	3,704	411	44	93.0	55.6	74.5	54.6	52.5
1905	2.00	12	5,745	477	44	148.2	51.7	88.5	64.9	64.2
1906	2.00	22	15,178	690	44	139.1	57.1	83.3	61.1	67.2
1907	2.00	13	5,979	460	44	130.6	66.8	81.0	59.4	58.2

over the details of the computations and the construction of the diagram, and found the computations correct, and the diagram substantially so.

The accompanying table shows the principal figures relating to computations, giving the total length of pipe included in making up the average for each year, the maximum, minimum, and average actual cost per foot, and the average cost as reduced to a uniform basis upon two assumptions, first, that mentioned above, on a basis of $2 per day, and sixty hours per week, and second, a further reduction made by use on the assumption of a uniform average length of job each year equal to 500 feet.

It is evident that the cost per foot of any particular piece of work will vary considerably with the size of the work, since the costs of assembling the forces and getting started constitute a considerable item upon a small piece of work, and a nearly negligible item upon a large piece of work. The effect of this is indicated by the maximum and minimum costs per foot given in columns 7 and 8 of the table.

PROTECTIVE COATINGS FOR STRUCTURAL MATERIAL.*

R. S. Perry, Philadelphia.

Although it is the intention in this address to deal especially with the subject of protecting paints, and to adhere to this subject as closely as possible, it will be necessary to outline to you in a brief way some of the scientific investigations that have led up to the subject of rust inhibition, or the prevention of corrosion.

The United States Government, two years ago, through the Department of Agriculture, started a series of tests to determine the causes of the rapid corrosion of the steel wire fences used by the farmers of the West to enclose the vast acreage of pastures and tillable lands. The complaints that the wire fences of to-day are found to corrode in less than one-fourth the time of the fences of twenty years ago have been found in many cases to be true, and the farmers and ranchers are justified in their demand for greater longevity for wire fencing.

Dr. Allerton S. Cushman, who conducted the investigations found that the absence of certain impurities in the old time Swedish charcoal iron, the material largely used for wire fencing twenty years ago, was responsible for the rust resistance of this metal, whereas the steel of modern times contains impurities that cause its rapid disintegration. Modern methods of steel manufacture necessarily demand that the product be turned out in vast quantity and with rapidity, thus necessitating the use of materials such as manganese. Such methods cannot be overthrown at once, and we must look to the metallurgist for a solution of this problem. That such materials may assert a destructive action on the steel of which they form an integral part, there can be no doubt; the difference in potential of the area containing manganese in excess, to the potential of the area containing less manganese, causes the flow of an electrical current, with the consequent effect upon the solution of the metal. Marked segregation of the impurities is another factor of a destructive nature, and causes the formation of pit-holes which are of great danger.

That these points should be given more careful consideration was made plain, very recently, on an inspection trip to the tunnels of the Manhattan and Hudson Company in Hoboken, New Jersey. Ten cars of one steel and ninety cars of another steel, that had been in service for six months, were brought into the roundhouse for examination. These cars had been built of two different grades of steel, but they were painted at the same time, with the same material and by the same workmen.

The conditions in the tunnel where these cars had been operated were most trying. Constant seepage caused drippings of an extremely corrosive nature to be deposited upon the car's surfaces, and an analysis of the drip showed the presence of 15 per cent. of chloride salts which caused rapid acceleration of rust. The tunnel drip also had a solvent action on the paint coal and in several spots the drip had completely removed the paint. The atmosphere in the tunnel was rich in carbon dioxide and high in moisture containing a considerable quantity of salt.

The large amount of rust formed on the edges of the cars could be accounted for by the abrasion of road-bed dust,

*Read before the Western Society of Engineers.

hurled against these vulnerable parts by the enormous pressure, and consequent blast, of air that is exerted when the cars are running at full speed in the tubes. Another condition observed was the appearance of a white coating of salt upon the surface of the paint after the cars had been in operation but a short time.

Subjected to these trying conditions, some of the cars stood the test in a remarkable manner, while others, made of a different grade of steel, were in very bad condition.

The points of corrosion were indicated by the surface being covered with wart-like concretions which, under a high power hand glass, showed the presence of rust forcing through the paint coat and exposing the steel to direct contact with the air. This eczema of the iron, although general, seemed to be most marked in certain places, and this would lead to the conclusion that the impurities in the metal were segregated.

According to the electrolytic theory of corrosion, certain fundamental principles underlie the corrosion of iron.

They are, briefly, as follows:—

That, when iron is in contact with water, there will be a transfer of electricity from the free hydrogen ions of the water to the iron ions of the iron, causing the solution and subsequent oxidation of the metal.

The presence of impurities having a difference in potential to that of the iron in which they are contained, and the uneven distribution of such impurities, increases the amount of electrical action.

We are indebted to Dr. William H. Walker, for the most recent research on the function of oxygen in the corrosion for iron, who says;—

"That the film of hydrogen deposited on the metallic iron at the beginning of the action is a non-conductor of electricity and prevents further passage of the current, and hence, further solution of the iron. Atmospheric oxygen removes the film of hydrogen by combining with it, thus 'depolarizing' the iron and allowing the solution of the iron to proceed. When once in solution in water, this dissolved iron is also oxidized by the atmospheric oxygen and precipitated as rust; but this oxidation is incidental to, rather than a necessary condition of, corrosion."

"That when iron is in contact with any surface on which this combination of the hydrogen, set free from the water, and oxygen, from the air, will take place more easily than on the iron itself, such as copper, bronze, mill-scale, etc., corrosion of the iron will be accelerated thereby."

Certain compounds are of such a nature as to excite electrical action, and, consequently, stimulate corrosion, while still other compounds are of such a nature as to inhibit or prevent corrosion.

To the class of compounds that inhibit corrosion belong bichromates of the alkaline earth metals, these salts being pre-eminent among such compounds. It has been found that salts of certain metals may be precipitated with the chrome salts to produce pigments which afford protection for the steel surfaces to which they are applied.

The results of a series of investigations into the rust preventive nature of these compounds demonstrated that it was not safe to state that the chromates, as a class, were rust-inhibitives. Quite the reverse is true of many of these products, and their composition, method of preparation, and impurities are factors which influence, to a marked degree, their value as protective compounds. Aside from those chromates which prevent corrosion, we have those which act in an inert manner, also those in which any inhibitive value is overbalanced by the effect of impurities, showing a strong stimulating action in the rusting of metal. But a simple test will show in which class the chromates come.

Turning, therefore, to the conservation of structural iron and steel and to its rust inhibition through particular coatings, we have the problem of choosing the proper materials for manufacturing a paint which will both exclude the agencies of rusting, and which, when moisture and gases do penetrate the coating, will inhibit the iron from rusting; and we also have the problem of giving to the chemist, engineer and architect some simple method of determining whether any given paint is, in at least a rough measure, harmful, safe or beneficial.

Some pigments largely used in the paint industry, and of value in a paint for protecting lumber, are unjustifiable in a paint for the protection of steel and iron. For example, sulphate of calcium, which, even if fully hydrated, has been shown to have a direct stimulative action upon steel. This is due to the fact that calcium sulphate, even if fully hydrated, is somewhat soluble in water, and when the water penetrates the coating of paint it carries this calcium sulphate into solution. Owing to the fact that calcium sulphate, in solution, has a high co-efficient of dissociation (or, in other words, has a tendency, in solution, to break up from its chemical form and identity), we get the reaction of the liberated sulphuric acid ions upon iron and steel, causing corrosion.

The highest type of paint product for the protection of iron and steel, therefore, avoids the use of such pigments as calcium sulphate.

Great caution must be used in selecting iron oxides for the protection of iron and steel, as they often carry traces of sulphates, etc., as impurities.

Venetian red, which is a favorite pigment, and which is of value for protecting lumber, is made by calcining green vitriol or sulphate of iron (commonly called copperas), in the ferrous form, in the presence of quick lime. The resulting mass from the furnace consists of artificial oxide of iron and sulphate of calcium, produced by the metathesis of the above reacting compounds.

Unfortunately, the reaction is never complete, and there is a tendency towards the formation of free sulphuric acid.

As a result, we have all the bad effects with Venetian red that we find in the use of calcium sulphate, and also the extra chance of corrosion due to free and aggressive sulphuric acid present.

It is true that there are some artificial oxides of iron which can with safety be used, as for instance, artificial black magnetic oxide produced by chemical precipitation, but, as a general proposition, the natural iron oxides should be used, unless it is absolutely certain that the artificial oxide has been proven safe.

Ochres are not meant to be included in the safe class in the above statements, for the reason that ochre is an extremely impure oxide of iron.

Recent investigations into the nature of pigments have revealed the fact that they may be divided into three groups and termed "Rust-Inhibitives," "Inerts," or "Rust-Stimulators." The nature of the pigment itself, or the nature of the impurities contained within the pigment, are factors deciding the position of the pigment in one of the three groups or types above mentioned. It may be expected that the use of rust-inhibitive pigments in paints designed for the protection of steel surfaces will give to such a paint very valuable properties. Further consideration of the subject will aid us in selecting the proper pigments for such a purpose.

In order to ascertain the rust-inhibitive value of all pigments, the Scientific Section was commissioned by the Bureau of Promotion and Development of the Paint Manufacturers' Association to erect a fence, having several hundred steel plates, upon which to try out the value of the different pigments when contained in an oil medium.

The American Society for Testing Materials was informed of the work proposed by the Scientific Section, and Committees E and U of that society decided to co-operate in inspecting and supervising the tests, proper specifications to be drawn up by the committees. The members of these committees and the Scientific Section conducted laboratory tests that served as a check upon the previous investigations and gave information upon which to base the main field tests. The plates used for the tests were

rolled from three kinds of metal—ordinary open-hearth structural steel, ordinary Bessemer low carbon steel, and pure ingot iron. In this way was secured data relating to the resistance to corrosion of certain metals when tested out simultaneously with others. The steel plates were painted in two ways, part of them being scratch-brushed in the ordinary way before painting, thus following out the usual mode of painting structural steel, and part of the plates being pickled in sulphuric acid, in order to completely remove the scale, and the plates were subsequently washed with lime so that all traces of the acid were neutralized.

The test was conducted in a thoroughly systematic and practical manner, following out the methods employed during the tests already made at Atlantic City and Pittsburg. The Master Painters' Association co-operated in the work and gave us the benefit of their practical experience in this line. Inspectors and painters, representing the committees and sections, were upon the ground throughout the period during which these tests were made.

It has been proven that corrosion generally takes place under normal conditions in an uneven manner, and pitting is evident at certain weak spots on nearly every grade of steel or iron, in a lesser or greater degree. From these spots the corrosion proceeds and develops upon the surrounding area. The corrosion at the start, where the pitting begins, is so extreme in some cases that holes are formed, of considerable depth, before the surrounding surface is attacked to any marked extent. The causes of this pitting have been fully explained by the electrolytic theory. This theory overthrows the former theories which were held, regarding corrosion. The carbonic acid theory, for instance, held by Calvert, supposed that carbonic acid attacked the iron, converting it into carbonate, and the carbonate being oxydized to hydrate or ordinary rust by the oxygen of the air, the carbonic acid regenerated and acting again on an unattacked part of the metal. According to the peroxide theory, the iron, oxygen and water were supposed to react to form ferric oxide, and to regenerate hydrogen peroxide which would attack a new quantity of iron. That the electrolytic theory is the most tenable has been demonstrated in many ways, but one of the most beautiful demonstrations may be carried out in a very simple manner.

A five per cent. solution of gelatine in hot water is made, and after careful neutralization, a few drops of phenolphthalein and ferrocyanide of potassium are added. A thin layer of this solution is poured upon the bottom of a glass dish, and when stiffened up by cooling, a clean strip of metal is placed thereon. A further quantity of the gelatine solution is poured upon the metal and allowed to solidify. The gelatine in this case is used to retard diffusion of the colorations which form. As stated before, when a strip of steel is placed in water, there are developed hydroxyl (OH) ions at the negative pole, and these are shown by a pink coloration formed with the phenolphthalein, whereas at the positive pole of the iron plate the development of hydrogen ions takes place, and solution of the iron proceeds. This solution forms, with potassium ferrocyanide, a blue coloration which to the paint chemist is known as Prussian blue.

It is a well known fact that zinc protects the iron from corrosion when in contact, the zinc going into solution, being electro-negative to iron, thus protecting the iron from being acted upon. It has been found that the zinc will protect the iron only to a certain extent, unless an electrolyte is contained within the water, this being due to the fact that pure water offers too great a resistance for the current to flow.

It has been shown by our investigations that certain pigments have the property of preventing galvanic action, and their use is highly desirable in a paint coating. Other pigments have been found to exhibit a strong tendency to excite galvanic action because they possess the property of being good conductors of electricity. Such pigments should never be used next to steel.

The Scientific Section of the Paint Manufacturers' Association have made a very careful and systematic study of this vital question, and are at present pursuing the work started, making tests of extreme value and recording their observations for future generalization. Such work can only be productive of the most valuable results and will ultimately result in the restriction to certain materials for use in painting iron and steel and the adoption of these materials in specifications for such work. The qualification of each and every raw product will be determined, and its legitimacy for existence in a paint will be closely questioned before giving it final approval.

