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Concrete Association Meeting

Canadian Engineer

A WEEKLY JOURNAL
For CIVIL, MECHANICAL, ELECTRICAL and STRUCTURAL ENGINEERS and CONTRACTORS

MONTREAL OFFICE:
B 32 Board of Trade Building

WINNIPEG OFFICE.
Room 315, Nanton Building

Vol. 16. Toronto, Canada, March 12th, 1909. No. 11.

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For the Assistance of Engineers, Contractors and Purchasing Agents

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Babcock & Wilcox, Ltd., Montreal,

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D. P. Battery Co., Ltd., Bakewell, Derbyshire, England.

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McLaren, D. K., Ltd., Montreal, Que.
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Boilers, Marine, Stationary and Water Tube
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Quebec.—La Compagnie Alpha, $20,000; concrete construction work; A. A. Leduc, L. A. Arcand, of Becancourt, J. S. Arcand, Three Rivers. The Royal Construction Company, $20,000; E. Fabre Surveyor, A. C. Casgrain, J. W. Weldon, Montreal. The John Morrison & Son Company, $10,000; contractors; Jas. Morrison, John Morrison, Wm. Morrison, Montreal. Life Saver Boot & Shoe Company, $250,000; W. E. Elmore, Fred. L. Monk, W. G. Mitchell, Montreal. Compagnie Etienne Dussault, $150,000; contractors; Etienne Dussault, E. Dussault, Jr., Levis.

Dominion.—The Ling Asbestos Company, Limited, $200,000; J. W. Cook, A. R. McMaster, A. A. Magee, Montreal. Crown Exploration and Development Company, Limited; $1,000,000; Robt. Reford, John Carson, W. I. Cear, Montreal. The Kent Company, Limited, $50,000; machinery; Wm. G. Kent, Geo. Darling, A. W. P. Buchanan. The Holden Company, Limited, $45,000; transportation equipment; N. J. Holden, Alex. L. Deguire, L. L. Johnson, Montreal. The Pacific Pass Coal Fields, Limited, $5,000,000, Archibald H. Cook, Jas. G. Scott, Vesey Boswell, Quebec.

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The Canadian Engineer

WEEKLY

ESTABLISHED 1893

VOL. 16. TORONTO, CANADA, MARCH 12th, 1909. No. 11

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

Present Terms of Subscription, payable in advance:

Canada and Great Britain:		United States and other Countries:	
One Year - -	$2.00	One Year - -	$2.50
Six Months - -	1.25	Six Months - -	1.50
Three Months -	0.75	Three Months -	1.00

ADVERTISEMENT RATES ON APPLICATION.

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TELEPHONE, Main 7404.

Montreal Office: B32, Board of Trade Building. T. C. Allum, Business and Editorial Representative, Phone M 2797.

Winnipeg Office: Room 315, Nanton Building. Phone 8142. G. W. Goodal Business and Editorial Representative.

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. Monday preceding the date of publication, except the first issue of the month for which changes of copy should be received at least two weeks prior to publication date.

PRINTED AT THE OFFICE OF THE MONETARY TIMES PRINTING CO., LIMITED, TORONTO, CANADA.

TORONTO, CANADA, MARCH 12, 1909.

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A reader is anxious to secure a copy of The Canadian Engineer for January, 1905, and will pay 25 cents for it.

If you do not file your copies of The Canadian Engineer kindly forward us the issue for February 19th, for which we will extend your subscription one month.

HUDSON BAY RAILWAY.

Mr. J. Armstrong, engineer-in-charge of the Hudson Bay Railway, has presented his first progress report. The present estimate is that it will cost from $8,000,000 to $11,000,000, according to the outlet port chosen. This estimate is based on a line whose controlling gradient will be a 0.4 grade for east or northbound traffic and 0.6 for southbound traffic. It calls for wooden culverts and trestles and 65-pound steel. Complete surveys of 320 miles out of a possible 465 are reported, while the exploration reports cover 400 miles.

The route to Churchill is completely covered so far as the work has progressed, the report giving in detail the character of the country traversed. The first division of 150 miles from The Pas to near Setting Lake is the lightest, being mainly earthwork with some small stretches of muskeg. The cost of clearing and grubbing will be comparatively heavy, but on the whole it presents no difficulties. The second section from Setting Lake to the summit between the waters of the Nelson and the Churchill, about 175 miles, is expensive work, entailing heavy rock cuts, more particularly along the Odel and Burntwood Rivers. The country is badly broken up, and would necessitate the moving of large amounts of material. An optional route along the east side of Setting Lake and Grass River is being made, where there are indications of a cheaper line.

Section three, from the Divide to Churchill, about 140 miles in length, presents great difficulties in the way of making an estimate of the cost of construction. A great many muskegs are met with, the last 100 miles especially being almost entirely a sort of moss-covered tundra, which appears to be perpetually frozen to within a few inches of the surface. Definite information as to the cost of handling this material, or as to how it will carry a railway line, is not available. No difficulty or particularly heavy work has been encountered which could have been materially lessened by the adoption of heavier gradients. By taking the quantities and classification of the material as estimated by the engineers on the work it is estimated that the cost of grading would average 55 cents a yard. The prices used were $1.50 per yard for solid rock, 60 cents a yard for loose rock, and 25 cents a yard for earth or common excavation.

The estimate includes the material to be moved in the construction of the roadbed, including side-tracks, terminal tracks and drainage ditches. The northern hundred miles toward Churchill being mostly over an open barren, more or less trouble with snow may be expected.

Following the complete report of the chief engineer must come a thorough examination into the possibilities of Fort Churchill and Port Nelson as suitable ports.

It is still a matter of some uncertainty as to what extent Hudson Bay may be open to navigation. Reports covering many years deal with the harbors on the west coast of the Bay, but we have little information of the navigability of the Hudson Straits.

A very interesting report, and one that should be prepared, is one dealing with the possibility of developing business along the line and from the Hudson Bay terminal, all independent of the through carrying trade to the ocean.

With the larger timber area as a feeder, the fish of Hudson Bay, the mineral wealth of the north district, there should be some considerable revenue from local freight.

A NEW WELLAND CANAL.

By far the most important announcement of the past week was that made by the Canadian Minister of Railways and Canals that the next large public work would be the enlarging and deepening of the Welland Canal. He did not hold out much hope that this work would commence soon, but still this announcement should do something towards settling many long delayed works.

For some years the Canadian Pacific Railway have delayed work on their line from Coldwater to Peterboro'. Whether the possibilities of a Georgian Bay Ship Canal had anything to do with this delay or not would be hard to say, but now it is likely this work will go ahead. The contract has been let by the C.P.R. for a large grain elevator at Victoria Harbor. A revised location is being surveyed; an early announcement as to construction is expected.

It may be the Canadian Northern Ontario Railway will now push forward the Key Harbor-Ottawa line.

At any rate, the visions of large rock contracts and massive concrete work on the Georgian Bay Canal, which some contractors had, will, for a time, vanish. Attention will now divert to the Niagara Peninsula and St. Catharines and Welland, the homes of so many contractors, will feel encouraged to expect the activity and business which was there during the construction of the present canal.

That Canadian shipping would largely benefit by an enlarged Welland Canal none doubt. The volume of freight transported annually by water is increasing. Trade between it east and west is increasing. The facilities must increase with it. The present shipping capacity of the Great Lakes is limited by the size of the Welland Canal.

Enlarge this link.

TO ABOLISH LEVEL CROSSINGS.

A very practical step towards the abolition of level crossings has been taken by the Dominion Government. A million dollars has been set aside as a fund to assist in the work. The Dominion Railway Board will apply the funds. It is to be hoped the Provincial Governments and the municipalities will be willing to accept some part of the expense where the work lies in their district. Such a fund, increased by the amount the railways will be called upon to pay, will be of great assistance in abolishing level crossings.

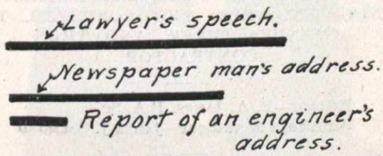
The railways should not be called upon to pay the full cost of the abolition of these crossings. They were allowed, and in many cases are not more dangerous to-day than when first constructed.

The desire for quick transportation, which the railways strive to satisfy, will be more safely secured. The Railway Board will be more careful in granting orders allowing level crossings.

The Minister is to be congratulated on the moderate measure he has introduced.

EDITORIAL NOTES.

The daily press in their search for news usually find the interesting things, but it is noticeable the space and attention they give to troubles and destruction and how little to construction. Perhaps we don't see clearly, but



we often think the reports of engineering meetings and engineers' addresses are all too brief. They have a wider interest than some suppose. Recently at a gathering of engineers, where other professional men were present, a dozen good addresses were given. The accompanying diagram illustrates the publicity given by the daily press.

COMING MEETINGS OF ENGINEERING SOCIETIES.

Architectural Institute of Canada.—6th April, 1909, general special meeting at 94 King Street West, Toronto.

American Railway Engineering and Maintenance of Way Association.—Tenth annual convention, March 16th-18th, 1909, Auditorium Hotel, Chicago, Ill. President, Wm. McNab, Principal Assistant Engineer, G.T.R., Montreal; Secretary, E. H. Fritch, Chicago.

Engineers' Club of Toronto.—Thursday, 18th March, 1909, at 8 p.m., "Development of the Bessemer Steel Process"—paper by S. B. Chadsey, B.A. Sc.

Providence Association of Mechanical Engineers.—June 22, 1909, Annual Meeting. Secretary, T. M. Phetteplace.

RAILROAD EARNINGS

Name of Company	For Month of February, 1909	For Month of February, 1908	+ or — *	From Jan. 1st to Feb. 28th, 1909	From Jan. 1st to Feb. 29th, 1908	+ or — ‡
C.P.R.	$4,819 000	$4,016,000	+$803,000	$9,580,860	$8,474 007	+ $1,106,863
Can. Nor.	506,600	485,600	+ 21,000	1,028,800	1,063,800	— 35,000
G.T.R.	2,529,471	2,393.435	+ 130,036	5,169,887	5.209.549	— 39,662
T. & N. O.	92,205	43.753	+ 48,452	1,740,060	93.157	+ 80,903
Mon. St.	281,107	256,243	+ 25,164	545,712	505,153	+ 40,559
Tor. St.	274,844	260,826	+ 14,018	534.355	503,707	+ 30,648

*Increase or decrease over 1908
‡Aggregate increase or decrease over 1908.

RAILWAY EARNINGS AND STOCK QUOTATIONS

NAME OF COMPANY	Mileage Operated	Capital in Thousands	Par Value	EARNINGS Week ending Mar. 6		STOCK QUOTATIONS TORONTO				MONTREAL			
				1909	1908	Price Mar. 5 '08	Price Feb. 25 '09	Price Mar. 4 '09	Sales Week End'd Mar 4	Price Mar. 5 '08	Price Feb. 25 '09	Price Mar. 4 '09	Sales Week End'd Mar 4
Canadian Pacific Railway	8,920.6	$150,000	$100	1,380.000	1,102,000	144½ 143½	168½	167½ 166	398	143⅞ 143¼	169¾ 169¼	166¾ 166½	825
Canadian Northern Railway	2,986.9	.....	.....	140,200	133,300	.....	.....	.....	.....	.....	.....	.....	.....
*Grand Trunk Railway	3,568.7	226,000	100	624,373	615,110	.....	.....	....*1st. pref. 104, 3rd pref. 44⅝, ordinary 18½	.....	.....	.....	.....	.....
T. & N. O.	305	(Gov. Road)	.....	.....	.....	.....	.....	.....	.....	178½ 177¾	207 206	207 205½	114
Montreal Street Railway	138.3	18,000	100	65,570	64.453	.....	.....	.....	.....	100 99¾	119 118¾	123½ 123½	1975
Toronto Street Railway	114	8,000	100	67,233	62,208	100	119½	123 122½	729	146		169½	30
Winnipeg Electric	70	6,000	100	.....	.....	146½ 170	167	169	96				

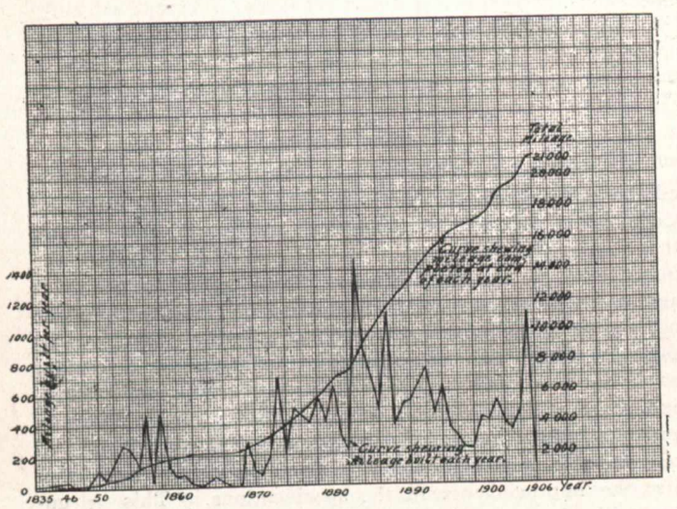
* G.T.R. stock is not listed on Canadian Exchanges. These prices are quoted on the London Stock Exchange.

CANADIAN RAILWAYS.

The Deputy-Minister of Railways for Canada, and his assistants, are to be congratulated upon the issue of their annual report for the year ending June 30th, 1908. Yearly this report is becoming of more value to those interested in railway construction, maintenance, and operation. Mr. J. L. Payne, Comptroller of Railway Statistics, has arranged his matter particularly well and altogether the report is one of the most valuable, to railway men, of the blue books issued.

Canadian railways represent an investment of over $1,239,000,000. These figures do not include the cost of Government-owned roads in Canada, which add another $325,000,000, making a grand total of over $1,564,000 and represent over 21,000 miles of track. An interesting table in this connection has been prepared by Mr. Collingwood Schreiber, C.M.G., from which the diagram given herewith was plotted, giving the mileage opened for traffic each year since 1835, and also the total mileage in service at the end of each year.

The curve of "mileage built each year" is very zig-zag, and the several "peaks" are interesting in that they are very pronounced and also that they do not occur just where some



of us expected to find them. The curve showing "mileage completed" is very slow in rising until about 1870, but since then has been rising uniformly.

Earnings and Operating Expenses.

The gross earnings of railways in Canada for the year ended June 30th, 1908, were $146,918,313.61, showing an increase of $180,098.93 over 1907. This total was made up of the following items:—

		Per Cent.
Passenger service	$46,854,158.07	31.89
Freight service	93,746,655.45	63.81
Stock yards, elevators, etc.	407,866.60	.28
Car mileage, switching, etc.	279,408.25	.19
Telegraphs, rents and other sources	5,630,224.34	3.83
Total	$146,918,313.61	....

An analysis of earnings from passenger train service for the year, and a comparison of the items with those for 1907, yields the following results:—

	1907.	1908.	Increase.
Passengers	$39,184,437.64	$39,992,503.11	$808,065.47
Mails	1,626,704.64	1,670,120.90	43,416.26
Express	3,277,695.09	3,486,300.63	208,605.54
Other sources	1,641,814.92	1,705,234.33	63,419.41
Total	$45,730,652.29	$46,854,158.97	$1,123,506.68

The gross earnings for 1908 represented an average of $6,389.37 per mile of railway, as compared with $6,535.64 for 1907—a decrease of $146.30.

The operating expenses aggregated $107,304,142.51, an increase over 1907 of $3,555,470.24—equal to 3.42 per cent. This total was made up of the following items:—

		Per Cent.
Way and structures	$20,778,609.78	19.37
Maintenance of equipment	20,273,625.95	18.89
Conducting transportation	62,486,270.59	58.23
General Expenses	3,765,636.19	3.51

The following comparative analysis of operating expenses throws a strong light on the figures given above:—

Maintenance of ways and structures—	1907.	Per cent.	1908.	Per cent.
Repairs of roadway	$11,160,086.67	11.79	$10,640,542.68	9.93
Renewals of rails	1,205,088.24	1.27	1,604,594.76	1.49
Renewals of ties	2,230,575.56	2.35	2,204,083.47	2.05
Repairs and renewals—				
Bridges and culverts	1,408,552.02	1.48	1,465,753.45	1.37
Fences, crossings, etc.	481,129.18	.50	519,671.89	.49
Buildings, etc.	2,144,109.98	2.26	2,690,915.90	2.51
Docks and wharfs	103,280.37	.10	167,017.45	.16
Telegraph	265,183.58	.28	294,301.15	.27
Stationery and printing	30,599.20	.03	43,924.32	.04
Other expenses	78,663.70	.08	1,122,793.11	1.05
Maintenance of equipment—				
Superintendence	591,196.08	.62	621,032.61	.58
Repairs and renewals of locomotives	7,999,802.52	8.45	8,008,613.01	7.48
Repairs and renewals of passenger cars	2,473,908.84	2.61	2,723,846.82	2.54
Repairs and renewals of freight cars	6,933,574.61	7.32	6,855,843 98	6.40
Repairs and renewals of work cars	146,148.39	.15	608,109.17	.57
Repairs and renewals of marine equipment	33,221.35	.03	52,181.21	.05
Repairs and renewals of shop machinery and tools	738,833.13	.78	779,160.38	.72
Stationery and printing	74,466.22	.07	77,384.68	.07
Other expenses	815,751.04	.86	523,535.96	.49
Conducting transportation	52,546,368.80	55.41	62,380,195.33	58.14
General expenses	3,173,185.75	3.38	3,707.64	3.45

The operating expenses averaged $4,672.30 per mile of line, showing an increase of $51.40 per mile over 1907.

The operating expenses per train mile for all trains—the average cost of running a train one mile—was $1.364, a decrease as compared with 1907 of .017 cent.

Covering a period of ten years, the cost of running a train one mile—using the mileage of all trains and total operating expenses as the essential factors in the calculation—is shown to have been as follows:—

1899	$0.779
1902	1.028
1905	1.213
1907	1.381
1908	1.364

It will be observed that the cost has been on a steadily ascending scale.

On the other hand, assuming that the revenue of a railway is more or less the result of the running of trains—since in one way or another all railway operations come down to that—a comparison of the gross earnings per train mile for ten years gives the following instructive showing:—

1899	$1.192
1902	1.501
1905	1.614
1907	1.953
1908	1.869

The percentage of operating expenses to gross earnings was 73.04, showing an increase of 2.34 over 1907.

Net earnings were equal to $1,724.90 per mile of line, as compared with $1,914.73 for 1907, a decrease of $189.83. On a capitalization of $1,239,295,013, representing the stock and bond issue of railways in Canada, the net earnings would yield a dividend of 3.19 per cent.

Fuel Consumed by Locomotives.

The cost of fuel for locomotives ranks next to salaries and wages in the operating expenses of railways. It reached the total of $17,718,468.24 in 1908.

In the volume the aggregate consumption of fuel in 1908 amounted to 5,970,791 tons, as compared with 5,608,954 tons in 1907. Following are the details:—

Class of Locomotive.	Coal. Anthracite.	Coal. Bituminous.	Wood. Hard.	Wood. Soft.	Total Tons of Fuel.	Miles run.	Fuel consumed per 100 Miles. Tons.
		Tons.	Tons.	Cords.	Cords.		
Freight		3,306,499	176	23,391	3,318,283	42,291,082	7.84
Passenger	1,404	1,440,057	216	10,699	1,446,919	30,504,171	4.74
Mixed	2,684	346,463	282	3,267	350,921	7,410,971	4.73
Switching	334	595,318	2	4,879	598,092	14,941,179	4.00
Construction	415	255,185	1	1,831	256,576	5,474,838	4.69
Total	4,837	5,943,522	677	44,067	5,970,791	100,622,241	

Two cords of wood calculated as one ton of fuel.

The average cost of fuel in 1908 was $3.19 per ton.

PRECIPITATION FOR FEBRUARY, 1909.

The precipitation was considerably in excess of the average in Ontario and over the larger portion of Quebec, while in the Maritime Provinces and also in the West, departures from average were not pronounced in either direction. The most striking feature was probably the large rainfall in the St. Lawrence Valley, heavy rains having occurred on several days. In Ontario and the Maritime Provinces days of rain and snow were nearly equally divided.

