PAGES

MISSING

The Canadian Engineer

WEEKLY

ESTABLISHED 1893.

VOL. 18. TORONTO, CANADA, JUNE 23rd, 1910. No. 25.

The Canadian Engineer

ESTABLISHED 1893.

Issued Weekly in the interests of the

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

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

Present Terms of Subscription, payable in advance:

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

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

ADVERTISEMENT RATES ON APPLICATION.

HEAD OFFICE: 62 Church Street, and Court Street, Toronto, Ont. Telephone, Main 7404 and 7405, branch exchange connecting all departments.

Montreal Office: B33, Board of Trade Building. T. C. Allum, Editorial Representative, Phone M. 1001.

Winnipeg Office: Room 404, Builders' Exchange Building. Phone M. 7550. G. W. Goodall, Business and Editorial Representative.

London Office: 225 Outer Temple, Strand, T. R. Clougher, Business and Editorial Representative. Telephone 527 Central.

Germany and Austria-Hungary: Friedrich Lehfeldt, 2 Lindenstrasse, Berlin, S.W., 68. Telephone IV, 3198, Telegrams Advertise, Berlin.

Address all communications to the Company and not to individuals.

Everything affecting the editorial department should be directed to the **Editor.**

NOTICE TO ADVERTISERS.

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

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

Index of this issue will be found on page 656.

REPORT OF THE ONTARIO RAILWAY AND MUNICIPAL BOARD.

The fourth Annual Report of the Ontario Railway and Municipal Board, issued by the Provincial Government, is an interesting volume, containing much valuable information as to the cost of operating public service utilities in Ontario municipalities.

Electric light plants and municipal waterworks, where municipally owned or municipally controlled, have presented their figures for the year 1909, and, although the statements of returns are not uniform, they are sufficiently in detail to serve as a method of comparison between municipalities of the different methods of operation.

In addition to reports of the municipal plants, there are appended reports dealing with the railways under Provincial control. For the year ending June, 1909, the total earnings for the Ontario-controlled roads were over six and a half million, and the net earnings were over one million and a half. Of the thirty-one roads reported, eight are reported to be operating at a loss and three have not furnished returns. The operating cost per car mile varies from 10.5 cents on the Irondale, Bancroft and Ottawa to 34.7 cents on the Berlin, Waterloo and Bridgeport. The Street Railway of Toronto operates at a cost of 17.9 cents per car mile; Ottawa Street Railway, 12.6; London Street Railway, 13.8. The Toronto and York Radial, an interurban line some fifty miles long, operates at a cost of 31.3 cents.

The accidents to passengers during 1909 were 3 killed and 201 injured; to employees, 2 killed and 23 injured; to travellers on the highway, 11 killed and 124 injured.

This is somewhat less than for 1908, when the total of killed was 26, and for 1909, 16, and total injured of 391, against a total of 349 for 1909.

It would add considerably to the value of the work of this Board if it were possible to issue in pamphlet or circular letter form the various findings and judgments and rules of the Board immediately they are given. Much of this information loses its value if it is not in general circulation immediately.

STANDARD RULES OF RAILWAYS.

At one minute after midnight on the morning of June 19th the Standard Railway Rules adopted by the Board of Railway Commissioners for Canada went into effect on all Eastern lines of the C.P.R.

These new rules were designed to standardize all signals, making travel much safer when a train of one company is running over the lines of another. In the past, when one company had running rights over the line of another railway, the men were compelled to be familiar with different sets of rules governing the movement of their trains.

Together with the additional safety in handling trains owned by separate companies on the same line, it will be much easier for trainmen leaving the employ of one company and entering that of another to feel sure of their ground in handling trains.

In the past a man who was familiar with rules on one road, attempting to handle a train where the method of signalling was somewhat different, would in a moment of stress or anxiety, confuse the signals. Where quick action is required for best results, the men must be able to act almost unconsciously, and the best way to secure this is to drill one system continually.

The Railway Board have worked for considerable time on the new rules, and it is expected that they will give satisfaction and be as kindly received as other innovations they have introduced from time to time.

THE ONTARIO RAILWAY AND MUNICIPAL BOARD.

Some four years ago the Provincial Legislative Assembly of Ontario passed an Act organizing the Ontario Railway and Municipal Board, giving them, among other duties, charge of the regulation of traffic affairs on routes of railways coming under Provincial control.

The Board have had many difficult and intricate problems to unravel and adjust. So far, they have been successful, preventing in a number of cases much litigation, with attending delays.

In the matter of the City of Toronto's street car service, they have attempted a solution of one of the most difficult and contentious transportation problems of the Province.

The City of Toronto granted a franchise covering a certain area.

The railway company secured the franchise on a sliding scale, and are to-day paying a higher percentage of their returns to the city than they expected. The city council demand that they extend their lines and improve their service. The company contend that they will extend their lines and improve their service if given a free hand, but will not undertake to do the work if it must be done under the direction of the Ontario Railway Board.

The test of the Board will be its usefulness in securing results. It was not expected to constitute itself a board of trial only; the people are looking more to it as an arbitration board, whose efforts will be directed more towards bringing the extremes together than to refereeing. Just as soon as the corporations realize that the purpose of the Board is to do all in their power to facilitate transportation matters, heartier co-operation will be certain.

The Dominion Railway Board quickly gained the confidence of the transportation companies and the people by making it clear that their sole purpose was to give to both the railways and the people every assistance in solving the difficulties and contentious questions which would arise. The Ontario Railway Board would lose nothing by following the example of the much more powerful, yet very considerate actions of the Federal Board.

THE USEFULNESS OF THE ONTARIO BOARD OF HEALTH.

The method of administering the affairs of the Provincial Board of Health for the Province of Ontario has been brought to the attention of the reading public by a letter from Mr. Fred. H. Chesnut, B.A.Sc., and an interview with Mr. T. Aird Murray, C.E. These gentlemen lament the secrecy which surrounds the investigations carried on by the Board. They offer suggestions which are undoubtedly well suited to the wants of the Province, but it appears to us that while we are waiting for this new arrangement, which in the course of time must come, in connection with the affairs of the Board of Health, some inexpensive method of making effective the laboratory work of the department might be found.

The Faculty of Applied Science of Toronto University is Government sustained. Engineers, physicists and chemists are upon its staff. Its departments are equipped to carry out experiments in chemistry, physics and engineering. But with all this it has, in addition, under its direction and sustained by the co-operation of the staff of undergraduates and graduates, a technical journal.

Let the laboratory branch of the Provincial Board of Health become a department of the Faculty of Applied Science, encourage in that faculty the teaching of basic principles of sanitary engineering, and allow Applied Science to publish monthly the information which is reserved for the annual blue book of the Department of Public Health, and the people of the Province will be kept in touch with the work of the Board and of the usefulness of this department, and the University will be more readily appreciated.

University presidents, professors and governors have recently been lamenting the lack of interest taken in University affairs and University work. We see in the experimental work of the Provincial Board of Health possibilities for the investigation of many problems that have to do with the health of the people of the Province and, at the same time, demonstrate the necessity and advisability of employing university-trained men in this investigation.

Lecture trips through the Province to bring the University to the people will not secure as direct practical results as would the knowledge that the practicability of treating impure water with calcium hypochlorite was developed by University men in a laboratory under the direct supervision of the University. The Board of Health of the University have the men for this work. The Faculty of Applied Science has a journal which has the circulation and the standing and the editorial staff that make it a suitable medium to properly place information before interested readers.

Why not combine these departments which are similar in their object, and in this way improve the efficiency both of the Board of Health and of the University?

EDITORIAL NOTES.

The new era in transcontinental railway building commenced with the placing on the Toronto Stock Exchange of Canadian Northern Railway stock. Although not placed on the Exchange as a stray subscription, yet the $5,000,000 worth of bonds listed last Friday is to be converted in 1916 into common stock at par. For some time Canadians have been watching for this announcement. By 1916 the Mackenzie-Mann roads will reach across the continent.

* * * *

The Grand River Improvement Association, with headquarters at Guelph, Ont., have petitioned the Hydro-Electric Power Commission to make a complete survey of the Grand River with a view to ascertaining the extent of water power locked in that stream. In addition to the possible water powers of this river, the question of reclamation of flat lands and disposal of waste along the river will also receive attention.

Remember that the Canadian Electrical Association will meet at the Royal Muskoka Hotel, Muskoka Lakes, July 6th, 7th and 8th. In addition to a splendid programme of technical papers, arrangements have been made for an enjoyable outing.

CANADIAN GAS ASSOCIATION.

Last week we gave a summary of the proceedings of the gas convention. This week we give in detail some of the most interesting papers as well, as the report of the Committee on the Illuminating Power and Calorific Value of Gases made in Canada.

The officers elected for the year 1910-11 are as follows: E. J. Philip, 1st Vice-Pres.; A. W. Moore, 2nd Vice-Pres.; J. Keillor, Sec.-Treas. Executive Committee, J. E. Leishman, J. H. M. Young, R. A. Wallace, Chas. Forbes, P. S. Coate.

REPORT OF ARTHUR HEWITT AND JOHN KEILLOR, THE COMMITTEE ON THE ILLUMINATING POWER AND CALORIFIC VALUE OF GASES MADE IN CANADA.

Your committee appointed to collect data as to the candle power and calorific value of coal and water gas supplied by gas companies and corporations throughout Canada, beg to report as follows:—

We recall that at the convention held last year in Montreal, the paper and discussion on the "candle power of gas" brought out the following facts and suggestions:—

"That there had been no change in the Dominion Government statutes, regulating the testing of gas and the candle power that is to be supplied, for 24 years."

"That during those 24 years the methods of using gas had so totally changed that there was no longer any necessity for gas companies in Canada supplying to consumers the quality of gas prescribed by the Gas Inspection Act, 1886."

"That in other countries, notably Great Britain and Germany, the regulations governing the testing of gas have been revised to suit the new methods of using gas and the candle power reduced."

"That in other countries more modern and efficient burners for testing the candle power of the gas had been adopted—notably the No. 2 Metropolitan burner and the old standard Argand burner discarded."

"That in view of the fact that about 90 per cent. of the total gas made in Canada was now being sold for purposes other than flat or open flame lighting, it was suggested that tests be made in Canada of from 12 to 20 candles for the special purpose of ascertaining the respective candle power and heating values of the gases lower than 16 candles: the idea being to obtain information which would guide the association in recommending a reduction to a lower grade candle power gas which would still contain sufficient heating units for the all-round requirements of the consumers."

Following the lines indicated your committee decided to make these tests in Toronto, where coal gas and water gas is made, and a blend of the two distributed to the consumers. The tests to be made as follows:—

(1) for candle power using the Sugg. 16 candle standard and the P. Pentane lamp. Calorific value to be measured by the Junker calorimeter.

(2) for candle power using the new No. 2 Metropolitan burner and the Pentane lamp. Calorific value to be measured by the Junker calorimeter.

It was also decided by your committee that the Association should be in possession of statistics covering the entire gas production of Canada, for the purpose of ascertaining first-hand the total quantity of gas made, the candle power of same, and the proportions sold for heat and fuel, mantel lighting, etc.

Accordingly, a circular letter was mailed to every gas company in the Dominion who make coal gas, water gas, or a mixture of the two, requesting that they supply information the committee desired on the form enclosed for the purpose. Returns were received from every company making coal or water gas with the exception of two.

The following is

A.—A tabulated statistical report of the gas made in the year 1909 in cities and towns in Canada.

B. C. D.—Tabulated returns of the tests for candle powers, and corresponding calorific values

Tabulated statistical statement of the gas made in the year 1909 in cities and towns in Canada, showing the proportions used for (1) heat and fuel (2) mantel lighting (3) open flame lighting—and the candle power, compiled from the returns sent in by the gas companies themselves:—

		Proportions used for.			
	Gas made, Cubic Ft.	(1) Heat & Fuel, Cubic Ft.	(2) Mantel Lighting, Cubic Ft.	(3) Open Flame Lighting, Cubic Ft.	Candle Power Supplied.
Barrie	12,000,000	6,000,000	5,400,000	600,000	18
Belleville	20,200,000	10,200,000	7,500,000	2,500,000	19.36
Berlin	35,000,000	26,250,000	6.750,000	2,000,000	16.7
Calgary	27,000,000	20,250,000	6,750,000	....	16.0
Cobourg	7,400,000	4,400,000	1,500,000	1,500,000	18.1
Guelph	44,000,000	26,400,000	13,200,000	4,400,000	17.5
Hamilton	101,000,000	53,500,000	38,000,000	9,500,000	16.0
Ingersoll	12,000,000	6,000,000	4,800,000	1,200,000	16.0
Kingston	40,000,000	20,000,000	20,000,000	....	20.0
Listowel	3,000,000	300,000	2,250,000	450,000	19.0
London	192,000,000	115,200,000	67,200,000	9,600,000	17.5
Montreal	1,459,000,000	875,000,000	510,600,000	73,000,000	17.46
Napanee	5,000,000	2,500,000	2,500,000	....	20.0
Nelson	7,100	5,000,000	2,100,000	....	18.0
Owen Sound	18,000,000	10,800,000	3,600,000	3,600,000	16.0
Oshawa	4,000,000	2,000,000	1,840,000	160,000	17.0
Ottawa	126,500,000	113,850,000	12,650,000	....	16.5
Peterboro	17,000,000	16,150,000	850,000	....	18.0
Quebec	120,000,000	72,000,000	45,600,000	2,400,000	18.0
Stormont	4,000,000	1,600,000	2,000,000	400,000	18.0
St. Catharines	18,650,000	13,100,000	5,550,000	....	18.0
St. John	36,200,000	1,800,000	30,800,000	3,600,000	17.0
St. Thomas	56,200,000	22,500,000	22,500,000	11,200,000	17.3
St. Hyacinthe	5,000,000	4,000,000	800,000	200,000	18.0
Toronto	2,226,200,000	1,113,200,000	667,800,000	445,200,000	19.0
Vancouver	123,000,000	95,900,000	27,100,000	....	16.0
Winnipeg	245,600,000	184,000,000	49,300,000	12,300,000	17.0
Woodstock	30,000,000	15,000,000	14,400,000	600,000	16.75
	4,995,050,000	2,837,300,000	1,573,340,000	584,410,000	

	Cubic Ft.	Percentage of total gas made.
Total gas made in Canada exclusive of several small companies who did not send in returns	4,995,050,000	100
Proportions used for:—		
(1) heat and fuel	2,837,300,000	57
(2) mantel lighting	1,573,340,000	32
(3) open flame lighting	584,410,000	11
	4,995,050,000	100

From the tabulated statement "A" it will be observed that out of the total gas made in Canada 57 per cent. is used for heat and fuel, 32 per cent. for mantel lighting, 11 per cent. for open flame lighting. We desire especially to draw your attention to the small percentage used for open or flat flame lighting, 11 per cent., as compared with the large proportion used for heat and fuel and mantel lighting combined, 89 per cent.

Compare these with proportions used for the same purposes in 1886 when the existing testing regulations were enacted.

	In 1886 approximately.	In 1910 Actual.
Gas used for heat and fuel	15%	57%
Gas used for lighting by mantel burners	nil	32%
Gas used for lighting by luminous or flat flame burners	90%	11%

Illuminating Power and Corresponding Calorific Values

10 tests each of coal gas—water gas—and a mixture of coal and water gas.

Sugg's 16 c.p. Standard. Junker's Calorimeter.

Test No.	Kind of gas used.	Candle Power Sugg's 16 c.p. standard.	Calorific Value, Gross.	Calorific Value, Net.
1		17.85	652.6	584.06
2		17.46	677.3	621.98
3	Straight	17.72	662.0	598.01
4		16.92	621.80	575.74
5	Coal	17.38	685.10	630.04
6		18.53	703.0	647.84
7	Gas.	17.81	665.30	605.20
8		18.68	674.60	593.53
9		16.85	626.80	584.53
10		16.22	614.40	557.09
1		17.46	587.30	536.67
2		19.42	585.70	535.35
3	Straight	19.92	600.00	586.01
4		19.43	592.42	555.59
5	Water	17.52	617.20	580.28
6		20.20	610.50	587.33
7	Gas.	21.72	612.40	577.48
8		20.77	612.10	572.39
9		18.53	565.00	538.33
10		18.08	570.60	538.50
1		15.64	587.30	533.09
2		16.06	601.30	541.37
3	Mixture	17.31	623.60	578.14
4	of	19.42	631.90	599.30
5	Coal	18.33	626.40	575.29
6	and	18.29	626.30	575.79
7	Water	17.39	621.10	575.22
8	Gas.	17.32	612.50	576.33
9		18.41	629.60	581.30
10		17.34	614.08	554.82

Illuminating Power and Corresponding Calorific Values

10 tests each of coal gas—water gas—and a mixture of coal and water gas

No. 2 Metropolitan Standard. Junker's Calorimeter.

Test. No.	Kind of gas used.	Candle Power No. 2, Metro. standard.	Calorific Value, Gross.	Calorific Value, Net.
1		17.79	587.30	533.09
2		18.38	590.80	558.68
3	Straight	19.58	653.70	598.32
4		19.15	607.50	560.70
5	Coal	19.30	614.30	554.69
6		20.48	644.00	588.12
7	Gas.	20.74	667.60	611.65
8		21.40	639.80	586.52
9		21.11	631.70	575.60
10		20.54	621.00	565.34
1		22.48	605.10	554.34
2		22.83	604.10	557.15
3	Straight	23.53	625.00	592.36
4		22.91	614.40	563.82
5	Water	25.10	612.40	577.48
6		21.94	570.60	530.50
7	Gas.	21.70	565.00	538.33
8		22.09	590.80	558.68
9		21.27	598.30	593.65
10		23.68	610.50	587.33
1		21.06	624.00	610.19
2		21.15	638.90	589.70
3	Mixture	21.92	668.40	603.13
4	of	22.59	634.70	592.91
5	Coal	22.00	609.90	572.67
6	and	21.59	621.30	569.91
7	Water	21.03	610.50	576.29
8	Gas.	19.85	632.20	590.54
9		22.09	626.40	575.29
10		20.54	623.60	578.14

Illuminating Power and Corresponding Calorific Values

15 tests of pure coal gas using

Sugg's 16-Candle Standard and Junker's Calorimeter

Test No.	Sugg's 16 candle standard	Calorific Value, Gross.	Calorific Value, Net.
1	11.76	575.25	538.96
2	11.87	548.20	501.69
3	13.83	603.90	546.76
4	14.32	607.50	560.70
5	15.56	610.40	575.57
6	15.83	633.30	577.59
7	16.06	627.30	557.62
8	16.17	632.10	571.57
9	16.71	644.00	588.12
10	17.27	639.80	586.52
11	17.81	665.30	605.20
12	18.03	633.10	579.38
13	18.28	648.00	578.92
14	18.68	674.60	593.53
15	19.00	669.00	611.30

These figures show how radically changed the conditions are to-day in the matter of using gas as compared with 1886. In 1886 when the Argand burner was adopted by the Government as the Standard burner for testing the gas, 90 per cent. at least of the total gas sold was used for lighting by luminous or open flame burners. This necessitated making high candle power gas so that with the "Standard Burner" a light equal to at least 16 candles could be obtained —the gas being consumed at the prescribed rate of 5 cubic feet per hour. In 1886 the Government decided that gas companies would have to maintain a 16-candle standard—a regulation intended to protect the consumers who used those luminous flame burners against the possibility of getting poor light. But remember that was in 1886, 24 years ago. The Argand and flat flame burners were the only ones in general use then and practically all the gas made was used by these burners. Now look at the changed conditions in 1910; only 11 per cent. of the total gas made is now used by luminous flame burners against 90 per cent., 24 years ago. To-day, as much as 89 per cent. of the gas made is being used for the combined purposes of heat, fuel, and mantel lighting; in 1886 approximately 10 per cent.

Taking into consideration these changed conditions of using gas, it is evident that what the gas industry is called upon to supply to-day and in the future is not a "lighting," but a "fuel" gas. We do not push the sale of a single gas appliance nowadays that necessitates the making of high candle gas. The gas range, water heater, gas engine, industrial furnace, gas arc, gas fan, etc., can all be well served with a lower grade gas than that prescribed by the 1886 Act.

Turn now to the tabulated statements **B, C and D.** It has already been stated that these tests were made for the purpose of obtaining reliable information based on Canadian practice to lay before the Deputy Minister and Chief Electrical and Gas Inspector, should the association decide to recommend a reduction of the candle power or the substitution of a calorific standard in its stead. There is no doubt in the minds of your committee that the calorific standard will eventually supersede the candle standard in Canada, but just how far the Government are prepared to go in the matter at this time we have no means of knowing. At any rate it is safe to assume that when it is made known to the authorities, that, in the opinion of the Canadian Gas Association, a change in the statutes is necessary in view of the radically changed conditions of using the gas, that either a reduction of the candle standard will be granted or the candle standard will give place entirely to the calorific standard.

Two important facts are to be deduced from the tabulated results of the tests referred to,

(1) That coal gas of about 12 candle power (Table D) as tested by the Sugg 16-candle standard containing about 540 B.T.U. net is sufficiently high in heat units for all practical requirements and the No. 2 Metropolitan burner

The difference in the efficiency of the old Sugg 16-candle standard burner and the new Metropolitan No. 2, when testing gases lower than 16 candles is very marked, but this is to be expected, because, whereas the Sugg Standard is made to test 16 candle gas only, the South Metropolitan burner with its adjustments can be adopted to test correctly any gases higher or lower than 16 candles.