It is not the intention to make any derogatory reference to certain products which are under suspicion or to attempt to tear down the business that has been built upon these products, but before we can give our candid endorsement to any raw product for use in a paint to be applied direct to iron or steel, that product must possess certain fundamental requisites which we have already outlined. The distinction between an inhibitive and a stimulative pigment may be easily determined, and it is essential to the preservation of the steel upon which such pigments are to be used, that the inhibitive principles should predominate.

That there is a marked difference in paints as well as as in steel has been proven beyond the shadow of a doubt, and evidence is collected every day confirmatory to this statement. One of our foremost metallurgists recently returned from a visit to the Isthmus of Panama, and, while there, he inspected some of the old steam engines used by the French Government, in their futile attempt to join the Atlantic and the Pacific. These engines had lain in the morass and jungle for many years, subjected alternately to the torrid heat of day and the excessive humidity of night; rare conditions for active corrosion being always present. Some of the engines were nothing more or less than a flimsy network of holes, and the material had completely gone to waste (of the open-work variety), resembling the latest thing in summer hosiery. Other of the engines had been protected with certain paint coatings that had preserved the steel intact, and the American engineers were able to pull these engines out of the morass and by substituting a few accessories, to use them again. The nature of these coatings which have withstood the test of years are at present being investigated by the Scientific Section to determine the pigments used therein.

Another engineer recently returned from Colon reports that the iron posts surrounding the consul's home and from which were suspended a line of linked chain, showed active corrosion on the south-east side in every case, while the back of the posts were slightly, if at all, affected. These posts back of the consulate were unaffected in any place because of the protection from the southeast winds afforded by the house. The winds blowing in, laden with salty humidity, had naturally exerted their corrosive effect on the surface not thus protected.

A recent examination of the steel test fences erected by the Scientific Section, at Atlantic City, was confirmatory of the above. The inspection was made early one morning, after a rainy night. The weather had cleared up and the brisk wind which had continued throughout the storm was blowing from the same direction and rapidly drying the moisture on the steel plates. The object of the inspection was primarily to determine the moisture penetration and water shedding properties of each pigment and paint. A better day or time for such a test could not have been chosen.

As has been described before, the fences are three in number, made of three classes of steel and each presenting toward the sea a series of 100 plates with as many upon the reverse side. It was apparent at once that the rain had impacted only against the steel plates facing the ocean or

shore side, and that our inspection would have to be made from the plates on the reverse side of the fence.

The panels facing the ocean and exposed to the action of the storm exhibited a variance of results. Some had been painted with pigments having a greasy nature, and being natural water-shedders were apparently dry, while others, painted with less greasy pigments, held on their surface a large number of rain drops. By wiping off these rain drops, the following differences were noted:—

(1) That in some cases a place resembling a water blister was left, showing just where the drops had remained on the surface, and showing that they were acting upon the paint coat.

(2) In other cases, when the drops of water had been wiped off, the surface was in the same condition as the balance of the plate, and the rain had no apparent effect upon the paint coat. On some panels, the penetration of moisture through the paint coat left a blotchy surface. This appearance being present on many panels, a record of impenetrability was obtained.

Very few corporations, whether manufacturing paints or buying paints, and very few engineers or architects have the facilities or the time to make exhaustive laboratory research when choice is to be made of a protective coating for their use.

What the practical man—either the paint manufacturer, the architect, or engineer—requires, is to have some practical result, easily obtainable, which will give him, in a definite and visible manner, a criterion and measure of the value of the new discovery, and of the refined laboratory work.

This accelerated field test consists in subjecting strips of any particular kind of steel that may be chosen to an atmosphere of maximum humidity, the steel being in intimate contact with the materials concerning which results are desired.

The apparatus is extremely simple, and the test can be started at thirty minutes' notice by any manufacturer, architect or engineer, at his office desk, and can yield him visible results in two days thereafter.

The idea was original with Dr. Cushman, and permission was requested from him to work it up in some practical way for the manufacturers of the raw materials and of paints, and for the consumers who have the work of protecting structural steel.

The chemist, engineer or architect who wishes to conduct this test on actual paint products instead of the materials used in the manufacture of paint products, may use a $7.50 centrifuge apparatus made by Bausch & Lomb, in other words, a small laboratory centrifugal machine holding test tubes.

Number the test tubes for reference purposes and place in each test tube a small sample of the paint to be tested, together with a large quantity of benzine. It is of extreme importance to add the benzine in considerable quantity and previous to inserting the tubes in the centrifugal machine.

Actuate the apparatus and most of the vehicle will be thrown away from the pigment and the pigment will settle towards the bottom of the tube.

Decant or pour off the oil, add more benzine, thoroughly shake and pour off the liquid. Do this two or three times unt'l the oil has entirely left the paint and nothing remains but the dry clean pigments.

Then take the pigments and proceed with the whole test as described below for the testing of dry pigments.

The materials required are as follows:—

An ordinary deep cigar box.

2 or 3 sheets druggists' thick filter paper.

1 dozen thumb tacks.

1 dozen safety razor blades (unless some special steel is to be tested).

½ dozen small butter dishes or saucers.

Each of the dry materials to be tested.

A clean pencil for stirring.

A pocket knife.

A glass of water.

An old towel or rag for cleansing hands, pencil, etc.

A piece of emery cloth.

A tooth brush.

2 or 3 test tubes.

Line all six interior surfaces of the cigar box with the filtering paper, using the thumb tacks for the purpose. Thoroughly wet the lining of the cigar box with water and stand it on one edge so that when it is ready for use it will be free from drip.

Place upon a piece of filter paper, large enough to cover the hand, some of the material under examination, add a few drops of water and rub up with the finger into a rough soft paste, this being easily accomplished with nearly all pigments, and bringing into a paste many pigments which are otherwise extremely difficult to incorporate with water. Be particular to cut the surface of the razor blade to the raw steel with "oo" emery paper, to insure the removal of any lacquer or surface treatment of the blade. It is necessary to handle the razor blades by the edges so as not to get any finger marks upon the surface. Now place a clean razor blade upon the plate, fold over the filter paper on each side of the razor blade in such a manner as to completely cover it with paste-coated filter paper, and place blade, paste and paper upon a butter dish within the cigar box.

Treat each sample of material under test in the same manner.

A word of caution is necessary regarding the testing of the inhibitives such as the chrome soaps, that are soluble in linseed oil.

These are not pigments, but soluble in oil and vehicle constituents, and therefore must not be applied in a water paste, but in a film, through the agency of benzol.

In the case of these materials, soluble in linseed oil, such as resinates and linolates, these are to be dissolved to a heavy solution in benzol, and a coating poured upon the razor blade. The evaporation of the benzol leaves upon the surface of the blade a thin film of the material to be tested, and, because of the fluidity of the benzol and consequent thinness of the film, a second coating is advisable. The coated blade is then to be placed in a butter dish within the box along with the other materials with which it is to be compared. Care should be taken that the plate is completely coated as there is a tendency for the liquid to segregate on the steel.

If a strip of steel in every case be treated with potassium bichromate in such a test, a convenient standard of minimum corrosion will be afforded, for purposes of comparison.

If so desired, in the foregoing test the operator may increase the quickness with which the test may be performed, by adding to a little bicarbonate of soda (baking soda) on a butter dish, a little sulphuric acid. An evolution of carbonic acid gas will ensue and as this gas rapidly stimulates corrosion, its presence will render the test still more positive.

A considerable degree of refinement and a fair index of result can be obtained from this apparatus if the strips are first carefully weighed in a laboratory balance, and then reweighed after the steel is scrubbed with a tooth or nail brush to remove any rust formed, in which case the loss in weight of the steel is the measure of the rust formed and the degree to which the pigment has stimulated rust.

It is evident to any man who will compare the conditions in this test with the field conditions, that practically all of the important factors which contribute to the corrosion of steel are present in this test in such a way, that they will indicate in a short time the results which would be obtained from the steel painted with a paint coating produced from these materials and over a considerable length of time.

After the proper selection of pigments has been made, the question of vehicle must be carefully considered. The addition of high grade fossil resins, carefully compounded with a carefully treated oil, adds greatly to the power of a

paint to resist penetration by gases and moisture, producing a better excluding paint and at the same time adding to the appearance. The glossy surface which a paint made along these lines possesses renders the paint a better repellant or resister of moisture. The quality and percentage of gum used influences to a great extent the wearing properties of this kind of paint.

During the transportation of machinery and structural steel from the factory to the field and the workshop, there is met a state of conditions that causes rapid corrosion. Moisture and gases attack the metal and assert their destructive action. In the past these results have been partially overcome by swabbing the metal with crude oil, in some cases, and, again, by giving the metal a dip in hot linseed or other drying oils or by applying tar and cheap paints as shop coats. The crude oil leaves upon the surface of the metal, even after wiping, a quantity of non-drying mineral oil which interferes with the drying of the paint coat which is afterward applied at the time of the assembling of the metal. It also prevents the paint coat from properly adhering to the steel surface, and this coat of crude non-drying oil, which still exists between the metal and the paint coat, is a source of never-ending trouble, causing peeling and shriveling. This crude oil treatment, therefore, should be avoided whenever it is intended that the steel is to be subsequently painted with oil paints.

Where linseed oil instead of crude oil is used, a film of the oil is left upon the metal and rapidly oxidizes to a coat of linoxyn. This coat will protect the metal for a certain period of time, but is extremely porous and ultimately admits moisture. If, within this coating of linseed oil, there had been contained a proportion of pigment, or if the linseed oil had been developed by gums into a varnish or lacquer, then the excluding properties of the linseed oil would have been increased, and, if the formula were inhibitive in nature, the steel would be better protected from corrosion, and the application of future coats of paints, after assembling the steel, would have been practical and facilitated.

It is sometimes desired to give to steel a thin adherent protective coating that is transparent and will allow of the inspection of the steel by the engineer, who desires to observe whether the metal is absolutely clean and free from rust before proceeding with the painting thereof. In a case like this, there is required a coating of oil containing materials which will not interfere with the transparency of the oil coat and which, at the same time, are thoroughly inhibitive in nature. Such a compound may be prepared by the use of inhibitive chromium compounds soluble in linseed oil, such as chromium resinate or chromium linoleate. By the use of these materials within an oil coat, thorough inhibition is obtained, and, at the same time, there is added the excluding properties which these compounds afford. A thoroughly inhibitive and transparent coating is thus formed and is most practical of use. A paint coat applied to steel protected by this inhibitive oil coat amalgamates with this oil coat and becomes an integral part thereof, rendering at the same time, the oil paint thoroughly inhibitive and causing close adherence to the metal surface.

ORDER OF THE RAILWAY COMMISSIONERS OF CANADA.

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

7470—July 7—Approving location of the C.P.R. Company's Moose Jaw north-westerly branch, from mileage 148.76 to mileage 190.63.

7471—July 7—Reporting to the Governor-in-Council for sanction by-law No. 9 of the British Yukon Railway Company re spitting in cars and on premises.

7472—July 8—Directing the railway companies, subject to the jurisdiction of the Parliament of Canada, to furnish and file with the Board returns of all highway crossings on railways at which any accident has happened subsequent to January 1st, 1909, causing bodily injury or death to a person using such crossing. (Copy of Order enclosed.)

7473—May 4—Requiring all railway companies, subject to the jurisdiction of the Board, where the land on either side of railway is not enclosed, settled or improved: 1. On or before January 1st, 1911, erect and maintain on each side of the right-of-way (1) fences of a minimum height of four feet six inches, with swing gates at farm crossings, with (2) Cattle-guards on each side of the highway at every minimum height aforesaid, with proper hinges or fastenings. highway crossing at rail level; providing that sliding or hurdle gates, constructed before the 1st day of February, 1904, may be maintained. (Copy of Order enclosed.)

7474—July 6—Dismissing complaint of residents of Watford, Ont., alleging poor and unsatisfactory train service on Grand Trunk Railway.

7475—July 6—Authorizing the Ottawa Terminals Railway Co. to take certain lands at Ottawa for the accommodation of traffic at the Central Union Passenger Station.

7476—July 6—Authorizing the Canada Southern Railway Co. to construct a subway at Tecumseh Road, in the Township of Sandwich West, to be forty feet in width, with a five-foot sidewalk constructed on either side, leaving thirty feet of travelled space. To divert the Tecumseh drain and locate a water pipe along Wellington Avenue, in the same township.

7477—July 6—Dismissing application of the Brunette Sawmill Co. for an Order changing location of the V.V. and E. Railway and Navigation Co.'s railway across Lots 1 and 2, Suburban Block 1, and Lots 4, 5 and 7, Suburban Block 8, New Westminster, B.C.

7478—July 6—Approving proposed deviation of the V.V. and E. Railway and Navigation Co. from Sapperton to the Fraser River Lumber Co.'s mills at New Westminster, B.C.

7479—July 6—Granting leave to the G.T.R. and C.P.R. and other railway companies concerned to appeal from the Order of the Board made in the complaint of the British Oil Co., of Toronto, May 19th, 1909, to the Supreme Court of Canada, in the question of law involved in the making of said Order.

7480—July 6—Directing that St. Phillipe, St. Ferdinand and Metcalfe Streets at St. Henri, Montreal, be protected between the hours of 6 a.m. and 7 p.m. by watchmen to be appointed by the G.T.R.

7481—July 6—Directing the C.P.R. to provide and construct a suitable highway crossing over its railway at Gainsboro' Avenue, Township of Nepean.