At the close of the month the ground was generally snow-covered throughout Canada, but the amount varied considerably with the district.

A depth of about 1 inch near the Bay of Fundy increased northward to about 60 inches over the greater portion of Quebec, and in the Cariboo District of British Columbia there was about 40 inches on the ground. In other portions of Canada the depth varied between a trace and 15 inches. Since the beginning of March, however, the Peninsula of Ontario has been covered with snow to a depth of from 3 to 8 inches.

On the 1st of March, reports from the Gulf of St. Lawrence show that the ice was closely packed from Anticosti to the Magdalen Islands, while between the latter place and Cape St. Lawrence there was a heavy open ice field.

Thickness of ice is reported from various stations as follows:—

Western Provinces.—Edmonton, 24 inches; Battleford, 30 inches; Medicine Hat, 30 inches; Swift Current, 30 inches; Qu'Appelle, 30 inches; Minnedosa, 27 inches.

Ontario.—Port Arthur, 17 inches; Bruce Mines, 25 inches; Gravenhurst, 20 inches; Barrie, 13 inches; Owen Sound, 3 inches; Southampton, 9 inches; Port Stanley, 10 inches; Brantford, 6 inches; Kingston, 15 inches; Arden, 24 inches; Rockliffe, 36 inches; Renfrew, 24 inches; Ottawa, 24 inches.

Maritime Provinces.—Chatham, 27 inches; Point Escuminac, sea ice, 14 inches, lake ice, 24 inches; Fredericton, 22 inches; Pt. Lepreaux, 18 inches; Yarmouth, 6 inches; Sydney, 12 inches; Charlottetown, 12 inches.

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

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

Station.	Depth in inches.	Departure from the average of twenty years.
Calgary, Alta.	0.40	—0.18
Edmonton, Alta.	0.50	—0.33
Swift Current, Sask.	0.20	—0.51
Winnipeg, Man.	0.70	—0.18
Port Stanley, Ont.	4.30	+1.20
Toronto, Ont.	3.18	+0.74
Parry Sound, Ont.	4.70	+1.76
Ottawa, Ont.	3.10	+0.44
Kingston, Ont.	4.10	+1.73
Montreal, Que.	4.20	+1.11
Quebec, Que.	5.70	+2.49
Chatham, N.B.	2.60	—0.47
Halifax, N.S.	4.80	+0.19
Victoria, B.C.	2.20	—1.30
Kamloops, B.C.	0.10	—0.71

PATENTS.

The following is a list of Canadian patents recently obtained through the agency of Messrs. Ridout & Maybee, 103 Bay Street, Toronto, from whom further particulars may be obtained:—James, J. C. & R. D. Metcalfe, Injectors; Edgar Flint, Vacuo-despatch system; Edward Tilston, Automatic force-feed lubricator.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.

(For first of article see page 371, this issue.)

ticular purpose. I know one case where a reinforced concrete roof on the fire-plant of the Pittsburg Railway Company at Bluenose Island is constructed entirely of slag concrete. The Universal Portland Cement Company is part of the Steel Corporation and makes a Portland cement from the mixture of granolithic blast-furnace slag and limestone, getting the two mixed up. Slag cement is made up from a mixture of blast-furnace slag and lime. Ours is a mixture of pulverized limestone and slag, which is burned in the rotary kilns the same as all high grade Portland cement. Last year we were fortunate enough to burn out a little over eleven per cent. of the total output of the United States. That is a jump from 1897 of about 7 per cent., as in 1897 we turned out about 4 per cent. of the total output.

Dean Galbraith: Have you made any examination into the difference between different kinds of iron slag, that is from different blast-furnaces—Bessemer furnaces, etc.?

Mr. Kinney: That is all to be investigated in this work. We have selected slags from different furnaces, different specimens.

Adjourned at 4.30 p.m. till 8.30 p.m.

SECOND DAY.

Evening Session.

Convention resumed at 8 p.m.—Mr. J. E. Moore addressed the meeting on the subject, "Tests and Inspection of Cement," as follows: Mr. Chairman and gentlemen,—I think that the inspection of cement has clearly kept pace with the increase in the cement business. Some ten or twelve years ago, when I first started in the testing of cement, there was not nearly as much cement used, and, I think there wasn't as much testing done in proportion to the amount of cement used. At that time we had a great variety of specifications, and some of them were, I would almost say were fearfully and wonderfully made. The progress in the manufacture of cement, of course, has been very great, as well as have been also the improvements in the specifications. This is undoubtedly due to the fact that committees appointed by the various scientific bodies and societies have not one year or two years, but several years in getting together and exchanging ideas until the present specifications of your Canadian Society of Civil Engineers, and also our American Society of American Engineers, and each one of those specifications is the result of years of work by some of our best engineers, and, I think, the specifications as they exist today, both here and in the States, are about as good as we could possibly expect in the present development of the industry.

With your permission I am going to go over the specifications of the Canadian Society of Civil Engineers touching on the different tests. I want to say a word with reference to the inspection of cement in regard to the manufacturer. A few years ago, I think, the manufacturer did not look quite as mildly on the inspection and testing of his product as he does now, but it has come to a point where I believe the manufacturer realizes that it is to his interests as well as the interests of the consumer to have his product tested. In the first place we can assume, I think, that the manufacturers of cement are all in the business to stay, and they are all trying to succeed, and for the most part and most of the time succeed in producing a good cement. Now this inspection and testing is a sort of a check continually, that is by an outside concern, engineer, or by the consumer, and there is always a check on the cement at the mill because these men who are responsible for the composition of the cement and the burning and the grinding, in fact all along the line of manufacture know that when stuff goes out that is not right that they are going to hear from somebody and it naturally makes them keen to keep their end of the manufacture up to standard. Now there is a great deal of the testing of cement done in the field by the superintendent on the job. These

tests are all right as far as they go, and very often are entirely sufficient, and, I believe, that where there is only some small fault to be found with the cement, and where it is done by a comparatively inexperienced man on the job, that the matter should be gone into further before the cement is rejected. The selection of the sample is obviously something that should be very carefully looked after, because it is just as easy to get a sample of cement which is not representative as of anything else. Most of the cement nowadays, I think, is shipped in sacks, and often the sampling is done either at the mill or in the warehouse or at the siding of the railway. Personally, I think, it is a very good idea to sample the cement at the mill where possible, as you gain the time that the cement is in transit, and then if there is any unsoundness it is shown by these accelerated tests, as, for instance, the boiling or steam test. Nearly all mills will hold a car of cement for 24 hours in order to enable the tester to get out his hot test, that is, the steam or boiling tests, and if the car is sampled as it is loaded, and the test made immediately, it can be finished in 24 hours, or within a very few hours over that, and there is much less chance of any cement which may afterwards have to be rejected leaving the mill at all.

I see in one of the paragraphs of your specifications that samples should be passed through a sieve having 20 meshes per lineal inch. I think perhaps a little bit more might be added to that paragraph, to this effect, that in sampling cement, if you pass it through a sieve you might have some lumpy cement which had been damaged by water, which was really hard lumps, and the quality of it was destroyed—so that cement which has been damaged by water and has hardened it to such an extent that the lumps are not easily broken up, of course, should be rejected without anything further being done.

With regard to the chemical analysis of cement, I think that the outside tester seldom makes a chemical analysis of the cement unless he figures that possibly there might have been an adulteration or something of that sort. Nowadays we do not expect very much adulteration, and as a rule one analysis of the cement will go a long way on account of the uniformity of most of the produce, and one analysis will suffice. For example, the specification requiring not more than 4 per cent. of magnesia and not more than 2 per cent. of sulphuric anhydrite agrees very closely with our American engineers' specification.

Another thing about the chemical analysis. Cement may analyze perfectly according to the accepted variations allowed in the different constituents and yet may be very far from being a sound cement. If the burning has not been properly done, or if the mixing has not been carefully attended to, there has not been a thorough mixing, or going back to the first stage of manufacture, if the raw materials have not been carefully pulverized almost to an improbable powder and thoroughly mixed, it may not show up in your analysis of cement, but it certainly will show up in some of the tests, and probably will in the work in which the cement goes, if it is allowed to go into work.

Another test which is not made as a general thing, and certainly not as often as the regular test, is that for specific gravity. The specific gravity of cement materially changes from the time it is manufactured until it is a few months old, especially if it has been at all exposed to any damp atmosphere, and the determination of specific gravity is liable to be misleading, owing to the fact that the gravity is lowered by the taking up of a small amount of atmosphere, or by the taking up of a small amount of carbolic acid from the atmosphere. I am going to pass over the methods for making a specific gravity test and go on to define this test.

The specification for fineness requires that not over 8 per cent. of the cement shall remain in a No. 1, 100 sieve, and not more than 25 per cent. shall remain in a No. 2, 100 sieve. As a matter of fact, I have made a great number of experiments on the residue that were made in these different sieves, and that residue which remains on the No. 1, 100 sieve, while it may be very fine and will clearly pass the 100, will have almost no hydraulic properties, it sets up very slightly and with comparatively very little strength. It is the very fine impalpable powder that is the life and essence of the strength of cement, and that is the reason that so much stress is now laid on the fineness of grinding. The manufacturer now will probably grind fully 25 per cent. or more finer than he did 5 or 10 years ago, and naturally the larger amount of the impalpably fine powder there is in the cement, the more particles of sand it is capable of coating and, therefore, greater sand-carrying capacity.

The size of the wire in the sieve, of course, is a very important factor, from the fact that you might have 100 meshes per lineal inch in your sieve, and if your wire is not of the specified gauge, perhaps your meshes are not anywhere near the size and, therefore, the specification states that the wire used in the sieves shall be of a certain mesh.

The setting time of cement varies a great deal, and oftentimes it is purposely made by the manufacturer to correspond with the season of the year in which it is to be used. For instance, in cold weather, the manufacturer often has a demand for a quick setting cement, and in the summer a demand for the very opposite of that. The setting time of cement is determined as a sort of a gauge to find out whether or not it is safe. If cement can be mixed with the mortar and got in the work previous to the time when it takes on its initial state, any disturbance of it is attended with a subsequent loss of strength. The setting time of cement when made in the laboratory is also influenced a great deal by differences in temperature of the water and the amount of water used and a difference in the temperature of the room, therefore all of those points are carefully taken care of in the specifications by stating that the temperature of the room and the water used should be as nearly as possible to 70 degrees Fahr.

I am not quite sure, in taking up the matter of the sand test, whether you here are able to get this standard sand from Ottawa, Ill., which is recommended in making the sand test. We have had a great deal of trouble in getting that sand; in fact, I remember that last year we had an order in for four months before we could get it filled; but I understand that there is now a concern which has recently taken up this matter of standard sand, and will guarantee to furnish any amount and fill orders almost right away for it. We have used for local work, in Chicago at least, torpedo sand, which is used in nearly all our buildings where sand is used at all and where they had not used crushed limestone screenings. Of course those tests are just as valuable and perhaps a little more so than if we used standard sand because in that test the same sand is used that is actually used in this work; but for purposes of comparison in the different laboratories, comparing results and tests of strength in the different laboratories it is almost essential to use the same kind of sand. The sand that is used and adopted is a pure white silica sand, which has been sifted through a 20 mesh sieve and remains on a 30 mesh sieve, that is to say, it was passed through a sieve that had 20 meshes to the lineal foot and also passed through a sieve having 30 meshes, and to have a run of sand which is extremely uniform throughout, and, I believe, if an immense amount of care is taken by the manufacturer of this sand in screening, it is possible to absolutely eliminate all that will not remain between those two sieves.

Another thing in making tests on cement that is very necessary, if it is hoped to secure uniformity of results in the different laboratories, and it very often becomes a case of more than one laboratory testing the one cement, and that is, that if there is any dispute you may rest assured that there will be more than one laboratory that will agree. The manufacture of the bricketts has been standardized and the amount of water to be used in mixing up the mortar, both in the cement and in the sand mixers, has been specified within certain limits, so that in our tests of the different laboratories we naturally expect to agree rather closely to each other. A great number of times samples have been sent out from a number of different laboratories, the sand has been mixed very thoroughly, and a large amount of cement and sand sent to different laboratories for the purpose of arriving at whether there is any chance of getting close together on results, and while perhaps one or two laboratories should disagree with the rest on the question of strength,

on the whole the results agree quite closely, and we have to thank for that the fact that the methods have been sort of standardized for making up the tests.

You are all familiar with the forms of specimens which are used in obtaining tests, in the shape of them, as is shown on the outside of that little book. They are an inch square in the centre, and the specimens after being made up are kept for 24 hours in a moist atmosphere, preferably in some sort of a closet, so that the air is kept moist continually, and after 24 hours the bricketts that are not broken are put in water for the balance of the week. They are kept for six days in water, and those that are kept for 28-day tests are kept for 27 days in the water, and when they are ready to be broken they are taken right from the water and broken, and your specifications gives the minimum strength which the cement shall show for the periods of time specified.

The next test, which I touched slightly on a little while ago is the test for consistency of volume. It is one of the most important tests that are made on cement, and one which is almost invariably made no matter what laboratory gives it, because, especially on the accelerated test, that which is known as the boiling or steam test, gives the information regarding the soundness of cement in a very short time. I know that in the United States at least, while we do not have a large percentage of rejection for any cause, we have perhaps more objections, or at least temporary rejections of cement on account of unsoundness than any other one thing. Sometimes a difference of two or three days time in the age of the cement will change it from being unsound to sound, and these tests for unsoundness are made by making up pats of cement with a certain amount of water and these pats are made up on a little plate of glass (I should say they are made about one-half inch thick in the centre and taper to thin edges), after remaining in the moist air of the cabinet for 24 hours, they are easily put in air under ordinary atmospheric conditions for a period of 28 days and observed from time to time, or placed in water at normal temperatures for that length of time or in the boiling or steam tests they are placed in a covered vessel in boiling water and exposed to the action of steam, the temperature, of course, of which is nearly at the boiling point. Sometimes they carry the test still a little further, and will lower the pats into the boiling water for a few hours? This test will certainly bring out any unsoundness which is in the cement by hurrying up the action. The unsoundness is largely due to perhaps a little free lime, which I suppose is the most common cause of unsoundness, and this is the test which brings out this unsoundness inside of a short time which possibly might take under normal condition weeks to develop, that is, it hurries up the action or hydration of that line, and the test, while it is heroic, is a safe one. A great many manufacturers, I think, claim that it is not fair to reject cement on account of the unsoundness shown by the steam or boiling test, nevertheless it is certainly a safe proposition to hold cement up and not allow it to be used until some further tests may be made. I have been personally engaged in the testing of cement for about 12 years, and have seen a great many improvements in testing in that time. We have a great many people, whom we number among our clients to-day, whom we did not have a few years ago, and we are getting more of them every year, and, I believe, that the testing of cement has come to stay, and increasing as it does every year people realize and feel that the cement which they are putting in their work is proper, and we know that we have every assurance that the cement which fills the requirements of the standard specifications of the Canadian Society of Civil Engineers and those of the American Society of Civil Engineers are very nearly alike, and we feel every confidence that the cement which passes the requirements of those specifications is certainly fit for any work that it may be desired to use it for.

Mr. Frank Barber, C.E., read a paper on "Concrete Bridges," which was give in full in The Canadian Engineer, Vol. XVI, page 326.

Mr. J. A. Smith, South Bend, Ind., read a paper on "Concrete Blocks."

Mr. Henry B. Gordon, representing the Ontario Association of Architects: Mr. Chairman and gentlemen,—I am glad the lights are out. I think it is about time we were going home. There is one thing at this late hour, however, that rather encourages me, and I suppose rather encourages you to wait for a moment, and that is the one word "brief" —it is to be a brief address. I was wondering coming along what I would say here to-night. I was down at the St. Lawrence Arena and saw the very nice exhibition there, and as I sat here listening to all the funds of information in the papers, I came to this conclusion that the gentlemen who got up this exhibition and the papers are a concrete sample of progress. I remember when I first started practicing architecture how every little while we had men coming to us to exploit cement blocks, and how in moments of weakness we were persuaded to let them try their hand, and how afterwards we regretted our moment of weakness. But now I am glad to know that the matter has passed through the early experimental stages, and now the experiments are being continued upon a very high and scientific plane that is almost beyond the comprehension of the ordinary architect, but we will take for granted that all they say is true, and that there is something so wonderful in this material that in the ages to come people will be standing looking at these monuments and wondering what wonderful skill the men had who planned such material and what awful bad taste the architects had that designed such a building. You see there is this advantage about the perishable material, gentlemen, that after we have passed away the things that are not particularly nice will have passed away also, and you see now we are starting to design this kind of material and we have to look at what we did, for we have heard it often before that the remarkable thing about this material is the longer it lives the stronger it gets, so that we have got to be dreadfully careful what we do with it.

Now, gentlemen, you have been solving the question of the quality of cement; the other gentlemen who are making these mixing machines and other things are trying to solve a problem of the constancy of the material and the elimination of that rather uncertain thing, human nature, or the lack of conscientious application in human nature to the problem, and some of you gentlemen have been solving very successfully the question of color, and so now it does seem to me that the architects have got a tremendous problem to solve, that is the suitability of design for concrete buildings. I do not know whether we should follow too closely Ruskin and other men who are so dreadfully down on imitation, but it does seem to me that it is a mistake for us to follow the designs in stone in concrete. Do not misunderstand me. I want to compliment the men who are making artificial stone, but after all I cannot help thinking it is an imitation and there is something better and something of a definite and specific nature or design that is better suited to it, and while we have been looking at these photographs to-night I could not help thinking that there is a great deal of credit due to a man who laid the blocks, and I hope it will last long enough so that when they are gone there will not be any reflection upon them, and I could not help thinking that after all designs are not suitable for concrete, and that, therefore, something that in some way will give the idea of stability, the idea of conscious strength, the idea of enduring power, something which will give strength and vigor and power in design is needed to go along with the concrete and so we have got the problem before us, you gentlemen have been solving that end of it grandly, and let me congratulate you upon it, and now it is up to me to go and tell the fellows to get their thinking caps on.

THIRD DAY.

Morning Session.

Wednesday, March 3rd, 1909.—At 10 o'clock a.m., Mr. C. H. Thompson presided. On account of the large number remaining at the exhibit it was decided to defer Mr. Larsson's paper till the afternoon session.

The motion was adopted and the meeting adjourned.

Afternoon Session.

Wednesday, March 3rd, 1909.—Convention resumed at 2.30 p.m., President Gillespie in the chair.

President: We have with us this afternoon Mr. A. C. Larsson, of Owen Sound, who is to give us a paper on Portland Cement Mortars. He was to have read his paper last evening, but on account of the prolonged discussion, it was necessary to throw it over until to-day; so we will hear Professor Larsson first.

Mr. Larsson read his paper, after which there was a short discussion.

Mr. Cooper: Do we understand that by having 10 per cent. of clay in the sand it increases the strength?

Mr. Larsson: Yes.

Mr. Cadwell: Ten per cent. of sand increases the strength.

Mr. Larsson: Increases the strength, 312.6 when no clay is present, and when 10 per cent. of clay was present it was 316.4.

Mr. Cooper: I have always understood it was good practice to have very good material. I think the gentleman stated that there was something like 2⅜ clay in sand, and that was washed out and he got 100 per cent. or under, and a better result with the washed sand than he did with the dirty sand. Would you consider it good practice in case you were using all washed material to add 10 per cent. of clay and get the very best results?

Mr. Larsson: These things have to be tested in each individual case. Supposing you wanted to waterproof it I think you might add from 5 to 7 per cent., and get good results. I have different tests. Mixing clay with sand I found good results from 5, 7, up to 10 per cent. I have not found in a single case any decrease up to that percentage. Of course I have only tested tensile strength, and not compression. Of course, those tests taken from the German paper when clay was present as a coating around the grains of sand, not as a fine powder. You see if clay is present in sand it is generally as a coating and not as a fine powder. So in case you find clay in sand it is better to use the sand if not too expensive.

Mr. Pearson: Would you mix the clay with the cement before making your mortar, or would you mix it with the sand?