Arthur Hewitt
John Keillor

(See also page 645)

THE

Sanitary Review

SEWERAGE, SEWAGE DISPOSAL, WATER SUPPLY AND WATER PURIFICATION

AN OZONE STERILIZATION PLANT WHICH REQUIRES STERILIZING WITH CALCIUM HYPOCHLORITE.

Such, after all, is the Lindsay ozone plant. This is the open confession of the combined part-owner, patentee, engineer, chemist and contractor who recently installed the ozone plant at Lindsay.

In a letter to Dr. Archibald, dated June 14th, 1910, written from Philadelphia, Mr. J. Howard Bridge states:—

"Two days prior to your test the entire plant was sterilized by allowing a weak solution of chloride of lime to pass through it and to stand for half an hour in the sterilizing well."

This is written to Dr. Archibald to explain why, by his test, he showed a fair reduction of bacteria by ozone, whereas by the three months' test made by the Provincial Board of Health the maximum reduction of bacteria by ozone was 28.7 per cent., the minimum removal 3.4 per cent., and the average removal 7.97 per cent.

Dr. Archibald in no test (eleven in number) found "B. Coli" present in the ozonized water. The Provincial Board of Health found "B. Coli" present in forty-one samples out of 109 of ozonized water.

The Provincial Board of Health state as a conclusion to their report:—

"Under the circumstances it seems reasonable and justifiable to conclude that there must be some reason for the difference in the results," referring to their own series of tests and those of Dr. Archibald.

The reason is now made plain by J. Howard Bridge himself. The whole plant was sterilized with calcium hypochlorite.

While this confession may come as a surprise to the public, it has simply anticipated a disclosure, the evidence of which has existed with the chemists employed by the Provincial Board of Health for some time back. In fact, when the report states: "The problem might well be worth investigating by the Water Commissioners of Lindsay," it refers to the fact that the plant was tampered with and the water doped for Dr. Archibald's benefit before or during his visit.

Dr. Archibald's report and test, dated July 11th, 1909, gave us and others some considerable trouble, especially with reference to a paragraph stating: **"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."**

Referring to this particular test, showing a very turbid water in the filter, we find the raw water contained 1,200 bacteria per c.c.; the effluent from the filter, 31 per c.c., and the ozonized water, 18 per c.c., a percentage reduction of bacteria by filtration of 97.4 and by ozone of 42 per cent., or a combined reduction of 98.3 per cent. The explanation of this test, together with its then unexplainable circumstances, is now apparent.

But what of it? Ozone as a germicide has not been on its trial at Lindsay. Ozone as a water germicide has been tried, found efficient and used in practice long before Lindsay ever dreamt of making use of it.

The trouble has not been that ozone is an inefficient germicide. The trouble has been in bringing a gas (practically insoluble in water) into contact with the water.

The De Fries and Siemens-Halske systems do not depend on calcium hypochlorite for sterilization, but upon ozone. This appears to be the main difference between the Howard Bridge system as installed at Lindsay and other well-known and tried systems on the European Continent.

The United Water Improvement Company, controlling the "Bridge" patents, alleges that by the use of simple aspirators the energy of gravity is utilized for sucking ozone from a producer chamber into the bottom of a sterilizing well, and the great expense incurred at Paris and other cities is thus obviated.

It is the principle of the "Bridge" aspirators, and not ozone, which has been on its trial at Lindsay.

The Provincial Board of Health found by the simple experiment of inserting an anemometer in the pipe leading from the ozone producer chamber to the aspirators that practically no ozone was being aspirated.

The Board of Health state: "The greater the head of water the greater the efficiency of any aspirator." "The greatest possible head in the well at Lindsay is three feet, which is the difference between the surface of the water over the aspirators and the surface of the water in the sterilizing water well."

Messrs. Walden and Powell, of Baltimore, have recently carried out experiments with aspirators, and they state the "lowest point or head that should be considered is about twelve feet." They also experienced a similar difficulty, as described by the Board of Health, in blowbacks of the ozone imput.

The possible efficiency of the aspirator does not appear to be a subject for bacteriologists so much as for the engineer expert in physics.

The one fact stands out plain at Lindsay: Ozone does not (or practically does not) come into contact with the water; and no bacterial reduction result can be expected unless the whole plant is first sterilized with calcium hypochlorite.

There is another phase connected with this Lindsay incident, however—a phase which we take no pleasure in writing or talking about. It is one, however, which will have to be faced both by Mr. Bridge and the Water Commissioners of Lindsay. The plant has been paid for and certified as efficient, not on the efficiency of ozone as a germicide, but on the efficiency of calcium hypochlorite.

Only at the very last moment, only after the Lindsay plant has been advertised broadcast as an efficient ozone plant, a model of economy and practical utility, has it been admitted by the author of the plant that calcium hypochlorite "may account for some of the differences in results obtained."

The original agreement between the town and Mr. J. H. Bridge calls for a water which shall have all taste, odor, color and harmful bacteria removed, the tests to be made by an expert agreeable to both parties.

Originally Dr. Amyot, the Provincial bacteriologist, was fixed upon as the umpire between the contractors and the town. This arrangement was made without consultation either with the secretary or the Provincial Board of Health. In fact, plans of the scheme were never submitted to the Board until the work was completed. When the work was completed the contracting company asked for sterilized bottles from the Board, which they themselves could fill and return to the Board for analysis. Naturally, this was denied them, and a thorough examination of the plant was offered.

On or about July 20th last year Drs. Amyot and Naysmith visited the works to make arrangements for the test, and were informed by the contractors that such could not be made until the 10th of September as the works required further alterations and additions to complete them. **The Provincial Government test was not undertaken until such time as the contractors assured the Board that the plant was completed in every detail.**

At or about the time when the Board refused to be rushed and send bottles for samples of the effluent, J. Howard Bridge made out a case of alleged prejudice against Dr. Sheard, the chairman of the Board, and obtained the consent of the Lindsay Commissioners to call in Dr. Archibald, of the Toronto University.

On Dr. Archibald's report the Lindsay Commissioners paid the contractors and practically took over the works.

By J. Howard Bridge's own admission he sterilized the whole plant two days before Archibald's visit. Dr. Archibald knew nothing of this. He and apparently everyone else were kept in ignorance of the fact that not only ozone, but calcium hypochlorite was playing a part.

Now, apparently, to clear Dr. Archibald, a gentleman whose ability, honesty and professional integrity have never been for one moment doubted by the Provincial Board of Health, or, in fact, by anyone who knows him, Mr. Howard Bridge makes the announcement which explains the (in part) efficiency results of his tests.

It requires no explanation from Mr. Bridge to affect Dr. Archibald's professional position one way or another.

It requires no letters, open or otherwise, written in gutter and scurrilous language, appealing only to mob taste, to affect the high professional character and respect which Dr. Sheard's name carries with it in Canada.

Scientific data affecting all sanitary questions, soberly and respectfully put, are always welcome in this Review. Sometimes it is necessary to write plain and strong, but it is the subject matter, the policy or the data which we deal with, not the personality.

The Howard Bridge system of "aspirators" has failed up to the present (from all evidence of data which we can possibly obtain) in bringing a germicide called ozone into efficient contact with water to provide results which warrant its use in connection with any water supply.

It is up to J. Howard Bridge to provide data and show clearly that his system of aspirators can be made to work efficiently. It is up to him to do this at Lindsay. We do not want explanations which explain inefficiencies, and why the Lindsay plant gave practically no results during the three months' test made by Drs. Naysmith and Philp on behalf of the Provincial Government. What we do want is proof of success—proof based upon absolutely independent tests every time with no one at or near the premises who can possibly slip a little calcium hypochlorite into the water. When we obtain this proof of success we will be among the first to say: "J. Howard Bridge has made good."

THE DISINFECTION OF WATER AND SEWAGE.*

Earle B. Phelps.

The subject of disinfection of drinking-waters and of sewage is in no sense a new one. Almost as early as the nature of infectious diseases and the methods of their communication became known, through the developments of modern bacteriology, the desirability of disinfecting waters in particular was recognized. Attention was first drawn to the practical possibility of such processes through the work of early investigators in connection with the water-supplies of troops in the field. Without going into details of these investigations, it will suffice for our present purposes to note that many disinfecting processes were developed by workers in England, Germany, and France. These processes depended, in the main, upon the application of prepared pellets of the various disinfectants employed, and in general involved the addition first of the disinfectant itself, and later of one or more neutralizing compounds, by which the active disinfectant was destroyed and harmless chemical products alone remained in the water. Compounds of chlorin, bromin, and iodin, copper salts, permanganate, and many other powerful disinfectants were employed in this way. On the whole, remarkably successful results for the purpose in hand were attained, but the processes were necessarily limited to small volumes of water, and were totally unsuited, owing to the nature of the reactions and the cost of the material employed, for application to large city supplies; consequently for many years attempts to purify domestic water-supplies have been confined in the main to sand filtration methods which are now so well-known that their discussion at this time is uncalled for. It may be pointed out that these processes are in reality disinfecting processes, since in most cases their chief aim is the removal of pathogenic germs. In the course of the rapid and well-nigh universal development of filtration processes, however, the basic principle of chemical sterilization has never been completely lost sight of. Great stimulus was given to these ideas about a decade ago by the development of commercial processes for the production of ozone. The well-known germicidal properties of this oxygen compound, coupled with the fact that its end-product is ordinary atmospheric oxygen, make the process an ideal one from a chemical and physiological point of view. Commercially, it has always been hampered by the relative high cost of production, by mechanical deficiencies in the machinery necessary for such production, and by certain physical difficulties attendant upon the introduction of the ozone into the water. Therefore, despite the fact that progress in the ozonization of water has been consistent and quite rapid, yet the use of ozone in water disinfection has not become general. It must be particularly noted, however, that the deficiencies of this process are purely mechanical, and that the work of investigation which is going on in many parts of the world may reasonably be expected eventually to develop a process as successful commercially as it is ideal from purely sanitary considerations.

*Read before the Engineers' Club of Philadelphia.

Quite early in the history of the chemical disinfection of water the possibilities of chlorin compounds were recognized. Electrolytic processes for the manufacture of these compounds were developed as early as in 1889, when Webster in England, and Woolf in this country, attempted the use of electrolyzed sea-water solutions in disinfection work of one kind or another. Here again mechanical difficulties were met with which, combined with the fairly high cost of production, prevented the general adoption of these methods. The commercial production of calcium hypochlorite or bleaching powder had in the meantime been developed to so high a degree of efficiency, owing to the great commercial demand for this product, that sanitarians soon had at their command an extremely efficient disinfectant which could be obtained in any desired quantity at very moderate cost. Attention, therefore, was early directed to the possibilities of this commercial product, particularly in connection with sewage disinfection. As early as 1854, the Royal Sewâge Commission of Great Britain recommended the use of this substance in deodorizing the sewage of London. In 1885 the Special Committee of the American Public Health Association carried out an exhaustive study of all available disinfecting materials, and found that hypochlorites in general were the most efficient substance that could be used, cost being considered. In Germany, at the Hamburg Hygienic Institute, the work of Proskauer and Elsner in 1897, and later of Dunbar and his associates in 1904 and 1905, demonstrated anew the possibilities of hypochlorite of calcium in sewage work, with special reference to disinfection rather than to mere deodorization. At the Royal Testing Station at Berlin, work carried out in 1906, confirmed the Hamburg results, and indicated that the disinfection of sewage by this means was entirely feasible. Rideal's experiments at Guilford, England, made about the same time, practically confirmed the German results.

All of these investigations, and more particularly those made in Germany, had reference to the emergency use of chemical disinfection during epidemics, especially of cholera. In such situations questions of economy do not usually arise, and, with their usual thoroughness, the German experts established standards of purification so high that their processes, although eminently satisfactory under the conditions for which they were devised, were still too costly for ordinary every-day use. It remained for the investigators of this country to demonstrate that much lower percentage efficiencies than those obtained previously would still suffice in routine work, and that the cost of obtaining these sufficiently satisfactory results would not be prohibitive. These conclusions were first reached as a result of investigations carried out at the Sanitary Research Laboratory of the Massachusetts Institute of Technology, with which the writer has the privilege to be associated. These studies, which were begun in 1906 and extended over a period of two years, were made possible by the generous co-operation and financial assistance of the United States Geological Survey. They were shortly followed by studies made by Kellerman, Pratt, and Kimberly for the United States Department of Agriculture and Ohio State Board of Health. The first practical demonstration of the use of bleaching powder on a large scale was made by the State Sewage Commission of New Jersey at Red Bank, under the speaker's supervision. The work was started in October, 1906, and carried on during the fall, and a portion of the following summer. Two hundred and fifty gallons of sewage per day were treated at this place. About this same time the writer was retained by the Baltimore Sewage Commission to carry on experiments at Baltimore looking toward the disinfection of the final effluent of the proposed trickling filters now being built at that place. Since that time numerous investigations have been made in all parts of this country, and many working plants have been installed or are now in process of installation. Without exception, the conclusions of the early Massachusetts experiments have been confirmed, and for the first time in the history of chemical disinfection, it has been amply demonstrated that sewage may be thoroughly disinfected at a cost which is not disproportionate to the cost of other purification processes.

Briefly, then, this is the history of the development of chemical disinfection. At the present time the most serious problem is not how to disinfect sewage or water, but rather under what conditions such disinfection is called for, just what the process accomplishes and under what amount of supervision it must be carried out. There is grave danger that, through ignorance of the essential aims and actual accomplishments of this process, it will be misused or employed in situations where its use is uncalled for. Therefore, this opportunity to explain the particular work which the process may be expected to accomplish, the peculiar conditions under which it may be properly applied, and its severe limitations, as a general method of sewage treatment, is especially welcome. It must be pointed out at the very outset, and will be reiterated throughout the course of this paper, that the chemical disinfection of sewage or of water is not a panacea. Except under strictly limited and peculiar local conditions it is not even a substitute for other purification methods. In general, it may best be described as an "adjunct," or, to use a term familiar to engineers, "a factor of safety." To the extension and development of this idea, and to a discussion of the actual place of disinfection in sewage and water work, these remarks will be chiefly addressed.

The recent revival of active interest in the possibility of chemical disinfection took place, first, in the field of sewage disposal, and later spread to water purification. It may be well to maintain this order of development, and to consider first the chemical disinfection of sewage and of sewage filter effluents.

Disinfection of Sewage.

Sewage consists of about 999 parts of pure water and 1 part of impurity, about one-half of which is organic impurity and bacterial life. Sewage disposal deals with this five one-hundredths per cent. A perfect process of sewage disposal may be defined as one which totally removes and finally oxidizes to a mineral form his very small proportion of the ganic matter. The slow sand filter, developed to its highest degree of efficiency, can be relied upon under specially favorable conditions to practically accomplish this result. It is possible to produce by such means a water fit for domestic purposes. The cost of such treatment is high even under the most favorable circumstances, where, as in the case of the Massachusetts towns, large areas of suitable sandy soil are readily available. In less fortunately situated locations, and always among the larger cities, the cost of such a process would be prohibitive. Therefore, the tendency of the times as illustrated by the work of experiment stations, and by the effort of municipalities along these lines, has been toward more rapid and less perfect processes. Unfortunately, along with this tendency there has come another tendency, namely, toward the standardization of processes, by which is meant a tendency toward the adoption of certain settled types of works regardless of the local requirements. This is a result in part of the unwillingness, and at times the inability, of communities to undertake special investigations of their own or to employ expert assistance. It results also in part from the unfortunate disposition of certain of our State authorities to demand this kind of uniformity throughout their jurisdiction. We have therefore a situation which might be amusing if it were not so serious, in which a designing engineer learns by experience that any plan submitted by him in certain jurisdictions will not receive the necessary sanction of the proper State officials unless certain standard features are incorporated; whereas he is equally well aware that in a neighboring State no plan will be approved which embodies these same standard features. The fact cannot be too strongly emphasized that the solution of any particular sewage disposal problem is one which depends mainly upon the requirements of the local situation. The only conceivable general solution of the problem would be perfect purification, such as has already been defined, and even if this were desirable the result might be obtained by two or more different methods. In general, such purification is unnecessary, and insistence upon it would be a grievous mistake. If partial purification methods are to be allowed, then surely they must be adapted to the requirements in each case. Therefore, your attention is first directed to the nuisance which lack of sewage disposal may bring about in order that the method of abatement may be indicated.

One serious nuisance which may follow the introduction of crude sewage into a body of water is the deposit of solid material. Such material we describe as "suspended matter" in the sewage, and one of the classes of treatment to which attention is most often directed has in view the removal of suspended matter from the sewage and the prevention of this form of nuisance. Obviously, now, if the stream is swift and the dilution large, or if the discharge be made into rapidly moving tidal currents, this nuisance will not occur, and special treatment for its abatement will be unnecessary and unwise. Under reverse conditions of discharge into slowly moving streams, particularly into streams which are dammed, or bodies of water which are shallow and do not possess strong tidal currents, the possibility of deposit upon the bottom is one which must be dealt with, and the removal of suspended matter from the sewage must be accomplished to a greater or less degree

The second kind of nuisance is that which results from the putrescible character of sewage, regardless of whether the organic matter is suspended or in true solution. This is the property of sewage matter by which it robs a stream of its available oxygen, and consequently of its power of self- purification. Under these conditions fish life is destroyed, noxious odors arise from the water, and the stream becomes virtually an open sewer rather than merely a polluted water. The line between these two conditions is a distinct one. The capacity of any stream to absorb sewage and maintain its own aëration is limited and calculable. If this capacity is exhausted, a very definite change in the character of the water occurs and the conditions above outlined result. The treatment of these conditions must be very different from that outlined in the first case. The question of suspended matter may or may not be a factor, but in this case the organic matter must first be oxidized and rendered stable or non-putrescible. The process of oxidation may go on independently of, or in connection with any other processes, according as one or more of these classes of nuisances is possible.

The third special class of nuisance, and one which refers to public health rather than to public convenience, is the ever present possibility that pathogenic bacteria may be contained in the sewage. The extent of this danger need not be argued, nor is it desirable at this time to take up the somewhat debatable question of the efficiency of our ordinary sewage purification processes in destroying such bacteria. Somewhat divided opinions upon this question are held. The most exhaustive study of the problem that has yet been made was carried out by Houston under the auspices of the Royal Sewage Commission of Great Britain, as a result of which it was concluded that "the biological processes at work in the filters were not strongly inimical, if hostile at all, to the viability of pathogenic germs." It is the speaker's opinion, based upon all the available evidence and upon a long personal experience with investigations of this character, that the removal of pathogenic germs by rapid filtration methods is not greater than would be accomplished naturally in the streams in an equal period of time. That such removal is considerable is frankly admitted. In the course of a few hours or of a day, under natural stream conditions, great improvement is always noted. This improvement, however, has not been sufficient to prevent the disastrous typhoid fever epidemics of Lawrence, Mass.; Butler, Pa.; Ithaca, N.Y.; and other places too numerous to mention. If, therefore, there be any danger in the possible discharge of pathogenic germs into the stream in question, this danger must be considered by itself, and distinctly apart from the possible nuisances already mentioned. It is upon the solution of this particular problem that chemical disinfection directly bears. Whether or not nuisance may arise from the discharge of suspended matter or from the discharge of putrescible matter will determine the type of purification process necessary; whether or not it is desirable to prevent the possible discharge of pathogenic germs into the stream will determine, and must alone determine, the advisability of disinfecting the sewage or the treated effluent.

Emphasis has been laid upon these few general principles, because curiously we are better advised at the present day as to the methods of disinfection than we are as to its necessity. As has been previously stated, there is more danger that the possibility of disinfection will be misunderstood and that processes will be used as a substitute for other essential processes than that it will not be employed when necessary. The various methods of chemical disinfection which have from time to time been proposed have been fully described in another place, and need not be referred to here in detail. Suffice it to say that the application of commercial bleaching powder has been found to be by far the most efficient and practical process, and that such application has now been developed to such a point that its cost is not at all out of keeping with the benefits to be derived.