7482—July 7—Dismissing complaint of Dominion Millers' Association respecting charges of the C.P.R. for the elevating and storage of grain at Fort William, Ont.

7483—July 6—Dismissing application of the town of Campbellford, Ont., for Order directing the G.T.R. to provide better passenger and train service connections between Campbellford and Toronto, Ont.

7484—July 9—Authorizing Canadian Northern Quebec Railway to construct its lines and tracks across public road between Lots 273 and 274, Parish of St. Stanislas, Que., at mileage 69.77 west of the Quebec bridge.

7485—July 9—Authorizing the Canadian Northern Quebec Railway to construct its lines and tracks across public road on Lot 301, Parish St. Stanislas, at mileage 69.30 west of Quebec bridge.

7486—July 6—Dismissing complaint of J. B. Grenier, of St. Tite, Que., alleging inefficient and unsatisfactory train service of the Canadian Northern Quebec Railway between Quebec and Montreal, and of lack of station accommodation at Heronville, Garneau and St. Tite, Que.

7487—July 10—Authorizing the C.P.R. to construct a bridge at mileage 97.8 on the Windsor section, Ontario Division, and rescinding Order 5796, April 8th, 1909, in so far as it authorizes the construction of the said bridge.

(Continued on Page 103.)

FREDERICTON MECHANICAL FILTER PLANT.*

Fredericton is situated on the St. John River and has a population of about 8,000.

The water supply is drawn from the river through a 15-inch riveted steel suction this taking the water from a crib pier 150 yards from the shore conveys it by gravity to a pump well located adjacent to the waterworks station. From the pump well the water is raised by two six-inch centrifugal pumps direct connected to reciprocating engines with capacity of 1,400 gallons per minute. These pumps raise the water to the coagulating basin (54 feet by 22 feet 3 inches), capacity 90,000 gallons, divided completely into two chambers to allow for the alteration of the period of coagulation to suit the varying conditions of the river. From the coagulating basin the water flows by gravity through the filter beds (10 feet by 15 feet) at the rate of 125 million gallons per acre per day to the clear water reservoir situated below the filter building. The clear water basin has a storage of 470,000 gallons.

The coagulating basin, filter tanks and clear water basin are constructed of concrete. The supply and effluent are controlled by hydraulic gates as are also the connections for cleaning the filter beds.

The water supply for the city is lifted from the clear water basin and supplied directly to the city by a cross compound Corliss Engine, manufactured by Allis-Chalmers-Bullock, Limited, which has a capacity of 3,000 gallons per minute. There is also a Gaskill Engine connected to the reservoir for emergencies. Both of these engines are also arranged to pump directly from the river.

From the above record the following Table is deduced showing the percentage of reduction in color due to the application of one grain of alumina sulphate per gallon:—

By an examination of the above table the following the deductions seem justified:

1. The color of the St. John River water is reduced a larger per cent. per grain of alumina sulphate used when the water carries from five to twenty parts per million of turbidity.

2. That when the color of the same water is fifty parts or more per million (platinum standlard), a larger percentage of color is removed per grain of chemical than when the color falls below this point.

* From the report of A. K. Grimmer, B.A.I., City Engineer, of Fredericton, N.B.

Table Showing Colour Reduction by Months.

Month	Average color of raw water. Platinum standard	Average turbidity of raw water	Grains alumina sulphate per gallon	Percentage of removal of color per grain per gallon	Remarks.
May	80.5	21	1.46	41.8	Note. — That where the table shows no turbidity for any month the intention is on certain days there was slight turbidity but it was not considered advisable to make the average of these to represent the month.
April	62.7	15	1.56	35.0	
June	78.2	10	2.02	30.9	
March	55.4	5	1.66	29.9	
December	56.	2	2.43	27.3	
August	52.7	0	2.16	27.3	
July	48.6	0	2.22	27.0	
November	51.0	2	2.11	26.5	
January	55.6	0	2.22	26.1	
February	44.0	0	2.32	26.9	
October	48.6	3	2.27	25.4	
September	48.6	0	2.71	24.1	

These facts having been noted in the daily operation experiments were made in the laboratory for the purpose of checking these results, and determining if possible the saving in chemical which could be made by the mechanical application of a specified quantity of turbidity. The following table shows the summary of experiments and results:—

The following table shows in detail the monthly operation of the filter plant:—

Record of Filter Plant Operation, 1908:

MONTH	Total water filtered per month in gallons	Daily average in gallons	Per cent. wash water used on filter beds	Total per cent. wash water	Air application in mins.	Turbidity (raw)	PARTS PER MILLION Colour Platinum Standard Raw	Eff.	Alkalinity Erythrosine Method Raw	Eff.	Alumina Sulphate in grains per gallon	Per cent. reduction of colour
January	16,801,600	553,385	.87	.92	7.0	0	55.6	23.3	41.8	22.8	2.22	50.
February	16,244,490	560,155	.82	.89	7.3	0	44.0	11.5	42.5	21.5	2.32	60.
March	15,781,800	509,020	.75	.80	8.1	5	55.4	28.8	37.2	23.3	1.66	48.0
April	16,448,510	548,284	.69	.76	8.5	15	62.7	28.5	35.1	22.0	1.56	54.5
May	16,960,650	547,118	1.05	1.12	6.5	21	80.5	31.1	23.3	10.5	1.46	61.1
June	16,357,450	545,248	.78	.82	7.8	10	78.2	29.3	31.2	14.3	2.02	62.5
July	16,525,080	635,580	.75	.79	8.3	0	48.6	20.5	39.5	20.2	2.22	59.9
August	19,806,550	703,437	.68	.75	8.4	0	52.7	21.6	40.5	22.4	2.16	59.0
September	17,211,200	573,706	.72	.77	8.0	0	48.6	16.8	44.4	23.7	2.71	65.4
October	16,174,190	521,747	.69	.73	8.0	3	48.0	20.5	48.0	24.8	2.27	57.8
November	15,977,650	532,588	.74	.77	7.4	2	51.0	22.5	42.0	24.5	2.11	56.0
December	16,486,600	531,822	.78	.83	7.5	3	56.0	20.	39.5	19.1	2.43	65.4
1908	200,775,770	563,513	.77	.83	7.7	..	56.8	23.3	38.7	21.1	2.09	58.7
1907	.....	544,000	...	.63	...	..	84.2	32.8	34.9	17.9	2.17	61.

Table Showing Experiments on Color Reduction.

No. of experiments from which average was deduced	Turbidity added. Parts per 1,000,000	PARTS PER MILLION Colour Raw	Eff.	Alkalinity Raw	Eff.	Alumina sulphate in grains per gallon	Percentage of colour moved per grain per gallon
4	0	59	17.5	40	19.3	2.35	30.
2	5	59	15.0	38	19.0	2.40	30.8
4	10	59	13.5	40	20.0	2.35	32.0
2	12	58	12.0	38	19.5	2.40	33.0
4	15	59	11.0	40	20.0	2.35	34.4
2	18	58	10.0	38	19.5	2.40	35.0
5	20	68	20.0	38	20.0	2.40	28.0
4	25	75	21.0	38	20.0	2.40	36.0
4	30	68	18.0	38	20.5	2.40	37.0

The experiments proved the records in as much as they show that an addition of turbidity increases the decolorizing action of the chemical, however, it should be noted that the laboratory experiments did not show as large an increase in the percentage of removal as was indicated by the daily records, and further that the reduction of alkalinity per grain of alum used decreased with the addition of turbidity.

It is a peculiar fact that the color of the St. John River water is harder to remove than is the case of any other plant whose records have been available or whose operation was personally observed. This is probably due to the fact that coloring matter in the water is caused by bark, lumber and other vegetable matter which reaches the plant in the form of tannins. A series of experiments will be conducted this year with a view of determining whether it would be advisable to hold this water for a period before treating it chemically thus giving the coloring matter a chance to decompose in which state it is believed the chemical would reduce the color by a much larger per cent.

From the annual record of the Provincial Board of Health the following table has been deduced showing the cases of typhoid per month and year, as far back as it has been possible to do so with accuracy:—

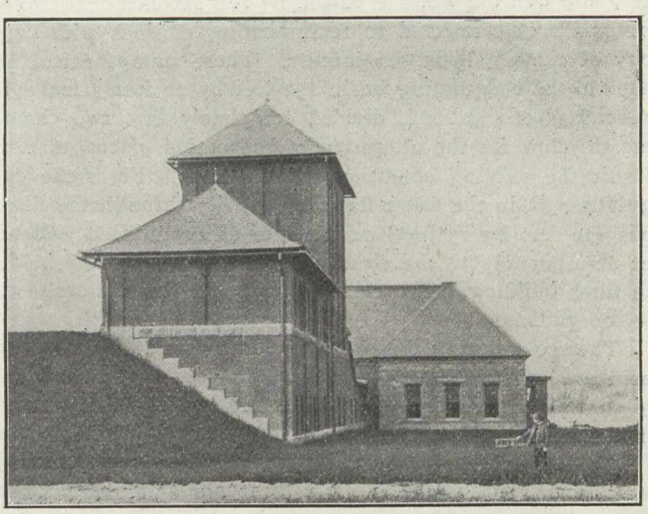
Cases and Deaths from Typhoid in Fredericton, compiled from Board of Health Records, 1895-1908.

DATE		January	February	March	April	May	June	July	August	September	October	November	December	Total Cases	Total Deaths
1895	C													66	
	D	0	0	0	0	0	0	1	3	1	6	2	0		13
1896	C													22	
	D								1		1				2
1897	C													19	
	D					1				1	1	1			4
1898	C													71	
	D	1								1					2
1899	C													23	
	D								1		1				2
1900	C													22	
	D								1		1		1		3
*1901	C														
	D														
1902	C	3	5	6	3	1	2	3	5	2	5	3	3	41	
	D										2	1	1		4
†1903	C														
	D														
1904	C	5	11	4	3	1	1	6	2	1	3	13	2	52	
	D	1	1	1		1						1			5
1905	C	4	9	40	27	6	0	3	1	1	6	8	3	108	
	D			2	1	1		1		1		3			9
1906	C	4	5	5	8	5	0	3	1	5	6	11	9	62	
	D		1		1	1						1	1		5
1907	C	5	6	15	17	30	8	1	1	1	1			85	
	D				1	1					1				3
1908	C	2	2	1	2	3	0	3	2	4	4			23	
	D														0

The Provincial Board of Health returns show deaths from typhoid every year back to 1888.

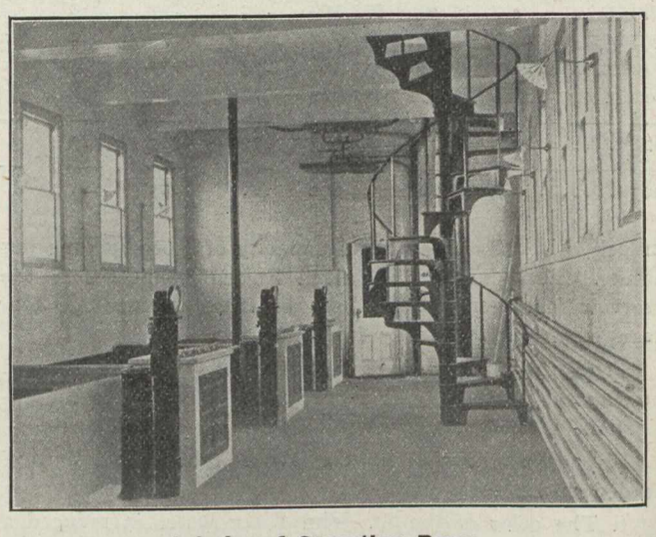
Previous to the installation of the filter plant the average number of typhoid cases per year was 55, or practically 1 per cent. of total poulation had typhoid fever every year, and an average death rate of 9.7 per cent., since the installation of the filtration the average number of cases per year is eighteen and the percentage of mortality has been reduced to 3.7 per cent. From personal examination and information obtained from the Local Board of Health, it has been ascertained that 80 per cent. of the cases of typhoid which have occurred since the installation of the filter plant would probably be due to local sanitary conditions on the premises, and it was further learned that two cases, approximately 10 per cent. were contracted outside the city, leaving 10 per cent. of the cases unaccounted for.

During the past summer the centrifugal pumps which supplied the raw waters to the filters were found to be inadequate in size and the contractors were obliged to install



End View of Filter Building and Power-House.

pumps with larger capacity, and are now operating satisfactorily. During the period which was required to construct larger pumps, the Gaskill Engine was used to supply water to the filters, but it was found to be practically impossible to supply water to the filters uniformly, and the chemical therefore was not applied with a uniformity sufficient to develop a high bacterial efficiency. The installation of the larger pumps was completed during the latter part of the month of October last. It will be noticed by reference to the table of typhoid cases, that the months of September and October showed an increase in the number of cases, which may or may not be due to the irregularity in the pumping, but which at least is a peculiar coincidence. The new pumps have proved most satisfactory and there have been no cases of typhoid reported since the first of November which fact strengthens the argument that the



Interior of Operating Room.

increase of typhoid during the months of September and October was due to irregularity of operation.

During the last year several sets of measurements were taken to ascertain the accumulation of sludge in the coagulating basin. Measurements were taken at six different points daily, the average of which would represent the average depth at the time in the basin. From these measurements it was possible to deduce a curve representing the decrease in volume of the coagulating basin and thus deter-

* 1901. Board of Health records give only deaths for this year.