Mr. Larsson. It does not matter as long as you mix it thoroughly; but generally when you mix anything that way the best way would be to get the cement manufacturer to mix those things with the cement if you can control him so that he does not mix too much for you. He could mix it better than you could do it in the field.

Mr. Cooper: Would it not be better in common practice to have everything as clean as you can have it?

Mr. Larsson: Yes, I think it would be better.

President: As many of your are aware, Professor Brown contributed a paper to the Canadian Society of Civil Engineers last year which provoked a good deal of interesting discussion, and I am sure we are delighted to have Professor Brown with us this afternoon.

Professor Brown, of Montreal, read a paper on "Designing and Testing of Reinforced Concrete Beams."

President: We have with us a number of engineers and others from whom we would like to hear on this subject, and I hope they will take advantage of the opportunity for discussion.

Mr. Clement: Have you ever found by your extensometer the mean of compression in the flange of a concrete T-beam

Prof. Brown:—No, I have not made any experiments other than on rectangular section beams. I hope to get on with the work, but I have not had a chance to take it up again.

President: Prof. Brown's experiments seem to point conclusively to the fact that for moderate loads a large percentage of the resisting moment is carried by the concrete. That suggests to me a question. I would like to know, if in view of that fact, he would consider it advisable to recommend a somewhat smaller percentage of metal than would be called for by the assumption that the entire stress is carried by the steel. In the second place, Considere and others, after making experiments on the beams somewhat similar to what Prof. Brown has described, cut sections from the tensile or lower portion of the beam after the beam had been stressed in a manner much exceeding that to which plain concrete will submit without failure; that he cut sections from the tension side of the beam, submitted these to tensil stress or tests afterwards, and found that after being subjected to what we would say are rather excessive stresses they were capable of considerable loads. In the next place, Professor Brown's experiments would seem to indicate, if I remember his address correctly, that up to loads to tensil stresses in the metal reaching as high as 35,000 pounds per square inch, as determined by his measurements, the concrete apparently did not crack; that is to say, when the tensil stress in the metal was as high as the figure I quoted, in some instances there were no apparent or microscopic cracks on the under surface of the beam. I would like to know if he would consider that an argument for the use of metal in reinforcing where elastic limit and ultimate strength are very much higher than we ordinarily find for structural steel. Of course the ultimate strength of structural steel, approximately, is 60,000 lbs. per square inch. We have steels which we test in our laboratories whose ultimate strength is 100,000 and 110,000, and whose elastic limit is correspondingly high, I would like to ask if he would recommend the use of that high carbon steel for his reinforcing?

Prof. Brown: I do not think that from a practical point of view it would be desirable to reduce the strength of steel. There are those here who are more capable than I am of speaking of the tensil strength of concrete. I do not think we have very much information. We know the tensil strength of mortars and of neat cements, but we do not know the tensil strength of concrete. And we know, as we do, that the tensil strength of cement—which is the material we are relying on in the concrete—will vary in a remarkable way, according to the manner in which it is handled or tested, I think that possibly we might be sailing too near the wind in making any attempt in practice to rely on the tension strength of our concrete. My own inclinations would be to stick to the method of assuming that all the tension will be carried by the steel. We cannot be sure, of course, of overloads. You see in the case of that beam there, we had 60,000 or so of load moment on the concrete when the load was 5,000 lbs. in a beam that broke at 20,000. We increased the load by 1,000 pounds only, and the amount of moment on the concrete jumped down 10 per cent. I don't know whether we can make concrete whose tensil strength we can depend on to be sure of. Even if we made a set of beams of the same mix and repeated those tests, I don't think you would find that you would always get 60 per cent. at 5,000 lbs. load on several similar beams. You might get only 40 per cent. When you are up against that, I don't think it is wise to try that. In regard to Considere's experiments, I did not quite catch the point of your question.

The President: If you believe that concrete in the presence of steel can be subjected to extraordinary strains and still not rupture, whether there are microscopic fractures there that are not visible, or whether the material is so radically changed in the presence of the steel that its elastic properties are quite different. That was my point.

Prof. Brown: I have no means of judging from my own experience. I think we could form some estimate of that if we had available data on the tensil strength of those concretes as tested by direct tension method, so that we might compare the results of those calculated tension values. These tension values that I showed in that slide are estimated in this way: there is a certain percentage of moment on the concrete; so much bending moment is on the concrete in tension, and therefore we can estimate quite easily the total force that must be in the concrete in tension; and if we know the area of the concrete in tension we can estimate the cubes of tensil strength. In this case we got 300 lbs. to our square inch, and then a crack. Whether the direct test would have shown 300 lbs. or not I would not be prepared to say. As to the

other point—of using the high yield-point steels, possibly opinions differ. Some people very strongly advocate using a high yield-point; others use a more moderate yield-point. If you have to carry a certain tension, then, of course, a smaller cross-section of steel of high yield-point can be used than if you had a low yield-point. That, of course, is one of the main arguments for the use of steel of a high yield-point. I don't personally believe in those patent rights that are advertised for raising the yield-point. It is a controversial question I don't care to enter into; but where is one point on the economies of reinforced concrete that I might mention. From the time the fire occurred in the engineering building of McGill College I had several concrete beams left over, and I tested one of them just recently. It was over two years old, and it was only 6 in. x 8 in., and tested at 6 ft. centres, and it was loaded at the third points, and that beam carried 26,100 lbs. It was highly reinforced with some twisted Ransome bars, which have a very high yield-point, but even so it was a very remarkable result. It made me turn my thoughts to the questions whether there was not in this problem we have been considering an enormous economic reserve, if I might put it so. For example, if you are going to put up a building with the idea of ultimately extending it or building additional stories, say, in the future, that the loads that are going to come on it will be of an apparently excessive character in proportion to the loads you will put on it in the next few years, the maturity of the concrete would add so enormously to it in the intervening time that we might safely figure on the bolts and columns to carry the loads, and that the natural maturing of the concrete would provide some margin for the subsequently increasing loads. I have only one or two beams to speak about, but they impressed me so much that I think a set of tests extending over a number of years would be possibly of very great value to the profession.

Mr. Kahn: Professor Brown's plea for simplicity in design is one that we, as specialists in reinforced concrete, are very much in sympathy with. It is something that we have tried to advocate for some time. Since this experiment referred to was based on average conditions, I should like to ask Professor Brown's opinion as to the average satisfactory percentage of steel in a concrete beam.

Prof. Brown: That is a rather broad question. Surely the particular conditions of the problem would bear very largely on that. I can imagine conditions in which you can produce the same bending moment by very diverse loading conditions; and it is not only a question of bending moment, of course, but the question of sheer reinforcement which has to be taken care of. I do not think we can really formulate any precise statement as to the average reinforcement that we must have. I understood Mr. Kahn is asking if one per cent., say, of reinforcement would be good enough for ordinary warehouse floors, or something like that. Is that the point?

Mr. Kahn: My special reason for asking is this: building laws are adopted in different sections of the country which specify a certain percentage of steel as being capable of developing, under ordinary conditions, uniform loads, they specify that the reinforcing steel shall not exceed a certain percentage.

Prof. Brown: Your calculations will show you that if you can only get a certain compression strength out of your concrete there is no point in putting in bigger than a certain percentage of steel. There is no use putting in more steel than will carry the weight you require. You require to have data as to the particular concrete—whether is was a rocky concrete at 1-2-4, or an ordinary rough concrete of 1-2-7, I don't see why anyone should not be able to prepare tables for different mixtures of concretes, allowing a reasonable amount, say, for variations which are inherent in the different conditions of mixing, which some such body as this might try to persuade the different building bodies to adopt. I rather think that Mr. Kahn is feeling that such a great variety of building conditions exists in different localities, demanding different proportion of steel, etc., and if we can get any uniformity in that it would be a very good thing to try to get down to some standardization. That would be a very important thing, based on either the results of practice in the particular direction in which you are applying these things, together with the results of experiments, getting at the fundamental laws. Generally speaking, I don't think you can formulate any statement as to that percentage of steel you would put in.

The President: Our programme calls for a brief address from the Representative of the City Paving Association, I don't know whether the Paving Association delegated a man to be present this afternoon or not. If so, we should like to hear from him. However, I notice Mr. Pearson, who, I am srue, will represent his Association with dignity and credit, and I shall take the liberty of asking him to speak to us.

James Pearson: Mr. President and Gentlemen, I came to hear papers and to benefit by what others would say, and did not expect to be called on to speak. But as representing the Toronto Concrete Pavers' Association—not the President, nor one of the prominent men of it, but still belonging to it—I wish to say, on behalf of that Association, that we are very pleased to have with us the gentlemen who are assembled in convention, and also the fine exhibition in connection with your Association. We feel that we are very much indebted to your Association for holding this Exhibition, and for bringing so many gentlemen together who are interested in the use of cement. I cannot say anything from the scientific standpoint with regard to the manufacture or even the use of Portland Cement, but from a practical standpoint, I must say that I was very much impressed, like many others, by its great utility. In days gone by we had nothing but wooden sidewalks, and in Toronto, at all events, wooden or cedar block pavements. Now those are giving way entirely to pavements and walks in which the use of cement enters largely, and in fact, to such an extent, that I think we can say that the permanent pavement is one in which the use of cement enters. I don't think you can class as a permanent pavement any that has not a concrete foundation or concrete in its manufacture or laying. Our sidewalks are now being constructed entirely of concrete. Our street pavements are now asphalt, stone blocks, bricks, and even the bitulithic, which was not based on concrete; and it is now being recognized that in order to make a permanent pavement you require a concrete foundation. The advantage of them is this, that when the surface wears out you still have the foundation, and it costs much less to put a surface on it than it does to build a new pavement. The remarks of Prof. Larsson were very interesting to me as a member of the Concrete Pavers' Association, because he made use of some expressions that I hope will reach our City Engineer's Department. In the use of sands we have been led to believe that no sand is fit to make good concrete foundation or a good concrete pavement unless it is a very coarse sand. We have had sands condemned on the street that I thought, from a practical standpoint, were very good; and we have had sands demanded to be used from certain pits that I thought were not very good. I know sand that has been used and recommended and required that contains, to my way of thinking, too much fine gravel; it is scarcely to be called a sand at all. I think from a practical standpoint—and we have made some tests of its strength—that the angular sand is the best. We have in Toronto sand that is gathered out of the lake, having been washed up and down for ages, and it has the corners worn off, and it has become smooth, and from my practical standpoint it does not, in my experience, make as good a pavement as a pit sand that has not had so much of that wear and tear. The use of cement in road-building is increasing all the time. Not long since I was at a meeting in Washington where there were a great many contractors interested in paving, and one address was made by Mr. A. L. Barber, who is said to be the father of asphalt pavement, but a man who is perhaps as well informed on the building of roadways in the history of the world as probably any living man. In his paper on road-building he came to the conclusion that for country roads situated a distance from large centres, where the traffic isn't very great, the ideal pavement is a first-class macadam. He contended that the ideal

pavement for cities was a smooth surfaced asphalt pavement laid in concrete. Then there are roadways that are puzzling the community at the present day as to their solution, and those are the roadways in the vicinity of large cities. They are not in the city, and of course the cities do not pretend to take charge of them or build them, and the question is, who should bear the expense, and what kind of roadway it should be. Now, as you know, a macadam roadway will not last long where there is a very heavy traffic right close to a large city. I think anyone who knows will say that the worst roadways in any part of the country are those close to the city of Toronto, and the question is, how are those roadways to be improved? Now, Mr. Barber's idea was that a concrete foundation with a macadam surface—that is, a surface made of very fine broken stone mixed with bitumen—or an asphalt, that is, the bitumen mixed with sand—was the best, and he advocated a very, very coarse sand mixed with a fine sand. In building the surface of a roadway we find that the grading of the material is very important. I remember some years ago when, in the making of concrete for the foundation of pavements, we have to screen out the finer broken stone. I thought at the time, from the practical standpoint, that that finer broken stone, as long as it was broken stone, only helped to fill up the voids and made a better concrete than one of all coarse stone, and I think engineers have come to that conclusion, so that now a mixture of stone, fine and coarse, is the best. I believe that a mixture of fine and coarse sand so as to fill the voids, as long as it is angular and clean, is the best kind of stone with which to make a good mortar in making concrete. I am not interested in building construction, but the lecture of Prof. Brown with regard to concrete reinforced beams was very interesting. But it all simply goes to show that we are living at a time when new materials are taking their place both in this country and the old ones. The steel and the concrete age is upon us, and we don't know to what extent it may be carried, but at all events it is in the stage of progress. There is one practical question I would like to ask the scientific gentlemen here. In Toronto we put down two kinds of pavements, one of four-inch called a light pavement, and another of six inches, called a heavy pavement; those are the foundations on which to put the surface. Now, why will this concrete foundation last over the first winter without a crack, and the next and following winters they break? If you are travelling in the city on the asphalt pavements you will see a crack here and another over fifty feet, etc.; but you can't see one the first winter. Why does it crack the second year and does not crack the first? I have my own theory, but am not going to mention it. I would like to hear from some of these scientific gentlemen who are accustomed to the use of concrete. The same problem exists with regard to concrete stone. You look at a piece of artificial stone like the Roman stone that is made in this city, and it looks very nice; but after a year or two you go up close to it and look into it and you will see it is all full of little cracks. Now, to eliminate those cracks is, I think, one of the aims and objects of the scientists in concrete; but the cracks I speak of in the concrete underneath the surface on the streets are not little, but big cracks. The question is, how do they come there? I am very much pleased to be here. I did not expect to see so many gentlemen present. I hope the result of this Exhibition will be such that we will have more of them hereafter.

The President: The difficulty concerning which Mr. Pearson speaks in the concrete foundation, as far as the asphalt pavement exists, is pretty well known. Save for Mr. Pearson's own explanation, I know of none. If there is anyone present who has a theory to offer I think we will have time to hear it. There is doubtless no one subject in cement construction that is of more general interest than that of cement sidewalks. Mr. Cadwell, of Windsor, is here to give us a paper on:—"Twenty Years' Experience in Cement Walk Building." C. W. Cadwell, Manager, Cadwell Silex Stone Company, Windsor, Ont., read the following paper:—

Twenty years' observations and experience in the Portland Cement Walk business would be to look ahead seem a long time, but looking backward it seems a very short period. Twenty years ago very little was being done with cement for walks as lumber was plentiful and cheap, good cement scarce and high-priced, and the majority of walks laid at that period with cement proved a failure, and nine out of ten persons you solicited would give you a flat refusal, saying that next to lumber, natural stone sawed or split, was the only sure walk, and from many who have tried cement came a wail when they saw the walks breaking up.

Driven out of my business, (a travelling dry goods man), by sickness, I was led to investigate the cement industry by watching a small gang of men building walks as approaches to houses, etc., on a small scale. I became convinced that if they could be built to last as some of them believed they could, ilt would mean the building up of a large business. But with cement at $4 per barrel, and hard to get, as the supply was limited and often delayed by vessels bringing it to this country, being caught in a storm and driven out of its course or wrecked, it was surely a slow and expensive process.

Many were the formulas that were being exploited, and many patents obtained to control a certain way of building walk and holding the trade. One-quarter of a pound of lampblack or a few spoonfuls of glycerine in a barrel of water made a formula that was foisted upon the public as a secret formula used by certain contractors as the very best. But the general specifications or formula then in vogue was somewhat similar to that of to-day, being six parts of sand and gravel to one of Portland coment, put into a box and hoed over seven times dry, then water enough to moisten and hoed over seven times more. The top was 1 to 3 of coarse sand mixed five times dry and then five times wet. The grout was carried on to the walks in pails as also the top, and great care was taken by a good plasterer to make a very fine finish, so much so that the walks became very slippery and dangerous if frost or a little snow was on them, especially if neat cement was used freely by sprinkling the top.

The rails had to be put in by a carpenter and levelled up as perfectly as possible, and the care taken to do good work was even greater than it is now. The making of separate blocks and cutting of joints was a very great problem, and many ways were advocated, such as putting in strips of wood, tar, felt, metal strips, and sand joints, the latter being the most generally used in later years. Then 200 or 300 feet of finished walk was a good day's work for five men. I remember my partner telling me that if I could get the work, he would guarantee to put in three hundred a day for the whole season. That was a good business, but many of us would not hesitate to guarantee three to five thousand a day now. At that time from five to ten thousand feet was considered a big job, and caused a great deal of talk, but now a contract many times larger causes no comment.

The cement business, and especially the walk business, to insure success must be made good, as it is only a thin sheet spread over a long narrow space of ground and every inch subject to severe tests, and none but the best cement and materials will in time show up to advantage. Many times failure is due to the carelessness of the men employed as the work seems so simple that any one watching it for a few minutes or working at it for a few days thinks he can do it as well as anyone without having the slightest idea of the working of the cement, and in trying, makes a miserable failure. At other times, the best of efforts fail, and at such times, fault may be in the material used, for building walks in so many different localities where sand and gravel is more or less scarce much material is used that should not be used, but contractors take the chances as good material is hard to get and expensive, and in order to take the work at low cost to town or individual, recommended its use, hoping against hope that the work will turn out good. Such is a bad practice and detrimental to the trade in general. Although we may not have positive proof that the cement in many cases is responsible for much of the bad walks built in the past, yet we believe it has a great deal to do with it. We all know that cement will set up very quickly, as an instance, we are laying a piece of walk, and when we started to put the

top on, although we were using a mixer, and it was only about three minutes from the time the water was put on until it was spread on the walk we did not get time to float and trowel it, and some of it we could scarcely get out of the wheelbarrows. We stopped using it and wrote to the factory about it. They sent on their chemist to see what was the matter. We tried it again under his supervision, and experimented in different ways from running it on quite dry to so wet that we had to dip it up with a pail and finally had to leave it in a very rough condition. We watched it closely, and in two hours could walk upon it. Next day it was not as hard, and the second day we could dig a hole through it with our heel without any trouble, but in four or five days after, it was hard again, and although it is eight years ago the walk is in splendid condition at the present time, although other pieces turned out a failure, presumably from not being sprinkled often enough with water. I have seen cement taken from the car when one sack would be quite hot and set up very quickly, while another sack would be cold and set up very slow.

Years ago the great object with many was a good foundation. That meant excavation from ten to twenty inches, and filled with sand and gravel or cinders well tamped, and in some cases even more with a layer of cobble stone on the bottom. I have objected to this deep fill for the last fifteen years, and have proven many times that it is unnecessary. As for myself, I would rather guarantee a walk laid on heavy clay soil with one inch of fill than with ten, and have for many years laid long strips of walk on heavy clay soil with one or two inches fill, or practically with just enough to make a level bottom, and this way I think is becoming very general in walk building.

Looking back over the past twenty or more, particularly the last ten years of the cement industry, who can comprehend this monstrous heart throbbing, pulsating giant, Portland Cement, so much alive that none of us can realize its workings, and who of us can even guess at its life, and as we gaze at the mammoth monuments erected to its honor, all in the cement business will take courage and strive for higher attainments, knowing that if we give cement its just due, it will not fail us in severe trials.

Discussion on Mr. Cadwell's Paper.

James Pearson: In this city we have had some sidewalks go to pieces by the frost blowing them up. I contended it was the depth of cinders under those walks that caused the trouble. Those failures took place in clay soil always where there was a concrete kerb between the sidewalk and the ordinary street pavement; there was a kerb that is impervious to water; then there was a trough dug in the clay to put the sidewalk down; it was clay under; clay to the right of it, and on the left was the concrete. Now, in filling in with cinders, you know that cinders are porous and hold a lot of water. In the spring-time the water got in there in sufficient quantity that when the frost came the water blew the sidewalk up. I think some members of our Association paid dearly through their pockets for just what happened there. Now, I contend that that was not the contractor's fault; that it was bad engineering. I think that where you have clay, so that the water will not sink away but hold there, it is a bad thing to put a very porous substance underneath the concrete surface in order to give it a foundation. You must drain it properly, if you don't, you will do better to lay your concrete right on the clay than on a depth of cinders that will catch the water and blow your sidewalk. (Applause.)

The President: I see a number of engineers and contractors here, and we should like to hear from them. We appreciate that there is quite a difference between the theorist and the man who does things. It would be a valuable acquisition to our programme if we could get these men to give us their experience. Mr. Pearson's remark suggests a question I would like to ask: With what success has cement tile been substituted for underdraining in place of tile heretofore used?