Bleaching powder is an impure commercial product manufactured in large quantities abroad by some of the earlier chemical methods, and in this country at Niagara by modern electrolytic methods. Owing to the fact that in the latter case it is essentially a by-product of the much more important caustic soda industry, its present market price is very low, and in fact less than the cost of production on a small scale. Upon admixture with water it goes into solution only partially; a residue of carbonate of lime and an excess of free lime remaining in the tank as a white sludge. In practice it is desirable at larger works to keep this mixture stirred up and to discharge the sludge with the solution; at smaller works economy indicates the use of the clear solution and the disposal of the lime sludge in a convenient manner. To the layman one of the most striking features of this process is the relatively small amount of disinfectant necessary. For crude sewage an amount of so-called "available chlorin" equivalent to about five parts per million parts of sewage, which amounts to about 125 pounds of bleaching powder per million gallons, suffices. Upon the present market price of $25 per ton or less, it will be seen that the cost of bleaching powder necessary will be in the neighborhood of $1.70 per million gallons of sewage disinfected. By the use of the quantity indicated, disinfection is accomplished within a very few minutes, and storage periods of not over thirty minutes are ample. Sewage stronger than the average American sewage would require somewhat larger amounts than these indicated, but twice the quantity probably represents the maximum. For partially purified effluents, such as those resulting from trickling filters, lesser quantities are sufficient. At Baltimore three parts per million of available chlorin, or 75 pounds of bleaching powder per million gallons, were found effective in the disinfection of the trickling filter effluent. At Boston satisfactory disinfection of a similar effluent was accomplished through a period of six months by the application of three and a half parts of available chlorin. Effluents of a higher degree of purity can be disinfected with corresponding smaller amounts. The total cost of the processes, including interest charges and depreciation upon the necessary fixtures, labor, and other items, will range from $1.00 or less in the case of effluents to about $3.00 in the case of crude sewages. These details are given in the accompanying table. The results, which have been described as satisfactory, are numerically expressed by removals of the total bacteria, averaging 97 per cent. in the case of effluents and 99 per cent. or more in the case of crude sewage. In the former case the combined efficiency of the filter and the disinfection will bring the figure up to 99 per cent. or more. Special studies have also been made in this connection to show the probable effect upon typhoid fever germs as compared with the effect upon the total bacterial content. The indication has been that the former are affected to fully as great an extent as the latter. They are probably more completely removed.

ESTIMATES OF THE COST OF OPERATION OF A PLANT FOR DISINFECTING SEWAGE OR EFFLUENT WITH CHLORID OF LIME, BASED ON A CAPACITY OF 5,000,000 GALLONS A DAY.

			Cost per Million Gallons. Fixed.		Operating.			
Available Chlorin, Parts per Million.	Bleach, Pounds per Mil. Gal. (Approx.)	Time of Contact, Hours.	Storage Tanks.	Other Fixed Charges.	Bleaching Powder.	Labor.	Power.	Total.
1	 25	5.0	$0.10	$0.02	$0.30	$0.10	$....	$0.52
2	 50	2.5	.05	.04	.60	.10	....	.79
3	 75	1.6	.04	.05	.90	.10	$0.02	1.11
4	 100	1.2	.03	.07	1.20	.10	.02	1.42
5	 125	0.8	.03	.08	1.50	.10	.03	1.74
10	 250	0.5	.02	.16	3.00	.15	.06	3.39
15	 375	0.5	.02	.24	4.50	.20	.09	5.05

Disinfection of Water.

Considering now the application of these same methods to the water problem, it may be said in brief that the principles involved are identical. Whether or not the chemical disinfection of water is desirable in any given situation must be determined upon principles similar to those already laid down. If the result desired is the simple removal of germs, this process probably represents the cheapest and perhaps the most desirable one now available. The word "perhaps" is inserted here advisedly. The question of just how desirable this treatment may be is one which must be submitted eventually to the consumer who pays the bills. There is a popular objection to the addition of chemicals to drinking-water. This objection was raised most seriously against the use of alum, but has largely disappeared, as the use of alum has become more and more common and as no ill-effects have been developed. However harmless certain chemicals may be considered in the minds of those best qualified to judge, and however ill-directed popular clamor against their use, it must be admitted that it is a legitimate consideration to be dealt with. Whether or not actual harm will be done is one matter; whether or not the purchaser of the water desires to have small amounts of chemical substances added to his supply (especially if he is willing and able to pay for more expensive processes which do not involve the use of chemicals) is quite a distinct matter. Assuming, however, that, as in the case of alum, any feeling which may be developed at present will disappear in the course of time, it is certainly true that under certain circumstances the chemical disinfection of water may be used to great advantage. As in the case of sewage, so also in the case of water, special consideration must be given to the primary needs of the situation. Disinfection merely kills the germs; if this is all that is required, then disinfection is indicated; if the removal of organic matter from a water seriously polluted with sewage is deemed advisable, then some other process must be employed. If that process is efficient also in the removal of germs, disinfection is uncalled for. If that process, on the other hand, is insufficient, or if economy indicates that it may purposely be made insufficient,—through the use of high rates of filtration, for example,—then disinfection may be advantageously employed to supplement the imperfect process. The two great fields which are open to water disinfection are the treatment of a very slightly or only occasionally polluted supply by disinfection alone, and the treatment of a more seriously polluted supply by the present methods at highly increased rates and by subsequent disinfection. In the latter case disinfection will be found a valuable adjunct to overload mechanical filters. The limiting rates of operation on slow sand filters are determined largely by the organic content of the water and by consequent economy in the expensive cleaning processes. The limiting rates on mechanical filters, on the contrary, are practically determined by the necessity for obtaining bacterial purification. Therefore, it is especially with reference to this latter type that disinfection will be found important.

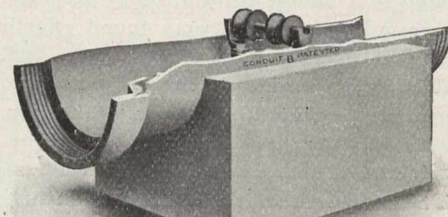
Although, as has already been indicated, the chemical disinfection of water has been practised from time to time at various places, the first notably successful plant in this country at least, and the one which is directly responsible for the present favorable consideration which this process has acquired, was constructed and operated early in 1908 by Mr. George A. Johnson, of New York City, at the Chicago stock-yards. At this plant the highly polluted water of Bubbly Creek was treated first by chemical precipitation and then by means of bleaching powder. The results of this undertaking were highly satisfactory. Later Hering & Fuller, of New York City, of which firm Mr. Johnson is a member, were called upon to construct at Boonton, New Jersey, on the Jersey City water-supply, a plant for the complete disinfection of forty million gallons of water daily. This plant, which has been in operation since September, 1908, has been so fully described in various papers by Dr. Leal, who is primarily responsible for its installation, by Mr. Fuller, and by Mr. Johnson, that it will be unnecessary to discuss it in detail at this time. It is sufficient to note that the water in question is the somewhat polluted water of the Rockaway River, which has received the advantages of storage and sedimentation in its passage through the immense Boonton reservoir. The results of the continuous operation of this plant have been eminently satisfactory. It might be stated here that the recent litigation in connection with this plant had to do with certain contract requirements rather than with actual results achieved. In Mr. Johnson's report of the operation of the plant it is shown that the bacteria in the water before treatment ranged from a few hundred to a thousand or more, whereas after treatment the water was often found to be sterile, and contained, as a rule, not over ten bacteria per cubic centimeter. The bacillus coli was reported present almost uniformly in the raw water in 1 c.c. tests, and was seldom or never found in the treated water. Quantities of available chlorin not exceeding 0.3 part per million, or eight pounds of bleaching powder per million gallons of water treated, were four efficient. Mr. Johnson estimates the total cost of treatment, including additional labor required, at 14 cents per million gallons. The successful outcome of this great and novel undertaking has resulted in the introduction of this process in at least thirty localities in the eastern United States. The speaker has recently completed the installation and three months' study of a small plant used in connection with mechanical filters. Quantities of available chlorin ranging between 0.25 and 0.4 parts per million were found necessary, and results substantially like those already quoted were obtained, in spite of the fact that the raw water contained at times several thousand bacteria per cubic centimeter.

Here again, as in the case of sewage, the danger is that this process will be misused through a lack of understanding of its possibilities and its rightful field. It is not in general a substitute for filtration. It may be that filters are used where germ removal is all that is necessary. Such filters could be replaced by disinfection methods at an immense saving in the cost. A further danger, which is not so conspicuous in sewage work, lies in the use of this process by inexperienced persons. The proper regulation of the necessary amount of material does not require expert supervision at all times, but the question of how much disinfectant to employ in any given situation, and of the proper method of applying it, and other details of the operation, should in every case be submitted to expert judgment. In addition, the routine operation of the plant should be safeguarded in such a way that the possibility of mistakes should be minimized. As little responsibility and as little chance to go wrong as possible should be left to the operator. In other words, the operation should be made as nearly fool-proof as possible. With these safeguards properly applied, and under the conditions which have been outlined, it can safely be said that a new epoch in water purification methods has begun, and that the methods developed and introduced by Dr. Leal and Mr. Fuller, and especially by Mr. Johnson, have already established their rightful place in the ever-growing field of water purification.

SULPHUR-SAND JOINTS FOR SANITARY SEWERS.

Some practical and valuable facts on the management of sulphur-sand joints for vitrified sewer pipe are presented in the report of Chief Engineer J. B. F. Breed, and Consulting Engineer Harrison P. Eddy, of Boston, to the Louisville, Ky., Sewerage Commission. This method of jointing was employed in a section of the city whose topography made it profitable to construct separate systems for house sewerage and storm drainage. In all cases both conduits were constructed in the same trench, inlets for house sewerage and storm water being provided in each conduit at the same point.

The sewers were built of vitrified pipe, and sand-and-sulphur joints were adopted in order to prevent as far as possible the entrance of ground water, which would have lessened the actual capacity of the sewer. The sulphur-sand method was new to Louisville, and in consequence much experimenting with local materials was done before the best material could be determined upon. In the preliminary stages of this work a mixture of sulphur and sand in equal parts was tried, a very fine moulding sand from a local pit being used. From the first this mixture gave trouble, several radial cracks which appeared on each joint as soon as the joint was poured indicating excessive shrinkage of the mixture. It was also found that about twelve hours after being poured the entire joint loosened, permitting the easy separation of pipes. All materials and methods used were then subjected to careful examination. The sand used contained a considerable percentage of clay and was therefore washed, by which process a large portion of the clay was

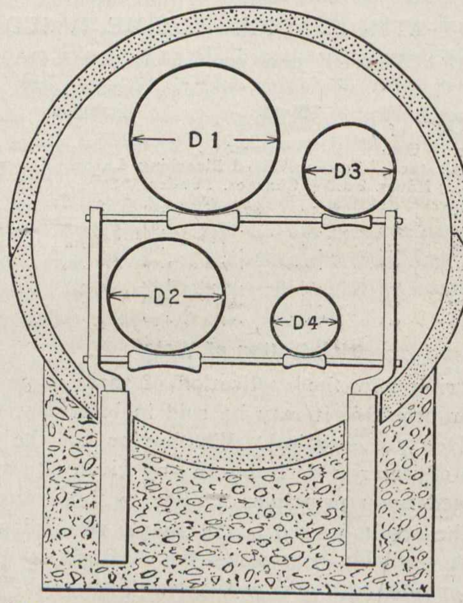


removed. Using the washed sand and the utmost care in making joints gave no better results than before. Finally, sand of about the same grade as that already in use, but with less clay in it, was obtained from the same local pit. To ascertain what sands were best adapted to this work, test joints were poured, as follows:

Using (1) Moulding sand containing little clay, ten parts to ten parts sulphur.

(2) Ohio River sand, screened through No. 20 sieve, ten parts to ten parts sulphur.

(3) Moulding sand six parts to four parts screened Ohio River sand and ten parts sulphur.

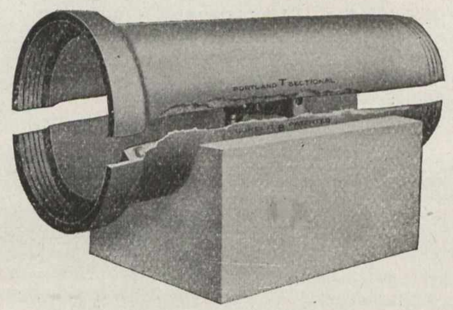


SECTION SHOWING 4 PIPE SUPPORT
D1+D2+8" = DIAM. OF CONDUIT.

The last named mixture gave the best results, there being in it as much Ohio River sand (screened through No. 20 sieve) as could be carried in suspension in the fluid mixture. Further experiments were made on other pieces of construction by varying the proportions of sand and sulphur and also the proportion of the two grades of sand. These experiments confirmed the results of the former tests, i.e., that with local materials the mixture composed of six parts moulding sand, four parts Ohio River sand screened through

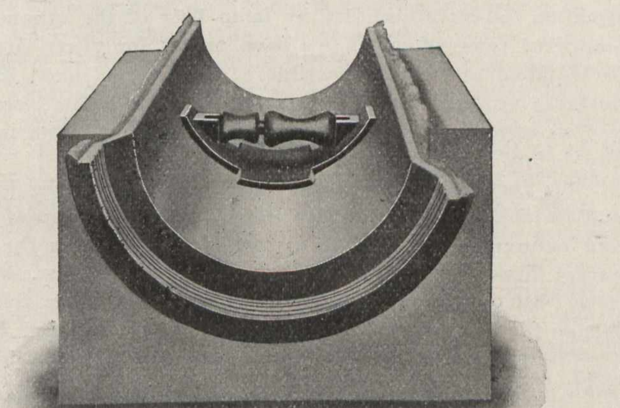
No. 20 sieve, and ten parts sulphur, gave best results. With this mixture the loosening of the joints entirely disappeared, radial checks occurred only very rarely, and these cracks appeared not to allow ground water to enter the sewer.

In making these joints three or four lengths of pipe were placed in a wooden cradle resting on the surface of the ground, carefully fitted together, lined up and caulked with jute, the pipe at one end of the cradle being so braced that the pipes could be forced firmly together by wedging, before the joints were made. "Pipe jointers," made of square, braided asbestos, were then so placed around the pipes at each joint and fastened as to prevent the liquid jointing material from running out of the bells. After these jointers



were secured in place the joints were poured with the mixture of sulphur and sand, which had been melted and brought to the proper degree of fluidity.

Care is required to keep the temperature of the sulphur-sand mixture at the proper point, because while the mixture begins to melt at a temperature of about 200 degrees Fahrenheit and becomes thin and suitable for pouring at about 260 degrees, if the temperature is allowed to rise more than 25 degrees to 40 degrees higher, it again becomes thick



and plastic, in which condition it cannot be poured. These facts are shown clearly by the following tabulation:

Physical Condition of Sulphur and Sulphur-sand Mixture at Different Temperatures.

Condition.	Temperature. Sulphur.	Temperature. Sulphur-sand.
Began to melt	176° F.	201° F.
Fluid	212° F.	261° F.
Slightly viscid	234° F.	302° F.
Would not pour	248° F.	315° F.

It is interesting to note to what an extent the admixture of sand with sulphur affects the temperatures at which it changes its condition. After pouring, the mixture hardens very rapidly, so that in an interval of time of perhaps one minute the asbestos jointers can be removed. While the jointing material is still warm it is coated with hot, tar pitch, as a further safeguard against leakage. Within five minutes after the joints are poured the entire length of three or four pipes, as the case may be, can be removed from the cradle and placed in position in the trench. Although the joints attain an almost incredible strength in this short interval of time, care must be exercised in moving the pipe so that the joints and bells of the pipe shall not be unnecessarily strained. The joints between sections of pipes were poured in the trench. When water was encountered in the work, care was taken to hold its level below the pipe joints. Otherwise, the liquid mixture skipped the portion of the joint submerged in water.

This method of jointing pipe aids materially in the inspection of the work, since perhaps three-fourths of the joints are made on the ground surface, where they are readily accessible. The large proportion of the work of pipe jointing which can be performed on the surface of the ground regardless of conditions in the trench has, in many instances, tended toward better progress and economical work.

Experience in the Louisville work proved that a total length of eight or nine feet of pipe on the cradle was most satisfactory. In other words, when two-feet lengths of pipe were used, four pieces of pipe, and when in three-feet lengths only three pieces could be advantageously jointed at one operation. After a fair trial of make-shift jointers, it was decided that an asbestos jointer, with spring clamp, facilitated the work and gave best results. A substantially built cradle, with the templets holding the pipes accurately placed as to line, was found to be both necessary and economical. Coal heaters, copper kettles and generous sized ladles all tended to better work and progress.

Good briquettes made of sulphur and sand of the proportions used on the work showed a tensile strength of from 520 to 640 pounds per square inch.

SOME RECENT INSTALLATIONS OF GAS ARCS IN HAMILTON, ONT.

E. A. Howe, New Business Solicitor, Hamilton.

Recent improvements in the construction of inverted lamps led the Hamilton Gas Light Company to make a 6 months' test of twelve 5-burner inverted arcs placed in prominent stores in the city. This turned out to be satisfactory that we decided to adopt in the future, the indoor and outdoor inverted arcs for our Free Lamp scheme to the exclusion of all uprights.

The few remarks I have to make to-day will be devoted to a number of installations of both indoor and outdoor 5-burner arcs we recently installed. These, however, serve to illustrate two types of outside installations we have adopted —(1) the 5-burner inverted arc suspended from a suitable pipe outside the store front; (2) the 5-burner inverted are suspended boulevard posts in the sidewalk. In connection with the latter I have been successful in making contracts in the last two months for 45 outdoor 5-burner inverted arcs on boulevard posts of the type shown on picture. Thirteen of them have already been erected and are certainly a disclosure to the Hamilton business men. These are lighted up every night all the year round, on a flat rate basis, lighting and extinguishing and cleaning being done by our employees. Apart from the scheme of lighting by boulevard posts we have been recently very successful in our adoption of the inverted arcs for indoor lighting.

I particularly want to say with regard to the inverted lamps installed in Hamilton that there is practically an entire absence of carbon formation in or around the mantles of the lamps. Contrasted with my experience in the States where 20 and 22 candle gas is extensively used, my experience is that the inverted lamps in Hamilton are giving a very much higher efficiency in candle power and all-round general results, in addition to requiring less cleaning and maintenance. One could scarcely imagine there could be so much difference from month to month. The difference was so marked that I discussed the matter with the manager, Mr. Keillor, who says it is most assuredly due to the fact that we were making a straight coal gas of not more than 16 candle power. The 16 candle power gas will work infinitely better in mantle burners than 20 or 25 candle gas. Inverted lamps of almost any type, I know, will work better with low candle power gas than high grade candle gas. The high grade gas producing, as it does, too much carbon which is very detrimental to high efficiency.

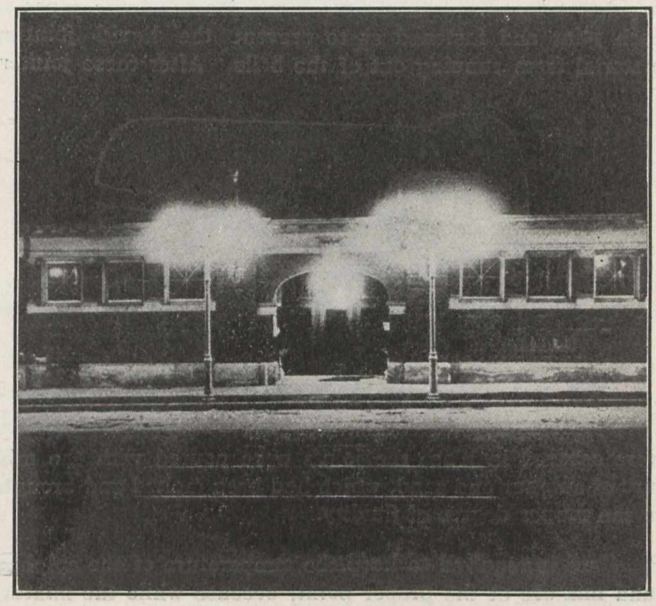
It has been generally believed by most gas company managers that free lamps and free maintenance is not a good proposition for any gas company to consider..

This has been proven to the contrary by the Hamilton Gas Light Company, who started a campaign of free inverted lamps and free maintennce on and about March 1st, 1910, and up to the present date we have installed over two hundred and fifty. We have found that the free lamp proposi-

Inverted Arcs.

tion we offer to the public has been the means of our success. We would not have been able to obtain any such amount of business on a rental basis. We furnish, install and maintain all lamps free. Our inspectors or trimmers inspect all lamps every 10 days, clean same and furnish the mantles necessary, and keep the lamps in good order. The lamps always remain the property of the gas company.

Our outdoor lamp proposition is as follows: We install all outdoor lamps and piping for same, furnish the gas and man to light and extinguish and maintain same for three dollars per month per lamp, or thirty-six dollars per year per lamp. This gives the company twenty-four dollars per year per lamp for the gas consumed and twelve dollars per year for its maintenance. We have over fifty Outdoor Humphrey Inverted Arcs in actual use, which we have installed since April 1st, 1910. Each outdoor lamp is installed by contract for one year, to be lighted at dusk and extinguished at 10.30 p.m. every night except Sundays.



Night View.

One hundred lamps then would consume two million four hundred thousand cubic feet per year.

We have another proposition I would like to call your attention to—street-lighting by lamp post of the ornamental boulevard type, of which we have orders for thirty-three to be installed as soon as possible in the various parts of the business section of this city, some are now being installed, and we expect to install over one hundred lamp posts in this city before the coming September.

We furnish and erect the posts, and install the lamps, and furnish the gas, also the man to light the lamp at dusk and extinguish same at 10.30 p.m. every night in the year except Sundays, for fifty dollars per year per post, we receive $36.00 per year for the lamp, divided as follows: $24.00 for the consumption of the gas consumed and $12.00 for the maintenance of the lamp and $14.00 per year for the post, making a total of $50.00 per post per year.

GAS ENGINE DEVELOPMENT, CONSTRUCTION AND APPLICATION.

By R. A. Fraser, Manager Gas Engine Department, Canadian Fairbanks, Toronto, Ont.

The prevailing impression in the minds of the majority of people is that the gas engine, or as it should be more correctly termed, the eternal combustion engine, is a development of modern times. Such is not by any means the case, as very early in the history of mankind it was understood that heat had the effect of producing work by the expansion which it caused in the substances upon which it acted.