† 1903. Board of Health records give only deaths for this year.

mine definitely the coagulation period which has proved to be one of the most essential features in the operation of this plant.

The Provincial Board of Health in its report to the Lieutenant-Governor in Council makes the following comment on the filtration plant and its results:

"It is with great pleasure and satisfaction that we have to report that the large expenditure made by the city in the inaugurating of a most perfect filtration plant in connection with their water supply from the St. John River, and their modern system of sewerage, has been fully justified by the results shown in the general health of the city as appears on examination of the statistics hereto appended. Typhoid fever, heretofore the blight of our otherwise most healthy city has been eliminated as an epidemic and from the present year's results we may fairly hope for and look forward to a continued improvement in the general health of this district as the result of these great sanitary improvements."

Filtration Plant Operating Expenses.

Cost of operation, exclusive of interest charges, $1,451.33. This, however, does not take into consideration the fact that the city at the end of the fiscal year 1907 had 34,875 pounds alumina sulphate in stock, which should be charged to 1908. This would otherwise have been an extra expenditure $553.38, or a total expenditure for 1908 of $2,004.71 for the operation of the plant.

SOME SUGGESTIONS REGARDING FORMS FOR CONCRETE HIGHWAY BRIDGES.*

By F. A. Peterson, Fairmont, Minn.

Reinforced concrete, for the construction of bridges and culverts, is superior to any other material that has been employed for such purpose. If properly made, it is not affected by storms, winds, or floods, and not subject to decay, rust or disintegration. It requires no paints or protection, no new floors to repair, and is constantly getting stronger and better with age.

The art in concrete bridge designing is its simplicity. There is at this time no form of bridge construction more simple and effective than the straight-beam design. It has the advantage of an unobstructed water-way and is somewhat cheaper than the arch design on account of the cost of forms.

Those contemplating building bridges of concrete should employ a competent engineer to draw the plans. Do not think of doing it yourself. If you undertake this class of work, failure will surely overtake you. I have heard many contractors complain that most engineers were too exacting in their specifications. In most cases they have themselves to thank. If the contractor is honest in his work and is willing to do the right thing, he will soon get the confidence of the engineer and the two will work together in harmony.

The cost of building concrete bridges, compared with steel, will vary somewhat according to location. I believe reinforced concrete bridges for county purposes can compete in price with the combination iron bridges that have been built in the past. The up-keep for the concrete bridges is nothing compared to the painting and repairing of iron bridges.

One of the difficulties to be met with in the construction of concrete bridges is the procuring of suitable labor, and the average carpenter, who has no experience in building forms, is of very little help to you. He does not realize the enormous weight that the timber has to bear and therefore, as a rule, does not build the centering strong enough. By employing a man used to building forms, much lumber will be saved. Usually too many nails are used in the work, causing a loss of time in building and ruining a large amount of material. No. 7 nails will generally be found large enough. Bracing can be done away with largely by using bolts, and the average man who does the bracing does not do it as it should be done, causing delay and loss. When bolts are used and well greased, they can be readily released at any time.

*Read before the Northwest Cement Products Association, Minneapolis, Minn.

Examination of the Site.

Before bidding on your job, examine the soil, bore down, and find what foundation you have to contend with. If you find any quicksand you must expect trouble, and your bid must be in accordance with the foundation you find. Insist on having the location and height of bridge to be built staked out so that there will be no question afterward.

Your bid will be governed largely by the distance your gravel an sand will have to be hauled. If your work is over a river, generally a good quality of sand and gravel can be found in pockets, but it is frequently mixed more or less with a large percentage of clay and shale. Be very careful of this material. One engineer declares that a 1:2:4 mix is extravagant, when a 1:3:6 mix will do just as well. This is rather misleading. The writer will admit that if the proper sand and aggregates can be procured, the 1:3:6 mix will do for the footings, abutments and wings, but where one has to procure the material in the country, the 1:2:4 mix is safer to use, on account of the class of material generally found.

Much has been said and written regarding the proper amount of water to be used in concrete, where it is to be poured, as is generally the case in bridge building. Concrete made as thick as cream is preferable under general conditions, but the mass should be thoroughly churned with paddles to dispose of the air. There are times and places when one should know when not to use very sloppy concrete. For instance, when filling bridge beams with concrete, where usually a network of reinforcement is used, judgment must be used so that the reinforcement will not hold back the coarse material, and allow the fine to pass to the bottom of the beam, thereby causing an arch under which there is no support, making your concrete uneven in aggregates and consequently weakening it in strength. The foreman should be constantly on the watch for errors of this kind.

Cost of Forms.

The cost data for form work in bridge building are misleading. The writer believes that there is a greater opportunity for investigation in the construction of centering and form building than in any other branch of concrete work. It is generally estimated that it costs from forty to fifty per cent. of the total cost of concrete in any building for form work. The system known as the "two-board form method" is a great improvement over the old style, and when the forms can be successfully made of steel, a still greater saving can be made. When your forms are all erected, be careful that your lines are in place and see that your work is measured a second time so that everything is true and in line. In placing your steel, keep strictly to your plans; see that every piece is placed as directed. Too much care cannot be exercised in that branch of the work. Do not neglect wiring, just because it is a little tedious. Have the wire cut about eight inches long before you begin your placing of steel. Number 18 wire is generally used by the writer for wiring rods together. If it is necessary to use stronger wire, just double the Number 18. See that all the steel is placed before pouring concrete. See that all sawdust and dirt are removed before placing steel, and that your lumber is thoroughly wet before concrete is placed.

Tools Needed in the Work.

Now a few words about a few of the tools needed: An anvil, a small forge, a few cold chisels, crow-bars, sledge hammers, post mauls, a good strong vise, tanner's nips, pliers, wire cutters, several claw pullers, several pieces of steel bars with both ends turned, to be used in taking the forms from the concrete; a few locomotive jacks, in case of forms giving way; grindstone, pipe cutters, stock and dies, taps and dies for bolts.

Nearly all of these you will find are indispensable. Your steel should be ordered the proper lengths from the factory, but the bending will have to be done at the job. Nearly all

(Continued on Page 103.)

LEGAL NOTES.

J. E. Parsons, B. A., Barrister-at-Law.

[This department will appear in the third issue of every month. Should there be any particular case you wish reported we would be pleased to give it special attention, providing it is a case that will be of special interest to engineers or contractors.—Ed.]

CONTRACT—CARRIAGE BY WATER—BUSHEL.

Mellady vs. Jenkins Steamship Co.—The defendant company were an American company running steamers of United States registry from Chicago. The vessel they supplied in this case was an American vessel, and of American register. The plaintiffs by agents in Toronto, opened negotiations with the defendants in Chicago for the carriage of oats from Fort William to Buffalo. These communications, after being carried on for a number of days, culminated by the Chicago brokers wiring the Toronto people, offering the steamer named "The Squire" to carry 90,000 bushels of oats at 2½ cents per bushel, and the plaintiffs, in reply, telegraphed, accepting the offer. It then followed that the steamer "Squire" proceeded to Fort William, where she loaded oats (98,163 bushels), which were received by the ship at 34 pounds per bushel. It transpires that 34 pounds to the bushel is the Canadian standard, but the United States standard is 32 pounds to the bushel. The oats were duly carried to Buffalo, and, upon their delivery there, freight was claimed by the vessel and paid by the agents of the consignees at the rate of 2½ cents per bushel of 32 pounds instead of per bushel of 34 pounds, and the shippers brought an action for the additional freight they had been forced to pay, the steamship company, on the other hand, claiming that upon paying the freight all right to object to the amount had been lost.

The Court held that, inasmuch as refusal to pay would have resulted in demurrage and other loss, the amount was paid perforce, and it could not be said it had been agreed to or any rights waived by making the payment.

The case, indeed, calls up an interesting point as to the formation of contract. It is an established principle in English law, which also applies in the United States, that where two parties adopt a common means of communication, as, for example, the post-office, then that common agent is equally identified with both, so that the contract is complete as soon as a letter of acceptance is mailed, and even before that letter has been delivered. Thus, too, in this case, both parties, if not in the earlier stages, did finally accept the telegraph company as their common agent. The offer was wired from Chicago to Toronto and was accepted by the return telegram. Therefore, the contract was completed, or, in other words, made in Toronto, and, therefore, it was to be supposed that the Canadian customs and standards would apply. In addition to this is the fact that the cargo of oats when loaded at Fort William was received by the steamship company as measured by the Canadian standard of 34 pounds to the bushel.

The Courts have held that freight could only be legally demanded at 2½ cents per 34 pounds, and that the balance must be refunded. 18 O.L.R., 251.

CLOSING OF HIGHWAY.

Taylor vs. Village of Belle River.—The council of the village of Belle River passed a by-law in August, 1908, providing for the closing of part of the Tecumseh Road through the said village, and Taylor, one of the ratepayers, moved to quash the by-law as ultra vires of the council. By Sec. 637 of the Ontario Municipal Act, 1903, municipal councils have power "for.....stopping up roads .....**wholly** within the jurisdiction of the council." It was contended that "wholly" applied to the territorial limits of the roadway, and, therefore, the council could not close a road which passed through several municipalities; but the Court held it applies not to the locality of the road, or part of road, but refers to the question whether any other council or person has any control over that particular road or portion of road. They held, therefore, that the council may close that part of a highway lying within its own limits, although the road is a general highway extending from township to township. 18 O.L.R., 330. It seems probable, however, that in closing such a road the council would be bound to open up some other highway in substitution for same.

Any unlawful stopping or diversion of a public highway is an obstruction, and amounts to a criminal offence. "Once a highway, always a highway," and a highway cannot be stopped or diverted except by special Act of Parliament, or following the provisions of some general Act. In Canada this power of Parliament is handed over to the Provincial Legislature. It is the duty of local councils to protect public rights-of-way within their confines, and they cannot proceed to close or otherwise interfere with any highway except by such precise methods as the Legislature has prescribed.

DRAINAGE—OUTLET FOR WATER.

Hiles vs. Township of Ellice.—The Township of Ellice, wishing to drain certain lands within their own township, exercised the powers given by the Municipal Act of carrying the work into the lower adoining Township of Elma, for the purpose of finding an outlet, without any petition from the owners in the adjoining township. The plaintiff claimed that the defendants did not carry the drain to any proper outlet, but brought in the water from the Township of Ellice and deposited it on the land in Elma at a point from which it spread over several lots, eventually reaching his land, where it lay, to the detriment of his farm and crops.

Held, that a municipality constructing a drain cannot let water loose just inside the boundaries of, or, indeed, anywhere within an adjoining township, without being liable for injury caused to surrounding lands.

Held also, that a tenant of the lands injured can maintain an action and recover damages for such injury as results during his occupation. During the term of lease his rights rest upon the same basis as if he were a freeholder. 23 S.C.R., 429.

Where the owner of lands is thus injured he has two means of redress, and may suit himself as to which he will follow. He may apply for arbitration to the drainage referee, and thus assess his damages, or he may issue a writ for the amount of the injury he has sustained and obtain judgment of court. 25 O.A.R., 226.

CONFIDENTIAL RELATIONSHIP—SPECIFIC PERFORMANCE.

Henderson vs. Thompson.—The plaintiff, who lives in Rossland, B.C., visited the defendant, Mrs. Thompson, who lived in Seattle, Wash., and ascertained that she was willing to sell a house and lot which she owned in Rossland; and he offered to act in a friendly way for her in helping her to secure a purchaser. Upon his return to Rossland he opened up correspondence with her, representing that he was in

touch with prospective buyers, whom, however, he did not name. He informed her that the house was in a dilapidated condition, and, therefore, a good price could not be obtained, and advised her to accept the offer made, which she did. Later, when she discovered that the plaintiff and his wife were themselves the purchasers, she refused to carry out the sale, and they brought this action to force her to convey to them.

It was admitted that the defendant thought the plaintiff did not want the property himself, but only wished to befriend her in finding a purchaser. He refused, indeed, her offer to pay him a commission for his services, but that, of course, made no difference, as he left her clearly under the impression that he was nevertheless to act as her agent in the prospective transaction.

When he returned to Rossland he continued the misrepresentation, and led her by letters to believe that he was in treaty with some third parties for the purchase, and advised her to accept that third party's offer as being the best he could get out of them. As a matter of fact, it transpires that the third party was his wife, and that he himself had an interest in the purchase. He, therefore, occupied a position where his interest and his duty conflicted, and the authorities are conclusive that, in such cases, where there is a non-disclosure of that which it was the plaintiff's duty to disclose, no specific performance can be granted. In this case there was not only non-disclosure, but misrepresentation of material facts.

The plaintiff's action was dismissed with costs, 41 S.C.R., 445.

In the days when English law was in the evolutionary stages the courts knew nothing of such a process as enforcing specific performance of a contract. If one man refused to carry out his contract, the other party could institute an action for damages, and these, if obtained, would be proportioned to the seriousness of the loss or injury suffered by reason of the breach of contract. Then the plaintiff must proceed to collect his judgment, which was in many cases useless, as the defendant was not a man of substance, and thus the legal remedy was really a farce.