Mr. Cadwell: I built a walk right in front of my house seventeen years ago, about 1,200 feet long, with 12-inch of foundation. A banker lived there, and wanted to have his lawn a little better than the ordinary, so he put a 4-inch tile under the walk, with a fall of nearly three feet in a slope of 200 feet, and direct connection with a sewer. The trench was not filled up with clay but with broken brick and gravel and thin sand in order to make it as good a trench as possible. I did not object to it at that time, but I will say that it is the worst piece of heavy walk in the town. The man has frequently told me he wished he had let me do it myself. The next year I built a walk on the opposite side of the street, put in one, two or three inches of cinders, and make a nice little profit on it, and to-day that is by far the best walk; there is far less heaving in it. We work on almost entirely heavy clay, and I have had the specifications changed until we have only one inch of a foundation. At the Cleveland Convention I was asked why I wanted any cinders at all. Well, there may be method in even that little madness. Suppose your walk is level on one side and has a slope on the other, the water on the inside would have to rise clear over the walk, when the soil is clay, but if you have an inch of cinders it will soak away under the walk, and in that way a lot of bad walk when there is a lot of water on the surface. You gain at least that much by an inch of cinders. Apart from that I would do away with cinders altogether. I have seen them dig up pure sand and put in 10-inch of a lot of stuff they called cinders, perhaps scraped up from the streets for foundations.

Among those present at the cement show were:

Nova Scotia.—Halifax, Geo. B. Law.

Quebec.—Montreal, L. O. Armstrong, A. W. Bremner, E. Brown, G. L. Dobbin, Walter J. Francis, T. S. Griffiths, W. H. C. Mussen, C. R. Osland, Kennedy Stinson; Three Rivers, J. Allan Ritchie.

Ontario.—Beamsville, Samuel H. Shields; Belleville, Lucias E. Allen, D. M. McCargar, E. U. Vermilyea; Blenheim, Jos. J. Cookson; Bobcaygeon, J. T. Rolinson; Brampton, J. Pickering; Brantford, Goold, Shapley & Muir, Schultz Bros. Co., Limited; Brooklin, W. J. Haycroft; Chatham, W. H. Stewart; Chippewa, T. H. Hogg; Churchill, G. C. Allan; Clarkson, G. W. Oughtred; Cobourg, A. L. Jox, H. Skitch; Colborne, F. A. Philp; Davisville, Thos. McQuain; Durham, W. Laidlaw; Enfield, A. E. Niddery; Galt, A. D. Griffin, W. Mogg, W. B. Sherk, St. Clair Bros.; Garnet, W. D. Roulston; Granton, Geo. W. Cheney; Hamilton, H. Baghott, A. Donald, Dr. W. M. English, D. F. Griffith, Sackville Hill, W. Holmes, Thos. Lewis, Geo. H. Lewis, A. L. McTaggart; Jordan Harbor, R. F. Martin; Laskay, John A. Watson; London, S. Greenhalgh, W. G. Howlett, A. Irwin, G. H. Muir, Chas. Talbot; Mitchell, Wettlaufer Bros.; Nanticoke, Jas. G. Hedges; Newcastle, H. W. Dudley; New Liskeard, Leonard Hill; North Bay, S. B. Clement; Norway, D. Binns; Orangeville, E. F. Dewar, J. W. Hunter, Geo. McIntyre; Orillia, J. D. Coates; Ottawa, E. A. Hassan; Owen Sound, T. L. Dates, J. C. Forster, A. G. Larsson, Robt. McDowell, J. M. Wilson; Peterboro', F. Mason; Port Arden, Philip Latbe; Port Colborne, John A. Reeb, J. Fred. Reeb; Renfrew, J. K. Stewart; St. Catharines, Geo. C. Rough; Sandwich, J. V. Gray; Sudbury, D. L. Brown; Swansea, Rowland M. Houser, A. B. Hutchison; Tintern, C. E. Stewart, W. H. Stewart; Tiverton, C. S. Wood, Wm. Wood; Toronto, Frank Barber, Andrew Bates, Thos. Bengough, S. W. Black, F. M. Blackburn & Sons, Bond & Smith, A. W. Burge, A. P. Campbell, A. W. Campbell, S. B. Chadsey, A. Chamberlain, E. W. Coles, A. W. Conner, D. Corbett, R. H. Cotton, R. W. Coulthard, A. V. DeLaporte, C. Dengate, J. C. Dodds, A. R. Duff, E. J. Elliott, G. W. Essery, R. B. Evans, C. J. Fensom, John A. Findlay, Thos. Fount, O. J. Fuce, W. J. Fuller, Dr. John Galbraith, Galt & Smith, R. G. Goss, W. F. Green, H. M. Harmwell, F. K. Harris, John T. Hepburn, Beaumont Jarvis, P. T. Kirivan, H. N. Klotz, R. J. Qua, H. M. Lancaster, C. A. Lingham, C. G. Luke, K. A. MacKenzie, A. L. MacLennan, J. J. Main, A. Mason, W. S. McEwen, W. A. McLean, E. B. Merrill, J. S. Miller, L. C. Mitchell, C. M. Moore, J. E. Murphy, T. Aird Murray, C. W. Noble, P. J. Pettinger, W. R. Prowse, D. C. Raymond,

(Continued on Page 379.)

RAILWAY SIGNALLING.*

John Murphy, E.E.

After having received instructions to investigate signal systems in use and to secure information on railway signalling, I conferred with Mr. J. L. Payne, Comptroller of Railway Statistics, and attended the Railway Signal Association.

The Railway Signal Association had on November 17th, 1908, a membership of 1,225, and this figure, in itself, will convey an idea of the extent to which the art, profession and business of railway signalling has grown. One important work which the Railway Signal Association has already accomplished is in connection with the standardization of signal practice and signal appliances. Formerly an engine-man going over the various railway lines on this continent might meet 105 different "aspects" (i.e., signals the indications of which conveyed certain directions or information), but the Railway Signal Association has reduced this number below 25. In this standardization work the Association has had for its object the simplification of the language of fixed signals. In railway operation it is agreed that the burden on the engineman's memory should be lightened so that he may act almost automatically and without conscious effort at the instant a signal "indication" is presented to him. Judging by the reports of committees and the discussions following their presentation at the annual meeting, it is evident that the work of standardization was only accomplished after much labor. When it it is recalled that each railway had, without regard to any other, developed standards of its own, it can readily be imagined that these were not laid aside before the whole question had been thoroughly convassed and the best designs selected. The committees which have drawn up detailed specifications for the materials used in the various branches of the signal business have also done a vast amount of useful work. Two recommendations adopted by the Railway Signal Association are worthy of special attention on account of their apparent reasonableness. One of these is in connection with the discontinuance of the use of the "clear" light altogether, as a signal, and the other is in connection with semaphores. It is considered advisable to do away with the use of a clear light for the "proceed" indication, because the red glass roundel of a "stop" signal may be broken and a "clear" signal be then wrongfully displayed. A green light should be used to "proceed" and a yellow light should be the "caution" signal. In the event of any of the colored glasses becoming broken, and a clear light being displayed, it is the duty of the engineman to "stop and investigate" when this color scheme is in vogue. The Association goes further than this and recommends that two lights be placed in defined positions on every automatic and train order signal, and three lights on interlocking signals so that the engineman cannot be misled by false signals. The semaphore recommended for use by the Railway Signal Association is the one which moves in the "upper quadrant." In the horizontal position it indicates; "stop;" at an angle of 45° above the horizontal; "caution;" and when vertical (90° above horizontal): "proceed." When this semaphore is out of order—overburdened for example, with sleet or snow—it cannot do worse than fall to, or stay at, the horizontal position and stop a train.

Another source of very valuable information in connection with this general investigation of railway signalling was the "report of the Interstate Commerce Commission on Block Signal Systems and Appliances for the Automatic Control of Railway Trains," dated February 23rd, 1907. This report contains a comprehensive treatment of these subjects and it deals concisely with all phases of the question of safety in railway operation.

In the absence of definite directions regarding the features of railway signalling which I was expected to investigate, I looked into the question from the following view points:—

1. What signal practices are the largest signal manufacturers advocating?

2. What signalling is being done by the largest railways, and what are their signal engineers advising to be done?

3. How successfully are the various signal systems operated?

4. What railway signalling should be done in Canada?

(1) I found that the signal manufacturers are exceedingly cautious in the matter of tendering advice, but they are willing to make almost any apparatus that is required. They are anxiously waiting for the adoption, by all the railways, of "standards"—such as those recently approved by the Railway Signal Association—so that the production of standard apparatus can be systematized and, consequently, cheapened. Their energies seem to have been concentrated during the last few years upon automatic signals and interlocking outfits, on account of the great demand for these devices which have been developed to a high state of perfection. The cheapest signal apparatus—the non-automatic—is the kind that is most costly to operate. The reverse is true of automatic apparatus, and as the automatic features are multiplied so the first cost is increased. The signal manufacturers while exhibiting automatic devices did not, however, attempt to prescribe the indiscriminate installation of automatic signal apparatus. It was gratifying to note that they were as anxious to know all the conditions in connection with any railway before attempting to offer advice as though they were acting in the capacity of consulting signal engineers.

(2) The largest railway companies seem to have their attention centred on the subject of automatic signals and their signal engineers are impatiently waiting for authority, and funds, to automatically signal all important pieces of of track which are not already so equipped. A great deal of automatic signalling has been done recently—about 4,000 miles of track in the year and a quarter ending January 1st, 1908,—and, I was informed in many quarters, a very large amount of this class of work would also have been carried out in 1908 but for the prevailing financial stringency.

(3) The successful operation of the automatic signal installations which I inspected may be gauged by the statement that millions of signal movements have been recorded without any failures. Automatic signals show the engineman whether he should or should not "proceed," and they also indicate whether the train speed should be limited or not. The condition of the track ahead of a train controls the automatic signal, and the presence of a car in the "block" ahead, an open switch, a broken rail, or, a part of a train on a diverging track so close that it might be "side-swiped" by an engine, will prevent an automatic signal from indicating "proceed" unrestrictedly. All other types of signals are dependent upon the action of men; the automatic signal gives orders directly to the engineman without the intervention or co-operation of anyone.

(4) Although I had the benefit of interviews with some of the best authorities on the art of railway signalling in America, none of these gentlemen would go so far as to say automatic signals should be installed on every railway. Some of them had been afforded the opportunity of studying the question of safe railroad operation in Europe and they said that while they personally favored the use of automatic signals on their own railroads they could not lose sight of the fact that only a very small amount of automatic work had been done in England and Germany where the records for safe operation were very good. In the United States I found that the tendency seems to be to make automatic signals do all the work. In Europe it would appear, trained men are more readily retained for long periods in positions of importance which are not very remunerative and, therefore, the necessity for automatic signals is not so acutely felt as it is in the United States. "In Germany," said one of my informants,

*Slightly abridged from a report of Mr. John Murphy, electrical engineer of the Department of Railways and Canals to Mr. M. U. Butler, Deputy Minister of Railways and Canals, Canada.

"every railway signal seems to be supplemented by an attendant."

The signal engineers who are connected with railroads which operate two or more tracks all agree that these should be automatically signalled. These engineers do not give such an unreserved opinion about single track work. Some of them would only express an opinion upon the signal requirements of any railway after examining the details of its physical and traffic conditions and learning what kind of employees were available. On the other hand the officials of some single track railways which are equipped with automatic signals told me that the investments which they had made in this connection—and which varied in cost from $900 per mile, in one case, to $2,400 per mile in another case—were the most satisfactory investments ever made, because (1) the automatic signal increased the capacity of their track and postponed, indefinitely, the necessity for double tracking, and, (2) it made operation more safe; as they said: "automatic signals prevent collisions and run-offs from occurring—it is difficult to estimate what one collision, or a run-off at an open switch or a broken rail may cost." It is simply lack of funds that prevents these operators from equipping all their single track lines with automatic signals. With a view to handling dense traffic safely and expeditiously, the tendency on all the railways that I visited is to interlock crossings and divergencies and to use semi-automatic signals at these points, i.e., signals which can only be moved by a hand controller to the "clear" position when the "route" which it is intended to "set up" is "clear." At all other points automatic signals are to be used, and, as above stated, this removes the responsibility of safe train movements from the shoulders of everyone but "the man at the throttle." Tributes to the efficiency of the enginemen are constantly appearing in connection with the reports of what is called "surprise checking" or "signal observance records" on the railways which are using automatic signals. As the immediate observance of an automatic signal "indication" is absolutely necessary in connection with high speed railroading, it is the practice of officials to unexpectedly set signals at the "stop" position in order to ascertain if the enginemen are alert and obedient. It is not uncommon to find a whole month's work without a single case of disregarding signals being discovered.

With a system of automatic block signals in perfect order, and an ideal group of enginemen, there is only one other contingency to provide against, and that is the sudden death or disablement of the engineman. To provide against the engineman's failure to respond to a "stop" indication "automatic train stops" have been developed. There are some automatic stops in actual operation on electrically operated railways in this country, and I have heard of others in Europe. There is, in the opinion of a number of railway operators, a need for automatic stops. This subject has been thoroughly investigated and in this connection I will quote from the last report of the Automatic Stops and Cab Signal Committee of the Railway Signal Association. Under the heading of "Recommendations" this report says:—"Up to the present time descriptions and drawings of automatic stop and cab signal devices referred to in this committee have not included those which seem to be the best and the most practicable. Your committee is not in a position, and does not think it advisable, to recommend for trial any type of cab signal or automatic stop device with which they are familiar, believing that demonstrations of the practical workings of these systems should be made by the patentee, the manufacturer, or under the auspices of the Block Signal and Train Control Board of the Interstate Commerce Commission."

In this connection I beg to quote from the report of the Interstate Commerce Commission on Block Signal Systems and Appliances for the Automatic Control of Railway Trains, dated February 23rd, 1907. On page 20, after referring to the fact that in their belief an efficient "automatic stop would prevent that last small percentage of such accidents as are due to the engineman falling dead at his post, and other like causes," the report goes on, under "Other Appliances," to say:—"A considerable number of inventions, embodying cab signals, automatic stops, and combinations of the two, have been brought to the attention of the Commission. Most of these indicate on the part of the inventors entire lack of familiarity either with the practical conditions of railroad operation or with the present state of the art of signalling. Many violate a universally accepted principle that, in the electrical control of signal appliances, the closing of the electric circuit should be necessary for the display of the clear signal, while the breaking of the circuit, intentional or accidental, should result in the stop indication of the signal. Many appear to have merit, but in the absence of actual continued use, or even extended trial on any standard steam railroads, no very definite opinion concerning their practicability can be formed."

The above opinions expressed by signal engineers and experts of the Interstate Commerce Commission who have every facility for fully investigating these subjects, are, in my opinion, of special interest at the present time.

The need of some kind of a block system, i.e., a space-interval system, for the safe operation of railway trains, is generally recognized. Moving trains must be kept definite distances apart and must receive "stop" orders at safe stopping distances from obstacles, otherwise collisions will occur. The only point upon which there is any difference of opinion amongst railway operators is in regard to the type of block system which any railway should, or can afford, to install. My investigation has shown that automatic railway signals and their electrical controlling circuits and devices have been developed to such a state of perfection that it is safe to say they would be installed throughout the entire length of every railway if they were not so costly. In regard to their costs it is frequently said, and generally accepted, that $1,500 per mile is an average estimate for this work on either single or double track railways. As might be expected, the various complications at terminals, railway crossings and switches increase these costs extensively. For example: I learned that one railway had recently spent $100,000 on the interlocking and automatic signalling of ten miles of railway, between two important cities, and that a similar amount of money had been spent on the interlocking and automatic signalling of 60 miles of railway on another section of the same system—$10,000 per mile in one case and $1,667 in the other. The operator of one single track railway claimed to have done his automatic signalling at a total cost of $900 per mile. Another stated that he had spent $2,400 per mile in connection with automatic signalling a single track, but that about one-third of this amount had been expended for general track improvement work done at the same time and in connection with the signal work. The cost of yearly maintenance of automatic signals seems to vary from $75 to $125 per signal. Some authorities claim that this cost will always be at least $110 per blade per year if the maintaining organization is properly made up.

A system of railway operation that is highly commended for single track work is called the "lock and block," or "controlled manual block system." The equipment for this system consists of an instrument costing about $200 at each station, and one, two or three wires, at a cost of about $40 per mile for each wire, strung between stations. By means of these instruments "clear" signals can only be given by the joint action or co-operation of the attendants at both ends of a block. There are, sometimes, no automatic features in this system and dependence is then placed entirely upon the attendants to know that a train has left a block. An improvement consists in the placing of mechanical or electrical contrivances near the ends of the blocks—near stations or signal cabins where the instruments are located—and these contrivances prevent the attendants from giving "clear" signals until a train has actually passed out. A portion of a train may be left between the points in question and no warning of this be given to the attendants. To provide against occurrences of this character the simple lock and block system is supplemented by what is electrically known as the "track-circuit." The lock and block or controlled manual

block system, with complete "track-circuit" control, is considered by many railway operators as being the safest method of train operation. The "track-circuit" automatically prevents clear signals from being given unless the track is clear and intact, and the "lock" features makes it essential that the operators at both ends agree to give a clear signal before one can be given.

The basis of the automatic system of railway signalling consists primarily in the employment of the "track-circuit." To establish a track-circuit the rails are insulated from each other throughout their entire length, and they are also "cut," electrically, into "sections" approximately 3,000 feet long. Each of the two rails is connected at one end of a "section" with a terminal from one or two cells of battery, and at the other end with a "relay"—such as is used in telegraph work. Under normal conditions, i.e., when no wheels and axle join the two rails together electrically, and, when the continuity of the rails is unbroken by an open switch or a broken rail, a feeble current flows from the battery along one rail through the coil in the "relay" and back along the other rail to the battery again. The continuous passage of current through the "relay" maintains an "armature" in a position opposed to gravity. An interruption or diminution in the flow of current—such as would be caused by a broken rail or a train entering the block—releases the armature, the latter in falling changes the electrical connections of the signal operating circuit and a "stop" indication is given. The failure of any of the electrical circuits or appliances is responded to by a similar indication. For stretches of railway where protection is wanted, and where money cannot be obtained to do any automatic signal work, it would seem to be wise to install "track-circuits" which would show the operators whether the track was intact and clear, or otherwise, and thus prevent them from making errors. The "lock and block," or "controlled manual system," with track circuit control costs much less than the automatic system; but, of course, it requires men to operate it. The station instruments cost about $200 each, and the bonding, relays, track insulators and line wires about $350 per mile. Therefore, two stations and ten miles of single track could be equipped with a complete lock and block outfit for about $4,000 or at the rate of $400 per mile. The lock and block system without track-circuit control costs about $200 per mile. Automatic signals can readily be added to a railway that is "track-circuited" as soon as the demand for them is made by increased traffic.

The "train staff" is another scheme sometimes employed on single track railways for giving directions to proceed instead of using train orders. A train must not proceed without a "staff," and the removal of a "staff" from its holder is only possible, at either end of a block, when all other "staffs" are in the holders. A modification of this scheme provides for the passage of several trains through long blocks, in the same direction, "permissively," by dividing the staff into sections, or by using "tablets" in addition to the staff; but, in any event, all the parts must be delivered at the other end of the block before a staff can be obtained for a train moving in the opposite direction. Devices have been arranged for the picking up of the staff while a train is moving at the rate of about 25 miles an hour. The weakness of any "permissive" system of railway operation lies in the fact that the safety of two trains is always entirely dependent upon the ability of a man on a forward train, which may have been stopped from any cause, to run back and signal the engineman on a following train, and the latter's action in stopping his train in good time. "Permissive" running is tolerated on many roads, but no one advocates it or attempts to justify it; the principle is acknowledged to be wrong.