Probably the earliest records which we have of such action appears in the records of Hero of Alexandria, in which we find a description of the action of heat and water, and the manner in which this was applied by the priests of the time, about 130 B.C., in the production of phenomena which appeared to the common multitude to partake of supernatural power.

It is altogether probable that the ancients possessed a greater knowledge of the effects of heat than has reached us in any permanent records, and as such knowledge was practically lost sight of during the ages of darkness which followed the downfall of the Roman Empire, it is possible to trace the history of modern prime movers only to a period at which the light of modern thought began to illuminate the doings of mankind.

It is probable that one of the earliest machines in which the action of heat was converted directly into motive power was not only a gas engine, but a gas turbine.

The so-called "smoke jack" used in medieval times to operate the turnspit before the fire consisted of a sort of screw propeller wheel, placed in the chimney and caused to revolve by the action of ascending gases, the motion being transmitted by means of gearing and belts to the spit which carried the roast before the fire.

There are numerous instances of such devices, illustrations appearing in the sketch book of the great artist engineer, Leonardo da Vinci, as well as in other works of the time, and the "smoke jack" may be considered as much a prototype of the gas turbine as the machines of Hero and of Franco have to be considered predecessors of the steam turbine.

About the first record of any patent covering gas engines was a British patent taken out in the year 1791 by John Barber for a motor which seems like an anticipation of present-day attempts to produce a gas turbine. Strange to say, Barber used gas, produced by distilling wood, coal, oil, or other hydrocarbons in a retort, the coal gas being delivered with the proper amount of air into an explosion or combustion chamber where ignition took place and the products of combustion were discharged against the buckets of the turbine wheel. Barber went so far as to anticipate a modern device used on gas engines of large power in injecting water into the combustion chamber to reduce the temperature of the mixed steam and gases acting on the wheel.

There appears therein to have been an anticipation of most of the elements of the gas turbine, but as the principles of turbine construction were not clearly known at the time, the machine was doubtless of very low efficiency. This, however, seems to have been the first real effort to develop a machine utilizing combustion at constant pressure.

Leaving these early engines as more or less impracticable, the first real combustion motor in the modern sense of the term, seems to have been that of Robert Street, who in 1794 took out a British patent for an engine in which the piston was moved in a cylinder by the pressure of gases generated by the combustion of spirits of turpentine. In Street's engine the bottom of the cylinder was heated by a fire underneath and with the piston at the lowest part of its stroke a few drops of turpentine were injected and vaporized. The upward movement of the piston drew in some air and also sucked in a flame which ignited the inflammable mixture and the explosion drove the piston to the top of the stroke.

Here we find the use of the suction of the piston to draw in the charge and the use of the external flame for ignition together with other details embodied in more recent machines. Unfortunately the constructive methods available at the time were inadequate, and prevented the development of the ideas of this clever inventor.

The next development of the internal combustion engine is found in a patent taken out in 1801 for the utilization of illuminating gas. At that time illuminating gas had been but very recently introduced and this is probably the first record of the use of illuminating gas for the production of power.

This remarkable man seems to have anticipated nearly all the elements which go to make up the modern gas engine. He admitted the gas and just sufficient air to make it ignite into the cylinder, the gas and air being compressed separately in two pumps before entering the engine cylinder and ignition was effected by the electric spark.

You will note that development towards the modern gas engine was proceeding along logical lines and in a definite manner. Street, as we saw, used the suction of the piston to draw in the charge, Lebon appreciated the necessity of compression, and utilized this feature as well as electric ignition, and it is probable that his early death alone prevented the development of the internal combustion engine much earlier than actually was the case.

It is true that the manufacture of illuminating gas was then in its infancy, and that the production of the electric spark was also possible only in a very primitive manner, but the principles of the most modern types of gas engines were included in the plans of Lebon, who must be considered as an important pioneer very early in the field.

That the correct principles upon which an internal combustion motor should be built were beginning to be understood at the commencement of the nineteenth century was evident. Cheverton, who experimented in 1826 with the problem, stated the case very clearly, and the situation could hardly be expressed more definitely to-day than in his words: "It has long been a desideratum in practical mechanics to possess a power engine, which shall be ready at any time, capable of being put in motion without any extra consumption of means, and without loss of time in its preparation. These qualities would make it applicable in cases where but a small power is wanted and only occasionally required. They are so numerous and the consequent saving of human strength would be so great that the advantages accruing to society would be immense, if even the current expense were much greater than steam power."

The American patent of Drake is of interest, because it contains mention of the incandescent tube for the purpose of igniting the charge, a plan also suggested by Siemens, and practically applied later by Daimler. It is also of interest to note that both Drake and another inventor, Varnett, stated that their engine could be operated with the vapor of hydrocarbon liquids, which was evidence that the field of the internal combustion engine was being extended beyond the limitations of gasoline fuel.

It is, however, a somewhat sad commentary which the Association would do well to consider, in so far that while the earlier experiments and engines were all built to use illuminating gas, the most remarkable developments have followed the application of engines using hydrocarbon liquids as fuel, whereas little or nothing is being done to extend the use of engines using gas as fuel.

While numerous patents were taken out from time to time, it was not until the year 1866 that any important developments took place, when Dr. Otto, the German inventor, brought out his patent, and to him is undoubtedly due the credit for developing the internal combustion engine as a commercial possibility, and in spite of the great advance made in the design and construction of gas engines since that time, as in the case of the steam engine, which to-day practically retains all the principal characteristics originally designed by Watt, so in the case of the gas engine, what is still known as the Ohio cycle of operation, as first developed by Dr. Otto, still stands.

The operative cycle, as defined by Dr. Otto, is:

1. Drawing in the charge of gas and air.

2. Compression of the gas and air.

3. Ignition at dead point with subsequent explosion and expansion.

4. Discharge of the products of combustion from the cylinder.

It is a striking tribute to the wonderful efficiency and economy of the gas engine, that while only one stroke out of four is the working stroke, or expressing the same idea in another manner, three parts of the engine's time is wasted, yet in face of this severe handicap the internal combustion engine to-day bids fair to eventually beat all rivals in the economical generation of power.

We have just seen that four operations are needed to make up the cycle, namely, suction, compression, ignition and exhaust, from which the title four cycle is taken, this being the type in most general use to-day, particularly for industrial service.

In the modern four cycle engine, it takes four strokes of the piston, or two revolutions of the crankshaft to complete the cycle, only one stroke being the working stroke, the remaining three strokes being taken care of by the momentum of the flywheel.

Right at this point is where some confusion frequently arises in the minds of those not familiar with the operation of the gas engine, and it is made to suffer in comparison with one of its competitors, steam engines, since in the case of the steam engine, only two functions are carried out in the steam cylinder, that is, ignition and exhaust of the steam, the preparation of the fuel being provided for apart from the engine through the agency of the steam boiler, and it is really through the failure to grasp the simplicity of the principle upon which the internal combustion engine operates, that we so commonly hear the expression that gas engines are unreliable. As a matter of fact, nothing could be more unreasonable than a statement of this nature, as it is only necessary to recall what constitutes the four operations necessary to complete the cycle, and remembering these, it may be taken for granted, that provided an engine draws in a full and proper charge, provided that charge is properly compressed, fully ignited, and freely exhausted, then no matter how crude the design may be, how indifferent the materials, nor how poor the workmanship, that engine will run, and continue to run, until one of the functions which go to make up the cycle fails.

It is impossible to lay too much stress on this aspect of the matter, as it lies at the very root of the subject, and a proper appreciation and understanding of the cycle of operations would often save much mental research and quite often a good deal of hard physical effort extended in a vain effort to start an engine by turning the flywheel, the engine having stopped, apparently for no good reason, but as a matter of fact through the failure of one of the functions which go to make up the cycle of operations.

Dealing with the factors which make up the cycle, and commencing with the piston beginning the suction stroke, a partial vacuum is created, which draws in a mixture of air and gas, the mixture continuing to flow in until the end of the first stroke, when the inlet valve either automatically closes or is mechanically closed. The return stroke of the piston compressing the confined mixture is brought about by the momentum of the flywheel. Compression is absolutely necessary in order to obtain the proper ignition of the charge and get power and economy from the engine. In a very general way and within limits, the higher the compression the greater the power developed. The amount of compression, however, it is desirable to have is of course limited as if excessively high compression is carried there is a tendency to ignite the mixture prematurely, setting up very severe stresses in the engine. The best accepted practice is to carry a moderate compression of from 50 to 60 pounds per square inch in gasoline up to as high as 170 pounds per square inch in the case of producer gas.

The third stroke in the cycle is the working stroke obtained from the ignition or explosion of the charge, or to put it more correctly, due to the rapid expansion of the charge which corresponds to the expansive effect obtained in the steam cylinder from the steam.

It is important to note that in order to get the maximum power from a gas engine, ignition should take place when the crank pin is about fifteen degrees below or behind the dead centre. This practically corresponds to lead in the steam engine, and this lead has to be provided for since there is an interval of time which elapses between the time the electric spark takes place and before the charge is fully ignited—and by properly arranging the igniter lead, the greatest force is given to the piston just as it passes over the dead centre. I may point out that the internal combustion engine is sometimes referred to as explosive engines, and the ignition of the charge we speak of, as an explosion. This, of course, is an erroneous way of expressing the action, as what actually takes place in the cylinder is very rapid ignition and expansion, and the fact that lead has to be given to the ignition to provide for complete ignition and expansion would seem to prove that this contention is correct.

The fourth operation of the cycle is the exhaust stroke, the exhaust valve being mechanically opened at the end of the working stroke and remaining open until the piston has reached the top, being carried up by the momentum stored up in the flywheels, thus driving out the burnt products.

A brief consideration of the fuels available for use in the internal combustion engine is of interest, as these cover a comparatively wide field. Those in most general use are gasoline, kerosene, alcohol, crude oil, illuminating gas, natural gas and producer gas.

Gasoline, which is the fuel in most general use for engines of small power, is obtained from distilling crude oil and is classified under two grades, known as engine gasoline of 76 degrees and stove gasoline of 67 degrees. This fuel has a heat value of about 18,000 to 20,000 B.T.U. per pound, and when used in an engine the accepted consumption is claimed by all reputable engine manufacturers, is about one pint per B.H.Pf. per hour.

Kerosene is also one of the fluids obtained from distilling crude oil and is a lower grade than gasoline. It differs from gasoline in so far that it is not an explosive and will not give off vapor when exposed to the air as gasoline will, but on the other hand, it can be readily vaporized. This fuel has about the same heat value as gasoline, but is not by any means in such general use for power purposes.

The use of crude oil has not so far become general, as while it is a remarkably cheap fuel, it calls for a special type of engine. A good many inventors have tackled the problem of using crude oil, but only a very few engines using this fuel can be said to be commercially successful. It has been found that in order to utilize this fuel it is necessary to use very high compression, amounting to 400 pounds per square inch or more. This constant pressure of 400 pounds per square inch, coupled with the further liability of a sudden further rise in pressure, together with the weakening effect on the metal due to the high temperature, which also varies within wide limits, all tends to frighten probable users and one or two disastrous accidents to engines using this fuel would indicate that handling this type is somewhat in the nature of monkeying with gunpowder.

Illuminating gas is an excellent fuel for gas engines, and in an engine will develop a H.P. on a consumption of from 15 to 18 cubic feet per H.Pf. per hour. Unfortunately, however, this fuel is only available in cities and large towns.

Natural gas is without question the best of all known fuels available for the internal combustion engine, and will develop a H.P. on a consumption of from 12 to 13 cubic feet per H.P. per hour. Natural gas is probably the cheapest known means of generating power, and it is unfortunate that it is only available in certain sections and cannot be used everywhere.

Of all the fuels available for the internal combustion engine, producer gas is undoubtedly the most promising from the fact that the fuel used is generally available with the result that producer gas is coming to the front in nearly every part of the globe as a serious rival to every existing known form of generating power. A discussion of the possibilities of producer gas would have to be made a subject of a paper by itself, and is altogether too comprehensive to deal with in the scope of the present paper. It is simply necessary to observe that we have only touched the fringe of development in this country, and while it has received a temporary setback in this territory due to the development of electrical power, it is very doubtful if long distance electric transmission can eventually compete with producer gas, as it is important to note that all comparisons of cost have been based on the cost of coal as fuel. The use of coal, however, is entirely a side issue, as it is important to note that there is no known fuel not already in a gaseous form that may not be converted into gas through the agency of the producer, and if we are to follow the development in the use of producer gas in Great Britain and on the continent of Europe, it would seem to be only a question of time when the garbage collected from the streets of our cities, the waste products of many of our large industries, that at the present time are going to waste or costing large sums of money to get rid of, will be converted through the agency of the producer into useful energy for the distribution of power and light at a very low cost.

A paper of this nature would not be complete without a brief reference to some of the applications of the internal combustion engine. One of the most important of these, and probably the most widely apparent to the general observer, is that of the mechanical propulsion of vehicles. The moderate size, high power and general convenience of the internal combustion engine, burning gasoline or other light hydrocarbon fuels, has rendered it specially applicable to this service, and if anything were needed to convince the general public of the practicability of the generation of power, by the direct combustion of the fuel in the working cylinder, the modern automobile should furnish that demonstration.

As a means of transportation, when you stop to consider that the small gasoline engine applied to a motor cycle, the entire outfit weighing a little over a hundred pounds, is capable of carrying a man for over 100 miles through all kinds of roads and grades on a consumption of one gallon of gasoline, we can appreciate the possibilities of this form of power in the direction of cheap transportation.

Some years ago, in a paper read before one of the engineering societies, the writer ventured the statement that if the solution of mechanical flight was ever to be reached the internal combustion engine would play an important part in that field of research. The very remarkable cross channel flights of Messrs. Bleriot and Rolls, and the still more wonderful long distance flight of Faulham from London to Manchester, are a striking tribute to the reliability of the modern internal combustion engine and should materially assist in setting at rest any prevailing doubt that the gas engine is more or less unreliable.

In the matter of durability, one instance out of several which have come under the writer's notice may be of interest, our company recently receiving a letter from one of the leading railroads in the United States, stating that they had in use a 25 H.P. Fairbanks-Morse engine, the records showing that this engine had averaged 21 hours per day for seven years, with only one hour's delay due to water getting into the gasoline tank pit and freezing up the tank and pipes. During that time the engine has had but two sets of piston rings and two igniters. These are all the repairs that have been required.

Remembering the rapid strides and remarkable achievements which the internal combustion engine is making in the field of transportation, we surely have some grounds for being confident and enthusiastic regarding its assured future and possibilities in industrial life.

We have just seen that the gas engine was early in the field, but for some reason, and, by the way, probably no one is in a better position to explain the reason than the members of this Association, the gas engine for industrial work has not kept pace with the development in transportation and has suffered considerably from the competition of electric power. When it is remembered that it very seldom happens that the gas engine does not prove more economical than electric power, the question may fairly be asked as to why they are not more generally used.

If the writer may be allowed to suggest at least one reason, it is certainly due to the lack of interest and aggressiveness on the part of many of our gas companies. The remarkable development of electric power is undoubtedly largely due to the aggressive enterprise and educative campaign carried on by the various electric power and distributing companies. One has only to refer to the daily press to note the incessant efforts on the part of the electric companies to educate the public to the use of their commodities. On the other hand, is it not a fact that we find little or no effort made by the gas companies along similar lines?

If it were possible to present here in detail the different industries to which gas power has been applied and could be applied, the result would show an extraordinary array covering every modern industry. There are very few industries, indeed, where power cannot be utilized, and in nearly all cases with decided advantages in the way of labor saving and economy to the consumer. For instance, take the baking industry, which is a field for the introduction of small power, particularly adaptable for gas where heat and power are both desirable. It is a well-known fact that a power-driven dough mixer with a given amount of flour will produce more bread than when mixed by hand, besides making better bread. In fact, the saving is sufficient to eventually pay for the necessary machinery. This is only cited as a single example out of many as actable.

Of the many means available for transmitting power no one method is universally applied. Each has some peculiarity which renders it especially adapted for some particular situation not possessed by the other, and is therefore so selected. For short distances, solid transmission is used, such as shafts, gears, etc., are almost of universal application. Greater distances bring into play successively, belts, chains, ropes, etc., the whole series forming a purely mechanical means of transmitting power by the direct transmission of force through a solid medium. It is only a short step from mechanical transmission of a force against a resistance as a means of transmitting power to the various other methods available. With the development of the air compressor, there became available a more economical and flexible means of transmitting power, and compressed air, power transmission systems, have become quite common, principally where small amounts of power are required, such as to operate tools, drills, hoists, etc.

Simultaneously with the evolution of power transmission methods of transmitting power, by reason of their adaptations, electric progress has been very rapid, and electrical methods of transmitting power by reason of their adaptability and comparative freedom from limiting distances, has enabled it more or less to outshadow all competitors. Electric power transmission is equally feasible through a few feet or very many miles, although, of course, with somewhat unequal losses, and may small amount of energy or the enormous output of our great waterfalls, without difficulty, electrical transmission by reason of its good features has brought the stored energy of nature from waterfalls to industrial communities. It has likewise removed innumerable shafts, belts, etc., from our factories. So successful, indeed, has been the application of electrical apparatus to the transmission of power that among engineers it has come to be regarded as the best means of transmitting power.

But it is well to bear in mind that no matter how good a method or piece of apparatus may be, the history of all engineering progress seems to indicate that some time and somewhere a better one will be found, if not better for all applications, at least better for some. Engineering practice really consists in the process of differentiation, applying the principle that "what is best in one place or time will not necessarily be so in another, or that something new may always find a useful field if essentially good."

In the development of the natural gas fields in the United States, there were built very extensive pipe lines for transmitting gas to towns and cities to be used for lighting, heating, and power purposes. As the gas wells ran out and as the cities and towns were equipped with apparatus requiring natural gas, it appeared to be more economical to seek distant wells and transmit the gas, than to substitute for it anything else. Thus there has grown up in the natural gas fields long distance pipe lines for handling natural gas and for the sake of economy, transmission is effected at high pressure, this pressure being usually maintained by the gas engine-driven air compressors. What was primarily intended to be a convenience for postponing the inevitable has proved to be a practical method of transmitting power by the concentrated energy in the form of gas fuel in pipes.

Apart altogether from the economy of the gas engine for power purposes there are some points decidedly in favor of a pipe line for transmitting gas power. There is practically no danger of a break in a well-laid pipe line, whereas at the present time, there are constant interruptions and more or less danger in the case of overhead electric transmission lines carrying electric current of very high voltage and exposed to the vagaries of wind and weather. In the case of electric transmission systems, the rotary motion is converted into electric energy at the dynamo with a loss, transmitted over lines with another loss, and converted back into rotary motion at the motor with a still further loss. Furthermore, many manufacturing plants require heat and there are now available apparatus whereby the waste heat from the exhaust and cooling water can be utilized, further adding to the advantages and economy of the gas engine.

I have endeavored to present in this paper a calm statement regarding the present position and the possibilities of gas power, and to avoid making any extravagant claims for this excellent form of power, but if we are to have cheap power why not have the cheapest available? What would seem to the writer to be most required at the present time is hearty co-operation between the various gas companies and the manufacturers, so that the public and prospective users may be properly educated to the many advantages which accrue from the use of gas as a means of cheap power.

SOME METHODS OF MEASURING LIGHT.

W. C. Philpott, Chemist Consumers' Gas Co., Toronto.

The measuring of light may be said to belong to one of the more important branches of physics. The sense of sight enables us to determine the difference between light and dark, and we can, with the aid of the eye, determine the difference of intensity between two or more sources of light: we can judge when one light is brighter than the other, yet our sense of sight is incapable of deciding with precision how many times one light is brighter than another.

The measuring of light is, therefore, in the first place dependent upon the sensitiveness of the eye, and this, together with the aid of proper instruments, we are able to determine (to a good degree of accuracy) the intensity of one light compared with that of another.

The measurement of light is based on various laws, the chief of which is that of the law of inverse squares. The intensity of light varies inversely as the square of the distance from the source of the light is the fundamental law of photometery. This law holds good for lights when placed in the horizontal, but when it is necessary to experiment with lights out of the horizontal, we have to use the general photometric law—$e = \frac{1 \cos 6}{D2}$. Where "e" equals the light effect (to be ascertained in foot candles), equals 1 the power of the source of light multiplied by the cosine of the angle of incidence divided by the square of the distance from the screen.

When we speak of certain sources of light having a certain candle power, we mean that the source placed at a given distance from a surface illuminates that surface so many times more than does that of a candle placed at the same distance.

Many of you are familiar with the Bunsen method of ascertaining the relative value of artificial light. In his arrangement Bunsen invented and employed a screen or disc of paper greased over part of its surface so as to render it partially translucent. The disc was supported on an upright and the two lights were placed one on the one side and one on the other of the disc. The smaller light was then brought towards the disc until the disc was equally illuminated on both sides. The distance from the disc to the centre of the source of the light was then measured and squared, and the quotient obtained from the division of the one square with the other resulted in the relative illuminating power of the flames.

The Bunsen photometer, although a good instrument, has been greatly improved upon, with the result that not only more accurate measurements are obtained, but also the measurement of different colored lights (such as those given out from incandescent lamps and electric lights) can be made with accuracy.