A secondary practice arose later in allowing the injured to elect to proceed for damages as above or sue for performance of the contract. The older remedy was based upon strict law, and if a plaintiff could prove a breach, he was entitled to a judgment, be it ever so small; but the new process was based upon equity and good conscience, and the Courts would refuse to help him if his own conduct had not been open and honorable. In the case above the plaintiff proved the existence of the contract, but the Court refused to enforce it because obtained by dishonorable means.

(Continued from Page 101.)

of it should be bent cold; unless you have an experienced blacksmith there is danger of overburning your steel, thereby weakening your material.

Most of your outside forms can be removed the next day after the concrete has been placed, by wetting the concrete thoroughly. Then apply a 1:2 mix of fine sand, brushing and rubbing down with a carborundum stone. This gives the surface a very smooth and pleasing effect.

Last but not least see that all plank walks and scaffolding are rigid and strong, preventing any cause for accidents. This one item alone may save you an expensive law-suit. Take no chances.

RAILWAY ORDERS.

(Continued from Page 98.)

7488—July 9—Directing the G.T.R. to provide a night watchman at Wellington Street crossing, Hamilton, Ont.

7489—July 9—Authorizing switching connections between the Bay of Quinte Railway and the Kingston and Pembroke Railway at Harrowsmith, Ont.; Bay of Quinte Railway to install and maintain semaphores at its own expense on each line of railway.

7490—July 6—Authorizing the Canadian Northern Ontario Railway Co. to cross and connect the tracks of the Ottawa and Prescott Railway Co. at mileage 56.6 west from Hawkesbury, Ont.; interlocking plant to be installed.

7491—July 9—Approving Canadian Northern Ontario Railway Co.'s freight tariff, C.R.C. 74, for use on the company's line of railway east of and including Toronto and Sudbury.

7492—July 6—Refusing application of corporation of Township of Rochester for Order varying Order No. 6981, May 10th, 1909, authorizing the construction by C.P.R. of Bridge No. 92.1 on Windsor section, Ontario Division.

7493—July 10—Authorizing the Canadian Northern Ontario Railway to open for traffic that portion of its line from South Nation River to Rockland, a distance of twelve miles.

7494—July 7—Disallowing Canadian Express Company's notice of cancellation of rate of 30 cents per 100 pounds on freight shipments from Queenston, Ont., to Toronto, Ont., which was made effective by the company on 14th June, 1909.

7495—June 25—Directing the G.T.R. and Bay of Quinte Railway Companies to publish and file with the Board a joint rate on bituminous coal from Black Rock, N.Y., and Suspension Bridge, N.Y., to Marlbank, Ont., of $1.43 per ton of 2,000 pounds on a minimum weight of fifteen net tons per carload, except in case of cars having a less marked capacity than fifteen net tons, the said marked capacity, but not less than twelve net tons shall be the minimum carload weight. Rate to become effective not later than 23rd August, 1909.

7496—July 6—Authorizing town of Prescott, Ont., to lay and maintain a sewer outlet pipe across tracks of C.P.R. at Prescott.

7497—July 10—Approving by-law of the Atlantic, Quebec and Western Railway Co. authorizing Alphonse Lemieux, general manager of the company, to prepare and issue tariffs to be charged for all traffic carried on its railway.

7498—July 6—Dismissing application of Herbert Bingham and Joseph Quenneville, of Crysler, Ont.; Robert Stevens and Thos. Fleming, of Township of Finch, and Louis A. Landry, Township of Cambridge, for an Order directing the Ottawa and New York Railway to rebuild its railway station at Crysler, Ont., at a point on the north-east side of its railway line about 1,657 feet in a north-westerly direction from the site of its previous station.

7499—July 6—Dismissing application of the Montreal Park and Island Railway for authority to extend its line of railway along St. Denis Street, Montreal.

7500—July 7—Dismissing application of the Manitoba Grain Growers' Association for Order directing C.P.R., C.N.R. and G.T.R. to reduce their charges for the elevating and storage of grain at terminal elevators at Fort William and Port Arthur, Ont.

7501—July 13—Authorizing the C.P.R. to construct its railway across the highways in Township of Tay at mileage 2.98, 3.05, 5.36, 8, and 9.14.

7502—July 8—Approving location of the Union Station of the C.P.R. and C.N.R. at Maryfield, Sask.

EXPERIMENTS MADE AT GARDEN CITY, DODGE CITY, BUCKLIN, AND FORD, KANS., WITH SAND-CLAY.*

In the semi-arid portions of Kansas and Nebraska there is an extensive area of sand hills. These hills are usually parallel to the rivers, and vary in width from a few hundred yards to several miles. They are continually shifted by the winds, and hence road building in this region is a difficult problem. Good road material is scarce and the country is sparsely settled. In many localities there are no road ma-

* From information furnished by the Public Roads Department of the Department of Agriculture, U.S.

terials except an alkali soil, gypsum clay, or a gumbo-like sedimentary clay.

Experiment at Garden City, Kans.

At this point sand hills run parallel to the Arkansas River on the south side, and form a strip nearly seven miles wide. A careful inspection of the vicinity revealed no available road material except occasional deposits of gypsum clay distributed irregularly across the sandy belt. From two of these deposits was taken the material used in the construction of the road at this place. The first pit was opened about 900 feet east of the road and the other near the roadside. From the first pit 68 cubic yards was hauled, but it was then abandoned because of the distance of haul, and because the clay showed a lack of binding power. The road was completed with material from the second pit. The farther down in the pit the stickier was the clay and the better it compacted after the addition of sand.

The problem to be solved in this case was the best method of handling the local material, gypsum clay, so as to produce a road with a wearing surface capable of resisting the action of the constant winds, which are generally from the south. For this experiment a section of road 765 feet long, situated on the slope of a sand hill, was selected.

The clay was hauled directly upon the road, down the centre of which a width of 12 feet had been staked. The clay covering was spread to a depth of about nine inches immediately after it had been dropped on the road. The clay was hauled over the loads previously deposited and all holes so made were filled at once. Traffic was allowed upon it, and this compacted the clay firmly. During the time of hauling the clay no rain fell, but after the hauling was completed a heavy rain soaked the clay, and the road was finished as follows: While the road was wet a spike-toothed harrow was put on and the clay completely pulverized. Then five furrows were backfurrowed on each side of the clay, thus raising the sand shoulders above the clay centre. A split-log drag was now put on the road, and the sand thus raised by ploughing was pulled from the shoulders upon the clay and thoroughly incorporated. The road was then smoothed and left for travel.

While the construction of this road followed closely the ordinary method of sand-clay construction, still there were some variations, owing to the peculiar conditions to be met, as has already been explained. It was believed that a surface was necessary which would resist the occasional heavy showers incident to this climate and at the same time the action of the winds. Therefore, the clay having the greatest tenacity was selected. Because of the dryness of the climate it was deemed best to proportion the clay far in excess of the sand. While the clays available may not be altogether desirable, still any clay that will pack under traffic will improve greatly the heavy sands found in this locality.

The cost data of this experiment follow, and also the miscellaneous details of all four sand-clay experiments (Table 6).

Stripping clay in pit	$ 7 17
Ploughing up clay in pit	10 50
Loading clay into wagons	33 00
Hauling clay to road	39 50
Spreading clay on road	10 00
Sanding, harrowing, and finishing road	2 33
Cost of clay on road per cubic yard	40
Cost per square yard of part clayed	10
Rate per mile	707 45

Table 6.—Miscellaneous Data of Sand-clay Experiments.

Place.	Length of road treated. Ft.	Entire width of road. Ft.	Width of clayed part. Ft.	Depth of clay layer. Ins.	Clay hauled to road. Cu. yds.	Surface clayed. Sq. yds.
Garden City	765	30	12	9	256	1,020
Dodge City.	9,750	30	14	all	3,703	15,167
Bucklin	4,271	30	14	12	1,883	6,644
Ford	350	30	16	13	179	622

a Depth of clay and sand.

Experiment at Dodge City, Kans.

The same natural conditions exist here as at Garden City, and the sand hills are on the same side of the river, though only two miles wide. A section of the road leading to Mineola, Kans., was selected, and after the work was started the citizens became much interested, and urged that the entire two miles be hard surfaced. This was done.

The general plan of construction at this place was similar to that at Garden City. A deposit of clay was found near the middle of the section to be improved, formed from silt from an old irrigation ditch no longer in use. The water had been allowed to run into a large basin, and about four acres were covered to a depth of 18 inches with this fine silt. It had thoroughly dried out, so that when ploughed up it was in excellent shape for handling with shovels. This material was almost gritless, and became very sticky when wet. Although this may be regarded as an unusual condition in this locality, nevertheless results may prove it expedient to use a river silt for road purposes in other irrigation districts when practicable. If this material had not been found the road would have cost fully 50 per cent. more.

The entire roadway was 30 feet wide. In the centre of this a 14-foot track for clay was laid out by ploughing two furrows 14 feet apart. The dirt was thrown out toward the side gutters. Beginning at the middle, the 14-foot part was ploughed by backfurrowing the dirt toward the centre. This formed a crown in the middle of the part to be clayed. Next, this was harrowed and the subgrade completed with a small grader. The shoulders were then made by running a furrow outside the subgrade and backing up the first furrow on each side. Two more such furrows were run, and in this way the shoulders were formed at least 10 inches higher than the subgrade. If the cross section is level, a toothed harrow is excellent to prepare the subgrade after it has been ploughed as has been described above. When it is necessary to move material from one side to the other, or to carry material along in the subgrade, a two-horse grader will be found useful.

After the subgrade had been prepared the clay was hauled and dropped three loads abreast. The centre loads followed the centre line exactly, and to this end a line of centre stakes was set 200 or 300 feet in advance of the clay hauling. It was then an easy matter to drop the side loads properly. It is best to keep the centre loads 30 to 50 feet in advance of the side loads. In this way three teams may be kept busy at the same time. In order to get a sufficient sand covering upon the road, drag scrapers were used and sand hauled from beyond the borders of the roadway. It was then spread with a harrow and a two-horse grader evenly over the road and mixed with the dust and fine particles of clay. After a rain the sand was quickly incorporated with the clay. Still more sand was evidently needed, and this was harrowed into the clay as the mass dried and packed under travel. Finally, a large grader was used to shape the road.

As has been stated above, the clay at this place was rather more of an accident than a natural condition of wide extent; still it is of sufficient importance to justify a careful study of its behaviour on the road. It would be an easy matter to provide settling basins along irrigation canals where this fine silt could be collected, and after the water had been shut off, the clay thus deposited could be hauled upon the road. In this way large quantities of material could be provided, and if its use proves as valuable as indications seem to show, much good may be expected from this source in the improvement of heavy sand roads along irrigation ditches. In this experiment the silt combined readily with the sand when wet and held it firmly. The addition of sand took away its sticky qualities.

The cost data of this experiment follow:—

Foreman for job	$ 51 50
Excavation (2,539 cubic yards)	396 69
Shaping subgrade	70 00
Ploughing up clay	54.875
Loading clay into wagons	470 00
Hauling clay to road	608 38

Spreading clay on road	93 00
Harrowing and mixing clay and sand	6 00
Sanding road and building shoulders	107.685
Dressing road with grader	27 00
Work on bridge, timber, etc	59 53
Repairs, water boy, and sundries	52 75
Cost per square yard of part clayed	.138
Rate per mile	1,135 83

Experiment at Bucklin, Kans.

For this experiment a portion of the road leading from Bucklin to Spearville was selected. It was on the south side of the Arkansas River, as in the preceding cases. The general plan of construction was identical with that used at Dodge City, but the clay was of a different quality. At the south end of the road a clay was used which proved to be a kind of buckshot. It hardened well, although the surface appeared to be of a loamy character and blistered badly at first, though later it packed and gave promise of durability. After removing the surface of the clay pit to a depth of 12 inches the character of the clay changed materially and it promised to be an excellent road material. At first it was feared that it might lack the necessary binding power, but as it was the only material within a mile of the road its use was begun as an experiment. When the pit was lowered 30 inches the clay became excellent in quality. This pit was located at the highest point on the road, and its use proved a great economy because of the ease of haul. From a place near the other end of the road an alkali clay was hauled upon the sand at that end. A section 6,771 feet long was laid out and ploughed and the subgrade shaped ready for the clay. Of this distance, a section 4,271 feet long was improved and a section of 2,500 feet left to be improved by the community.

Following are the cost data of this experiment:—

Foreman for job	$ 50 00
Excavation (1,584 cubic yards)	224 07
Shaping subgrade	32 37
Ploughing up clay in pit	16 75
Loading clay into wagons	235 75
Hauling clay to road	304.875
Spreading clay on road	44.625
Repairs, etc.	40 92
Cost per square yard of part clayed	.14
Rate per mile	1,183 64

Experiment at Ford, Kans.

At Ford a short section forming the south approach to the bridge crossing the Arkansas River was graded and clay added. This was really a matter of grading an incline to the bridge, but as the material for the approach was sand it was necessary to form a hard top surface. This was done by adding clay. The material was gotten from a valley basin where clay had settled. The section of road treated was 350 feet long, and a bed of clay 16 feet wide and about 12 inches deep was put on. The surface was then covered with sand two inches deep and left for traffic to mix. It was frozen hard when placed on the road.

Some of the cost details follow:—

Filling up and widening road	$ 17 25
Ploughing, loading, and hauling clay	10 50
Spreading clay	8 00
Sanding clay	8 00
Dressing road with grader	.50
Total cost	$104 25

TORONTO ENGINEERS' CLUB ANNUAL EXCURSION.