In order to show the extent to which the block signal system is carried out in the United States, the following figures are presented: they are taken from the Interstate Commerce Commission's Block Signal and Train Control Board's compilation up to January 1st, 1908:—

	Miles.	
Total railway mileage in the United States	151,455.2	
Non-automatic block signals	47,875.7	
Automatic block signals	10,803.0	58,678.7
Automatic signals on single track	4,363.5	
" " on double track	5,699.8	
" " on three track	197.8	
" " on four track	541.9	10,803.0

From September 30th, 1906, to January 1st, 1908, the increase in block signals in the United States was as follows:—

	Miles.	
Manual block, increase		5,959.4
Single track, automatic, increase	2,331.1	
2, 3 and 4 track, automatic, increase	1,645.0	
Total automatic block signal increase	3,976.1	3,976.1
Total increase	3,976.1	3,976.1

N.B.—Some 4,000 miles of track are now being operated under a system of telephone dispatching. (January 1st, 1908).

To enable enginemen to receive signals during periods of foggy or stormy weather it is suggested that cab signals should be used. While this suggestion seems to have merit I learned that railway operators offer the following objections to the general use of cab signals: (a) the introduction of any device into the cab serves to distract the engineman's attention from the road; (b) in the event of the cab signal's failure, on any part of a run, the engineman has no other guide during the remainder of the run—unless fixed signals are also used along the road; (c) it is essential to be able to check enginemen's observance, or non-observance, of signals; otherwise, an engineman who would persistently disregard caution signals could only be discovered after causing a wreck, and even then it perhaps could not be proven that he had received a "stop" or "caution" indication.

Automatic signals have become such a necessity on some railways that what is considered regular traffic could not now be handled without them—unless more tracks were laid. I was unable to collect any figures which would show what saving had actually been effected by their use, but I learned that trains guided by automatic signals were run at normal speeds in the same direction with two mile blocks between them "with absolute safety." Without automatic signals this procedure would not be attempted and much greater space and time intervals would be placed between trains. I heard of no case where the use of automatic signals had been discontinued after one trial and the extension of the automatically signalled sections of railways is regarded as inevitable.

To assist in forming an idea of the benefits to be derived from the use of automatic signals the following summary is presented. By the use of automatic railway signals:—

(a) The possibility of human error in misconstruing or disobeying orders or directions is reduced to the minimum—it is placed in the hands of the engineman alone. With the "automatic stop" it is entirely eliminated.

(b) The engineman will not be given a "proceed" signal (1) unless the track is intact (i.e., no broken rail, no open switch or drawbridge) and, (2) unless the track is unoccupied.

(c) After a train has received a "proceed" signal, over a given route, yardmen are (1) warned, by indicators, not to open switches, or (2) prevented, by automatic locks, from opening switches.

(d) Trains moving in the same direction can be safely spaced two blocks apart—say two miles apart. Without the use of automatic signals, when an absolute block is maintained between trains, the preceding train must leave one station before a following train is permitted to enter the block between stations—without regard to the distance between stations. The saving in time effected with the automatic block system when stations are far apart is apparent.

Keeping in mind the above advantages, which are secured by the use of automatic signals, it is easily understood why some railway operators in busy districts contend that they must be installed irrespective of cost.

The following extract from the Interstate Commerce Commission's report of February 23rd, 1907, seems to apply with equal force to conditions in Canada:—

"To investigate accidents....may be called an indirect method of securing information as to the efficiency with which safeguards to life and property are administered. To investigate signals and signal practice directly, without regard to accidents, would be a more direct method of promoting safety."

ENGINEERING SOCIETIES.

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

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

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—29 West 39th Street, New York. President, H. L. Holman; Secretary, Calvin W. Rice.

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

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

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Vice-President, C. F. Pulfer, London, Ont.; Secretary-Treasurer, Alfred E. Uren, 62 Church Street, Toronto.

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

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, J. F. Demers, M.D., Levis, Que.; Secretary, F. Page Wilson, Toronto.

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

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

CANADIAN SOCIETY OF CIVIL ENGINEERS.—413 Dorchester Street West, Montreal. President, Geo. A. Mountain; Secretary, Prof. C. H. McLeod. Meetings will be held at Society Rooms each Thursday until May 1st, 1909.

QUEBEC BRANCH OF THE CANADIAN SOCIETY OF CIVIL ENGINEERS.—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 OF THE CANADIAN SOCIETY OF CIVIL ENGINEERS.—96 King Street West, Toronto. Chairman, J. G. G. Kerry; Secretary, E. A. James, 62 Church Street, Toronto.

MANITOBA BRANCH OF THE CANADIAN SOCIETY OF CIVIL ENGINEERS.—Chairman, H. N. Ruttan; Secretary, E. Brydone Jack. Meets first and third Friday of each month, October to April, in University of Manitoba.

CANADIAN STREET RAILWAY ASSOCIATION.—President, J. E. Hutcheson, Ottawa; Secretary, Acton Burrows, 157 Bay Street, Toronto.

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto. President, C. A. Jeffers; Secretary, C. L. Worth.

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

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

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

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

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

WESTERN CANADA RAILWAY CLUB.—President, Grant Hall; Secretary, W. H. Roseberry, Winnipeg, Man.

WESTERN SOCIETY OF ENGINEERS, 1735 Monadnock Block, Chicago, Ill.—Andrew Allen, President.

SOCIETY NOTES.

American Electrochemical Society.

It now seems highly probable that the May meeting of the American Electrochemical Society, to be held in Niagara Falls on May 6th, 7th and 8th next, will go down in history as the most enthusiastic and satisfying convention of electrochemical and metallurgical interests ever held. Because of the fact that one day is to be devoted to electrometallurgical subjects, unusual interest is being displayed by men connected with that line of research, both in this country and throughout Europe. The American Electrochemical Society, under the activity and vigor given to it by the officers and members associated with President Edward G. Acheson, is fast gaining most pleasing recognition as one of the most important bodies of workers. It has come to be realized that electrochemistry and electrometallurgy have much in them of common interest, and at the Niagara meeting it is proposed to cement the development and growth of the sympathetic assistance one field offers to the other, so that the Niagara Convention will possess more in it for workers in these fields than any other convention ever held. American workers along the lines indicated will have pleasure in meeting some notable foreign workers, and the fact that the Convention is to be held on Canadian soil affords the intimation that these large interests at home and abroad will come together, as it were, on neutral soil.

In addition to the valuable papers previously announced, the information is given that word has been received from Monsieur Ch. Albert Keller, Ste. des Establissements Keller-Leleux, Paris, France, saying that he will contribute a paper.

Cav. Ernesto Stassano, Forni Termoelettrici Stassano, Turin, Italy, will also contribute a paper and expects to be present at the meeting in person.

Monsieur Paul Girod, Societe Annoyme Electrometallurgique, Ugine, France, has given further information as to the nature of his paper, which will apparently be largely devoted to an illustrated description of the new steel works at Ugine. This plant will probably be in operation in April. The installation includes two furnaces of 12½ tons capacity, two furnaces of 2½ tons capacity, two rolling mills, large forge and steel moulding shop, the whole installation being exclusively worked by electricity.

ONTARIO GOOD ROADS ASSOCIATION.

(Continued from last week.)

Hon. Dr. Reaume, Minister of Public Works, addressed the Good Roads Convention on the second day. His department was keeping a record of roads all over the province, "and," he said, "we are watching with interest the working out of certain plans now in vogue. In new Ontario the roads are paying their own share of maintenance, but in some of the older counties they are not. I want to make these old counties which have been dragging on Government support, self-supporting."

Mayor Oliver thought that some arrangement might well be entered into between the Government of the province, the municipalities and the county authorities, whereby the various roads leading from a municipality might be properly constructed and kept in a state of thorough repair for the distance of some 10 or 15 miles from such municipality. The provincial automobile taxes ought to be devoted to the upkeep of the roads, and the present tax on motor cars be doubled or trebled.

L. H. Clark, for the Board of Trade, promised hearty co-operation in improving the roads around the city, and H. J. Bowman, C.E., of Berlin, county clerk of Waterloo, argued that the province should build the main roads.

"The first and foremost piece of machinery in road building is, in my estimation, a good, intelligent man, a man with brains," said A. J. Davidson, superintendent of streets, Galt. One of the most important features in good roads was good drainage.

T. Aird Murray, C.E., read a paper written by Andrew F. Macallum, B.A. Sc., C.E., and himself, entitled, "The Boulder Rocks in Southern Ontario." Macadam surfaces should be composed of good cementing medium as little liable to dust and mud production as possible.

W. B. Rittenhouse, of Beamsville, spoke on "Earth Roads: Their Improvement and Maintenance."

"Road dragging should begin early in the spring," he said, "as the road will then be in good condition all summer. Further, the work should be kept up."

"Bad work cannot be made good, therefore, a competent engineer should be consulted before building a bridge or a concrete culvert," said C. L. Hicks, of the Humber, in his address on "Concrete and Steel Bridges."

K. W. McKay read the auditors' report showing that a balance of $233.07 remained. The receipts for last year were $305.93, and the expenditure $72.86. He moved that the Secretary, Col. J. E. Farewell, be presented with $50 in recognition of his services.

Mr. W. H. Pugsley was re-elected President, and Mr. J. E. Farewell, of Whitby, Ont., was elected Secretary-Treasurer. Mr. W. A. McLean Assistant Secretary. These officers, with R. H. Jupp, of Orillia, and J. L. Taylor, of Hamilton, are the Executive Committee.

Among those present were:

Ontario.—Atkinson, T. W. Spence; Aylmer, J. L. Thayer; Beamsville, W. B. Rittenhouse; Black Creek, J. F. Beam; Bolton, S. A. Egan; Bowmanville, J. Degruan, S. A. Lole, A. Wright; Brampton, R. B. Ashley; Brantford, James Young; Brooklin, W. J. Haycroft, J. J. Moore; Collins' Bay, A. Rankin; Cromarty, John A. McLaren; Freeman, J. G. Wilson; Galt, A. E. Buchanan, A. J. Davidson, W. N. Robinson; Garnet, W. D. Roulten; Greenwood, W. J. Devitt; Grimsby, W. B. Russ; Hamilton, Thos. Barnes, J. W. Gage, J. Taylor; Hespeler, Ont., W. Brewster, J. Simpert; Humber Bay, C. S. Hicks; Kinsale, R. R. Mowbray; Lakeview, S. S. McDermand; Laskay, John A. Watson; Listowel, John Hamilton; Mayfield, P. Spiers; Meadowvale, F. J. Jackson, N. A. Steen; Molesworth, S. E. Smith; Nassagawga, Jas. Erwin; Nelson, J. P. Griffin; Newton, C. Yost; Norwich, H. S. Moore; Oakville, Jas. C. Ford; Omagh, John Ford; Orillia, R. H. Jupp; Oshawa, W. S. Bowden, J. E. Farewell (Secretary), A. E. Henry; Picton, H. Dempsey, R. E. Taylor; Queenston, J. Sheppard; Queensville, R. Granby, W. G. Hill; Richmond Hill, W. H. Pugsley; St. Mary's, J. Patterson; Scarboro', W. H. Patterson; Simcoe, A. E. Mason; Solina, E. Willson; Speedside, J. Grieve; Stratford, F. Brampton, G. L. Griffith; Sutton West, A. E. Pugsley; Toronto, Frank Barber, A. W. Conner, E. A. James, W. A. McLean, W. L. Smith; Wallacetown, John Dromegale; Waterloo, G. Suggett; Winona, Thos. W. Allan; Woodbridge, J. E. Harris, D. C. Longhouse.

Dominion Land Surveyors' Association.

About 50 members of the Dominion Land Surveyors' Association from all parts of Canada are meeting March 2nd, 3rd, and 4th, 1909, in Ottawa. This is the third annual meeting and the delegates assembled on March 2nd at the Carnegie Library. The session was opened by the address of the President, Mr. E. W. Hubbell, D.L.S. He outlined the work of the Dominion Land Surveyors when the surveying first started in Manitoba in 1869. That province was then surveyed into squares of 800 acres each. The first official map of the Prairie Province was issued in 1871. Then the surveyors received $15 to $25 a mile for surveying. He pointed out that now the surveyor is practically free to take in his service any person he chooses and Government pull is nearly done away with. He showed by reference to the maps that there was still much work to be done by the land surveyors of the Dominion Government. A deputation recently waited on the Government to get the salaries of the surveyors increased with the result that those formerly getting $6.50 a day will now get $8 and those formerly getting $7.50 a day will henceforth get $10.

Nominations were received for the different officers of the Association and the election will be by means of letters sent to the Secretary by each member. The nominations are:

Patron—Surveyor-General E. Deville.

Honorary President—Dr. W. F. King.

Honorary members—Mr. R. H. Campbell, Dr. Otto Klotz.

President—Mr. W. Hubbell.

Vice-Presidents—of whom one will be elected—Messrs. P. L. A. Belanger, Thomas Fawcett, Samuel Bray, L. S. Lafontaine.

Secretary-Treasurer—Mr. T. S. Nash.

Executive (re-elected)—Messrs. W. T. Gray, T. Shanks, and P. D. Henderson.

Second Vice-Presidents—Messrs. Thomas Fawcett, H. W. Selby for Ontario, Senator Casgrain for Quebec, Mr. W. A. Ducker for Manitoba, Mr. E. H. Phillips for Saskatchewan, Mr. C. A. McGrath, M.P. for Alberta, Messrs. J. F. Garden and J. A. Cleveland for British Columbia, and Mr. T. D. Greene for the Yukon.

Lecture of Forestry.—There was a large attendance in the evening at a lecture given in the Normal School Hall before the Association by Mr. R. H. Campbell of the Forestry Branch of the Interior Department, on Forestry. It was illustrated by steropticon views. The speaker outlined the great consumption of timber in the United States which each year was about ten times as much as in Canada, and pointed to the inevitable exhaustion of the supply there very soon unless the demand is met elsewhere. It will remain for Canada to be the great timber country of the world and it is very important therefore that it should take great precautions to save its forests. If ruthlessly devastated to supply United States as well as Canadian demands without scientific method of growing more forests, the supply would be gone in about half a century. He explained the great loss due to forest fires and said that the patrol system was the only way to protect Canada's forests from this scourge and in spite of that there must be much loss. If the forests could be protected from such fires and forestry was systematically carried on the situation of the supply being equal to the demand in Canada would be solved as far as lumber was concerned. He outlined the work of the Government in surveying the timber limits of the reserves and also the work at Indian Head, where fifteen million young trees have been given out to the farmers of Manitoba to grow tree belts about their farms, which form a great protection. His lecture was followed by a general discussion on forest fires in which it was emphasized that every surveying party should be impressed with the necessity of avoiding endangering the forests with fires such as by dropping lighted matches or leaving camp fires still smouldering when the party moves on.

In the afternoon of the second day they met and listened to an admirable address by Mr. W. J. Stewart, of the hydrographical survey, marine department, who went thoroughly into his subject, which was the comprehensive one of The Hydrographical Survey of Canada. Mr. Stewart produced charts and instruments to further illustrate his points.

At the evening session, Mr. R. E. Young, superintendent of Railway and Swamp Lands, was to have spoken upon the newly applied Torrens System, but owing to lack of time had not been able to get together the data necessary. Instead he gave a talk on the recommendations of the recent Washington conference on conservation of the natural resources of North America. The speaker went through the clauses separately, lucidly explaining them, and showed the reasons for them all. He declared that the Americans were sincere in their anxiety for conservation. He showed how the conservation of public health was the first duty. Canada was threatened with the same danger that confronted Buffalo on Lake Erie. There was the risk of the Great Lakes being

turned into cesspools, as Lake Erie was at the present. And this was preventable, for much of the sewage could be used for the purpose of fertilizing the soil. Then, too, afforestation was troubling Canada, and he suggested that there might be schools devoted to the training of special forestry officers as the United States possessed. There was one in Canada. The present system of taxation of forest land higher than bare land was ruinous to the forests. Looking a century or so ahead, the lecturer saw that when the coal supply of the United States gave out and the water-power there was in the hands of capitalists, Canada could be relied on to assist her neighbor; that is, if the water-power was conserved. The time was fast approaching when the land would have to be looked after. United States farmers were sending their sons here, where they could obtain land so much cheaper and where the soil was so much more fertile. Canada was still in the making, and he had no doubt that the Dominion Surveyors would help in its making.

Thursday afternoon, Mr. F. W. Wilkins, D.L.S., addressed the Convention and Thursday night a banquet was held at the Russell House.

ORDER OF THE RAILWAY COMMISSIONERS OF CANADA.

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

6332—February 13—Directing the C.N.R. Company to construct a proper fence along both sides of its right-of-way where the same crosses the N.E. Quarter Section 21, Tp. 19, R. 21, W. 2 M.

6333—February 13—Directing the C.N.R. Company to construct a suitable farm crossing across the right of way and through the lands of Chas. Mann, Lumsden, Sask., at a point to be agreed upon, and in the event of a dispute the said point shall be fixed by an engineer of the Board. Also directing the railway company to furnish gates 16 feet in width, and to put in the necessary planking at the said crossing.

6334—February 13—Directing the carrying railway companies to refund the over-charge admitted by letter of J. E. Dalrymple, A. F. F. M., of G.T.R., February 8th, 1909, on shipment of settlers' effects from Mount Forest, Ont., to Moose Jaw, Sask.

6335—February 20—Amending Order No. 1876, dated October 22nd, 1906, which authorized carriage of traffic by C.P.R. from Bolton to Craighurst, Ont., by striking out the clause limiting the speed to 15 miles an hour at which trains shall be operated over the portion of the line of railway authorized to be operated by the said Order.

6336—February 20—Authorizing the Stormont Telephone Company to place its wires across the G.T.R. tracks at Aultsville, Township Osnabruck, County Stormont, Ont.

6337—February 20—Authorizing the city of Winnipeg, Man., to lay a sewer under the C.P.R. tracks, known as the "Brown & Sutherland Spur," where the same intersects Sutherland Avenue, Winnipeg.

6338—February 19—Authorizing the Robitaille Eureka Distillery, Limited, to place a water pipe under the track of the Quebec Railway, Light & Power Company, near Beauport, Que.

6339—February 16—Authorizing the C.P.R. Company to construct its railway across 15 highways in the Township of Medonte, Simcoe, County, Ont.

6340—February 22—Directing that the G.T.R. crossing on Main Street, Welland, Ont., be protected by gates and watchmen.

6341—February 12—Directing that the crossing of the M.C.R.R. on South Main Street, Welland, Ont., be protected by flagmen, to be appointed by the railway company, for the purpose of warning persons on the highway of the approach of trains Nos. 17 and 31.

(Continued on Next Page).

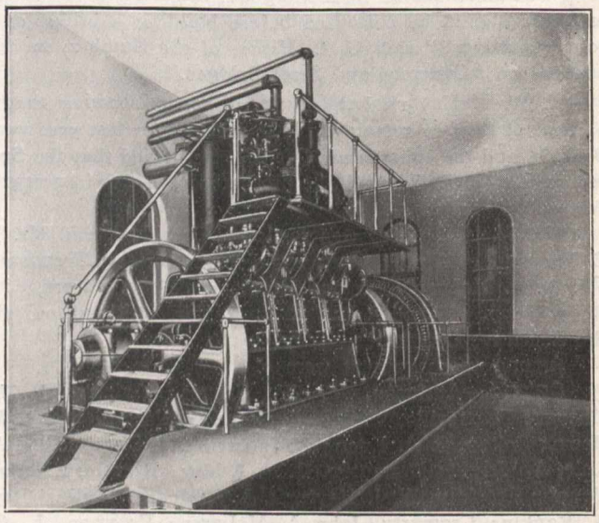
AN AMERICAN MUNICIPAL GAS ENGINE ELECTRIC LIGHTING PLANT.

By Frank C. Perkins.

In Germany there are a large number of municipal electrical central stations where gas producers are utilized for supplying fuel to high power gas engines driving electrical generators for lighting service, but in the United States very few plants of this character have been installed.

The accompanying illustration, therefore, is of interest, showing a 300 horse-power gas producer engine direct connected to a 200 kilowatt alternating current generator in the Municipal Electric Lighting Plant at Peru, Indiana.

This engine is of the four-cylinder, four-cycle vertical type, operating at a speed of 200 revolutions per minute. It is directly connected to a three-phase generator of the Western Electric type, generating an alternating current of 2,200 volts, with a frequency of 60 cycles per second, the exciter dynamo being belted from the main shaft.