In comparing and measuring the intensity of various lights one must of necessity have a standard to work to. It is to be regretted that there is no common standard of light. Various countries have various standards, and this prevents the result of work done in one from being compared (with accuracy) with that done in another. It will be of no avail to discuss the merits and demerits of the various standards of light used in different countries, and I will confine myself to the official standards of the English-speaking countries.

(To be concluded next week).

ELEMENTARY ELECTRICAL ENGINEERING.

L. W. Gill, M.Sc.

CHAPTER IV.

DIRECT CURRENT APPARATUS AND SYSTEMS.

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

Direct Current Generator.—When the current in any circuit or system flows in one direction only, it is referred to as a "direct" current in contradistinction to an "alternating" current, the direction of which changes periodically. To obtain a uniform and continuous flow of current requires a constant unidirectional e.m.f. Any machine which will generate such an e.m.f. is known as a "d.c." (direct current) generator. It may be here noted that this term is misleading, since it is e.m.f. which is generated and not electricity.

The essential elements of a direct current generator are shown in Fig. 32. Referring to this figure, it will be noted that this generator consists of a circular frame

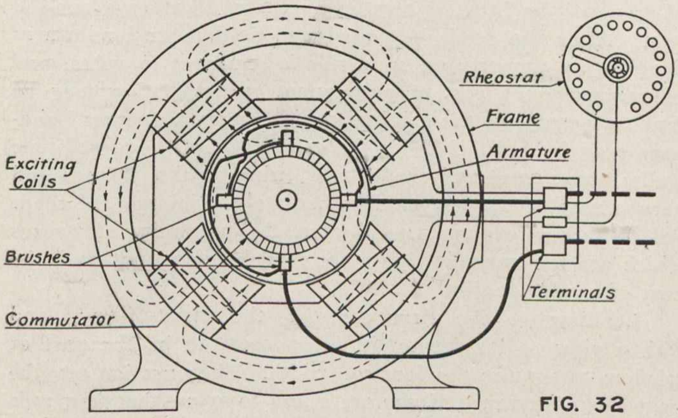


FIG. 32

or yoke, from which four "poles" project radially inwards. The number of poles is not fixed, but increases with the size of the machine. There must always be an even number, however, since for each north pole there must be a corresponding south pole. On each pole is placed a coil of wire, and these coils are connected in series in such a way that when a current passes through the circuit thus formed, the m.m.f. of every alternate coil causes a magnetic flux to flow into the frame, while that of every coil causes a magnetic flux to flow out of the frame. Under these conditions a current passing through the coils will cause a flux to flow through the poles and frame as shown by the dotted lines in Fig. 32. In the central space, which is made concentric with the frame by machining, there is an iron drum mounted on a shaft so that it can be rotated. This drum is made up of thin sheets of iron or steel of high permeability, and consequently provides a path of low reluctance for the flux, which passes from pole to pole. The magnetic circuits are thus composed entirely of magnetic material with the exception of the small clearance between the drum and poles. On the surface of the drum there are a large number of slots, in which copper wires or "conductors" are placed. (These slots and wires are not shown in Fig. 32, but may be clearly seen in Fig. 33, which shows two of these drums with part of the wires in place.) These wires are cross-connected at one end of the drum, and at the other end they are connected to a series of copper bars, which are arranged like the staves of a barrel, and held firmly together, each bar being completely insulated from its neighbor and its support by some nonconducting material. After being clamped in place, these bars are turned down to a smooth surface,

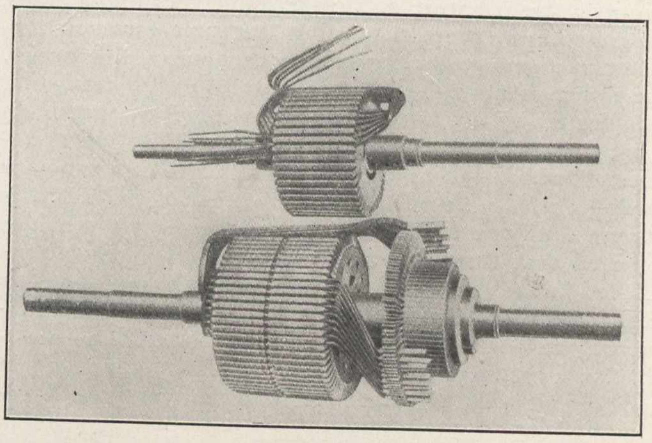


Fig. 33.

on which rubbing contact is made by stationary fingers or "brushes," usually made of carbon. The iron drum, with its complement of wire, is known as the "armature," and the ring of copper bars, with which the brushes make contact, is known as the "commutator." The partially-wound armatures shown in Fig. 33, are shown completely connected to their commutators in Fig. 34.

One method of connecting the conductors to the commutator is shown in Fig. 35. Here the armature winding and the commutator is developed into a plane (the plane of the paper). The dotted lines represent the position of the poles, and the dots and crosses represent the magnetic flux passing at right angles to the plane of the paper. In this case a motion of the conductors in the plane of the paper will correspond to actual rotation of the armature. When such motion occurs, the conductors will cut the lines of force which pass between pole and armature. There will thus be generated in each conductor an e.m.f.,

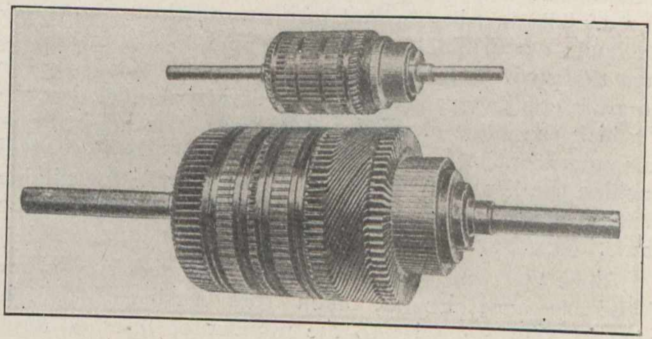


Fig. 34.

the direction of which will change as the conductor passes successive poles. The point at which the change takes place will obviously be midway between the poles. At this point the conductor does not cut any lines of force, and consequently there will be no e.m.f. generated in it. This point, which is called the "neutral point," is not a fixed point on the armature, but is that particular point at which there is no e.m.f. being generated. The point on the commutator which connects directly with this point on the armature is known as the neutral point on the commutator. In modern machines this point is either directly opposite the neutral point on the armature, as shown in Fig. 32, or directly opposite the poles, depending on the method of connecting the conductors to the commutator. These points on the commutator coincide with the position of the brushes.

Referring to Fig. 35, it will be noted that the neutral points on the armature divide the conductors into groups, the direction of the e.m.f. being the same for each conductor in a group, but opposite in each successive group. The direction of the e.m.f. generated in each conductor is indicated by an arrowhead. Starting from brush, b_1 or b_3, and following either circuit formed by the armature conductors—there are two circuits leading from each brush—it will be noted that the direction of the e.m.f. is positive until the brush b_2 or b_4 is reached. It will also be noted that there are an equal number of conductors included in each circuit from brush to brush, and that this number remains constant notwithstanding that the conductors are continually passing from one group to another as a result of the motion. The e.m.f. generated in each circuit will, therefore, be constant and unidirec-

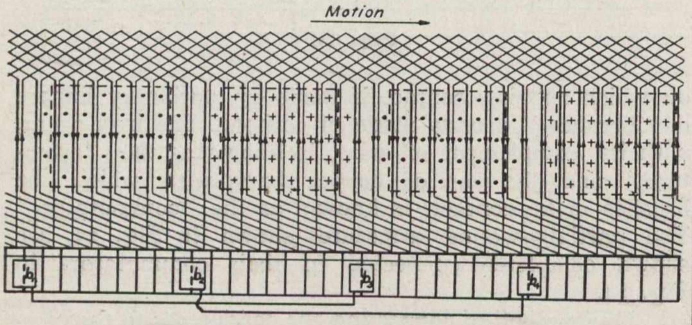


FIG. 35

tional; and if the density of the magnetic field is the same opposite each pole, the average e.m.f. generated by each conductor in the several circuits will be the same, and consequently the total e.m.f. generated in the conductors forming the circuit between the brushes b_1 and b_2 will be equal to that generated in the circuit between b_1 and b_4. The potential of b_2 will, therefore, be equal to that of b_4, and if the two are connected no current will flow from one to the other. For the same reason b_1 and b_3 may be connected. The brushes b_1 and b_3 thus constitute the negative pole or terminal of the machine, while b_2 and b_4 form the positive terminal. Between these terminals the armature conductors form four circuits in parallel, in each of which the same e.m.f. is generated. The armature is thus equivalent to four batteries in parallel. In the actual machine the brushes are connected by a cable to suitable terminal blocks conveniently located on some part of the frame. (See Fig. 33.)

Since the total e.m.f. which is generated in any one of the armature circuits, taken from brush to brush, is equal in absolute units to the number of lines of force cut per second by all the conductors in this circuit, as explained in Chapter III., the magnitude of this e.m.f. may be varied : (1) By varying the number of conductors included in each circuit; (2) by varying the density of the magnetic flux, or (3) by varying the velocity of the moving conductors. As the number of conductors cannot be changed after the machine is built, it follows that the e.m.f. of any particular machine can be varied only by varying the magnetic flux or the speed at which the armature revolves. In either case the e.m.f. changes proportionately; i.e., if the flux is doubled with constant speed, the e.m.f. is doubled, and if the speed is doubled with constant flux, the e.m.f. is doubled. This is true of all kinds of generators. In commercial work the speed of the generator can be varied only by varying the speed of the prime mover (engine or turbine), which is usually designed to run at constant speed. Variations of e.m.f. are, therefore, effected by varying the magnetic flux, which is done by increasing or decreasing the "exciting" current (the current which passes through the coils placed on the poles). This introduces the question as to the source of this current and the method of controlling it.

WIDTH OF ROADS.*

F. W. W. Doane, C.E.,
City Engineer, Halifax, N.S.

The unnecessary width of country roads and city and town streets would perhaps be a more appropriate and comprehensive title for the brief address contemplated in the preparation of our programme.

The subject should be considered under two distinct headings. First—The perhaps unnecessary width between boundaries; second, the unnecessary width of the roadway constructed and maintained for the use of wheel traffic.

In laying out country roads through undeveloped and perhaps useless land, the cost of acquiring a four-rod right-of-way may be little, if any, in excess of that for a two-rod road. After the road is opened and settlers or landowners develop the property on each side it increases in value, and consequently the cost of subsequent road-widening may be much greater than the original cost. Houses and other buildings may be built close to the road; fences, hedges, stone walls, ornamental and shade trees, wind-breaks, flowers and shrubs may occupy the land immediately adjoining the road. All these improvements, and even the proximity of houses which are not immediately on the road boundary increase the cost of road-widening.

Looking at the first cost of the right-of-way, and with a view to the future, it would seem to be the part of wisdom to acquire the four-rod width. The question may be asked here, however, if you are going to argue that four rods is an unnecessary width for a country road why should that width be acquired at all? Why not acquire only the width absolutely necessary?

That question has been answered partially in the preceding paragraphs. In the woods, in unsettled and uncultivated districts, one-half of the four-rod right-of-way is ample for all present requirements, but who can foretell the needs of the future? The wheel traffic of to-day cannot accommodate itself to the narrow lane of the past. The ox-teams of our forefathers could haul out into the bush to pass a traveller journeying in the opposite direction. Such treatment for a rubber-tired buggy or automobile is out of the question. This new and progressive style of transportation can be accommodated, however, on less than four rods. In fact, outside of the city, town and large village, a width of two rods is ample for traffic needs and for roadway construction. If there were no other consideration, we should have to decide only if it is probable that the natural features and facilities for reaching the outside world would justify the municipal authorities in deciding that the future settlement would grow into a village and the village to a town. Even after arriving at a favorable conclusion, it is a question whether the present generation should provide for the future or leave posterity

* Read before the Union of Nova Scotia Municipalities.

to look out for itself. There is another consideration, however, which no doubt would carry more weight than any other hereinbefore mentioned.

Presumably the special reason for making the country highways so wide was that there might be plenty of material available along the roadside for mending the roads in the old-fashioned way of throwing material from either side into the centre of the road regardless of suitability of the material for road purposes.

Now that better ideas on road construction are gaining practical recognition, this argument for wide highway reservations, only one-fourth or less of which is used, loses much of its force. Of course, there are hundreds of miles of little-used country roads which must be repaired in the future as in the past with whatever adjacent material can be most cheaply thrown into the roadway. The most that can be hoped for on these highways is that the road-scraper, drag and roller will be substituted for the plough, pick and shovel. By such means the best possible use will be made of such material as is closest at hand, and, what is more to the point of the subject under discussion, extra wide highway reservations hundreds of miles in length will not be required in order to make available a chance deposit of gravel here and there.

When a new road is located gravel deposits should be sought at the same time, and all necessary borrow pits either alongside or off the highway should be acquired while land is cheap. Rarely, indeed, do the demands for road material call for a continuous four-rod right-of-way, even under the old system of road construction and repair, and the difference in cost would perhaps pay for the borrow pits.

Even in the village, from two rods to two and a half is ample if borrow pits can be provided, say, every half mile. When borrow pits are made between the travelled roadway and the road boundary, most unsightly conditions are created, and no matter how attractive the private property may be, the appearance of the margin of the highway destroys the effect which the labor, care and expenditure of the householder has aimed at.

The greater the width of the travelled roadway, the greater the cost of construction and maintenance, and in this country of frost and sunshine the greater the difficulty in maintaining a satisfactory surface. Carriage wheels use about five or six feet of road surface, and the widest vehicles can pass on a fifteen-feet width; yet it is not unusual to see parts of country roads twenty-three, and even forty feet wide between ditches. Furthermore, road foremen continue to repair the full width of such wide places for no other reason than that their predecessors did it, although the rest of the road in their district may be less than half the width of such places.

In Nova Scotia conditions, no country roadway more than one rod wide can be thoroughly, easily and economically drained. The result is that the frost and rain destroy the road surface, and when the frost comes out in the spring it leaves it so uneven that it holds water all over it. This keeps the top softened so that it can be cut and ground by traffic making holes and ruts deeper. When the heat of summer drys the surface water, the covering material blows off in dust or remains to make mud when the wet and frost return.

The nearest treatment to a preventive is a one-rod roadway, well-rounded and well-ditched or guttered. On existing roads, the majority of which are flat or hollow in the middle, the sod on the side of the road next the ditch should be dug off and thrown outwards across the ditch. The material under the sod is very often good road-repairing material, and in such case should be dug down and thrown into the centre of the road, thus narrowing the road and raising it in the middle so that the rain will run off and out of the road instead of sinking into it. Where the road is very wide new ditches or gutters should be cut closer to the centre.

Along the village roads, after the best of the material along the sides has been removed, the margin outside the travelled way is left in a condition which seldom reflects credit on anybody, interested or otherwise. Gravel pits full of water, pollywogs and dirt, bare boulders, weeds, stumps, brush and rubbish have become such a common trimming that only the stranger notices the unsightliness of such decorations. Would it not be far preferable, after the available suitable material has been removed from the margins, to use only a right-of-way two rods or two and one-half rods wide and allow the property-owners to use the rest? The majority of the property-owners would remove the objectionable features and the whole community would reap the benefit. The rights of the public could be easily protected and preserved by preventing permanent encroachments. Of course, special legislation would be required, and it must be well thought out, so that every precaution would be taken to prevent the title passing from the public to the private property-owner. It may be that such a course would not be practicable at present, but, as appearance is becoming more important in public work than it has been in the past, the question is well worth more than a passing thought.

In those sections of the country where the unused portions of the highways rapidly grow up with weeds and underbrush, the growth should be cut annually. This entails considerable trouble and expense without any compensating return. If the fence line were removed (under lease) nearer the roadway the ordinary operations of tillage would keep down the weeds and brush where the land is under cultivation.

In some parts of the country, pasture lands excepted, fencing is neither so necessary or common as it once was. In the absence of fences there seems to be no good reason why land worth cultivation should not be cropped to the ditch line, thus utilizing all the land not required for road purposes, while at the same time keeping down noxious weeds and objectionable brush.

The arguments in favor of reducing the width of the roadway of city and town streets to the actual needs of vehicular traffic are even more forcible, relative length of roadway considered, than those for narrowing country highways. With one or two exceptions, Nova Scotia towns have no permanent pavements. Few towns have macadam or similar improved roadways, and are able to keep all their roadways in good condition. With the constantly increasing demand for a better roadway and for a form of macadam construction that will be dustless, it will become more and more difficult to secure sufficient funds to construct and maintain good street surfaces from curb to curb of the hundreds of miles of unnecessarily wide streets that now extend through our towns.

It is not the intention to argue in favor of a reduction of the width of town streets between street lines, but of the roadway only. The extra width between lines becomes an absolute necessity for the admission of fresh air and sunlight, general comfort and aesthetic purposes, especially when high buildings are erected along the thoroughfare.

The narrow street of to-day may have to be widened in the future to meet growing traffic demands. A sixty or sixty-six feet width for business streets leaves no margin to work upon when heavy foot traffic requires sidewalks ten or twelve feet wide or more, and double track street railways and cars occupy at least sixteen feet of the roadway.

On the residential streets, however, where there is no probability of a street railway being constructed in the future, where both foot and vehicular traffic are light and where blocks are not too long between intersecting streets, a great saving in maintenance charges and a great improvement in appearance may be made. On such streets a twenty-four feet roadway is ample and on hills even less may suffice. It is most important, economical and advantageous to make the roadway on a hill (especially a steep one) as narrow as traffic conditions will permit. The narrower the width the less danger there is of the roadway being washed out by rains. It can be well sprinkled in one trip of the street sprinkler, and that is absolutely necessary in hot weather to prevent horses from tearing or ravelling the surface. The area to be kept in repair is less, consequently the street appropriation will go farther.

On such streets usually a five or six feet sidewalk will accommodate pedestrians and the remaining space should be covered with grass. The sod after it gets a good start will not be washed out by rains and the damage done in such streets during storms will be lighter. A man with a scythe will keep in order miles of such parking (as it is called) while the same expenditure would not repair the damage sometimes caused by a single storm in one or two blocks of unnecessarily wide roadways. Not only is the cost maintenance less because there is less surface to wear out, but the first cost is less where the roadways are macadamized and where heavy general repairs are needed it pays to relocate the gutters and sidewalks.

This method of dividing and constructing streets makes it easier to work out a practicable cross section on streets running along a side hill. It is always desirable to have the roadway level instead of sidling and the difference in elevation between the upper and lower sidewalks may be all taken up in the parking on each side of the roadway leaving the latter so that vehicles do not tip sidewise in passing along.

Further improvement in appearance may be made by tree planting in the pathway.

The narrowing and parking of unnecessarily wide city and town streets has been receiving considerable attention from city and town engineers, but in towns where such officials are not employed the wide roadway is not unusual. The benefits to be obtained by the change suggested are quite generally recognized in engineering and aesthetic circles and are slowly dawning upon the minds of the general public.

In contrast, however, little thought even has been given to the hundreds of miles of our brush, weed, boulders and rubbish covered and unnecessarily wide country roadsides. Although a large percentage of the land along these highways is still of little value there are hundreds of miles of double highway strips taken out of valuable farm lands which are not only largely useless to-day but are actually breeding places for noxious weeds.

The time is rapidly coming, if it has not already arrived, when much of this roadside area ought to be devoted to useful purposes.

TESTING CEMENT FOR LOUISVILLE, KY., SEWERS.

Some practical interest attaches to the record of methods and results obtained in testing seven specified brands of cement used in the construction of the new sewerage system of Louisville, Ky. The details are given in the report of J. B. F. Breed, of Louisville, chief engineer, and Harrison P. Eddy, of Boston, consulting engineer. Early in the course of the construction work the Louisville Sewerage Commission established a cement-testing laboratory of its own, and the following results were obtained by the permanent staff:—

Cement-testing Methods.—The contracts provided that tests of cement should be made in accordance with the methods recommended by the Committee of the American Society of Civil Engineers on Uniform Tests of Cement, and that all cement should conform to the requirements adopted by the American Society of Civil Engineers, November 14th, 1904.

The minimum tensile strength required for Portland cement was fixed as follows:—

Neat Cement.	Strength.
24 hours in moist air	175 lbs.
7 days (one day in moist air, six days in water)	500 lbs.
28 days (one day in moist air, twenty-seven days in water)	600 lbs.
Mortar: One part cement, three parts sand.	
7 days (one day in moist air, six days in water)	175 lbs.
28 days (one day in moist air, twenty-seven days in water)	250 lbs.

Briquettes made for testing tensile strength were broken by a Fairbanks testing machine.

The average results of all tests are given in Table I.

Cement Used.—From July 1st, 1908, until December 31st, 1909, 825 carloads, equivalent to 146,437 barrels of cement, have been sampled and tested.

Sampling.—Samples were taken in accordance with the recommendation of the said Committee of the American Society of Civil Engineers. Each lot of cement was tagged at the time samples were taken. The practice of tagging varied according to the character of the work and the location of storehouses and other conditions. Upon small work, where the cement was taken from the storehouse and delivered to the work in small lots, it was found advisable to tag each bag. This was done as the cement was unloaded from the car or the team into the storehouse, at which time samples were taken for the laboratory. After acceptance, cement was taken from the storehouse to the work as required, and the inspector upon the work, having been informed of the identification number of the lots which had been passed or rejected, knew from the tags upon the bags whether or not the cement had been tested and accepted. Upon the larger work, where the contractor stored his cement

TABLE I.