On Friday and Saturday, July 16th and 17th, the Engineers' Club, Toronto, held their annual excursion. Last year they journeyed from Toronto to Peterboro', and sailed up the Trent Valley Canal from Peterboro' to Bobcaygeon. This year they went by C.P.R. from Toronto to Bobcaygeon, and sailed west through sixty-eight miles of lake, river and canal to Lake Simcoe, then across Lake Simcoe from Beaverton to Jackson's Point, and home to Toronto by the York Radial Railway.

The members of the club who were along, together with a few friends, were: C. H. Rust, City Engineer; J. G. Sing, Government engineer, both of whom are past presidents of the club; John Tolmie, M.P., J. H. McGregor, C. J. Printz, W. A. Johnson, John Scott, W. G. Bligh, E. A. Collyer, E. A. James; A. T. Malone, resident engineer, Newmarket Canal; O. N. Scott, J. A. Richardson, W. A. Bucke, B. G. McBurney, T. C. Irving, jr., R. Home Smith, C. B. Hamilton, A. F. McCallum, W. C. Brennan, R. A. Baldwin, chairman Executive; T. L. Somerville, D. D. James, C. W. Dill, E. H. Keating, T. J. McConkey, R. Southam, J. S. Fielding, and L. J. Street, the treasurer of the club, and who capably managed the expedition.

On the boat the party were the guests of Mr. M. J. Butler, Deputy Minister of Railways and Canals, and in the hands of Mr. J. Harris McClellan, superintendent Trent Valley Canal, who was not only an ideal host, but a veritable cyclopedia of information as well.

The trip was really the second chapter of last year's outing, which was over the eastern end of the canal. The day was spent aboard, with intervals for examining the engineering works along the route.

The expressions of approval were very general among the visitors at finding the work done along the whole route of so substantial and permanent a character. The new steel lift locks at Kirkfield naturally drew the closest attention, and the ease and precision with which these immense steel tanks lowered the boat from the level of Balsam Lake, the highest of the system, to the reach forty-eight feet below, as well as the massive and finely-finished character of the whole lockage work, was the subject of much favorable comment.

Boats can now travel on the canal from Lake Simcoe to Healy's Falls, a distance of 165 miles. Between Simcoe and the high level at Balsam the rise is 122 feet, this being overcome by six locks, one of eleven feet, three of fourteen feet each, one of twenty-two feet, and the Kirkton lift of forty-eight feet. There will be eight feet and four inches of water over the sill, and the locks will accommodate vessels 140 feet long by 34 feet beams. A barge this size will hold 25,000 bushels of grain. The total length from Lake Simcoe to Trenton will be 210 miles, or, when the Severn works are completed from Georgian Bay to Trenton, it will be 272 miles. The supplementary canal from Cooke's Bay on Lake Simcoe to Newmarket is 17½ miles in length. On the main canal there are great contributory lake and river waters, which are controlled by dams and weirs, while there is a drainage area of over one hundred square miles contributory to the Newmarket system, over which the water can easily be controlled, thus assuring abundance of water for operating at all times of the year, and furnishing as well very large quantities of valuable water power.

Before parting, Mr. Rust, on behalf of the club, expressed to Mr. McClellan their appreciation of the most hospitable entertainment provided. They were delighted to see the country and the work that was being done. In his reply Mr. McClellan spoke of the scope of the work and the good progress that was being made, especially since the Deputy Minister, Mr. Butler, had taken it in charge. He hoped to see it opened all the way from Midland to the Thousand Islands. In New Jersey alone, he said, there were $50,000,000 spent annually in the tourist trade, and the large and increasing tourist traffic in the waters served by this canal would soon make this alone a very important source of revenue, in addition to the local and through commodity trade. The character of the work showed for itself, and he was delighted to have the Toronto engineers with him to inspect it.

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.

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 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 INDEPENDENT TELEPHONE ASSOCIATION.—President, J. F. Demers, M.D., Levis, Que.; 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 FORESTRY ASSOCIATION.—President, Thomas Southworth, Toronto; Secretary, R. H. Campbell, Ottawa.

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.

Nova Scotia Society of Engineers: September 9 and 10. Third annual meeting at New Glasgow, N.S. S. Fenn, Halifax, N.S., secretary.

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.

National Irrigation Congress.—Seventeenth meeting, August 9-14, at Spokane, Washington; Arthur Hooker, Secretary, Board of Control, Spokane, Wash.

League of American Municipalities.—August 25-27. Thirteenth annual convention at Montreal, Que. John MacVicar, Secretary, Des Moines, Iowa.

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.

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.

Nova Scotia.

HALIFAX.—Tenders for supplying furnishings for the Nova Scotia Technical College will be received up to Saturday, July 31. F. W. Smith, secretary to commissioner.

SYDNEY.—Tenders are wanted until August 4th, for sewer extensions. D. McD. Campbell, City Engineer.

Quebec.

MONTREAL.—Tenders will be received until Thursday, the 29th July, for the supply of: (1) A ten ton steam road roller. (2) 1,600 tons of ¼-inch "Banc-Rouge" gravel (screenings). (3) 900 tons of 2-inch "Banc-Rouge" broken stone. L. O. David, City Clerk.

Ontario.

BERLIN.—Tenders are invited for bitulithic, asphalt block, and vitrified brick pavements. Davis and Johnson, City Engineers.

LONDON.—Tenders will be received up to Saturday, July 24th, for construction of the Scanlon drain, London East. F. W. Farncomb, Township Engineer.

MIDLAND.—Tenders will be received up to Monday, the 26th July, for the construction of approximately 20,000 lineal feet of concrete walks. Thos. I. Trueman, Town Clerk.

OTTAWA.—Tenders will be received up to August 15 for the furnishing of iron posts for use on the survey of Dominion lands. P. G. Keyes, secretary, Department of the Interior.

OTTAWA.—Tenders will be received up to August 15th, for supplying the lubricating oils required by the Department of Marine and Fisheries for three years. G. J. Desbarats, acting Deputy-Minister of Marine and Fisheries.

OSHAWA.—Tenders wanted until Aug. 2 for supplying material and erecting a Y.M.C.A. building in Oshawa. Plans and specifications may be seen at Mr. F. Bull's office, Oshawa, or at the office of C. J. Gibson, 75 Yonge Street, Toronto.

RAINY RIVER.—Tenders will be received until July 28th for pipelaying, pumping machinery and other waterworks equipment. Jas. A. Bell, Consulting Engineer, St. Thomas, Ont. J. H. Wilson, Town Clerk. (Advertised in The Canadian Engineer.)

SIMCOE.—Tenders for Post-Office fittings will be received until July 30th. Napoleon Tessier, Secretary, Department of Public Works, Ottawa.

TORONTO.—Tenders will be received up to Tuesday, August 3rd, for the construction of reinforced concrete arch of 35-foot span, having a 42-foot roadway, and two 6-foot sidewalks, containing about 1,500 cubic yards of concrete. Joseph Oliver (Mayor), Chairman Board of Control.

TORONTO.—Tenders will be received until July 28th for the construction of transformer and interswitching stations at Toronto and other points in Ontario. Hydro-Electric Power Commission, Continental Life Building.

Manitoba.

WINNIPEG.—Tenders will be received until August 2nd and August 16th for hydraulic, electric, and auxiliary equipment for the generating station at Point du Bois. For plans, etc., apply Smith, Kerry & Chace, engineers, Winnipeg; William Kennedy, jr., Y. M. C. A. Building, Montreal, and M. Peterson, secretary, Board of Control, Winnipeg.

WINNIPEG.—Tenders for supply of quantity of brass and galvanized fittings will be received to Saturday, July 24th. M. Peterson, Secretary, Board of Control.

Saskatchewan.

FRANCIS.—Tenders will be received until Monday, July 26th for: (a) Furnishing material and constructing a concrete collecting basin, 25 ft. x 25 ft. x 18 ft. (b) Furnishing 9,750 feet 6-inch wooden pipe. (c) Furnishing 4,630 feet 6-inch cast-iron pipe, with necessary special castings. (d) Gate valves, valve boxes and soft lead. (e) Labor laying wooden and iron pipe. C. R. Gough, Secretary-treasurer.

MOOSE JAW.—Tenders will be received until Monday, August 9th, for the construction of a reinforced concrete bridge and abutments. J. Darlington Whitmore, City Engineer. (Advertized in the Canadian Engineer.)

MOOSE JAW.—Tenders will be received until August 9th, for the construction of concrete walks and concrete block crossings. J. Darlington Whitmore, City Engineer. (Advertized in the Canadian Engineer.)

SASKATOON.—Tenders are wanted for the construction of a subway under the C.N.R. tracks. Geo. T. Clark, City Engineer.

British Columbia.

KAMLOOPS.—This city desires tenders for pipe, hydrants and fittings in connection with waterworks extensions. R. H. Lee, City Engineer.

NEW WESTMINSTER.—Tenders will be received up to Monday, August 9th, for supplying about 74,600 feet of steel pipe, with an inside diameter of 24 inches, and about 16,000 feet of steel pipe with an inside diameter of 12 inches. Specifications may be seen at the office of Messrs. Hermon and Burwell, Vancouver, B.C. W. A. Duncan, City Clerk.

CONTRACTS AWARDED.

Quebec.

WESTMOUNT.—Cairnie & Company have secured a contract from this city for laying sidewalks and channels at 25 cents a square foot. Gutters and channels will be constructed by Morssen & Company at 69 cents a square foot, and gutters only at 52½ cents. The acceptance of the Structural Steel Company's offer of $3,800 for incinerator extensions was ratified.

Ontario.

AMHERSTBURG.—The Gutta Percha & Rubber Company have been given a contract by this municipality for 300 feet of No. 1 Paragon hose. The town has been buying this brand for many years with satisfactory results.

LONDON.—At a recent council meeting the following contracts for sewers were awarded: Hamilton road, F. Harding, $499, side drains 28 cents a foot; Palace Street, F. Harding, $524, side drains 26 cents; Ardavan Place, Blight & Fielder, $623, side drains 50 cents.

PETERBOROUGH.—James Peat & Sons, of Petrolia, Ont., have received a contract to bore for gas and oil at $1.50 per foot for 2,500 feet.

TORONTO.—The Provincial Department of Public Works has awarded the contract for the construction of the new dam at Dog Lake to Mr. Wm. White, of Burlington.

TORONTO.—The contract for the new boilers for the Normal School heating plant has been awarded to the Polson Iron Works, Toronto, at $1,895. The Institute for the Blind at Brantford is also getting a new set installed, for which the Waterous Engine Works Company, of Brantford, will receive $1,940.

Saskatchewan.

NORTH BATTLEFORD.—One hundred thousand dollars will be spent by this municipality for the installation of waterworks, sewerage and electric light. Contracts have been awarded as follows:—Excavations, McManus & Marocco, of Winnipeg; power house and pump house, William Cook, Saskatoon, Sask.; steel water tower and housing, Ontario Wind Engine & Pump Company; foundation for water tower, William Cook; water pipes (cast iron and special); hydrants, valves, etc., Canada Foundry Company.

Alberta.

EDMONTON.—The Edmonton Standard Coal Company has been given a contract for 1,400 tons of coal at $2.90.

EDMONTON.—Tenders for the new high school were as follows:—

	Roman stone.	Calgary.	Tyndall.
*Carmel & Spencer	$105,101	$105,101	$115,601
Manson & Dunlop	113,690	114,494	117,799
Rendall & Mackay	114,578	115,578	.....
McHardy & Sheppard	.....	.....	135,377
Geo. C. Porter	117,184	.....	119,684
Chas. May	116,400	116,980	.....
Pheasey & Batson	114,300	114,800	.....

*Accepted.

RAILWAYS—STEAM AND ELECTRIC.

New Brunswick.

MONCTON.—The new I.C.R. freight car and passenger car repair shops, to be built at St. John, will be of the most modern and advanced style, according to the plans now on file at the chief engineer's office of the I.C.R. here.

ST. JOHN.—The C.P.R. will spend $75,000 on improvements at Aroostook Junction. Tenders for the extensions, which include a six-stall engine house, turntable and pit, will be opened in a few days.

ST. JOHN.—A. & W. D. Wheaton have been awarded the contract by the Drummonds for the twelve mile section of railroad between Bathurst and their mines in Gloucester County. They have sublet five miles of the work to the contracting firm of Mitchell & Sutherland. Both of these firms have been subcontractors from the Toronto Construction Company on their work on the G.T.P. Mitchell and Sutherland were at Chipman, and the Wheatons about eight miles northeast of Stanley in York County.

Quebec.

MONTREAL.—Most of the proceeds of the sale by the Canadian Pacific of $5,000,000 of its preferred stock in London will be applied to the enlargement of its terminal facilities at Montreal.

MONTREAL.—A strong belief prevails in railway and financial circles that negotiations are now in an advanced stage aiming at the acquisition of the New York Ontario and Western, either by the Canadian Pacific direct or through its Soo line. The assets of the New York, Ontario and Eastern are valued at $92,870,000, of which $77,000,000 represents franchises and property and $12,000,000 investments in other companies. Its common stock is $58,000,000, and its funded debt $23,000,000.

Ontario.