Three Hundred Horse-power Producer Gas Engine Direct Connected to 200 k.w. Generator.

This gas engine is operated on producer gas using semi-anthracite coal as a fuel, which costs $4.50 per ton laid down at the plant. There are two gas producers installed, each of 150 horse-power capacity. The current is utilized for supplying the city with three public services, including water pumping, street lighting and commercial electric lighting and power service.

This gas engine generator set supplies current in part for operating two 60 horse-power induction motors driving two-stage centrifugal pumps, which furnish water at about 50 pounds pressure to the city main. It also is utilized for operating 175 alternating current arc lamps of 6.6 amperes each for street lighting service, the remainder being run in connection with a steam plant for furnishing current for industrial electric motors and for commercial electric and arc lighting.

The engine has not been operated at full load, but with an average load factor of 51 per cent., a fuel consumption of approximately 1.6 pounds of coal per brake horse-power was shown, while for short periods at full load the fuel consumption was found to be 1.2 pounds of coal per brake horse-power per hour. It is stated that when a full load is available for a considerable length of time, without doubt even more favorable results as to performance will be shown.

Undoubtedly in the near future many gas producer plants will be installed throughout the United States for electric light and power service as equipments of this character have been shown to be economical and reliable.

The Nova Scotia Government, on the recommendation of the Lumbermen's Association, is preparing a way for descriptive survey of provincial forest lands.

CORRESPONDENCE

[This department is a meeting-place for ideas. If you have any suggestions as to new methods or successful methods, let us hear from you. You may not be accustomed to write for publication, but do not hesitate. It is ideas we want. Your suggestion will help another. Ed.]

FAT AND LEAN YEARS.

Sir,—The writer has for many years advocated the procedure recommended by Col. Sam. Hughes, M.P., regarding the construction of some public works. If the Dominion and Provincial Governments adopted such a policy it would automatically prevent or lessen "hard times."

If each of the Provincial and Dominion Government had surveys, plans and estimates prepared and filed away, ready for almost immediate use, anticipating the construction of public works, buildings, canals, roads, railway extension, development and manufacture, it would give a confidence to finance and trade in Canada that nothing else could, in the event of our stock-jobbing neighbors hatching out another financial stringency.

The German Government not only has the plans prepared, but the good gold laid aside in anticipation of a not much greater danger than financial wreck and panic.

Would it not be wise for our Government at least to imitate the wisdom of Joseph, and lay up something in the years of plenty against the lean years, and not need to borrow much, if any, when the pinch threatens to come.

There are plenty of public works which must be prosecuted during the prosperous years, but there are some, which, not so pressing, must be surveyed, estimated and laid aside for construction in dull times. As there are new ones of that character coming in view all the time, it would not follow that a public work, filed for hard times, would never be taken up. It would only mean that when replaced by later, but not pressing projects, the older plans would be acted upon, even in prosperous years, if of sufficient value and interest.

For instance, supposing a financial crisis in 1910—which I am glad to say, owing to superior financial intelligence and system in Canada, would not affect us much—we would be less affected if it were known that our Dominion and Provincial Governments were pledged in such case to begin the construction of public works in all the provinces. Let us mention a few. Harbor and navigation works, railway extension in British Columbia. Building the Hudson's Bay Railway, and other projects in the West. Harbor works on Lake Superior, Welland Canal enlargement, building the G. B. S. Canal in Ontario. Harbor works, railway extension in Quebec and the Maritime Provinces; besides numberless enterprises which future Provincial Governments will wonder why they never took in hand before, as, for instance, the Temiskaming Railway, etc.

Increased stability and prosperity would more than counterbalance any increase of borrowing, or any danger of excessive expenditure.

It seems very unwise that just at the time when private monetary concerns shut down on local borrowers, ship gold to New York, and endeavor to augment the financial stringency in Canada, our own Government should aid and abet this procedure by shutting down on public enterprise, more particularly as that is the time when public works can be most easily and cheaply constructed.

As a proof of this let me say that about the only thing which saved Canada from absolute stagnation and financial ruin in the middle seventies was the construction of the Canadian Pacific Railway west of Lake Superior as a Government enterprise

To show how public works may be more cheaply constructed during dull times, it can be said that locomotives, rock drills, and other machinery were bought by the Whiteheads, of section 15, C.P.R., during 1878 or 1879, in the nearly bankrupt United States, where the big steel concerns were tottering on their feet, at such a price that, after being given hard usage for over two years, these locomotives and machines were sold on an average for more than the purchase price on the return of good times to Canada.

This was in the days when our country suffered sympathetically with the United States, and is one of the few cases where buying machinery in the United States for Canadian enterprises might possibly be excused.

Henry J. Woodside.

Ottawa, March, 1909.

FOREST PRESERVATION.

Dear Sir,—Much has been said, and many meetings of importance have been held both in Canada and the United States in the interests of forest preservation, and in fact our universities are establishing departments devoted to the study of forestry. In the face of this the Engineering Contracting, (Chicago, February 3rd), gives us to understand that "forest preservation has become a farce, and forestry a ridiculous occupation."

The writer goes on to say that the "stone age" is returning to us in the form of cement, reinforced when necessary by steel, and therefore we should cultivate our lands for fruit raising instead of timber raising. He points out the marked success of concrete when used for building purposes the world over, and how the fence posts, telegraph poles, etc., are being replaced; also that cross ties for railroads of reinforced concrete are as certain to replace timber ties, as cement sidewalks have replaced those of wood.

The average engineer believes these facts to be true, but who is going to say when the market for lumber will cease? and at any rate are these various meetings as mentioned above only for discussing forestry when applied to commerce? We understand that the commercial side of forestry is not the real value to place on our wooded lands, but that these lands are the sourse of irrigation, and of general assistance to lands now under cultivation.

Encourage the man who will agitate the progress of concrete or any other material to replace wood, for it would be the greatest benefit to those who agitate for the forest preservation.

Yours truly,

E. L. Miles.

Bala, Ontario, March 3rd, 1909.

RAILWAY ORDERS.

(Continued from Preceding Page).

6342—February 22—Authorizing the Okanagan Telephone Company to place wires across the tracks of the Shuswap & Okanagan Railway Branch of the C.P.R. at Mission Street, Vernon, B.C.

6343—February 22—Authorizing the Winnipeg Electric Railway Company to place its transmission wires across the C.P.R., in the town of St. Boniface, near the Junction of its line with the C.N.R. Company's main line.

6344—February 22.—Authorizing the Winnipeg Electric Railway Company to place its transmission wires across the C.P.R. tracks near Molson, Sec. 25, Tp. 12, Man.

6345—February 22—Authorizing the Winnipeg Electric Railway Company to place its wires across the C.P.R. tracks in Sec. 35, Tp. 13, R. 9, east of 1st Meridian, Manitoba.

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

TORONTO SEWAGE DISPOSAL.

The original scheme proposed for the disposal of the sewage of the city at Morley Avenue site in the east end of the city, included septic tanks by means of which the sludge would be septically treated by the putrefactive and hydrolysis methods, the resultant liquor was then to be passed without treatment into the lake. As much objection was raised to the septic tanks being placed at Morley Avenue, sewage experts, Messrs. I. D. Watson, of Birmingham, England, and Rudolph Hering, of New York, U.S.A., were called in to advise in the matter.

Their report practically amounts to an agreement with the city of the site chosen, the principal of discharging the untreated sewage liquor into the lake; but septic treatment is reported against, and the city are advised to remove the sludge daily by means of electric pumps to Ashbridge's Bay, a marsh a considerable distance off.

It is thought that the objections to the site will thus be met by abandoning any form of sewage treatment at Morley Avenue, apart from the mere separating of the solids from the liquids. Both solids and liquids to be purified and dealt with away from the site, the former by scattering it in the march, the latter by pouring it into Lake Ontario.

METHOD OF SEWAGE PURIFICATION ABROAD.

Mr. Clark made a visit to England last year, and has recently formulated his impression of English work in sewage disposal in a paper addressed to the Boston Society of Engineers. The following digest of the paper should be of interest:

Description of English Methods.

In the first place, the number and proximity of sewage purification plants, especially in England, is forced upon one's attention at every hand; second, the variety of methods followed, and the variety often followed by one municipality, it being no unusual thing to find at one plant sewage farming, chemical precipitation, septic tanks, contact filters, trickling filters and secondary filters; third, the different methods of operating similar plants at different places; fourth, the curious lack of knowledge that often obtains at one borough in England in regard to methods and results at a neighboring borough, in spite of associations of sewage works managers, etc.; fifth, the solidity and cost of works; sixth, the fact that sludge disposal is still the chief problem in spite of all the work upon septic tanks and other methods of destruction; and, finally, the great part that chemical precipitation still plays at both old and new sewage plants, principally, however, as a preliminary treatment, although there are many huge precipitation plants without further methods of purification. Among the works described and illustrated by photographs are Manchester, Wolverhampton, Sheffield, Blackburn, Heywood, Chesterfield, Hanley and Birmingham. The author appears to have visited York and Buxton, but it is to be regretted that the works he describes and comments upon are all dealing with sewage charged with trade wastes, so that the references to methods of preliminary treatment and sludge disposal do not properly apply to works dealing with sewage of a purely domestic character, as in the greater proportion of sewage works in this country. Mr. Clark doubts whether the addition of the secondary beds at Manchester will fulfil the requirements of the Rivers Board, and he considers "the problem of making the Manchester filters work satisfactorily for the Mersey and Irwell Commission is almost hopeless, unless percolating methods can be adopted."

Fixed Sprays and Revolving Distributors.

The opinions expressed on the subject of distribution on percolating filters are exceedingly interesting. Mr. Clark states that when he started on his round of visits he was strongly inclined to believe that the use of nozzles (fixed sprays) was the common-sense method, but that he has become convinced that under English conditions revolving or travelling distributors are by far the best, as with these, other things being equal, filters produce better effluents per unit of filter surface, and every square inch of filter can be used. He points out that "by sprinkling nozzles operating under a constant head, as at Birmingham and Salford, as can be seen from observation of these areas, and as has been shown by experiments at Lawrence and elsewhere, only about 50 or 60 per cent. of the filter is really used. That is to say, if 2,000,000 gallons of sewage are applied daily to an acre bed by means of nozzles, a considerable area will operate at the rate of 5,000,000 or 6,000,000 gallons per acre daily, while a portion will operate at a rate of 500,000 gallons or less. There is little or no spreading of sewage as it passes through filters of clinker, coke or broken stone. In other words, if the sewage was as perfectly distributed over the Birmingham filters as over the Hanley, Heywood, and other filters, the area of these filters might perhaps be reduced 50 per cent., the cost of construction be not more than half as great, and the same purification result be achieved. Even in this country, I believe, perfect distribution, even if the form of distributor necessitates covered filters for winter work, may in the end be the practical method of construction and operation. Sprinkling nozzles acting under a variable head improve distribution, but it is evident that nozzles call for constant attention. The men tramping over the Birmingham filters, one to every 1½ acres, keeping the nozzles clear, have no sinecure. They are about the wettest objects at the plant. In cold American weather it would be a job requiring much fortitude.

Grading of Filter Media.

The remarks in connection with the question of the grading of material for filters are interesting, and may afford some explanation of troubles which have arisen in some filters in England. Mr. Clark says: "The best results were universally given, I believe, where the material was practically of the same grade throughout the greater depth of the filter, with coarse material over and round the underdrains. Other things being equal, the finer and rougher the material the better the effluent. At places where materials were mixed to any great extent different grades of broken stone or different grades of coke, more or less trouble from clogging was occurring, or had occurred. That is to say, just as we have

* Paper read before Boston Society of Engineers by Mr. H. W. Clark, chemist of the Massachusetts Board of Health, and in charge of the Lawrence Experiment Station.

found at Lawrence, we can run a good trickling filter with coarse stone, most of the pieces 2 inches in diameter, or a good trickling filter with fine stone, most of the pieces ¾-inch or 1-inch in diameter, but if the two grades are mixed the open space is more completely filled and clogging may ensue." Later we find an echo of the fine-grade filter controversy in the words: "The Hanley material, except when receiving a sewage as beautifully clarified as that at Hanley, would prove altogether too fine." This entirely confirms our own opinion.

Discussion—Sterilization of Effluents.

Prof. Winslow stated that the problem of the removal of bacteria from effluents is well in hand, and that it is now generally recognized that it can be accomplished efficiently and economically by treatment with chloride of lime. Later it was pointed out by another speaker that, "during the past year, we have, with the collaboration of Prof. Phelps, carried out in Baltimore, at the Walbrook sewage testing station, a series of experiments on the disinfection of sprinkling filter effluents with solutions of commercial bleaching powder. Our results have been so extremely satisfactory that the final plans for the sewage disposal works at Baltimore will include a chlorine disinfection plant." He then describes the testing plant, and states that the results were eminently satisfactory and that they are now experimenting to ascertain "if it will be possible to secure an effluent as well purified and as stable from a shallow bed treated with large quantities of chlorine as can be obtained from a deeper bed treated with small quantities of chlorine."

THE SEPTIC TANK.

Chapter I.

Its Evolution.

Referring to the Royal Commission Report on Sewage Dispoal, we find the following, page 21, paragraph 31:—"The notion that the solid matter of sewage would be digested by passing the sewage through a sealed tank is by no means novel, but it does not appear to have had any extensive practical application until Mr. Cameron, who held the office of City Surveyor of Exeter, proposed the adoption of the 'septic tank treatment' for that city."

The Commissioners are able to state that the "notion is by no means novel." Since 1895, however, this modification of the sedimentation process, introduced first at Exeter (England), has been adopted by numerous towns. The treatment differs from ordinary sedimentation, in as much as the sludge is not regularly removed before putrefaction sets in. The sludge is allowed to remain for months, and even in some cases for years.

Prior Practice.

Before 1895 it was the general practice in sewage disposal works to insist on the removal of sludge from settling tanks, while it was in a fresh state. In most reports and treatises we find stress laid upon the absolute necessity of treating fresh sewage, in almost every case, whether the ultimate method of purification was by land filtration or chemical reaction. Generally speaking, when septic conditions existed, such were purely accidental, caused by neglect to clean out the tanks, or caused by badly laid rubble built sewers, in which the sewage lodged and underwent putrefaction, the septic liquor only being delivered at the outfall. Cases existed in abundance, of the ordinary sedimentation tanks which in some cases were covered in, and in others left open, where, for lack of supervision, or for general economy, they were entirely neglected, except for an occasional cleaning out by means of a chain or other pump. The old-fashioned neglected cesspool was, in every particular, simply a septic tank. It cannot, therefore, be said that prior to 1895, there was, generally, any reasoned or scientific principle in vogue calling for the retention of the sludge in such tanks; to this general rule, however, there are noted exceptions.

The Theory of Putrefaction.

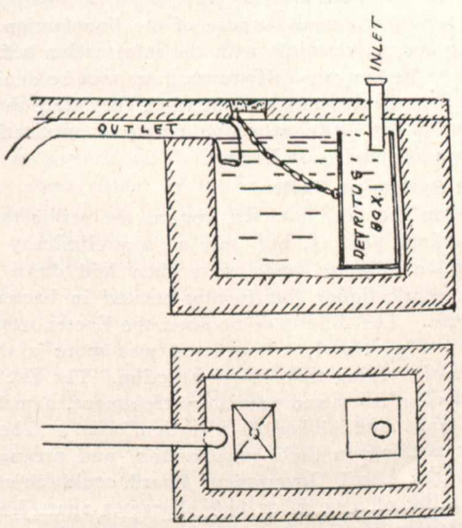
The theory that the putrefaction of organic matter was connected in some way with micro-organisms received some attention in the middle of the 17th century, they were not then called bacteria but microscopic-worms. Fermentation and putrefaction were put down to microscopic living things in 1773 by a chemist, Linné. In 1762 Pleniz ascribed the origin of putrefaction to masses of "microscopic worms." Pasteur in 1863, however, developed scientifically the fermentation theory. Investigations and experiments of the processes of decomposition in albuminoid substances, organic acids and sugars led to building up of the present theory of nitrification being the effect of micro-organisms.

Warrington, in 1882, was one of the first to point out that the oxidation which sewage underwent in soil was due to the agency of living organisms. Bacteria, in fact, are intimately connected with the transformation of inert organic matter into inorganic substances.

The processes of decomposition may be divided into two kinds; first, those going on as the result of the activity of organisms that are capable of taking up oxygen from the air; and, second, those the result of the activity of organisms that so break up and rearrange the organic molecules containing oxygen, that not only do they, the bacteria, take up oxygen themselves, but they allow of its being handed on to the products to which, in their processes of metabolism they give rise. The organisms found in the superficial layers of soil are aerobes; in the deeper layers they are called anaerobes, and give rise to the second form of decomposition. The decomposition which takes place in the septic tank is said to be due to the anaerobes. It was this theory of decomposition which led Mr. Cameron to make his experiments at Exeter, and attempt to find out just what could be done by providing ideal conditions in which these anaerobes might act. This then is the real basis of the so-called septic action.

Septic Tanks Prior to 1895.

We noted above that there were certain exceptions to the general rule that septic action was not desirable before the Exeter experiments.

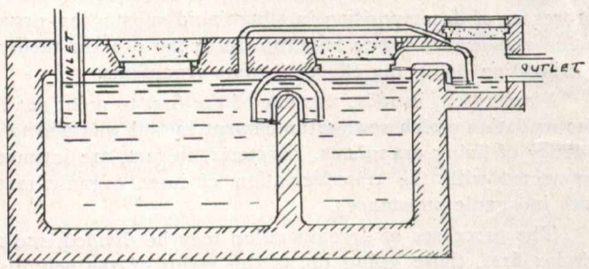


Fosse Mouras. La vidangeve automatique

The above sketch of plan and profile show a cesspool designed in 1860, by M. Mouras, of Vesoul. It will be noted that the inlet and outlet are trapped, and that air is excluded from the tank. All the putrescible solids were claimed to be liquefied in the tank by anaerobic fermentation allowing of only a slightly turbid liquid. These tanks were introduced into Paris by the Abbé Moigno, but the results from them were far from satisfactory. In Bordeaux, the city engineer introduced two compartments.

An examination of the above will show that there is very little difference in construction from the ordinary septic tank now in vogue for isolated dwelings. In the above case an air-pipe is introduced. It was found that the gas collected

over the liquid (under thorough air-tight conditions), and depressed the liquid below the level of the trapped outlet pipe. French hygienists, among them Richard State, that in accordance with their observations the forse mouras are perfectly useless. In Italy and Switzerland they have been rejected after careful investigation. They were introduced into Germany under the name of "biological purification plant for faecal matter," chiefly because they were confused with the artificial biological processes which were elsewhere coming



Fosse Mouras (Bordeaux)

into vogue. Professor Dunbar in his account of the Hamburg experiments states with reference to Germany, "Reports by engineers and sanitarians have not been found wanting in which it has been stated that sewage could be converted in such an apparatus into a non-putrescible liquid. The mistake has only been recognized after trial, and much money has been uselessly spent on this kind of apparatus. All experiments go to prove that sewage cannot be rendered non-putrescible in practice by septic action."

In 1878, Alexander Muller applied for patent rights for a septic process of tank treatment in which sewage was biologically treated. Air and light were to be excluded, but it was not claimed that the effluents were purified.

Again in 1891, Scott-Moncrieff constructed what he called a cultivation tank. The whole arrangement is merely a septic tank filled with stones. The action is qualitatively and quantitatively the same. Scott-Moncrieff claims that he was the first in Great Brintain to bring into practical operation any appliance for the claimed purpose of the liquefaction of sludge by putrefaction; certainly with the information before us this appears to be the case. However, it cannot be denied that the Royal Commissioners are right when they state that; septic tank action had little extensive practical application till Mr. Cameron adopted it at Exeter.

"The Cameron System at Exeter."

Mr. Cameron did not, however, regard the septic tank treatment as a final process, but only as a preliminary to biological filtration. Septic tanks were then laid down at Exeter and the septic liquor was further treated in bacteria contact filter beds. The difference between the Exeter works and similar works previously constructed was more a difference in mode of working than in construction. The Exeter works consisted of primary and secondary treatment, namely, sedimentation tanks and biological filtration beds. There was practically nothing in their construction, and arrangement to which the Local Government Board could object, or in fact, anything of a novel or new character apart from the avowed intention of the city engineer, not to clean out the sludge from the settling tank.