Cement Tested from July 1st, 1908, to December 1st, 1909.

Brands.	Carloads Tested.	Fineness. Per Cent. Passing Through No. 100 Sieve.	No. 200 Sieve.	Tensile Strength (Pounds). 24 hrs.	Neat, 7 days.	28 days.	Mortars 1-3, 7 days.	28 days.	Specific Gravity.	Sulphuric Anhydride (SO_3), (per cent).
Alma	24	94.3	82.4	321	728	802	259	321	3.165	1.25
Bedford	58	92.7	78.1	315	718	786	266	355	3.122	1.45
Lehigh	168	93.3	78.2	336	766	836	257	332	3.130	1.43
Old Dominion	5	94.3	78.2	347	769	841	243	364	3.095	1.68
Kosmos	185	93.7	76.8	271	690	862	223	333	3.133	1.42
Speed	284	96.4	77.8	321	747	822	288	358	3.142	1.40
Superior	9	....	....	340	760	880	269	364	....	....

in warehouses from which it was used exclusively for but one of his contracts, and which were located close to the site of the work, it was necessary to use only sufficient tags to identify each individual lot, as the inspector was able to visit the warehouse at frequent intervals, and thus keep under his personal supervision the work of removing the cement from storage.

Seven brands of Portland cement were used upon the work as follows: Speed, Western Lehigh, Kosmos, Bedford U.S., Alma, Superior and Old Dominion.

Rejections.—Of the whole number of carloads of cement tested, seventy-four, or about 9 per cent., were rejected for the following reasons:—

62 carloads for quick setting.
5 carloads for coarse grinding.
6 carloads for retrogression in strength.
1 carload for low specific gravity and excess of sulphuric anhydride.

In each case, when cement was indicated by the tests to be of inferior quality, duplicate tests were at once commenced to make sure that no errors had crept into the laboratory work. It was also customary to order retests whenever the results of tests appeared questionable, even though the results might warrant passing the cement. In some instances three or four additional tests were made at the request of the manufacturers whose representatives were always welcomed to observe the making of the duplicate tests, and to make such suggestions as they deemed pertinent.

The large number of rejections, due to quick setting, was apparently due to shipping of cement without due seasoning. While some of the samples gave a satisfactory test when brought to the laboratory, a rapid change went on, so that within a month after the arrival of the shipments they had so changed as to become quick-setting. In some cases samples of cement would set in as short a time as three or four minutes. The change that was going on within this cement is shown very clearly by tests of samples that were taken from different parts of the same bag in a number of instances. For example, a sample taken near the surface, which was more or less exposed to the atmosphere, set in six minutes, while another sample, taken from the centre of the same bag, required two hours and thirty-four minutes in which to acquire the initial set. This entire shipment was rejected, and a few tests were carried on afterward, one of which, two months later, showed that the cement was still unfit for use on account of the short time in which it acquired its initial set.

In view of the importance of uniform methods and proper conditions in the laboratory, special attention was given to securing uniform results of tests. Whenever an opportunity was afforded by a visit of an expert from the cement factories, during which he made tests, his work was duplicated by the regular laboratory force for the sake of comparing results. Table II. shows the results of a series of tests upon one brand of cement, the tests being made in duplicate, one by a representative from the mills, the other by an assistant in the laboratory. It will be seen from this table that in the main the results obtained by each tester varied within reasonable limits, and that those of the laboratory assistant and the representative of the mills agreed with each other fairly closely.

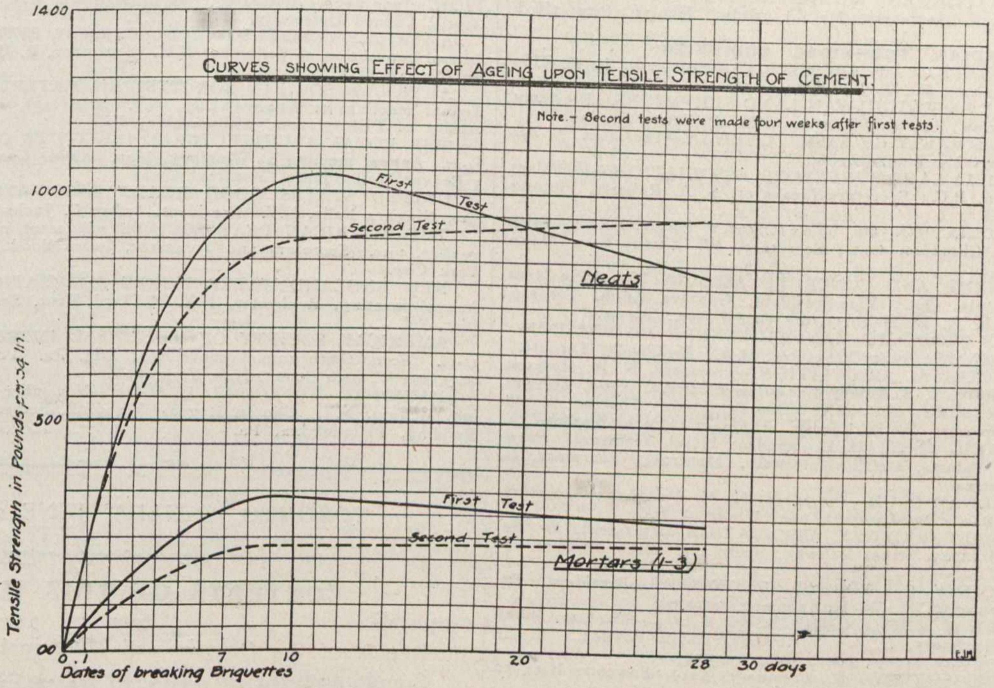


TABLE II.
Results of Duplicate Tensile Strength Mortar Tests.
(POUNDS).

A 7 days Mortar (1-3) Av.	Max.	Min.	Difference between Max. & Min.	B 7 days Mortar (1-3) Av.	Max.	Min.	Difference between Max & Min.	Difference between Averages.
397	420	375	45	288	307	270	37	109
272	281	263	18	283	293	273	20	11
278	292	255	37	291	297	285	12	13
390	400	380	20	246	260	232	28	144
272	283	261	22	283	312	255	57	11
226	34	218	16	316	345	287	58	90
296	303	290	13	219	283	265	18	77
263	285	251	34	263	272	253	19	..
270	281	260	21	266	270	263	7	4
320	325	240	45	266	270	263	7	54
Average			27				26	51

A—Represents Sewerage Commission cement tester.

B—Represents Cement Company's chemist.

(Continued on page 664).

ENGINEERING SOCIETIES.

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

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

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

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

VANCOUVER BRANCH—
Chairman, Geo. H. Webster; Secretary, H. K. Dutcher, 40-41 Flack Block, Vancouver. Meets in Engineering Department, University

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

MUNICIPAL ASSOCIATIONS.

ONTARIO MUNICIPAL ASSOCIATION.—President, Mr. George Geddes, Mayor, St. Thomas, Ont.; Secretary-Treasurer, Mr. K. W. McKay, County Clerk, St. Thomas, Ontario.

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

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

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

CANADIAN TECHNICAL SOCIETIES.

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

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

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

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

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

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Vice-President, Gustave Kahn, Toronto; Secretary-Treasurer, R. E. W. Hagarty, 662 Euclid Ave., Toronto.

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

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

CANADIAN FORESTRY ASSOCIATION.—President, Thomas Southworth, Toronto; Secretary, James Lawler, 11 Queen's Park, Toronto.

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

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

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

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

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

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

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

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

ENGINEER'S CLUB OF TORONTO.—96 King Street West. President, C. M. Canniff; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

INSTITUTION OF ELECTRICAL ENGINEERS.—President, Dr. G. Kapp; Secretary, P. F. Rowell, 92 Victoria Street, London, S.W.; Hon. Secretary-Treasurer for Canada, Lawford Grant, Power Building, Montreal, Que.

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

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

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

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

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

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

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

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

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

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

AMERICAN TECHNICAL SOCIETIES.

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

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

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

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

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

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

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

COMING MEETINGS.

CANADIAN ELECTRICAL ASSOCIATION.—July 6-7-8. Annual convention at Royal Muskoka Hotel, Muskoka Lakes, Ont. Secretary, T. S. Young, Confederation Life Building, Toronto, Ont.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION.—June 23-25. Annual meeting at Madison, Wis. Secretary, Henry H. Norris, Cornell University, Ithaca, N.Y.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.—June 27-30. Annual convention at Jefferson, N.H. Secretary, R. W. Pope, 33 West 39th St., New York City.

AMERICAN SOCIETY FOR TESTING MATERIALS.—June 28-July 2. Annual meeting at Atlantic City, N.J. Secretary, Edgar Marburg, University of Pennsylvania, Philadelphia, Pa.

THE ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—August 24-27. Annual meeting at Winnipeg, Man. Alcide Chausse, Hon. Secretary, 5 Beaver Hall Square, Montreal, Que.

UNITED STATES GOOD ROADS' ASSOCIATION.—July 28-29-30-31, 1910, Niagara Falls, N.Y. President, Arthur C. Jackson.

THE AMERICAN PEAT SOCIETY will meet at Ottawa, Ont., July 25-26-27, 1910. Secretary and Treasurer, Julius Boodollo, Kingsbridge, New York City.

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

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

NATIONAL MUNICIPAL LEAGUE.—November 14-18. Annual meeting, Buffalo, N.Y. Clinton Rogers Woodruff, Secretary, North American Building, Philadelphia, Pa.

TORONTO, CANADA, JUNE 23, 1910.

CONTENTS OF THIS ISSUE.

RAILWAY EARNINGS; STOCK QUOTATIONS.

Figures for the Past Week and from Beginning of Year, with Comparisons and Stock Prices.

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

Road	Wk. Ended	1910	Previous Week	1909
C.P.R.	June 14th.	$1,902,000	$1,841,000	$1,478,000
G.T.R.	June 14th.	891,252	791,354	795,519
C.N.R.	June 14th.	290,400	266,200	173,600
Mont. St.....	June 18th.	87,382	85,087	75,594
Halifax Elec..	June 14th.	4,049	4,203	3,910

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

Road.	Mileage.	Jan. 1st to	1910.	1909.
C.P.R.	10,236	June 14th.	$39,321,000	$32,949,000
G.T.R.	3,536	June 14th.	19,373,680	16,197,632
C.N.R.	3,180	June 14th.	5,283,700	34,707,900
Mont. St.....	14.179	June 18th.	1,930,702	1,672,790
Halifax Elec..	13.3	June 14th.	85,532	75,322

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

Co.	Capital 000's omitted.	Price June 7 1909.	Price June 9 1910.	Price June 16 1910.	Sales last week.
C.P.R.	$150,000	....	196	....	125
Mont. St...	18,000	218 217¾	242 241	244 243	553
Mont. St...	8,000	.. ..	120 ..	118½ ..	216
Halifax El..	1,400	116¾ 116	124½ 123	124 123	23
G.T.R.	226,000	1st pfd. 109½	3rd pfd. 63¾		

MONTREAL STREET RAILWAY.

The Montreal Street Railway's May statement shows:—

		Increase.
Total earnings	$ 370,234	$ 40,894
Expenses	199,616	18,469
Net earnings	170,616	22,425
Charges	54,435	8,554
Surplus	116,181	13,881
Eight months, October 1st to May 1st:—		
Net earnings	1,099,792	164,019
Surplus	781,242	130,026

CANADIAN ELECTRIC RAILWAYS.

From week to week we propose to give, on our page devoted to transportation interests, particulars of the equipment, mileage, and other information regarding the railways of Canada, together with a list of the officials. This series of articles commenced in our issue of October 1st.

Previously given:—

Ontario.

Brantford and Hamilton Railway.
Chatham, Wallaceburg and Erie Railway.
Cornwall Street Railway.
Guelph Radial Railway.
Galt, Preston and Hespeler Railway.
London Street Railway.
International Transit Co., Sault Ste. Marie.
Kingston, Portsmouth & Cataraqui Elec. Ry., Kingston
Toronto and York Radial Railway.
Windsor, Essex and Lake Shore Railway.
Ottawa Electric Railway.
Southwestern Traction Co., London.
Toronto Street Railway.
Niagara, St. Catharines and Toronto Railway.
Peterborough Radial Railway.
Berlin and Waterloo.
Sarnia St. Ry. Co.
Toronto Suburban St. Ry. Co.
Hamilton Street Railway.
Port Arthur and Fort William Electric Railway.

Quebec.

The Montreal Terminal Railway Company.
The Montreal Street Railway Company.
The Hull Electric Company.

LEVIS COUNTY RAILWAY

Purchasing Agent and Engineer, A. K. MacCarthy.
Chief Engineer,

Kind of Road: Electric.

Length of Road: Single track, 10.25 miles.
Double track,
Total in single miles, 10.25 miles.

Character of Service:

St. Joseph, 15 min.; Upper Town, 15 min.; St. Romuald, 30 min.
Number of cars, 25.
Type, open and closed.
Number of motors, 56.
Power of motors, 35 h.p.
Method of controlling, K 10, K 11.
Method of braking, hand wheel brakes.
Gauge of track, 4 ft. 8 inches.
Weight of rails, 60 lbs.

Power:

Direct Current,
Voltage of transmission, 2,200.
Trolley voltage, 550.
Frequency of transmission for A. C., 66⅔ cycles.
No. of phases, 3.
Power purchased from Canadian Electric Light Company, at Chaudiere.
Sub-station—2 250 k.w. synchronous motor gen. sets.
1 250 k.w. induction motor gen. set.

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

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

10768—May 23—Directing that, temporarily, and until further or other Order of the Board, in addition to the watchman already provided and maintained at the crossing at Cherry Street, by the corporation of city of Toronto, the G.T.R. appoint and maintain a watchman on the south side of the said crossing, the hours of the watchman to be from 7 a.m. to 7 p.m.

10769—June 1—Directing that no train of the G.T.R. shall cross any of the following streets, namely, Oxford, Richmond, Metcalfe, Caradoo, and Victoria, in Strathroy, at a greater speed than ten miles an hour, nor remain at any time within fifty feet of either of the boundary lines of any of the streets mentioned.

10770—June 6—Approving revised location of the Kootenay Central Railway Company's line of railway from a point on the British Columbia Southern Railway a short distance south of Wardner, at mile 0 to a point a short distance north of Fort Steel, at mile 24.9, in Kootenay District, B.C.

10771-72—June 4—Directing that within sixty days from the date of this Order the Canadian Pacific Railway Company shall install a Whyte Signal Electric Bell at crossing of Maria Street, and at the crossing of Mark Street, in the city of Peterboro, Ontario.

10773—June 4—Directing that the time for the completion of the interchange track of the P. M. and M. C. Railway Companies be extended for a period of two months from the date of this Order; and that the Leamington Canning Company convey the lands purchased by it, the title in which was vested in said company under authority of Order No. 9753, ½ to the M.C.R., and the other half to the P.M.R., division line being drawn from the point of junction of right-of-ways to a point half the distance on 370.48 limit.

10774—June 6—Ordering the Railway Company concerned in the crossing at the following point be relieved for the present from providing further protection at the crossing named, it appearing from an inspection made by the Board's Engineer and Operating Department, and from plans furnished, that the view at the crossing is excellent from both directions; that the crossing signboard is properly placed, and that there are whistling posts on the railway:—C.P.R. crossing of the highway in the north-west ¼ of Section 16, Township 12, Range 1, west Principal Meridian, two miles east of Meadows, Man.

10775—May 19—Authorizing that the G.T.R. use and operate jointly with the C.P.R. certain tracks leading to and on the premises of the Spietz Furniture Company, the Hanover Portland Cement Company, and the Knechtel Furniture Company, at Hanover, Ontario.

10776—June 2—Authorizing the C.P.R. to construct a branch line crossing Strickland Place and Earnbridge Street, in Toronto, Ont.

(Continued on page 665).

CONSTRUCTION NEWS SECTION

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

TENDERS PENDING.

In addition to those in this issue.

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

Place of Work.	Tenders Close.	Issue of.	Page.
Winnipeg, Man., railway bridge work	June 28.	May 6.	457
Girvin, Sask., telephone line	July 15.	May 20.	514
Lennox Island, P.E.I., wharf construction	June 27.	June 3.	569
Saskatoon, Sask., hospital extensions	June 30.	June 10.	52
Edmonton, Alta., interior equipment asylum	June 30.	June 10.	596
Tadousac Harbor, Que., wharf	June 29.	June 10.	596
Levis, Que., wharf	July 5.	June 10.	596
Little Tancook Island, N. S., breakwater	July 4.	June 10.	596
Toronto, Ont., bridge construction	June 27.	June 16.	54
Calgary, Alta., electrical plant supplies	July 12.	June 16.	54
Vancouver, B.C., lining reservoir	June 29.	June 16.	628
Ponoka, Alta., asylum equipment	June 30.	June 16.	628
Lethbridge, Alta., jail equipment	June 30.	June 16.	628
Toronto, Ont., band stand	June 28.	June 16.	628
Hampton, N.S., breakwater	July 4.	June 16.	626
New Richmond, Que., wharf extension	July 11.	June 16.	626

TENDERS.

Sydney, N.S.—Tenders will be received until June 29th for the construction of sewer extensions. James J. Curry, City Clerk.

St. John, N.B.—Tenders will be received until June 28th for mason work, carpentry, metal work and painting required for the extension of the St. John Exchange of the New Brunswick Telephone Company. G. Ernest Fairweather, Architect, 84 Germain Street.

Moncton, N.B.—Tenders will be received until June 22nd for digging and refilling trenches and laying water mains. J. Edington, City Engineer.

Montreal, Que.—Tenders will be received until June 31st for the reconstruction of a church. Jos. Art. Godin, 299 St. Denis Street.

Montreal, Que.—Tenders will be received until June 28th for the supply and delivery of coal, lead pipe, pig lead and tin, and for the purchase of scrap iron, steel, lead, etc. L. W. Senecal, Secretary, Board of Commissioners, Office, City Hall.

St. Agathe des Monts, Que.—Tenders will be received until June 25th for aqueduct works. Rudolphe Daze, Secretary-treasurer.

Sorel, Que.—Tenders will be received until July 18th for the construction of a breakwater. R. C. Desrochers, Assistant Secretary, Department of Public Works, Ottawa.

Cornwall, Ont.—Tenders will be received until June 30th for dredging canal. L. K. Jones, Secretary, Department of Railways and Canals, Ottawa.

Collingwood, Ont.—Tenders will be received until June 24th for the construction of a sewer on Fifth Street. K. S. Macdonell, Town Engineer.

Chatham, Ont.—Tenders will be received until June 30th for putting a concrete floor on the south approach to Kent Bridge. J. Gosnell, County Clerk, Harrison Hall.

Dunnville, Ont.—Tenders will be received until June 28th for the completion of a system of sanitary sewers. J. W. Holmes, Town Clerk.

Gravenhurst, Ont.—Tenders will be received until June 27th for the erection of a Presbyterian church. John M. Lyle, Architect, 14 Leader Lane, Toronto.

Lindsay, Ont.—Tenders will be received until June 27th for the construction of approximately 6,950 square yards of bituminous pavement. F. Knowlson, Town Clerk.

Lindsay, Ont.—Tenders will be received up to noon, Monday, June 27th, for the construction of approximately 6,950 square yards of bituminous pavements. F. Knowlson, Town Clerk.

London, Ont.—The city electrical department will call for tenders for power line hardware.

New Liskeard, Ont.—Tenders will be received until June 25th for the construction of sedimentation tanks, foundation for pumping station, and connecting with present and proposed sewers, and supplying and installing pumping machinery. C. H. Fullerton, Town Engineer; Murray & McAllister, Consulting Engineers, Continental Life Building, Toronto.

Newmarket, Ont.—Tenders will be received until July 1st for extension to High school building. E. A. Bogart, Chairman High School Board.

North Bay, Ont.—Tenders will be received until July 2nd for the furnishing of all materials and construction of approximately 60,000 square feet of concrete sidewalk. Jas. Sinton, Town Engineer.

Ottawa, Ont.—Tenders have been called by the Department of Railways for the bridge across the Saskatchewan River at the Pas Mission, which will be the starting point of the Hudson Bay Railway. The tenders must be in by July 4th. An appropriation of $300,000 for the construction of the bridge was voted at the last session of Parliament.

Ottawa, Ont.—The Department of Railways have issued a call for tenders for the construction of the Quebec Bridge. Tenders are returnable up to September. They will be advertised in all leading engineering journals of Canada, the United States, Great Britain and Germany, and it is expected that practically every great bridge-building company in the world will submit a tender. The Dominion Bridge Company, of Montreal, will, it is understood, make an effort to secure the contract, and the Krupps, of Germany, will also tender. Each tenderer must submit a guarantee bond of one million dollars to secure the Government against loss.

Smith's Falls, Ont.—Tenders will be received until June 27th for all trades in connection with the erection of a brick and stone public hospital. F. Whitcomb, Chairman of the Board.

St. Catharines, Ont.—Tenders will be received for the work in connection with the alterations and improvements to the Merritton mill for McSloy Bros. T. H. Wiley, Architect.