COBALT.—Chief Engineer C. G. Henry, of the Nipissing Central Railway, has gone to Ottawa to file with the Government and Railway Commission, final location and structural plans of the Nipissing Central Railway, which is to connect Cobalt and Haileybury by an electric line this year.

FORT WILLIAM.—A new union depot is being built at this point. The C.P.R. has put a force of men on the excavations.

HAMILTON.—It is believed that railway construction will be active about this city during the latter part of this year, as several railway companies are likely to begin operations in extending their lines. The Radial may be extended from Oakville to Toronto, the Guelph Junction spur line will probably be started, the Canadian Northern proposes to build its Niagara to Ottawa line, and the Hamilton, Waterloo & Guelph Railway will likely be started. The condition of the money market during the last year or more has interfered with the plans of some of the companies mentioned, but it is understood that this difficulty has been or is being met and that in a short time active operations will be commenced.

OTTAWA. — The Railway Commission has issued an order compelling every railway in Canada to have the whole of its right-of-way properly fenced in by January 1, 1911. The order states that the fence must be of a minimum height of four feet six inches, and gates must be provided at every farm crossing. At every level highway crossing there must be adequate cattle guards. The width of approaches to level crossings must be twenty feet on concession and main roads and sixteen feet on side and bush roads.

TORONTO.—The Canadian Northern Railway have just sold debentures amounting to $10,000,000, which will be applied on the construction of a line from Toronto to Niagara Falls, with an extension from Toronto to Smith Falls and Ottawa, to join existing lines to Montreal and Quebec via Hawkesbury.

TORONTO.—Writing to the Ontario Railway Board, the manager of the Irondale Bancroft and Ottawa Railway intimated that his line might shortly be extended in the near future towards Ottawa. At present the line extends from Kinmount Junction on the Grand Trunk to Bancroft, a distance of 48 miles.

Manitoba.

WINNIPEG.—The Fisher Construction Company, of Chicago, is considering the construction of an electric railway from Minot, N.D., to a point near Boscurnis, Sask. It is said that $150,000 has already been subscribed.

Saskatchewan.

NORTH BATTLEFORD.—Operations on the North Battleford-Athabasca line to the North-West began on Monday last. One of the construction parties arrived here on Sunday, followed on Thursday by a second party. Fifty miles of this road has been guaranteed by the Government, but it is probable that considerably more than fifty miles of this road will be built this year.

Alberta.

CALGARY.—Medium weight rails are being replaced by those of the heaviest weight on the Edmonton and Macleod branches of the C.P.R.

EDMONTON.—An eighteen-stall roundhouse and work shops will shortly be erected in Edmonton by the G.T.P.

EDMONTON.—Messrs. Foley, Welch and Stewart have received the contract for building that part of the Grand Trunk Pacific between Macleod River and Tete Juane Cache, B.C., which will carry the line through and fifty miles to the west of the Yellowhead Pass. This section is one hundred and eighty miles long. Rails are being laid from Edmonton west to MacLeod River, to which point, it is announced, trains will be running from Winnipeg by September. The railway company is also calling for tenders to be in by August 15th, for the construction of 140 miles of line from Kitsalas Canyon to Aldermere in Buckley Valley, being the second section inland from the Pacific Coast end of the line. With construction under these contracts in operation, there will be left but one section of 350 miles of gap in northern British Columbia.

British Columbia.

HEDLEY.—Construction of the V. V. & E. is being rushed as rapidly as possible. D. Stewart has the contract for track-laying.

KAMLOOPS.—The Canadian Northern surveying parties engaged in locating a line between Kamloops and Vancouver, have now reached Spuzzum. The bluff opposite Yale calls for a tunnel 2,000 feet in length.

PHOENIX.—A party of C.P.R. engineers recently made a survey of a proposed track 12 miles in length, from Phoenix to Wellington camp.

VANCOUVER.—The British Columbia Electric Railway have started laying the rails on the Hastings Street extension The rails are already down as far east as Park Drive, and the work is being rushed.

VANCOUVER.—Considerable work is being done by the Canadian Pacific in the Boundary country improving their track and replacing a number of wooden bridges with concrete and steel structures. Two of these a few miles from Nelson, B.C., are now being completed, and will each be five hundred feet long with five spans, the centre span being 130 feet wide. During the past three years fifty-four old wooden bridges have been replaced either by steel structures or by filling in ravines. Last year over 4,000 feet of wooden bridges were thus superseded, and it is expected that as much work will be done this season.

Foreign.

BOSTON (MASS.).—The Boston and Maine Railway has ordered 21,000 tons of rails.

MINNEAPOLIS (MINN.).—M. D. Rhame, division engineer of the St. Paul road, has prepared plans for the elevation of the tracks of the company in Minneapolis. They provide for the elimination of the grade crossing and would involve an expenditure of approximately $6,000,000. This cost it is estimated, would be $2,000,000 less than to depress the tracks. It would require two years to do the work.

CEMENT—CONCRETE.

Ontario.

ERIEAU.—Concrete will be used in the erection of a school here. J. L. Wilson & Son, of Chatham, are architects.

GUELPH.—Mr. C. H. Conery, of Guelph, has secured contracts for four new cement bridges. One is at Georgetown, another is in Nelson Township, while a third will be erected in Esquessing.

LONDON.—The city clerk gives notice of the city's intention to construct many local improvement works, including numerous cement sidewalks, curb and gutters.

Saskatchewan.

MOOSE JAW.—Elsewhere in this issue appears an invitation from J. Darlington Whitmore, City Engineer of Moose Jaw, for tenders on the construction of a reinforced concrete bridge and abutments.

MOOSE JAW.—The city engineer, Mr. J. Darlington Whitmore, desires tenders for the construction of concrete walks and creosote block crossings. Further particulars are given in our advertising pages.

NORTH BATTLEFORD.—This municipality will spend ten thousand dollars on concrete sidewalks.

WEYBURN.—Mr. Willis Chipman, C.E., of Toronto, has charge of the construction of a water power here, the foundation of which will require 500 barrels of cement. Tenders closed yesterday.

YORKTON.—Snyder Bros., of Portage la Prairie, have a contract for the erection of a building for the "Enterprise," in which concrete will be used.

FINANCING PUBLIC WORKS.

Quebec.

MONTREAL.—Longueuil Council is considering by-laws for the construction of concrete sidewalks and for building a street railway.

Ontario.

BROCKVILLE.—On August 5th the ratepayers will vote upon a by-law to raise $16,000 for rebuilding six bridges.

NEW HAMBURG.—The by-law voted upon in Wellesley township to take $15,000 stock in the People's Electric Railway was carried by 172 majority.

NORTH TORONTO.—The ratepayers have passed by-laws for a sewerage system and parallel roads. Mr. T. Aird Murray, of Toronto, prepared the plans for the sewerage system.

Saskatchewan.

SASKATOON.—The ratepayers will shortly vote on a by-law to raise $20,000 to assist the Northwestern Telephone Co., Limited.

SASKATOON.—The following by-laws have been given readings: Concrete bridge, $10,000; concrete walks, $19,000; electric light plant extensions, $35,000.

British Columbia.

KAMLOOPS.—The ratepayers here recently carried a by-law to raise $20,000 for waterworks.

SEWERAGE AND WATERWORKS.

New Brunswick.

MONCTON.—The new city pumping station and foundation for the pumps are completed and ready for the electric turbo pump to be installed. Operations have been commenced for the extension of the power house to accommodate the new boiler, engine and generator.

Ontario.

COBALT.—Messrs. Galt & Smith, of Toronto, have prepared plans for a sewerage system for this town.

LONDON.—For $48,000, J. H. McGregor, has offered to furnish two million gallons of water to city, with air lift and pumping plant of four million capacity.

PETERBOROUGH.—Work on the new waterworks dam, which is being constructed by the Bishop Construction Company, is progressing favorably.

TORONTO.—A special meeting of the Provincial Board of Health was held at the Parliament Buildings on Wednesday to consider the plans for a sewage disposal and waterworks system for the towns of Cobalt and Rainy River.

Saskatchewan.

WEYBURN.—Waterworks are being installed here by Murphy Bros.

British Columbia.

KAMLOOPS.—Mr. H. K. Dutcher, consulting engineer, of Vancouver, recently made a report on the possibilities of extending the water system in this city. The council decided to purchase a condenser at a cost of $1,400.

NEW WESTMINSTER.—At a recent meeting of the City Council Messrs. Hermon & Burwell, consulting engineers, Vancouver, submitted a report and estimate for the 24-inch supply main from Coquitlam Lake to Queen's Park reservoir, and a 12-inch supply main from the reservoir to the city boundary on Lulu Island. Clearing, grubbing, culverts and trestles, excavating trench and back filling 74,000 feet, pipe laying and steel pipe delivered along trench, gate valves, air valves and special bends, the engineers estimated to cost $325,000. This includes the delivery of the water to Queen's Park reservoir, while to supply 16,000 feet of steel pipe, laying, and placing a submerged pipe across North Arm of the Fraser River, with gate valves, etc., to serve Richmond municipality, they estimated the cost of $35,000. Contingencies, engineering, and inspection at five per cent. was figured at $18,000, or a total cost for the system of $378,000. Tenders for supplying the pipe are called for until August 9th.

PRINCE RUPERT.—The British Columbia Government have agreed to provide waterworks and sewerage systems and streets for this city.

VANCOUVER.—During the quarter ended June 30th nearly 12 miles of new water mains have been laid in Vancouver.

LIGHT, HEAT, AND POWER.

Ontario.

TORONTO.—The members of the Hydro-Electric Commission, together with the heads of the engineering staff, returned to Toronto a few days ago, after completing a tour

of inspection of the right-of-way for the new Government power line. The Hon. Adam Beck informed the press that the progress made was satisfactory. Eighty per cent. of the easements for the towers had been secured, 6,000 telephone poles distributed and eight miles of the line erected. Seventy towers are in the field ready for erection, and the contractors are now ready to deliver 70 more each week until their contract has been filled. Tenders for the erection of the remaining ten transformer stations will be received next week.

TORONTO.—The Ontario Government has cancelled the lease held by the Northumberland-Durham Power Company for the development of power at Healey's Falls, on the Trent River. The Government claims the company has delayed commencing operations and refuses to have the franchise tied up any longer.

Manitoba.

WINNIPEG.—In connection with the transmission line the clearing is well ahead of construction and almost completed upon the accessible right-of-way. The tower footings are being placed in the neighborhood of Tyndall. Road-making and ditching are being pushed. About 20 miles of the telephone line have been completed. The bulk of the ballasting on the tramway has been finished and staking out of towers is completed between Brokenhead River and Bird's Hill. Smith, Kerry & Chace have charge of the work.

CURRENT NEWS.

New Brunswick.

FREDERICTON.—Contractor Low's men have about completed work on the retaining wall and the concrete curbing and gutter on the approach to the highway bridge on Carleton Street. The work has been done for the Provincial Government under the direction of Chief Engineer Wetmore and City Engineer Grimmer.

Ontario.

SAULT STE. MARIE.—At 5 a.m., on July 12th, the steamer John B. Cowle, of the United States Transportation Company, downbound, loaded with 8,000 tons of iron ore, while passing Whitefish Point in Lake Superior, was struck amidships by the steamer Isaac M. Scott, upbound on her maiden trip. The Cowle was almost cut in two and sank in three minutes in forty fathoms of water, drowning thirteen of her crew. The Scott had a large hole cut in her starboard bow above water, but was able to reach the Soo in safety. The Cowle was a steel vessel, 400 feet long by 50 feet beam and of 3,911 tons net. She was built in 1902.

TORONTO.—The City Council, with only one dissentient, recently agreed to sell for $35,000 to the National Iron Works, Limited, of which Cawthra Mulock is the head, 5½ acres of land and 16½ acres water lot. The company undertakes to erect $100,000 worth of buildings within one year. A big iron smelting steel and ore reducing works will be erected on the site.

MISCELLANEOUS.

New Brunswick.

ST. JOHN.—A scheme, said to be new, is to be tried in St. John in connection with street paving. Asphalt is to be laid on top of wooden paving blocks.

Quebec.

MONTREAL.—It is announced that the C.P.R. has completed plans for an elevator at Victoria Harbor, having a storage capacity of twelve million bushels, which would make it the largest elevator in the world.

SHERBROOKE.—The new building which is being erected by MacKinnon, Holmes & Company, is nearing completion. About the middle of August, the company will commence operations. They will do plate and structural work of every description, including bridges, buildings, towers, coal and ore handling apparatus, apparatus for the loading and unloading of cars, tanks, boilers, etc., and will carry in stock a large quantity of steel plates and structural shapes. Mr. Holmes, one of the members of the company, and a noted structural steel engineer from Philadelphia expects to be in Sherbrooke next week to remain permanently; while Mr. MacKinnon has been a resident of this city for some years past, having been assistant to the general manager of the Jenckes Machine Company. Both are members of the Canadian Society of Civil Enginers.

Ontario.

GUELPH.—Fourteen thousand square yards of Westrumite pavement are to be laid on Upper Woolwich Street by the city of Guelph.

OTTAWA.—A by-law will probably be submitted to ratepayers at an early date with a view to the establishment of an incinerator plant.

TORONTO.—At a meeting of the York Township Council, on Tuesday, Engineer Barber submitted his report and estimates for the improving of Bathurst Street between St. Clair and Eglinton Avenues. He estimates the total cost at $12,060.

Manitoba.