The Exeter tanks were made air-tight, it then being held that the exclusion of light and air was necessary to anaerobic action. Promising reports of Mr. Cameron's experiments, quickly attracted the attention of the whole civilized world. Exeter became quite a show place, and by means of a glass cylinder let into the septic tanks the gas bubbles could be watched as they rose from the putrefying sludge in the base.

It was at once claimed that the sludge difficulty had been solved; that this sludge which was (and still is), the great difficulty at all sewage works, would resolve itself entirely into water and thin air, if only left undisturbed, by the action of anaerobic bacteria, which were constantly being supplied by the incoming sewage. Experiments of hanging solid organic substances, such as the skinned and unskinned bodies of animals, vegetables, bread and cellulose, in the septic tanks, proved that such were reduced rapidly by decomposition. In fact, it was maintained that, if a tank was properly constructed, ideal to the life and work of the anaerobes, the sludge difficulty, apart from the undecomposable mineral matter was at an end.

Is it then to be wondered at, that Exeter received attention not only in England, but all over the world? Deputations and engineers came, visited the tanks, and saw the practical proof of the putrefactive process by the ignition of the gas from the tanks. Mr. Peddie, C.E., of Belfast, was nearly blown to pieces by carelessly striking a match at one of the manhole openings. All were told that the whole of the organic matter was gradually being dissolved, that not only matter in suspension was being precipitated, but that the septic action in the supernatent liquor was attacking matter in solution. The following chief advantages were in fact claimed for septic action:—

"That it solved the sludge difficulty, inasmuch as practically all the organic solid matter was digested in the tank."

"That it destroyed any pathogenic organisms which then might be in the sewage."

"That sewage which has passed through a septic tank was more easily oxidized than sewage from which the solids had been allowed to settle, either with or without the aid of chemicals, in tanks which were frequently cleaned out."

It is no exaggeration to say that the above claimed advantages were generally taken for granted without any scientific and comparative experimental work, and that most sewage engineers never dreamt in their philosophy that after all anaerobic bacteria had very little to do with the small percentage digestion of sludge which has ultimately been found to be the case.

Mr. Cameron introduced some structural differences in his tanks which had not been always found necessary in the previous settlement tanks. For instance, they were larger, holding generally from 12 to 24 hours' flow of sewage to allow septic action to be determined. They were made air-tight, this being a sine qua non. The inlet and outlet arrangements were so arranged that as little disturbance of the sludge and floating scum was caused. Although there was nothing new in these points of construction, they had not, however, been generally in vogue for the set purpose of creating anaerobic action.

The Patents.

The process was patented both in England and abroad in the United States and Canada. The patents include not only the use of the septic tank in combination with any other biological system, such as contact beds, etc. The original patents were granted in England in 1894 and 1895. The first of these patents expires in 1909. A United States patent was granted in 1899 (applied for March 15th, 1897), and necessarily expires at the same time, as the English patents.

The statement has been made, and though we cannot personally vouch for its absolute accuracy, we have not seen it contradicted, that practically no royalties have been collected in England. Professor A. Marston, Ames, Iowa, in a paper before the League of American Municipalities, states as follows:—"In America the existence of this sewage patent and of others of less prominence, granted to other parties, has all along been generally known, but practically all municipal officers, attorneys,. and engineers who have had to look into the matter have sincerely believed that the so-called septic process was not patentable, but was simply a not new application of natural processes which had been used by man from almost the beginning of human life for the destruction of organic wastes. Scores, perhaps hundreds of American municipalities, therefore, proceeded to build sewage tanks of many and varied designs, planned by many different sanitary engineers, without paying royalties, and all such tanks have been called septic tanks, because efficiency depended on bacterial agencies.

The United States Case.

The Septic Tank Company first brought action against the Saratoga Springs, N.Y., for infringment. In the first instance the company lost,. but on appeal the opinion of the lower court was partially reversed. The Court of Appeal declared invalid eight apparatus claims, and upholds five claims known as the process claims. It is legal, therefore, in the United States, to build any kind of a sewage tank. It is not legal, however, to cease to clean out the tank and so employ septic action as such process is defined by the court.

The claims upheld are as follows:—

"1. The process of purifying sewage which consists in subjecting the sewage under exclusion of air, of light, and of agitation to the action of anaerobic bacteria until the whole mass of solid organic matter contained therein becomes liquefied, and then subjecting the liquid to air and light."

"2. The process of liquefying the solid matter contained in sewage, which consists in secluding a pool of sewage having a non-disturbing inflow and outflow, from light, air, and agitation until a mass of micro-organisms has been developed of a character and quantity sufficient to liquefy the solid matter of the flowing sewage, the inflow serving to sustain the micro-organisms, and then subjecting said pool under exclusion of light and air, and under a non-disturbing inflow and outflow to the liquefying action of the so-cultivated micro-organisms until the solid organic matter contained in the flowing sewage is dissolved.

"3. The process of liquefying the solid matter contained in sewage, which consists in secluding a pool of sewage having a non-disturbing inflow and outflow, from light, air, and agitation until a mass of micro-organisms has been developed of a character and quantity sufficient to liquefy the solid matter of the flowing sewage, the inflow serving to sustain the micro-organisms, then subjecting said pool under a non-disturbing inflow and outflow, and under exclusion of light and air to to the liquefying action of the so-cultivated micro-organisms until the solid organic matter contained in the flowing sewage is dissolved and then subjecting the liquid overflow to an aerating operation.

"4. The process of liquefying the solid matter contained in sewage, which consists in secluding a pool of sewage having a non-disturbing inflow and outflow, from light, air, and agitation until a mass of micro-organisms has been developed of a character and quantity sufficient to liquefy the solid matter of the flowing sewage, the inflow serving to s utain the micro-organisms, then subjecting said pool under a non-disturbing inflow and outflow, and under exclusion of light and air to the liquefying action of the so-cultivated micro-organisms until the solid organic matter contained in the flowing sewage is dissolved, then subjecting the liquid outflow to an aerating operation, and then to a filtering operation.

"21. The process of liquefying the solid matter contained in sewage, which consists in secluding a pool of sewage having a non-disturbing inflow and outflow from light, air, and agitation until a thick scum is formed on the surface thereof and a mass of micro-organisms has been developed of a character and quantity sufficient to liquefy the solid matter of the flowing sewage, the inflow serving to sustain the micro-organisms, and then subjecting said pool under the cover of said scum and under a non-disturbing inflow and outflow to tne liquefying action of the so-cultivated micro-organisms until all the solid matter contained in the flowing sewage is dissolved."

The Court ruled out the patents of the Englishmen—Scott-Moncrieff, and Dibden—on the ground, quoting the exact words of the Court, "They fell short of Cameron's process, since they did not provide for having the anaerobes cultivated and worked separately from aerobes, oxygen and agitation."

The American decision would certainly appear to cover almost any kind of a sewage settlement tank which was not immediately cleaned out.

Our next article on the subject will include recent information on the work done in a septic tank.

(To be Continued).

"THE HAMBURG EXPERIMENTS."

Those in Canada, interested in the question of sewage disposal from the legislative point of view, cannot do better than study Prof. Dunbar's concise remarks on the legal measures taken in England and in Germany, in "Principles of Sewage Treatment," reviewed in Engineers Library of this issue. It is interesting to note that the tendency in both countries is towards the establishment of authorities in the shape of rivers boards having power within certain watersheds to restrict the amount and character of river pollution. It is clearly shown where defects exist in the Local Government Board, this being the English Central authority. It is too far removed from the local conditions and does not command local sympathy. It is further cumbersome and bureaucratic in its constitution. It is generally admitted that Canada requires more drastic and effective legal machinery than it possesses at present in dealing with water pollution by sewage and trade wastes.

The formation by special acts of the "Mersey and Irwell Rivers Board," and "West Riding of Yorkshire Rivers Board," England, are quoted, showing the useful work that can be accomplished by the promotion of local authorities. Under the administration of the former board there were in 1893 only 45 mills possessing purification works, and 27 towns with sewage works; in 1906, however, 45 mills were purifying their effluents and 80 towns treating their sewage. Similarly, with the "West Riding Board," in 1893 there were only 155 out of 1,944 mills treating effluents, while of the largest towns only Leeds and Sheffield attempted to treat the whole of their sewage, whilst Bradford dealt with less than one-twelfth. In 1902 out of a total of 1,983 mills, only 422 were discharging untreated effluents. In 1904 all the large towns were treating their sewage at least to the extent of keeping 50 per cent. of putrescible matter out of the rivers.

Such river boards are under the jurisdiction of the "Local Government Board," and their powers are limited.

Unfortunately, Professor Dunbar published his book before the publication of the 5th report of the Royal Commission on Sewage Disposal. It would have been interesting to know, how he viewed the recommendation of the Commission, namely, that "Local Rivers Board" should act as a first tribunal, with a Central Authority as a court of appeal.

In older countries, where the necessity of sewage purification has only been recognized by degrees, laws have been made from time to time, many of which are contradictory. The general result being legal chaos. Germany has profited to some extent by the experience of Great Britain. Canada should profit by the experience of both countries.

Because of the fact that different localities present variable conditions, and that no stereotyped method of sewage disposal can be formulated to suit all conditions, it is necessary that the sewage engineer be well versed in the elementary principles and chemistry underlying the subject. Of course this does not only apply to the sewage engineer. The hundred and one failures and mistakes that are made would be eliminated to a great extent, by a clearer knowledge of both the chemical and biological actions and reactions appertaining to the reduction of sewages of variable concentration and consistency to non-putrescible or sterilized liquids.

Dr. Dunbar is the author of the "Hamburg putrescible test." For years he has worked at the problem of a simple test for putrescence. The organic carbon and the organic nitrogen are invariably regarded as the causes of putrefaction, and the oxygen and hydrogen contained in the organic matters are rightly neglected. The organic sulphur, he considers, is improperly neglected. It is the reduction product of this organic sulphur, sulphuretted hydrogen, which causes putrefying sewage to be a nuisance. The experiments were, therefore, to see if the estimation of the organic sulphur could not be made of practical utility. Sewage is no longer putrescible if its oxygen absorbed is reduced by 60 to 65%, by means of biological processes. Sewage is also no longer putrescible, in which the loss on ignition, the organic nitrogen, or the organic carbon has been reduced by the same amount by biological processes. Hence, since putrefaction

of sewage is always indicated by the formation of sulphuretted hydrogen, the above operation must be due to the fact that biological purification has taken place to an extent to ensure removal of the organic sulphur. The "Hamburg test" depends upon the conversion of the organic sulphur, after first removing the inorganic combined in sulphur, into sulphide, which can be detected by Caros methylene blue reaction. The results of the author's experiments showed that all crude sewages and effluents in which the reduction of the oxygen absorbed was less than 60 per cent., gave the methylene blue reaction, whilst effluents with a greater reduction than 60 per cent., did not give the reaction.

In dealing with the question of disinfection of sewage, Dr. Dunbar states, "I do not regard the total removal of pathogenic germs by means of filtration as practicable. Methods depending upon heat or chemicals can, therefore, alone be considered." The author does not view it as practicable to install sand filtration equal in area to the filter beds for the filtration of drinking water, as he does not consider that equally good results could be obtained in the case with sewage.

The city of Hamburg has given much attention to the problem of the disinfection of sewage. This problem has in Great Britain received no, or very little attention, apart from the proposal to disinfect sewage effluents in the neighborhood of shell fish beds in tidal waters. In Germany and in the United States, as also in Canada, the public are at present compelled to use sewage polluted waters for drinking purposes. The question of the most efficient means of destroying pathogenic germs in sewage effluents is, therefore, one of peculiar interest to such countries.

The efficiency of sand filtration for domestic water supply cannot be always depended upon, therefore in cases where sewage is discharged into streams or lakes it is necessary under certain conditions that the sewage effluent be rendered not only non-putrescible, but also non-infectious.

Dr. Dunbar has made many and careful experiments with most of the well-known disinfectants, and he concludes that chloride of lime forms the most efficient and economical agent. In several of his experiments the disinfected sewage was conducted to a biological filter without previously neutralising the residual free chlorine. One might expect this to cause a diminution in the action of the filter. This was found, however, not to be the case. When carbolic acid, mercuric chloride, and similar disinfectants are employed, the effluent leaves the filter in a putrescible condition. With hypochlorite, the active constituent of chloride of lime, reduction takes place in the uppermost layers of the filter, and the sensitive nitrifying organisms remain undisturbed, and the processes of purification and oxidation continue unlimited. This information is of great value. Engineers, generally speaking, fight shy of adding any chemical agent to sewage may have the effect of reducing the nitrifying power of filters. The proportionate amount of chloride added to the sewage in the experiments were 1:2,000, 1:5,000, 1:10,000, 1:20,000.

It is, however, to the interesting and exact experiments which have been made in the various processes of sewage filtration, that the engineer will find information of great practical value. The whole problem of the various chemical and biological actions has been laid bare in an exact and scientific manner. Those who have been accustomed to think that the changes which sewage undergo in a biological filter are only due to living organisms will be greatly surprised to find how many more important factors apart from the mere process of nitrification, have to be taken into careful consideration in order to obtain the greatest efficiency from a filter. Dr. Dunbar's theory of absorption makes plain many of the apparently difficult problems connected with degeneration. We will deal with these points on a future occasion.

The Rockwell Engineering Company, New York, has been absorbed by the Rockwell Furnace Company, of 26 Cortlandt Street, New York.

SPECIFICATIONS FOR ENGINEERING WORKS.*

By H. Laurence Butler, M.J. Inst. E., M.R.S.I.

The preparation of a specification, as a preliminary to entering upon a contract for engineering works, is unquestionably one of the most important of an engineer's duties, requiring very complete experience and thorough technical knowledge for its satisfactory accomplishment; yet some specification writers display a fine disregard of the true function of such a document, and show a childlike faith in the ability and generosity of the contractor, which, although very flattering to him, does not say much for the business instinct of its professors.

In this paper some of the points that are essential to the production of a specification which shall properly fulfil its purpose are touched upon, and this purpose is to amplify the contract drawings by giving detailed descriptions of the materials to be used, the methods of preparing and using them, and other information which cannot be conveniently written on the drawings themselves. The two main divisions of an ordinary specification are the conditions of contract and the specification, properly so-called. The form of tender is not infrequently attached.

The conditions of contract, as their name implies, form the legal part of the document, as distinct from the technical description of work to be done, but it cannot be too clearly borne in mind that the whole of a specification, when duly signed by the parties to the contract, is a legal document which must be produced in court if a dispute should unfortunately arise with reference to the works; and it is, therefore, of the utmost importance that it should be lucidly written in simple language, the clauses being arranged in logical sequence, and the descriptions exact and complete without being needlessly verbose. Every item of work should be allotted a separate clause, for when a single clause includes descriptions of several different matters confusion must ensue.

A complete alphabetical index, with the clause and page numbers attached, will be found to be (especially in the case of a lengthy specification) a great help in quickly finding any required subject, and cross references may sometimes be introduced with advantage.

Brevity, so far as it is consistent with completeness, being the hall-mark of a good specification, no information should be introduced which may be clearly obtained from the drawings, the intention being that the drawings and specification are to be taken together, and a clause to this effect is sometimes inserted. On the other hand, it is waste of labor, besides being confusing, to put descriptive matter on the drawings which would be better included in the specification; and a mistake which is frequently made is to duplicate information in this way, obscuring the drawings with unnecessary writing, and overloading the specification with identical information.

A very common fault in specifications is indefiniteness of description, and this generally arises from the writer not having a clear notion of the work or materials which he attempts to describe, though in some cases it is due to the obscurity of the language, or to the misuse of certain words, especially "proper" and "sufficient." The engineer should know what is proper and sufficient, and should describe it in precise terms, otherwise he is only opening the way for trouble when it becomes necessary to find the meaning of these words in terms of actual materials and workmanship. The word "etcetera" should be rigidly excluded, and the matters covered by it clearly defined.

It should be hardly necessary to say that the drawings must be completed and inked in before the specification is written, or at all events before it is finally completed, as any other procedure will almost inevitably lead to more or less important omissions, with the result that "extras" will be writ large in the contractor's little bill. It is an advantage, when time permits, to have the detail drawings (if any) com-

*Paper read before the Civil and Mechanical Engineers' Society.

pleted at this stage, as it is not unusual for important modifications to be found necessary when the details are got out on a larger scale. The drawings should, of course, be numbered, dated, initialled by the draughtsman, and signed by the engineer; and it may sometimes be useful to have reference letters or numbers on certain portions of the drawings, which may be alluded to in the specification.

An inexperienced writer of specifications is very apt to be uneven in his description of the work, writing with unnecessary verbiage on those matters with which he is familiar, and dismissing some equally important point with a brief direction that "the work shall be done to the satisfaction of the engineer." A general direction of this kind usually implies that the engineer does not know what he wants, and therefore leaves the matter to the superior knowledge of the contractor—an attitude not very creditable to the former.

The only really legitimate use of this phrase is in a general clause referring to the whole of the works. An example of uneven description within the knowledge of the author exists in the specification for certain works of sewerage, in which the tests for Portland cement occupy a half-page of closely printed foolscap. None of the tests was applied, and apparently they were not intended to be applied, but the whole description was taken en bloc from another specification, presumably with a view to overawing the contractor. In the same specification the description of some pumping machinery at the disposal works appears to have been copied direct from the estimate of a firm of mechanical engineers, only the prices having been left out, and the curious commercial brevity of the phraseology, comprising such phrases as "including all necessary fittings complete," stands out in striking relief from the rest of the document.

It is evident, then, that one of the most essential qualifications for a specification writer is a thorough knowledge of his subject, and he should have also a sufficient command of the English language to enable him to express his meaning clearly and tersely. It is quite unnecessary to indulge in legal jargon and high-sounding phrases which the writer possibly does not understand, and it is by no means a fault to repeat words again and again if they express the meaning of the writer more clearly and forcibly than an alternative phrase would do. A specification is seldom judged by literary standards of excellence.

It is also necessary that the specification writer should have a thorough knowledge of trade customs, such as discounts (in order to define "prime cost"), the methods of measuring timber and scantlings, the different modes of dressing masonry work, whether the word "best" applied to certain materials will really mean best, or if by trade custom it may be taken to mean an inferior quality. Moreover, in the case of structural work, he should make himself acquainted with the regulations in force in the district in which the building is to be erected, and should make it clear in the specification if the contractor is to take the responsibility of complying with the local authority's requirements or otherwise.

Another error which may occur through inexperience is that of specifying impracticable sizes of materials, such as timber and metals, and this may also occur when clauses are copied from obsolete or badly written specifications. The method of compiling a specification on the "scissors and paste" principle, by taking clauses from old specifications, is one that will lead an inexperienced writer into error more quickly than any other, because if he has any doubts as to the reliability of the description, it will be more or less discounted in his mind by the fact that that particular clause has been used before, regardless of when or under what circumstances it was used.

The degree of detail which a specification should contain is governed very largely by the magnitude and importance of the work, as it is obvious that the detail in the specification for a £50,000 contract would be merely a display of misdirected energy if applied to the specification of works costing, say, £500.

A practice which should be studiously avoided wherever possible is the specifying of alternative workmanship and materials. It is far better to be exact in defining what is to be done or supplied, because it then affords no ground for dispute or difference of opinion. However, with regard to the actual methods of carrying out the work, the contractor should not be tied to any particular means of effecting the required end, unless special circumstances require it, for, provided the materials and workmanship are satisfactory, it is better to allow the contractor to use his own discretion as to the manner of producing the required result.

The arrangement of a specification is generally as follows:—

(1) Conditions of contract and general regulations applying to the whole of the works.

(2) General description of materials and workmanship, excluding purely local or particular directions.

(3) Detailed description of the various portions of the work, systematically arranged.