Toronto, Ont.—Tenders will be received until June 28th for heating, plumbing and electric wiring for addition to Osgoode Hall; also for plumbing in lavatories of the Normal School. H. F. McNaughten, Secretary, Public Works Department.

Toronto, Ont.—Tenders will be received until June 21st for a quantity of scrap iron, copper, old boxes, lumber, etc. H. F. McNaughten, Secretary, Public Works, Ontario.

Toronto, Ont.—Tenders will be received until June 27th for wire. G. R. Geary (Mayor), Chairman, Board of Control, City Hall.

Toronto, Ont.—Tenders will be received until June 28th for the supply of 300 feet of 30-inch steel pipe. G. R. Geary (Mayor), Chairman, Board of Control. (Advertisement in The Canadian Engineer.)

Toronto, Ont.—Tenders will be received until June 27th for the brick, masonry, cut stone, fireproofing, concrete, etc., works for a mansion. E. J. Lennox, Architect, 164 Bay Street.

Toronto, Ont.—Tenders will be received until June 28th for the construction of asphalt pavements, bitulithic pavements, brick pavements, grading, concrete curbing, concrete walks, sewer and 30-inch steel pipe. G. R. Geary (Mayor), Chairman, Board of Control.

Toronto, Ont.—Tenders will be received until July 12th for masonry and carpenter work, galvanized iron and roofing, gas-fitting and plumbing, hot water heating, electric wiring, plastering, painting and glazing in connection with a new fire hall. G. R. Geary (Mayor), Chairman, Board of Control.

Morden, Man.—Tenders will be received until June 25th for the construction of 1,500 square yards of granolithic or cement sidewalks. C. McCorquodale, Secretary-treasurer.

Moose Jaw, Man.—Tenders will be received until July 1st for supplying and installing a complete air-lift system; also for supplying and installing one electrically-driven centrifugal pump and auto-starter; also for delivering 3,000 cords of field stone. J. M. Wilson, City Engineer. (Advertisement in The Canadian Engineer.)

Moose Jaw, Sask.—Time for receiving tenders for the following has been extended to July 18th: Contract "A."—Supplying material for and constructing sewage disposal plant, complete, and laying trunk sewer. Contract "B."—(1) Supplying and installing a complete airlift system. (2) Supplying and installing one electrically-driven centrifugal pump and auto-starter. Contract "C."—Supplying and delivering 3,000 cords of field stone. (See full particulars in advertisement on another page.) J. M. Wilson, City Engineer.

Winnipeg, Man.—Tenders will be received until June 27th for the supply of 1,000,000 feet of B.M. lumber. M. Peterson, Secretary, Board of Control Office.

Winnipeg, Man.—Tenders will be received until June 25th for all trades (except heating) required in the erection of a business block. Frank R. Evans, Architect, 506 Somerset Building.

Winnipeg, Man.—Tenders will be received until July 4th for supply and erection of two sets of line-disconnecting switches, with mechanism. M. Peterson, Secretary, Board of Control Office.

Winnipeg, Man.—Tenders will be received until June 22nd for supply of an asphalt mixer. M. Peterson, Secretary, Board of Control.

Winnipeg, Man.—Tenders will be received until June 28th for the construction of sewer connections and installation of plumbing. M. Peterson, Secretary, Board of Control.

Swift Current, Sask.—Tenders will be received until July 12th for 18,700 feet 7 inches salt-glazed standard vitrified tile pipe, over 30,000 feet of cast-iron water pipe and a quantity of hydrants and gate-valves. J. Darlington Whitmore, Engineer, Room 1, Mickleborough Block, Regina, Sask. (Advertisement in The Canadian Engineer.)

Vanscoy, Saskatoon, Sask.—Tenders will be received until June 30th for all work in connection with the erection of a rural telephone line. Jas. Smart, Secretary-treasurer, Vanscoy Rural Telephone Co.

Vancouver, B.C.—The Water Committee decided to call for tenders for pipe and supplies for a new 22-inch main to be laid on Pender Street, from Westminster Avenue to Campbell Avenue, at a total approximate cost of $16,235. W. A. Clement, City Engineer.

Victoria, B.C.—Tenders will be received until July 4th for the construction of a steel tug boat. The Secretary, Department of Public Works, Ottawa.

CONTRACTS AWARDED.

Halifax, N.S.—The city Board of Works has recommended the acceptance of W. Beverley Robinson's (of Montreal) tender to supply the city with ten thousand feet of six-inch water pipe at $29.20 per ton. This was the lowest of six tenders from Halifax, Montreal and Philadelphia.

Montreal, Que.—J. P. Mullarkey, of Montreal, was awarded the contract for building the Hawkesbury to Montreal section of the Canadian Northern Railway.

Montreal, Que.—The Canadian Mineral Rubber Co., of Toronto, have been given a $145,000 paving contract by the City of Westmount.

Montreal, Que.—The Canadian Pacific Railway have awarded a contract to the American Bridge Co., for 10,000 tons of structural material to be used in the construction of their bridge over the St. Lawrence, at Lachine, according to a despatch from Pittsburg. The steel will be fabricated at Ambridge, Pa.

Montreal, Que.—The contract was awarded to Peter Lyall & Sons for what will be the biggest office building in Montreal, at the corner of St. Francois Xavier and St. James Streets. The building will be ten storeys high, with 14,000 square feet of floor on each storey. Work will be started next May, and the contractors have agreed to hand it over complete by May 1, 1912. It will cost about a million dollars.

Ottawa, Ont.—Burns & Charleston, of Ottawa, were given the contract for wharf extensions at St. Charles de Caplan, Que.

Ottawa, Ont.—Doran & Devlin, of this city, have been awarded the contract for building the new wing to the Eastern block of the Departmental Buildings. Their tender, which amounted to $222,800, was the lowest received.

Toronto, Ont.—Montreal Harbor Commissioners placed an order with the Polson Iron Works for a new steel dredge for the harbor. The length of the dredge will be 104 feet, the beam 36 feet, and the breadth at bow 10 feet 9 inches. This dredge will be a great deal larger than any in use at present in either Montreal harbor or Lake Ontario, while the hull will be all steel.

Uxbridge, Ont.—J. Curran, of Orillia, was given a contract by this municipality for the construction of concrete walks at 10 cents a square foot. Howard Shurter, of Peterboro', tendered at 12½ cents.

Walkerville, Ont.—The Cadwell Silex Stone Company, of Windsor, were given a contract by this town for granolithic walk construction at 9 cents a square foot. Other tenders were: D. Todd, Windsor, 9⅞ cents; Thos. Chick, Windsor, 9½ cents.

Maple Creek, Sask.—A. P. Burns has been awarded the contract for the installation of a sewerage and waterworks system.

Regina, Sask.—The contract for the construction of the sewage disposal works was awarded to Wm. Newman & Co., of Winnipeg, amounting to $48,727.

Tenders were received from the following firms:

The Parsons Construction Company, Regina	$78,181
Rigby, Hyland & Plummer, Winnipeg	51,900
The Forest City Paving Company, Regina	49,953
Wm. Newman & Co., Winnipeg	48,727

Edmonton, Alta.—The contract has been awarded for a new hospital building to cost $250,000 when completed, to the Connell Spencer Construction Company; the contract is for $170,000.

Lethbridge, Alta.—A contract for 130,000 cubic yards of grading was given to H. Margnardt, at 30 cents per yard, for 1,000 feet haul, and 33 cents for 1,500 feet haul, while a contract for 27,000 square yards of concrete walks went to the Forest City Paving and Construction Co., of Regina, Sask., and London, Ontario, at 85 cents.

Prince Rupert, B.C.—The contract for building the Portland Canal short line railway has been given to S. Cameron, of this city. The line is to run from Stewart to various camps, its length being seventeen miles.

Vancouver, B.C.—The B. C. Electric Railway Co. have awarded to Christian & Hartney, of Vancouver, a contract for the construction of the Richards Street extension.

Vancouver, B.C.—Evans, Coleman & Evans were awarded the contract for supplying the First Narrows main pipe at $41.20 per long ton. Other tenderers were: Robertson, Godson & Company, $41.60; A. G. Langley, $45.60; Porter, Worsnop & Company, $45.11; Western Oil and Fuel Company, $45.44. The pipe is twelve inches in diameter and in twelve-foot lengths, comprising 1,600 feet, about 110 tons.

Vancouver, B.C.—M. P. Cotton was awarded contracts for block paving on Campbell Avenue, Fourth Avenue and Granville Street, as well as five miles of cement walks, at 12½ cents per lineal foot. The tenders were:

Block paving—Campbell Avenue, from Powell Street to Hastings, M. P. Cotton, $8,616; Palmer Bros. & Henning, $10,200; Hastings to Barnard, M. P. Cotton, $24,333; Palmer Bros. & Henning, $29,225. Fourth Avenue, Maple to Vine, M. P. Cotton, $32,100; T. R. Nixon, $34,000; Palmer Bros. & Henning, $35,433. Granville Street, Drake to Beach, including basement drain, M. P. Cotton, $32,500; T. R. Nixon, $33,000; Palmer Bros. & Henning, $36,000. Cement walks, 2½ miles in Ward VI., and 2½ miles in Ward IV., M. P. Cotton, 12½ cents per lineal foot; Palmer Bros. & Henning, 14 cents. Angus Morrison was awarded the contract for grading Sixteenth Avenue from Bridge Street to Oak Street, at $6,515, subject to the approval of the Point Grey council. Palmer Bros. & Henning tendered at $9,063.

Victoria, B.C.—City Engineer Smith recommended the purchase of a "Squeegee" street washing machine at $1,707, delivered in Victoria.

Victoria, B.C.—Tenders for the construction of permanent sidewalks were received from the following: City engineer, $19,707.21; A. Pike, $18,015.40; F. Stedham, $17,532. Tenders for garbage tins were received from: A. Blygh, $2.93½; W. Wilson, $4; L. Peake, $3.99; George Powell & Sons, $3.10; Watson McGregor, $2.75 and $3; C. M. Cookson, $2.95; P. R. Little, $2.49; T. A. Johnson, $2.55 and $2.60; H. Cooley & Son, $3; Hayward & Dodds, $2.25 and $2.65; A. & W. Wilson, $5.50.

RAILWAYS—STEAM AND ELECTRIC.

Montreal, Que.—The Canadian Northern has purchased a large block of property on City Councillors Street, above St. Catherine Street, as a site for a new station. To reach this site a tunnel will need to be constructed under the Mountain.

Guelph, Ont.—The People's Railway Company are reported to have purchased the construction outfit used by Contractor Macdonald a year ago in building the 39-mile stretch of the C.P.R. from the main line through Durham. The outfit is being shipped to Berlin, from whence it will be taken out to Bridgeport, where the grading operations will be commenced as soon as the book of references, submitted by the company, have been approved by the Ontario Government, and their plans passed upon by the Ontario Railway and Municipal Board. The intention of the company, as far as can be learned, is to build the 27 miles from New Hamburg to Guelph this year, get the surveying for the Fergus, Elora, Arthur and Puslinch Lake lines done this year and part of the grading. They hope, however, to have the line from New Hamburg through Berlin to Guelph in operation this year.

Ottawa, Ont.—Arrangements have been made for turning the first sod of the Morrisburg and Ottawa Electric Railway at Morrisburg in August.

Ottawa, Ont.—The annual report of the National Transcontinental Railway Commission covering the work of the last fiscal year shows that sixty-three per cent. of the grading on the whole line from Moncton to Winnipeg is now finished and 45 per cent. of the bridging. During the year 521 miles of track were laid, the total track mileage on March 31st totalling 760, with an additional 165 miles of sidings. At the present date steel is laid on about half of the distance from Moncton to Winnipeg. Construction work is being vigorously pushed this summer on every section of the line, and it is expected that the road will be ready for through traffic in August or September of 1912.

The line from Winnipeg to Fort William will be opened for regular traffic next August.

The total expenditure on the road up to the end of the fiscal year was $71,137,993.

Ottawa, Ont.—The Ottawa Rideau Valley and Brockville Railway Company have decided to go ahead with the project this summer. It is understood that the charter will be controlled by one of the big trunk lines now running into Ottawa which will construct and operate the railway. The survey will be completed without delay and construction, it is said, will be begun during the autumn. The line will run from Ottawa to Brockville, branching off from the G.T.R. at Graham's Bay and passing through Manotick, North Gower, Burritt's Rapids, Merrickville, North Augusta and Algonquin to Brockville. The road will be extended from Ottawa by way of the Interprovincial bridge to the iron mines at Ironsides and a company is to be formed to operate the mines. Tenders are to be called for electric power for furnaces. The directors of the company are: William C. MacLaren and James H. Gilmour, of Brockville; ex-warden Heney, E. W. Clarke, Donald Hector MacLean and G. H. Kidd, K.C., of Ottawa; Alfred McDermott and R. E. Elliott, of Montreal.

Winnipeg, Man.—John Armstrong, Dominion Government engineer in charge of the Hudson's Bay Railway surveys, left on Monday for the Pas, where a considerable amount of preliminary work is being done in connection with the construction of the railway bridge across the Saskatchewan. Plans have been completed for a bridge, which, it is understood, will be similar to the one at Prince Albert.

These are now at Ottawa, and tenders will be called for as soon as they have been approved. It is expected that work will be started next month.

Regina, Sask.—The Mayor and A. J. McPherson, as city commissioners recommended provision for street car lines on Albert Street.

Regina, Sask.—The first train on the G.T.P. Regina-Yorkton branch reached Yorkton on Wednesday, June 15th.

Calgary, Alta.—In a recent report, T. H. McCauley, superintendent of the municipal street railway, recommends the construction of two bridges, twenty miles of new track and the purchase of twelve new cars.

Vancouver, B.C.—The municipality of Point Grey will probably grant a 40-year franchise to the British Columbia Electric Railway which undertakes to provide an adequate system of street railway for the town.

Victoria, B.C.—The British Columbia Electric Railway Company has decided to equip its cars with modern safety fenders.

BY-LAWS AND FINANCE.

Following is a list of municipalities which sold debentures last week:—

Montreal, Que.—$20,000. Ville Emand.
Buchanan, Sask.—$3,000, local improvements.
Outremont, Que.—$75,000, streets.
Tofield, Alta.—$7,500.
Chatham, Ont.—$35,000, local improvements.
Peterboro', Ont.—$22,671, local improvements.
Portage la Prairie, Man.—$20,000.
St. Mary's, Ont.—$54,348.
Dunnville, Ont.—$30,000.

St. Lambert, Que.—A $100,000 roads by-law is being considered by council.

Montreal, Que.—The ratepayers of Montreal West approved of a by-law for a loan of $30,000 for the purpose of erecting a town hall.

Outremont, Que.—Tenders are invited for $200,000 street improvement debentures.

Thamesville, Ont.—$10,000 waterworks debentures are offered for sale by W. J. Cryderman, clerk.

Port Arthur, Ont.—Ratepayers have passed the following money by-laws: $30,000 for telephone extensions; waterworks extensions; $8,000 grant for Agriculture Society's new buildings; $10,000 electric light plant extensions; sewer construction; $800, ambulance.

Welland, Co., Ont.—A $100,000 good roads by-law is before the ratepayers.

Souris, Man.—Ratepayers will vote on July 8th on a $95,000 by-law for waterworks construction.

Dauphin, Man.—Until July 15th, tenders are wanted by W. Smith Jackson for $25,000 school debentures.

Portage la Prairie, Man.—A $20,000 school by-law has been passed.

Saskatoon, Sask.—Ratepayers passed eleven money by-laws on Friday, including $300,000 for waterworks, sewers, concrete sidewalks, electric light extensions and the purchase of a motor combination chemical and hose wagon.

Calgary, Alta.—Ratepayers sanctioned by-laws as follows: Trunk sewer, $60,000; grading, $96,000.

LIGHT, HEAT AND POWER.

Galt, Ont.—The Grand River Improvement Association has petitioned the Hydro-Electric Commission to survey the Grand Valley to determine the possibilities of storage for power development and water supply.

Windsor, Ont.—The ratepayers decided to enter the Western Ontario power union and contract for a power supply from the Hydro-Electric Commission.

Saskatoon, Sask.—The ratepayers, by a vote of nearly 3 to 1, decided in favor of making a contract with the Saskatchewan Power Company, which means that the Saskatchewan River at this point will be harnessed to provide cheap electrical energy. The company is to build a generating plant twelve miles below the city at a cost somewhere in the neighborhood of one million dollars.

Stettler, Alta.—The John Galt Engineering Company have been engaged by this municipality to install the proposed electric light plant.

Prince Rupert, B.C.—A committee, whose report was adopted, recommended the installation of an electric light plant to cost $70,000. V. W. Smith is chairman.

SEWERS, SEWAGE AND WATERWORKS.

Moose Jaw, Sask.—Council sanctioned by-laws aggregating $415,000, included in which is $375,000 for sewage disposal and waterworks. The works were designed by J. M. Wilson, city engineer, to meet future requirements.

Estimates of the cost of main drainage works for this year are as follows: Trunk sewers, $27,297; sewage disposal plant, $113,364; machinery, $16,077; supplies and labor, $10,101, and contingencies $4,000 making a total of $170,839. Council have authorized the city engineer to call for tenders for the construction of the sewage disposal plant, and for the extension of the water and sewer systems in the city, the acceptance of any tender being subject to the passing by the ratepayers of the necessary by-laws.

Stettler, Alta.—The waterworks will be installed by the John Galt Engineering Company who have also been commissioned to prepare plans and superintend the electric light works construction.

MISCELLANEOUS.

Hamilton, Ont.—According to a letter received by the Mayor, J. G. Sing, the resident engineer of the Department of Public Works, at Toronto, will shortly invite tenders for the revetment wall extension for which $20,000 was included in the supplementary estimates of the Department some time ago.

Brandon, Man.—W. A. Elliott, architect, has completed plans for a new business and apartment block of pressed brick and cut stone. Tenders will be invited shortly.

Winnipeg, Man.—Two $50,000 apartment blocks are to be erected on the north side of River Avenue. A permit for these buildings was issued to J. E. Wilson. Each of the blocks will occupy 139 feet by 45 feet. The height will be three storeys in addition to a basement. The architect is J. D. Atchison.

Chilliwack, B.C.—The Government has decided to erect a new post-office here of reinforced concrete construction, estimated to cost $30,000.

Point Grey B.C.—Board of Works decided to grade Granville Street, at a cost of $18,750.

Vancouver, B.C.—The Middlesbrough Steel Strip and Hoop Company, of London, Eng., is interested in a project for establishing iron and steel mills, including blast furnaces and rolling mills, on Vancouver Island.

Vancouver, B.C.—Board of Works will construct a granatoid pavement on Westminster Road, to cost $57,400. A $21,810 tile drain will be laid on the lane east of Granville Street.

Victoria, B.C.—Applications will be received by the Minister of Public Works up to Monday, the 27th June, for the position of Supervising Architect. F. C. Gamble, Public Works Engineer.

OBITUARY.

Mr. Arthur White, who was general manager of the Midland Railway when the line was taken over by the Grand Trunk, died in Toronto, last week, in his seventieth year.

PERSONAL.

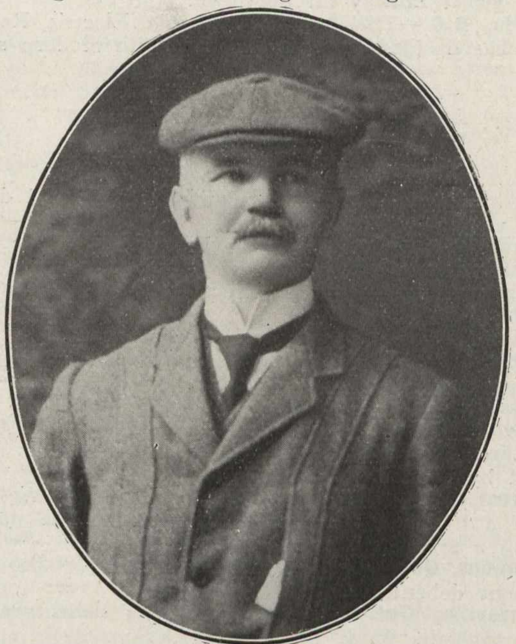
Readers are invited to forward notes of staff changes and new appointments for publication in this column.

Mr. E. L. Cousins, A.M., Can. Soc. C.E., whose recommendation for appointment as assistant city engineer of Toronto on special work, which will include the railway engineering, as announced in The Canadian Engineer last week, was adopted by the city council on Monday.

Mr. W. F. Tye, the consulting engineer who was engaged by Toronto in the viaduct case before the Railway Commission, has made Toronto his residence, coming from Montreal. For the past three years Mr. Tye has been a vice-president of the Can. Society of Civil Engineers.

Mr. T. Aird Murray, M. Can. Soc. C. E., has opened offices at room 303, Lumsden Bldg., cor. Adelaide and Yonge Streets, Toronto. From his new offices, Mr. Murray will carry on his practice as consulting engineer, giving special attention to pure water supply problems and sanitary engineering.

Mr. Alan M. Jones, Assoc. Mem. C. S. C. E., resident engineer of the C. P. R. in Ottawa for the past seven years, has been appointed assistant engineer in charge of the construction of the new Quebec Bridge. He is a graduate of Upper Canada College, Toronto, and of the Royal Military College, and has been employed by the Illinois Central and the Baltimore and Ohio Railway. He was also on the engineering staff of the Chicago drainage canal.