BRANDON.—City Engineer Speakman recently prepared an estimate of the cost of projected road improvements and an issue of debentures amounting to $12,000 will probably be authorized.

British Columbia.

VANCOUVER.—The question of establishing an incinerator upon a central site is being discussed by the City Council here.

TELEPHONY.

Ontario.

BROCKVILLE.—At a meeting of representatives of the seven rural telephone lines in Leeds and Grenville Counties it was decided to form a federation, with an exchange in the village of Athens.

TORONTO.—Telephone companies have been incorporated at Hawkestone, Ont., and Easton's Corners, Ont. R. W. Metcalfe is interested in the Oro Telephone Company at Hawkestone, while W. H. Watts is a provisional director of the Walford Rural Telephone Company at Easton's Corners.

Saskatchewan.

REGINA.—The Government recently awarded the contract for the completion of the long distance telephone line from Saskatoon to Prince Albert to J. S. Bartleman, of Regina. The line is to be completed this fall. Work on the Arcola branch long distance telephone has progressed from the Manitoba boundary as far as Fillmore, and the line is now in actual operation from the boundary to Forget.

PERSONAL.

MESSRS. HARRY A. MOORE and JOHN J. SCOLLAN, electrical and mechanical engineers, have opened offices in Toronto at 43 King Street West.

MR. T. T. SHERWELL, Jr., of the firm of Drummond-McCall & Company, Montreal, sailed last week for England.

MR. FREDERICK FETHERSTONHAUGH, of Fetherstonhaugh & Company, patent barristers, Toronto, has been engaged by the Ontario Government to prepare a report in connection with the alleged patent infringement claimed by the Cameron Septic Tank Company.

PROFESSOR A. R. GREIG, of the Mechanical and Engineering Department of the Manitoba Agricultural College, has accepted a position on the staff of the University of Saskatchewan, as Professor of farm mechanic and rural engineering, in the Saskatchewan College of Agriculture. Professor Greig will have from the outset, direct superintendence of all

constructed work in connection with the erection of the college buildings at Saskatoon, plans and specifications for which are already being made by the university architects in Montreal.

MR. A. W. CAMPBELL, Deputy Minister of Public Works in Ontario, has returned home from Seattle, where he attended a good roads convention.

MR. GORDON GRANT, inspecting engineer of the Transcontinental Railway Commission staff, has accepted the position of chief engineer of the Eastern Division of the system.

MR. ROBERT W. GRACE, general superintendent of the Canada Foundry, Toronto, Ont., has resigned to accept the position of general superintendent of The Clatt Iron Works Company, of Dayton, Ohio.

LATE TENDER.

TORONTO.—Tenders will be received until July 27th for the construction of asphalt and vitrified block pavements, concrete curbs and concrete walks. Joseph Oliver (Mayor), Chairman, Board of Control.

OBITUARY.

MR. LEFFERT LEFFERTS BUCK, one of the best known civil engineers in America, who was associated with Roebling in the building of the Brooklyn bridge, was chief engineer of the Williamsburg bridge across the East River, designed two steel arches across the Niagara River from the United States to Canada, and had direction of many other engineering works of note, died at his home at Hastings-on-the-Hudson on Saturday, July 17, at the age of 72.

RAILROAD ORDERS.

(Continued from Page 103.)

7503—July 9—Authorizing the Canadian Northern Ontario Railway to construct a steel bridge over Rideau River near Ottawa at mileage 56.9 west of Hawkesbury, Ont.

7504—July 9—Authorizing the C.P.R. to construct Bridge No. 40.8, branch of Elk River, Cranbrook section.

7505—July 12—Authorizing the C.P.R. to construct its standard No. 6 station at mileage 25.7, Township Ekfrid, Ont.

7506—July 10th—Authorizing Vancouver, Victoria and Eastern Railway and Navigation Co. to divert portions of Riverside Avenue, Vermillion Avenue, Hoy Street and Surrey Street, and the lanes in Blocks 27 and 33, Princeton, B.C., to construct its railway upon, along and across Bridge Street and Vermillion Avenue, and occupy with its railway those portions of Riverside Avenue, Surrey Street and Hoy Street so closed up.

7507—July 9—Authorizing the G.T.R. to construct two additional railway tracks along and across Geddes Street, Clifford, Ont.

7508—July 9—Authorizing the town of Midland, Ont., to lay and maintain a drain pipe under lands and track of G.T.R. east of Victoria Street.

7509—July 9—Authorizing the Bell Telephone Co. to carry wires across tracks of the Toronto, Hamilton and Buffalo Railway at public crossing 1½ miles west of Fenwick Station, Ont.

7510—July 12—Authorizing J. A. Lake, Jackson's Point, Ont., to erect telephone wires across track of G.T.R. at Jackson's Point, Sutton, Ont.

7511 to 7513—July 9—Authorizing the Bell Telephone Co. to erect wires across tracks of Michigan Central Railway at: (1) Just east of Erie Street, Leamington, Ont. (2) At public crossing, Talbot Street, Leamington, Ont. (3) At public crossing, Erie Street, Leamington, Ont.

7514 to 7517—July 9—Authorizing the Norfolk County Telephone Co. to erect wires across tracks of G.T.R. at Lots 6 and 7, Con. 3; between Cons. 2 and 3, Lot 7; between Cons. 3 and 4; between Lots 3 and 4, Con. 4, in the Township of Woodhouse, Ont.

PATENTS.

The following is a list of Canadian patents recently issued through the agency of Messrs. Ridout & Maybee, 103 Bay Street, Toronto, from whom further particulars may be obtained:—

Wm. J. Clifford, Paper Bag Holder; The Toronto Type Foundry Company, Limited, Assembling Mechanism of Typographical Composing Machines; N. S. Friderichsen, Machine for Casting Lead Seals; Thos. D. Kelly, Manufacture of Concrete for Roads; W. H. Emery, Sewing Machines; S. Z. de Ferranti, Process of Electric Welding; S. Z. de Ferranti, Electric Welding Machine.

MARKET CONDITIONS.

Toronto, July 22nd, 1909.

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

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. The spring rush is over and business steady.

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., 70c. per ton of 2,000 lbs., 1-inch, 2-inch, or larger, price all the same. Broken granite is selling at $3 per ton for good Oshawa.

Cement.—Cement is being offered at the low price of $1.55 per barrel in car lots, including cotton bags, which is an indication of the state of the wholesale market, a price heretofore unheard of. The over-supply continues. Smaller dealers report a fair movement in small lots at $1.40 to $1.50 per barrel in load lots delivered in town, bags extra. In packages, $1.40 to $1.50, including paper bags.

Coal.—Retail price for Pennsylvania hard, $6.50, steady. This price applies to grate, egg, stove, and chestnut; only pea coal is cheaper, namely, $5.50. These are all cash, and the quantity purchased does not affect the price. Soft coal is in good supply, American brokers have been 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.—Unchanged and quiet at $13.85 to $14.05 per 100 lbs. Speculative handling put it down a trifle, but it recovered as above.

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.—Unseasonably quiet, price maintained at $1.80 per 100 lbs.

Fire Bricks.—English and Scotch, $30 to $35; American, $27.50 to $35 per 1,000. The demand is steady and stocks light.

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, $3.05; 12-14-gauge, $3.15; 16, 18, 20, $3.35; 22-24, $3.50; 26, $3.75; 28, $4.20; 29, $4.50; 10¾, $4.50 per 100 lbs. Fleur de Lis—28-gauge, $4.30; 26-gauge, $4.05; 22-24-gauge, $3.50. Queen's Head—28-gauge, $4.50; 26-gauge, $4.25, per 100 lbs. Sheets continue in active request.

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, $42.50; 6-inch, $56. Galvanized, ¼-inch, $2.86; ⅜-inch, $3.08; ½-inch, $3.48; ¾-inch, $4.31; 1-inch, $6.10; 1¼-inch, $8.44; 1½-inch, $10.13; 2-inch, $13.50, per 100 feet. Some talk of an advance in price.

Lead.—Prices steady outside. This market is rather weaker, 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. In active demand.

Lumber.—Considerable demand for both Southern and Canadian dimension pine continues; hemlock dull. Prices are rather stiff all along the line. Dressing pine quotes $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 quotes $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, wholesale, $2; retail, $2.15 per barrel of 300 lbs.

Putty.—In bladders, strictly pure, per 100 lbs., $2.25; in barrel lots, $2.05.

Ready Roofing.—In moderate request at prices per catalogue. It is impracticable to quote figures, so great is the variety of this kind of goods, but prices are steady.

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.

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	.....

Not much moving; 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.—Prices steady and demand good. The price continues at 31c. to 31½c.

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.

Sugar.—Granulated, $4.70 per 100 lbs. in barrels; Acadia, $4.60; yellow, $4.30; bags, 5c. lower; bright coffee, $4.60; bags, 5c. less.

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

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

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

Teas.—Japans, 18 to 35c .per lb.; Young Hysons, 16 to 35c.; Ceylons, medium, 16 to 45c.

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, $1.80 to $1.85; yellow, $1.90 to $1.95; strawberries, 2s, heavy syrup, $1.90 to $1.95; raspberries, 2s, $1.90 to $1.95.

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

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.

Dried Fruits.—Raisins, Valencia, new, 5½ to 6c.; seeded, 1-lb. packets, fancy, 7½ to 8c.; 16-oz. packets, choice, 7 to 7½c.; 12-oz. packets, choice, 7c.; Sultanas, 7½ to 9c.; fancy, 11 to 12c.; extra fancy, 14½ to 15c.; 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, 7½c.

Rice.—B grade, 3½c. per lb.; Patna, 5½ to 5¾c.; Japan, 5¼ to 6c.

Eggs.—New laid, 22c. per dozen, in case lots.

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

Cheese.—Old cheese, 15c. for large; 15½c. for twins; new cheese, large, 12¾c.; twins, 13c.

Lard.—Tierces, 14¼c.; tub, 14¾c.; pails, 15c.

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

Potatoes.—Ontario, old, 75 to 90c. per bag in car lots on track.

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Montreal, July 22nd, 1909.

The past week has been a very quiet one in the pig-iron markets, practically no price changes taking place. Throughout the United States, however, the tone of the markets was firm and the demand, although not specially active, was all that could be expected. In fact, the situation in the United States is one of the bright spots in the markets of the world, the recent activity in the purchasing of material for railway equipment, coupled with the enquiry for prices of still further supplies of a similar nature, being of a most satisfactory nature. On the whole, if present anticipations are only realized there will shortly be small cause for complaint on the other side of the international boundary.

In Great Britain, however, the situation shows exceedingly little improvement, although it cannot be denied that the general feeling, at the moment, is somewhat better. Actual business passing, however, shows very little alteration in volume. The export demand from Germany and the Continent is still light, and the recent slight improvement seems of but a temporary character. Prices, on the whole, hold about steady. An advance was recently quoted, but was followed by a slight decline, once more, so that little progress towards higher levels is made.

In Canada, reports are mostly of a very encouraging nature. Demand from all sources is all that the trade can look for, particularly in view of the less encouraging news from other quarters. The probability of a larger crop of coarse grains in the West, and of at least as large a wheat crop as a year ago, is a strong factor, and is making for permanency in the somewhat improved demand for iron. As to finished and semi-finished lines, no changes have taken place in prices, and but little in demand, quotations being as follows:—

Antimony.—The market is steady at 8¾ to 9c.

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, $1.90 for 1 x ¾-base; toe calk steel, $2.35; machine steel, iron finish, $1.90; smooth finish, $2.70; imported, $2.20.

Boiler Tubes.—The market is steady, quotations being as follows:—1½ and 2-inch tubes, 8½c.; 2½-inch, 10c.; 3-inch, 11½c.; 3 1-2-inch, 14¾c.; 4-inch, 19c.

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.—The market is steady as follows:—¼-inch, $5.30; 5-16-inch, $4.05; ⅜-inch, $3.65; 7-16-inch, $3.45; ½-inch, $3.20; 9-16-inch, $3.15; ⅝-inch, $3.05; ¾-inch, $3; ⅞-inch, $2.95; 1 inch, $2.95.

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

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

Explosives and Accessories.—Dynamite, 50-lb. cases, 40 per cent. proof, 15c. in single case lots, Montreal. Blasting powder, 25-lb. kegs, $2.25 per keg. Special quotations on large lots of dynamite and powder. Detonator caps, case lots, containing 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.

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 25c. less than 28-gauge. American 28-gauge and English 26 are equivalents, as are American 10¾ oz., and English 28-gauge.

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

Iron.—The outlook is steady. The following prices are for carload quantities and over, on dock, Montreal: No. 1 Summerlee, $19.50; selected Summerlee, $19 to $19.50; Clarence, $17; Midland or Hamilton pig is quoted at $19.50 to $20, Montreal. It is said Dominion and Scotia companies are not quoting prompt delivery. Carron special, $19.50; Carron soft, $19.25.

Laths.—See Lumber, etc.

Lead.—Prices are about steady, at $3.55 to $3.65.

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, $22 to $25. Spruce, 1-in. by 4-in. and up, $16 to $18 per 1,000 ft.; mill culls, $14 to $16. Hemlock, log run, culls out, $14 to $16. 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.—The market is 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; 2¾-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 11c. for Manila. Wire rope, crucible steel, six-strands, nineteen wires; ¼-in., $2.75; 5-16,