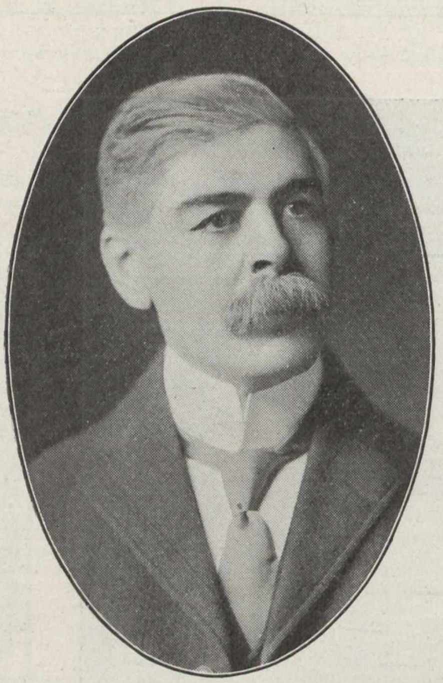
Mr. William Mahlon Davis, M. Can. Soc. of C. E., who, as announced in this column last week, was recently appointed city engineer of Prince Rupert, B.C.

Mr. Lachlan T. Burwash, of White Horse, has been appointed mine recorder at Dawson. He will combine with that office the duty of Government Mining Engineer in the Yukon Territory.

Senator Raoul Dandurand has been elected to the board of directors of the Grand Trunk Pacific Railway.

Mr. A. E. Eastman, of Lachine Locks, Que., has removed to Regina, Sask., to join the staff of G. Darlington Whitmore, Consulting Engineer.

Mr. Alan Macdougall Jones, A.M., Can. Soc. C. E., has resigned as resident engineer C. P. Ry., Maintenance Dept., Ottawa District, to accept a position with the Quebec Bridge Commission. Mr. Nelson, of the Resident Engineer's office, C. P. Ry., Montreal Terminals, has been appointed to succeed Mr. Jones.



Mr. C. M. Canniff, late chief engineer of the Expanded Metal and Fire-proofing Co., Toronto, and Mr. John, S. Fielding, consulting engineer, have opened offices under the name of Fielding & Canniff, Civil Engineers, 15 Toronto Street, Toronto. This firm will specialize in steel and reinforced concrete, in both buildings and bridge design, dam construction, hydro-electric power plants and power transmission. Mr. Fielding and Mr. Canniff have been for many years connected with engineering work in every section of Canada.

Mr. D. Chene, the new city engineer of Hull, Que., was born in Hull in 1885. After following a course of studies at the local schools he secured a position as draughtsman with a well-known architects firm of Ottawa, Band, Burnett and Meredith, where a good, practical knowledge in architecture was secured. Mr. Chene passed the matriculation examination for Laval in 1905, and was admitted in same year at Polytechnique School, of Montreal, from which he graduated in civil engineering and chemistry, with distinction, in 1909, taking honors in his last three years of study. Mr. Chene carried out some important works for the City of Hull and for the Dominion Government before taking the position of city engineer.

Capt. W. J. Press has been appointed to N. Y. Ry. engineering staff as engineer in charge of erection and installation of machinery and equipment for shops six miles east of St. Boniface. He is now engaged at Ottawa in going over tenders for the equipment of shops. Later he will make his headquarters at St. Boniface, Man.

DOUBLE-ENDED PADDLE STEAMER

Launched on Saturday at the Polson Iron Works, Toronto. Will be in commission by July 1st.

The "Trillium," the latest addition to the Toronto Ferry Company's fleet, was successfully launched on Saturday, June 18th, at the shipyards of the Polson Iron Works. It is a double-ended paddle steamer on the lines of the "Bluebell," but with increased accommodation and improved conveniences. The contract price is in the neighborhood of $75,000. The vessel has a length of 150 feet, and a beam of 45 feet. Her engines are of the inclined compound type, with 17-inch and 34-inch cylinders, and a 48-inch stroke, capable of driving her at ten miles an hour. The electric light plant will generate power enough to handle 350 sixteen-candlepower lamps. The contractors, the Polson Iron Works, Limited, have undertaken to have the boat ready for commission within two weeks, quite a feat in rapid outfitting. The engines were installed in the boat before launching, and the boiler, which was slung on a crane in readiness, went into her a couple of hours after the launching. The cabins are all ready to be lifted on and fixed, and the builders are confident that the "Trillium" will be on the service by July 1.

TESTING CEMENT FOR LOUISVILLE, KY.

(Continued from page 655).

There is necessarily a variation in the results of the tests for tensile strength, both of neat cement and mortar, although with care and skill in manipulation the variations may be materially reduced. After making a large number of tests it was decided that, for the ordinary routine work of the laboratory, the difference in strength between the highest and lowest tests of mortar briquettes, either seven or twenty-eight days' old, should not exceed sixty pounds. If this amount was exceeded, a new test was immediately started. In cases of special experiments or shipments of cement, the quality of which was particularly doubtful, and other cases requiring great accuracy, judgment was based upon tests in which the limit of variation was materially less than that adopted for the ordinary routine of the laboratory.

Whenever tests of neat cement at the end of seven days showed a tensile strength exceeding 800 pounds, a new test was at once started, experience having proved that in most cases, if the manipulation and conditions had been good, cement-testing above 800 pounds in seven days will show a retrogression in twenty-eight days. In all cases at least forty briquettes were made up from each carload tested, eight for each period of time in case of both neat and mortar tests, and, where the tests were made for the purpose of passing upon the quality of the cement, all results were booked and judgment passed upon the average. In experimental work eight briquettes were made up for each test of tensile strength, but only those breaking within five per cent. of the mean were used in the tabulations.

Storage for Twenty-eight Day Test and Lumpy Cement.—The specifications required that the contractors should hold cement in storage long enough to allow for tests of twenty-eight days' duration. It was found, however, during the winter of 1908 and 1909, that in several of the warehouses the dampness of the atmosphere had penetrated so as to cause the cement to become somewhat lumpy. In some cases this was due largely to the fact that doors and windows had been left open, allowing the damp air to enter freely; but it was also found that in other warehouses in which cement seemed to be well protected there was also some deterioration in quality. Permission was given to contractors, therefore, to cut down their storage during the winter and spring, so that the cement might be used in a shorter time if found satisfactory at the end of the seven-day test. Cements, however, which upon the results of the seven-day tests did not give promise of fulfilling all the requirements, were held for the full twenty-eight-day test.

Samples of the lumps of cement were tested, and in some cases were found to have lost nearly all of their original strength. The fine material in the same bags was found to be of good quality, and was allowed to be used after the lumps had been screened out. There appeared to be no difference in the effect of the dampness upon the different brands of cement in storage, all of them seeming to suffer to about the same extent.

RAILWAY ORDERS—Continued from page 657.

10777—June 2—Directing that the C.N.R. be made subject to a penalty of twenty-five dollars a day for every day after the first of July, 1910, that the requirements of par. 1 of Order of October 16th, 1909, in re diversion of Thibault Street, St. Boniface, Man., has not been complied with.

10798—June 7—Approving of location of proposed new C.P.R. station at Chalk River, Ont.

10799—June 6—Authorizing G.T.R. to construct branch lines with spur from point on railway south of River Do , Toronto, into the premises of the Toronto Iron Works, Limited, and British American Oil Company, Limited, and along roadway 150 feet wide on the north side of Keating's Channel.

10800—June 7—Authorizing the Province of British Columbia to construct a subway across right-of-way of C.P.R. 300 feet northerly from junction of Kimberley Branch and the main line of its Crow's Nest Branch.

10801—Authorizing the G.T.R. to construct, rearrange, etc., its tracks, switches, and sidings upon, along, and across Hibernia Street, Albert Street, Nunn Street, Third Street, and certain lands and premises within the corporation of town of Cobourg. G.T.R. to provide roadway 16 feet wide from east end of Nunn Street along south-east side of its right-of-way to ferry dock. Work to be completed within three months.

MARKET CONDITIONS.

Montreal, June 22nd, 1910.

The market for pig-iron in the United States shows but little difference as compared with a week ago. Quite a quantity of buying has been going on recently, and there are many enquiries from different sections, so that it looks as though at any time an improvement might take place in the situation. Prices continue at previous levels. Interest in the East is still largely in basic iron, there being several new enquiries in the market aggregating 20,000 tons.

It is said that steel works of various kind are also in the market for considerable quantities for shipment covering the third quarter. Basic iron, for delivery in the near future, is quoted at $15.50 to $16.00 per ton, delivered.

One of the most encouraging features in the market is the heavier buying movement in finished steel products. Some purchasers are demanding immediate shipments of structural material, and higher prices have actually been made in some instances. For the most part, however, fabricating shops will have no difficulty in making shipment of all the iron required, as their output has been accumulating somewhat during the past few months.

A view of the trade which has been receiving some attention is found in the gradually decreasing demand for wire nails. This demand seems to have been decreasing steadily for some time past, and the explanation which is offered is interesting, to say the least. It is that wooden buildings are giving way to steel and concrete buildings. This, as may easily be seen, would, no doubt, account for the falling-off in demand for nails, inasmuch as less nails would be required in the construction of steel and concrete buildings than in the construction of wooden buildings. It is a movement which is of more than local importance, and should be given full consideration by all those who are likely to be affected. The replacing of wooden buildings by steel and concrete buildings, while it may give occasion for the use of less nails, will, as can readily be seen, not be detrimental to the iron and steel business, inasmuch as it will give occasion for the use of more metal than the old wooden buildings.

It begins to look as though the United States Steel Corporation will shortly undertake the building of a steel plant at Duluth. This they promised to do some years ago, the idea at that time being that they would expend somewhere in the vicinity of five or six million dollars on the undertaking. The matter has been brought forcibly to their attention recently by the agitation in the State of Minneapolis against taking away so much iron ore from the State, thus losing to the State the manufacturing process. It is now considered by the Steel Corporation that to spend less than $10,000,000 upon the plant will be uneconomic.

Reports from England are uninteresting in many ways, inasmuch as no alterations in prices, worthy of comment, are taking place. All eyes seem to be fixed on the situation in the United States, and the feeling is that an improvement there would be followed almost immediately by an improvement throughout Great Britain. The demand from Germany and the Continent is slow.

In Canada the situation shows very little real change. The entire market is interested in the developments which are going on in connection with the Dominion Steel and Coal Corporation, as well as in the amalgamation of the steel finishing works. The situation is shaping up gradually, but there seem to be a number of cross purposes, the situation being thus rendered unsettled and somewhat prejudicial to the interests of the trade. With this exception, there is little to comment upon. The market for finished and semi-finished products, continues to show no change, having now been in that position for almost a year past. This is certainly an extraordinary condition of affairs. In fact, the market throughout the entire list of iron and steel, and products thereof, shows no change worthy of comment.

The market holds steady at recent prices:—

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

Bar Iron and Steel.—The market promises to advance shortly. Bar iron, $1.90 per 100 pounds; best refined horseshoe, $2.15; forged iron, $2.05; mild steel, $1.90; sleigh shoe steel, $1.90 for 1 x ⅜-base; tire steel, $2.00 for 1 x ⅜-base; toe calk steel, $2.40; machine steel, iron finish, $1.95; imported, $2.20

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

Cement.—Canadian cement is quotable, as follows, in car lots, f.o.b., Montreal:—$1.30 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 has advanced again, being now per 100 lbs., as follows:—¼-in., $5.30; 5-16-in., $4.70; ⅜-in., $3.90; 7-16-in., $3.65; ½-in., $3.55; 9-16-in., $3.45; ⅝-in., $3.40; ¾-in., $3.35; ⅞-in., $3.35; 1-in., $3.35.

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

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

Explosives and Accessories.—Dynamite, 50-lb. cases, 40 per cent. proof, 15c. in single case lots, Montreal. Blasting powder, 25-lb. kegs, $2.25 per keg. Special quotations on large lots of dynamite and powder. Detonator caps, case lots, containing 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 strength, per 100 fuses:—4-ft. wires, $3; 6-ft. wires, $3.54; 8-ft. wires, $4.08; 10-ft. wires, $5.

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

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

Iron.—First boats are now arriving at Montreal, and importers are quoting prices, ex-wharf, about $1 per ton under prices ex-store. Following are the prices, on cars, ex-wharf, Montreal:—No. 1 Summerlee, $20.50 to $20.75 per ton; selected Summerlee, $20 to $20.25; soft Summerlee, $19.50 to $19.75; Carron, special, $20 to $20.50; soft, $19.50 to $20; Clarence, $17.25 to $17.50; Cleveland, $17.25 to $17.50 per ton.

Laths.—See Lumber, etc.

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

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

Lumber, Etc.—Prices on lumber are for car lots, to contractors, at mill points, carrying a freight of $1.50. Red pine, mill culls out, $18 to $22 per 1,000 feet; white pine, mill culls, $16 to $17. Spruce, 1-in. by 4-in. and up, $15 to $17 per 1,000 ft.; mill culls, $12 to $14. Hemlock, log run, culls out, $13 to $15. Railway Ties; Standard Railway Ties, hemlock or cedar, 35 to 45c. each, on a 5c. rate to Montreal. Telegraph Poles: Seven-inch top, cedar poles, 25-ft. poles, $1.35 to $1.50 each; 30-ft., $1.75 to $2; 35-ft., $2.75 to $3.25 each, at manufacturers' points, with 5c. freight rate to Montreal. Laths: Quotations per 1,000 laths, at points carring $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 and prices are firmer, $2.40 per keg for cut, and $2.35 for wire, base prices. Wire roofing nails, 5c. lb.

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

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

Pipe.—Wrought and Galvanized.—Demand is about the same, and the tone is firm, though prices are steady, moderate-sized lots being: ¼-inch, $5.50 with 63 per cent. off for black, and 48 per cent. off for galvanized; ⅜-inch, $5.50, with 59 per cent. off for black and 44 per cent. off for galvanized; ½-inch, $8.50, with 69 per cent. off for black, and 59 per cent. off for galvanized. The discount on the following is 71½ per cent. off for black, and 61½ per cent. off for galvanized; ¾-inch, $11.50; 1-inch, $16.50; 1¼-inch, $22.50; 1½-inch, $27; 2-inch, $36; 2½-inch, $57.50; 3-inch, $75.50; 3½-inch, $95; 4-inch, $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 rails, per gross ton of 2,240 lbs., f.o.b. mill. Re-laying rails are quoted at $27 to $29 per ton, according to condition of rail and location.

Railway Ties.—See lumber, etc.

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

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

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

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

Telegraph Poles.—See lumber, etc.

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

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

Zinc.—The tone is easy, at 5¾ to 6c.

CAMP SUPPLIES.

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

Butter.—Fresh made creamery, 25 to 26c.

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

Cheese.—The market ranges from 11c. to 11½c., covering all Canadian makes.

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

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

Eggs.—New laid, 20 to 22c.

Flour.—Manitoba, 1st patents, $5.60 per barrel; 2nd patents, $5.10; strong bakers, $4.90.

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

Potatoes.—Per 90 lbs., good quality, 45 to 50c.

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

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

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

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

Fish.—Salted.—Medium cod, $7 per bbl.; herring, $5.25 per bbl.; salmon, $15.50 per bbl., for red, and $14 for pink. Smoked fish.—Bloaters, $1.10 per large box; haddies, 7½c. per lb.; kippered herring, per box, $1.20 to 1.25.

Provisions.—Salt Pork.—$27 to $34 per bbl.; beef, $18 per bbl.; smoked hams, 16 to 20c. per lb.; lard, 16½ to 17½c. for pure, and 12½ to 14c. per lb. for compound.

* * * *

Toronto, June 23rd, 1910.

The most noticeable item to-day is in the camp supplies' department. Prices of flour are advanced 25c. per barrel. This is caused by an advance in the Chicago and Winnipeg wheat markets of 7 and 6 cents per bushe' respectively, the impelling idea being the drought in the American and Canadian West. This advance may or may not last. Pork and salt meats are easier.

Very marked activity has developed in lumber during the fortnight; large bills of hemlock as well as pine have been sold, and the demand continues. The ingot metals are easy; pig-iron steady under a moderate demand, sheet steel moving briskly.

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

Antimony.—Trade is quiet, market easier at $8.50.

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

Bar Iron.—$2.00 to $2.10, base, per 100 lbs., from stock to wholesale dealer. Free movement.

Bar Mild Steel.—Per 100 lbs., $2.10 to $2.20.

Boiler Plates.—¼-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate. Tank plate, 3-16-inch, $2.40 per 100 pounds.

Boiler Tubes.—Orders continue active. Lap-welded, steel, 1¼-inch, 10c.; 1½-inch, 9c. per 10 foot; 2-inch, $8.50; 2¼-inch, $10; 2½-inch, $10.60; 3-inch, $11 to $11.50; 3½-inch, $18 to $18.50; 4-inch, $19 to $20 per 100 feet.

Building Paper.—Plain, 27c. per roll; tarred, 35c. per roll. Demand is moderate.

Bricks.—In active movement, with very firm tone. Price at some yards $9 to $9.50, at others, $9.50 to $10 for common. Don Valley pressed brick are in request. 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., 75c. until further notice, per ton of 2,000 lbs., 1-inch, 2-inch, or larger, price all the same. Rubble stone, 55c. per ton, Schaw station, and a good deal moving. Broken granite is selling at $3 per ton for good Oshawa.

Cement.—Car lots, $1.75 per barrel, without bags. In 1,000 barrel lots $1.60. In smaller parcels $1.90 is asked by city dealers. Bags, 40c. extra. Demand good.

Coal.—The price of anthracite still remains at $6.50 per ton, net, and pea coal at $5.75; but as the usual monthly advances have been made at the mines, a higher figure may be anticipated in the near future. From these prices a discount of 25 cents per ton can be had on considerable lots. 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, $3.75 to $3.80; mine run, $3.65 to $3.70; slack, $2.75 to $2.85; lump coal from other districts, $3.55 to $3.70; mine run 10c. less; slack, $2.60 to $2.70; cannel coal plentiful at $7.50 per ton; cook, Solvey foundry, which is largely used here, quotes at from $5.75 to $6.00; Reynoldsville, $4.90 to $5.10; Connellsville, 72-hour coke, $5.25.

Copper Ingot.—A very large volume of business is being done, but the market is weaker at $13.50 to $13.75. Production goes on at a rapid rate.

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

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

Felt Roofing.—The spring trade has opened very well at an unchanged price, which is $1.80 per 100 lbs.

Fire Bricks.—English and Scotch, $30 to $35; American, $25 to $35 per 1,000. Fire clay, $8 to $12 per ton.

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.

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.—A steady request at former prices:—Black, ¼-inch, $2.03; ⅜-inch, $2.25; ½-inch, $2.63; ¾-inch, $3.28; 1-inch, $4.70; 1¼-inch, $6.41; 1½-inch, $7.70; 2-inch, $10.26; 2½-inch, $16.39; 3-inch, $21.52; 3½-inch, 27.08; 4-inch, $30.78; 4½-inch, $35.75; 5-inch, $39.85; 6-inch, $51.70. Galvanized, ¼-inch, $2.86; ⅜-inch, $3.08; ½-inch, $3.48; ¾-inch, $4.43; 1-inch, $6.35; 1¼-inch, $8.66; 1½-inch, $10.40; 2-inch, $13.86, per 100 feet.

Pig Iron.—We quote Clarence at $20.50, for No. 3; Cleveland, $20.50; Summerlee, $22; Hamilton quotes a little irregular, between $19 and $20. The demand is moderate.

Lead.—A very fair demand exists, at an unchanged price of $3.75 to $3.85.

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 without freight. Demand is moderate.

Lumber.—An unusually brisk demand has characterized the month, and prices are fully maintained. Pine is good value at $32 to $35 per M. for dressing; common stock boards, $28 to $33; 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 is in demand and held somewhat higher, we quote $17.50 to $18; spruce flooring in car lots, $22 to $24; shingles, British Columbia, are steady, we quote $3.10; lath, No. 1, $4.60; white pine, 48-inch, No. 2, $3.75; for 32-inch, $1.70 is asked.

Nails.—Wire, $2.35 base; cut, $2.60; spikes, $2.85 per keg of 100 lbs.

Pitch and Tar.—Pitch, unchanged at 70c. per 100 lbs. Coal tar, $3.50 per barrel. Demand moderate.

Plaster of Paris.—Calcined, New Brunswick, hammer brand, car lots, $1.95; retail, $2.15 per barrel of 300 lbs.

Putty.—In bladders, strictly pure, per 100 lbs., $2.25; in barrel lots, $2.10. Plasterer's, $2.15 per barrel of three bushels.

Ready Roofing.—An active demand; prices are as per catalogue.

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 Bangor slate 10 x 16 may be quoted at $7 per square of 100 square feet, f.o.b., cars, Toronto; seconds, 50c. less. Mottled, $7.25; green, $7, with a prospect of advance. Dealers are fairly busy.

Rope.—Sisal, 9½c. per lb.; pure Manila, 10½c. per lb., Base.

Sand.—Sharp, for cement or brick work, 90c. per ton f.o.b., cars, Toronto siding.

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