The conditions of contract usually begin with a definition clause, which, in order to obviate needless repetition, defines such words as "employer," "engineer," "contractor," "prime cost," and similar matters. Other clauses enumerate the conditions to be observed in carrying out the works, and make the contractor responsible for giving notices required by the local authority, require him to sign the drawings and specifications within a given time from the acceptance of his tender, to provide sureties for the satisfactory completion of the work, and to commence the work within a stated period after receiving notice from the engineer to do so.

A very useful clause is that empowering the engineer to vary or alter any part of the works without vitiating the contract, and a clause requiring the contractor to render weekly accounts in writing of all omissions, extras, and variations greatly assists the engineer in deciding what payments may be made from time to time on account of work done, as well as in the final adjustment of accounts.

Other clauses may refer to the method of ascertaining prices for extra works, the power of the engineer to take samples for testing purposes, the opening up of work for inspection, the prohibition of assignment or sub-letting of the contract, responsibility for accidents, time for completion, period of maintenance, suspension of works through various causes, mode of payment, engineer's certificate of completion, and other matters of this nature, the conditions usually concluding with a clause providing that all disputes may be referred to an arbitrator for settlement.

It is not unusual, however, to have, in place of the arbitration clause, a condition that the engineer shall have the exclusive right to authoritatively determine the meaning of the contract. Such a provision is, perhaps, rather unsatisfactory from the standpoint of the contractor, who may be inclined to consider the engineer unsuitable to act in this capacity, by reason of the fact that the latter has generally formed an opinion on any dispute which may arise before the matter is referred to him for settlement; but unless it could be demonstrated that the engineer's opinion was not open to argument or reconsideration, or that he had deliberately shown prejudice or partiality, the courts could scarcely be persuaded to declare that he was unfit to be arbitrator, The chief advantage of the clause, from the engineer's point of view, is that it supplies a summary means of remedying the faults and supplying the omissions in a badly-drafted specification. It would appear that the arrangement most satisfactory to all parties is for the engineer to have the final decision as regards workmanship and materials, and to provide for appeal to an external arbitrator on all matters relating to payment, such as the amount of extra works, loss to the contractor through delay or alteration of the works, and similar questions. A further modification of this provides that no appeal to an outside arbitrator shall be made during the progress of the works, but that disputes on any matter arising out of the contract shall be temporarily decided by the engineer, and his decision shall be binding on all parties

until the completion of the works, after which the matter (unless explicitly reserved for the final and binding decision of engineer, without appeal) may be brought before a referee. This arrangement is designed to prevent any disputed matters from causing delay in the execution of the works.

In alluding to the drawings, it is a good plan to add a paragraph to the effect that figured sizes are to be followed in preference to the scale dimensions, except in cases of obvious clerical error. The clauses enumerated above do not by any means exhaust the list of provisions that it may be necessary to make in the case of a large contract, and in very small works some of the clauses may be reasonably omitted, but they are mentioned as being generally applicable to contracts of moderate size.

The specification proper usually begins with a description of the site of the works, specifying any unusual features which may exist; and if the site is very inaccessible, involving a great deal of haulage work, it is an excellent thing to provide a key plan, showing the distance from the nearest station, and marking on it any unusually steep hills, bad roads, or other circumstances likely to affect the cost, although some engineers prefer to let the contractor find out all these things for himself, and insert a clause in the conditions to the effect that "the engineer cannot be held responsible for any incorrect information supplied."

The next clause generally enumerates the drawings, giving the number and title of each one, with the words, "and such further detail drawings as may be supplied by the engineer to the contractor from time to time." Then follows the description of materials and workmanship applying to the whole of the works, and including such matters as cement, sand, mortar, concrete, bricks, brickwork and the like, leaving the particular description of the individual parts of the work to be dealt with later.

The general description may conveniently conclude with a clause requiring the contractor, before commencing the work, to deposit with the engineer a sample of each kind of material intended to be used, all materials employed in the execution of the works to be equal in quality to the samples so deposited.

The remainder of the specification consists of detailed descriptions of the different parts of the work, subdivided under general headings. For instance, in the case of a new road and sewer, the first part would be headed "sewers and manholes," and the first clause would deal with "excavation," followed successively by "timbering," "filling in," "concrete pipe laying," "brickwork," "manhole covers," and so on. The next general heading would be "roads," and the headings of the clauses would follow some such order as "excavation," "foundations," "hard core," "kerbing and channelling," 'metalling," "grouting and rolling," "footpaths," etc.

A systematic arrangement of this nature tends to exclude the probability of any serious omission, and assists any subsequent reference to the specification. Printing a brief note of the contents of each clause on the margin of the page is a convenience when it is desired to refer to any particular item, but it should be made clear that these marginal notes are merely auxiliaries, and do not form part of the specification any more than the index does.

Another arrangement is to divide the work up under the headings of various trades, such as "excavator," "bricklayer," and so forth, the general description of materials preceding the detailed enumeration of particular items under the heading of the appropriate trade. This method, however, is usually applied only to specifications for building works.

Some engineers and architects advocate the free use of marginal sketches to further elucidate the intention of the written description, but where the specification is printed this method is inapplicable, owing to the extra expense involved in printing, and in any case it is doubtful whether such details would not be better demonstrated on the drawings. A competent specification writer should be able to describe his meaning with sufficient clearness to enable him to dispense with such a superabundance of illustrations. In the case of any very complicated piece of work, a detail drawing to scale is obviously of more utility than a mere sketch, and in simpler cases a written description should be all that is required.

Trade catalogues form one of the most useful items in the specification writer's stock-in-trade, and here, again, the advantage of system will be apparent. A complete set of trade catalogues filed on the decimal system, and accompanied by a card index in two divisions, one of subjects and the other of names of firms, will enable the engineer to turn up at the shortest notice the information with regard to any manufactured article that he may require, and to make a comparison between the manufactures of different firms, with a view to finding the particular article best suited to his purpose.

In this connection it may be said that the practice of specifying that certain articles shall be supplied by a particular firm is one that should not be carried to excess. It is not an unheard of thing for a manufacturer, who has been specified to supply certain goods, to raise his prices for the occasion, but if estimates are obtained from firms of equal standing and reputation, it is generally possible to obtain a lower price than if the other course were adopted. The selection of one firm to the exclusion of all others may also suggest unfairness on the part of the engineer, and may create the idea that his selection is not without profit to himself, although it is to the credit of the profession and the manufacturers that cases of bribery are so extremely rare as to be practically non-existent. It may here be remarked that a good commercial knowledge (including the ability to price out roughly the present market value of any ordinary materials and labor) is a distinct advantage to a specification writer, enabling him when selecting goods to thread his way through the maze of trade discounts, discounts for cash, and special discounts for large quantities with which some merchants conceal the actual cash price of their manufactures, especially as in some cases it is not unlikely that he may be called upon for advice upon particular items when the settlement of accounts takes place.

A matter which too seldom receives thorough consideration is the question of what part (if any) of the materials for the works can be obtained locally. The practice of specifying goods which must necessarily be conveyed long distances before they can be utilized, while equally satisfactory materials can be procured near the site of the works, argues negligence on the part of those responsible for drafting the specification, and is usually due to culpable ignorance of local conditions. As illustrating this point, a case may be mentioned where a contract was secured at abnormally low prices, the contractor making a good profit by utilizing the sand and gravel obtained from the excavations, which other less wideawake contractors had counted upon having to bring several miles by road In this instance it was even hinted that the contractor went to the extent of carting away alleged "surplus material" from the site, which he afterwards turned to his own use and profit.

Although the preparation of bills of quantities does not form part of the work of writing a specification, it may not be out of place to mention that attempts have been made in the past to combine the two documents in one, but as each has an independent function, any attempted combination must be unsatisfactory. The bills of quantities are merely schedules of labor and materials, arranged so that prices may be conveniently attached, and the endeavor to make them serve another purpose is inevitably foredoomed to failure. Moreover, if the quantities are made a part of or annexed to the contract, and any dispute should arise, the court may hold that the contract on the builder's part was not to complete the works, but only to execute the quantities.

It is not possible, within the limits of this paper, to touch upon all the points which may arise in connection with preparing a specification, yet enough has been said to demonstrate that specification writing is worthy to rank high among other more showy, but scarcely more interesting, professional work; indeed, it requires for its satisfactory accomplishment a high degree of technical knowledge, besides something more than a smattering of legal information and

(what engineers too often lack) a sound commercial training. If, in addition to these qualifications, the specification writer possesses plenty of sound commonsense, allied to practical experience in his work, he will be well fitted to assist in dispelling the much too popular fallacy that the preparation of specifications for engineering works is a necessary but uninteresting piece of drudgery, carrying with it no reward but that which will always accompany work well done.*

CANADIAN CEMENT AND CONCRETE ASSOCIATION.

(Continued from last week.)

President Gillespie: The next item is a paper by Mr. William M. Kinney, on "Why Sidewalks Fail." Mr. Kinney is connected with the Universal Portland Cement Company, with whose plant many of you are doubtless familiar, in the capacity of assistant inspecting engineer. He and his superior officer, Mr. Boynton, have given a great deal of attention to the construction of sidewalks, and the latter has published a very tidy little volume on the subject which no doubt many of you have in your possession.

Mr. Kinney said he had arranged for a number of slides with which to illustrate his paper, and the operator was now on the way to the hall.

Dean Galbraith: While the lantern is being got ready I should like to touch on a part of your address Mr. President. You spoke of the discussion by the Canadian Society of Civil Engineers with reference to the report of one of their committees as to the establishment of an Investigation Laboratory by the Government. I feel that that is a most important matter. That committee recommended that the Government should be approached with reference to establishing a testing laboratory along the lines of the St. Louis laboratory for examining and investigating "all materials of engineering interest." It was not intended that that should be simply a testing plant for the purpose of determining whether materials came up to certain clauses of specifications, such as elasticity, strength, etc. The Government have established a laboratory already for that sort of work at Ottawa. The intention was to make investigations, and not simply to make tests to see whether specifications have been complied with. In consequence of the St. Louis Exposition the United States Government started their testing laboratory under the United States Geological Survey. While it may be quite true that between cement and cement there may not be such great differences as to require separate investigations in Canada for the purpose of determining the general features; while it may be quite true that we can learn a great deal from the reports of the St. Louis testing plant, yet I don't think it is quite the proper position for Canada to occupy—to get all her knowledge and to depend for everything of that kind upon her neighbors. I think that possibly we shall find with respect to our own testing plant that we may have a line of investigation that they will not have in the United States. We lie altogether to the north of the States, and even the question of weather will force us into lines of investigation that they might not think of. There are many other things in which we may differ. Our conditions are not necessarily the same as those of the United States, and, I think, it is highly important that something of this kind should be done. Although I am not authorized to speak for the Canadian Society of Civil Engineers I feel that their Council would welcome any help that they can get from such an Association as this in the way of pushing such a laboratory as is suggested. We are all interested in that sort of thing, and it can be carried on only at the Government's expense. The investigations are of such a nature that no private cement factory would ever think of going into them in the way in which they ought to be entered upon. I suggest that as an important thing to think about as far as the country is concerned. (Applause.)

President Gillespie: I have now much pleasure in calling on Mr. Kinney.

Mr. Wm. M. Kinney, assistant inspecting engineer Universal Portland Cement Company, read his paper on "Why Sidewalks Fail," but through some oversight the paper was not turned into the Association.

Delegate: How often should you apply the tap to the base?

Mr. Kinney: In hot weather not more than 15 or 20 minutes.

Mr. Murphy: In what proportion should the sub-base and top be mixed?

Mr. Kinney: That is difficult. We all know that sand and gravel differ. A man in Toronto cannot say that a man in Buffalo should use 1:2½:5 mixture. He has got to know sand and gravel and determine the voids in it, and make the mixture so that the concrete will give the best results. It would not be a bad idea for the city engineer to determine about how the sand and gravel runs in a particular sand bank or river bed, and instruct the contractors in the proper proportions to use for that particular sand and gravel. Some sands and gravels differ even in the same bank. You must use your judgment.

In case of doubt 1:2½:5 mixture will probably give satisfactory results, although it may not give the greatest strength.

Mr. Cromar: What about sidewalks that have water under them?

Mr. Kinney: At the National Association in Cleveland a large number were in favor of no foundation at all. However, we have studied the specifications of some 35 or 40 cities of the United States, and they all specify a sub-base or foundation course of cinders or gravel or something of that kind varying from 4 inches to 12 inches, so we don't believe we are very far from the accepted standards when we say about 8 inches. The climatic and local conditions will vary this limit.

Dean Galbraith: From the point of view of a sidewalk user, as against the sidewalk maker, I should like to ask one question. I notice that our granolithic sidewalks in Toronto have the unfortunate property of being extremely slippy about this time of year. That is to say, when the sidewalks have been practically cleared of ice, and a little water forms on them, and ice forms on that. As distinguished from the old wooden sidewalks they are very dangerous. A person's foot would catch in the wooden sidewalk and there was no danger of slipping, but in the granolithic sidewalks, even though several square inches may be free of ice, yet that part is just as slippy as though it had soap on. What endeavors have been made to remove that extremely unpleasant property? I do not know whether the condition is general to other places than Toronto.

Mr. Kinney: Smooth finish on cement sidewalk is something that is due to the man who lays the sidewalk, more than to anything else. A sidewalk can be overtrowelled, that is, too much cement can be brought to the surface. Wherever possible we should eliminate all trowelling, but a great many people think that a smooth sidewalk looks nicer, and they insist on it. A sidewalk with a cement coat is much more satisfactory, and there is less danger of it cracking and of people slipping. Trowel as little as possible, so that the very fine cement is not brought to the surface, else you bring a great quantity of the impalpable powder in the cement to the surface, and it does not seem to have the binding qualities at the surface that it would have in the mixture, and it gradually wears off.

J. W. Klink: Suppose you don't put a great deal of cement in the aggregate, and sprinkle a little on the top and trowel it down.

Mr. Kahn: Do you consider it good practice to finish a walk or floor by sprinkling it dry?

*Some useful works of reference on this subject are:—"Specifications in Detail," by F. W. Macey (Spon), 21s.; "Building Specifications," by John Leaning (Batsford), 18s.; "Conditions of Contract issued by the Royal Institute of British Architects" (published in Laxton's and other Price Books), 1s.; "Specifications," published annually, (Technical Journals, Limited), 2s. 6d.; "Municipal Engineer's Specification" (Technical Journals, Limited), 2s. 6d.

Mr. Kinney: I am opposed to that method. I do not believe it is necessary. I believe a man can prepare his walk in such a way that he does not have to put on a dryer to hustle it along. Very often a man has to stay till 8 o'clock at night to finish a walk. Of course that is rather a mean proposition; at the same time the resulting walk would in the end be much better, and it would probably pay him to stay and finish that walk in a proper manner. His reputation would be lost by having a slippery walk or a poor grade of walk. There are many sidewalk contractors who use a dryer in such a way that they get very satisfactory results, but, I believe, the practice in general is to be looked down upon.

Harry Winstanley (Morrisburg, Ont.): I cannot conceive why there should be any more than 4-inch foundation concrete. Why is not 4-inch as good as 12-inch? I have laid them on 2-inch and they have been eminently satisfactory.

Mr. Klink: The thickness of the foundation would depend very much on whether the bottom was sandy or clayey. Frosts are very hard on clay, and something must go; it will contract and expand.

The President: I would like to ask Mr. Kinney what his experience has been in laying sidewalks without an excavated foundation—laying them on the surface of the ground. I understand that has been done in some cases; also whether he thinks that some soils are much better adapted to that than others; also what he thinks of drafting a standard specification for all localities; whether the variations in condition and locality, etc., are so different that a standard specification is of very little use?

Mr. Kinney: We can hardly draft a standard specification that would suit all localities. That is an impossibility; but we can draft a specification which can be used in part, and used to advantage by all localities. Then the municipal engineer can insert in those specifications such clauses as will limit them to use in his particular locality. A gentleman spoke of using a 4-inch sub-base as a foundation. I do not doubt at all that there are many towns where 4-inch would be satisfactory; but when we are drafting a specification for use in general we should set our limit a little high and have the engineer cut it down, rather than put it too low and depend on the engineer to bring it up. That is a problem, not in sidewalk construction, but in philosophy and that sort of thing that men get mixed up in. I have seen sidewalks laid on the surface without excavation that have stood up without failure; but I have also seen a great many that have been laid on the ground that have failed. That depends on the climatic conditions. A sidewalk laid in one of the Southern countries on the ground, where it was perfectly dry and without danger of frost, would be entirely satisfactory if the ground was solid.

Mr. Bowden: The gentleman does not approve of the dry duster in connection with finishing. I had some experience in finishing last year, especially with day labor on corporation work, and I found it a little hard to get an inspector and a troweller to put on facing sufficiently dry to suit my views, and some bad effects arose. How does the gentleman approve of putting on facing—rather wet, or on the dry side?

Mr. Kinney: The great thing in laying the wearing course is to have sufficient water so that you can float it. I mean, by the floating, stock that is run on the top side of the forms and floats the stuff into place. The great object is to have it just fluid enough so that the stock will work easily, and at the same time have it dry enough so that the water won't come to the top. (A voice: "That's the point.") Because the water in coming to the top brings the very fine cement to the surface—which, of course, is to be avoided. In order to prevent that water from coming to the top you have got to hold back your trowelling until such time as it dries out; that is, provided you do get too much water into the mixture. That is something that has got to be worked out by each individual. You cannot sit down and say a man shall use 10 per cent. of water in his mixture, or 15 per cent. He has got to work it out.

Mr. Bowden: If a facing is put on wet you can delay the trowelling until it comes to a proper stiffness.

Mr. Kinney: Yes.

Mr. Murphy: What is the best protection against frost—manure or sawdust? Has manure any injurious results?

Mr. Kinney: Of course there are weak acids in manure, but I do not think they would affect concrete to any extent with the possible exception that it might stain the concrete. Manure is a good thing to keep a sidewalk warm; no question about that. Very often salt is used in the concrete mixture to lower the freezing point. The question of using salt has been open to criticism, but I have found no real good reasons why a small quantity of salt should not be used, say 2 or 3 per cent. Of course that will only lower your freezing point a few degrees, but as a general thing you do not want to lower it too much.

Mr. Kahn: I believe of late that calcium carbide has been quite commonly adopted instead of salt as being quite as effective and not so liable to effervesce as salt is.

Mr. Kinney: The trouble with the use of calcium carbide is the fact that it takes up moisture from the air very rapidly, and is rather hard stuff to keep. As you know, calcium carbide is used as a dryer. For instance, if you want to dry air, pass it over calcium carbide and it will take up nearly all the moistture there is in that air. You cannot keep calcium carbide on hand unless you keep it in air tight cans. It does not matter to the concrete whether it has moisture in it, but it is rather poor stuff to handle when it begins to take up a lot of water from the air.

The President: Do you recommend the use of slag concrete and cinder concrete in the construction of sidewalk? I thought that because of the connection between the Universal Portland Cement Company and the Carnegie Steel Company they might have investigated that, and have had some interesting data for us.

Mr. Kinney: I am sorry I have not the data I had. Mr. Brown, the chief engineer of the Carnegie Steel Company, has been making some tests as to using slag in concrete, and he promised to give me the result of his tests up to three months. At that time he told me the results were very satisfactory. They were having very remarkable strength results from the slag aggregate concrete. I believe the Robert W. Hunt Company has also made some tests in which they find the slag aggregate concrete shows strength results better than limestone of similar character as composing the same cement. I do not want to say I would advocate slag concrete. I do not believe our tests have been carried on to a sufficient extent that we could say it positively, but we hope for the best, and we are looking for good results at six months and one year. The six months' tests will be out next month if I am not mistaken. Then we will have a one-year, two-year and three-year and five-year tests. By that time, I think, we will know something about it. Of course there are different kinds of slags. There are some slags that do not give satisfactory results. It depends entirely on the way they are made. For instance, a slag that is granulated at 15 pounds pressure does not seem to give very good strength results, because it is too soft to mesh. We granulate our slag for cement manufacture under 15 pounds pressure, because it gives a slag that is easily ground. Now, if we granulate slag at 90 pounds pressure it gives us a much more gritty and harder material. That seems to be a very satisfactory sand. Then a coarser aggregate is made in various ways. One is the pancake slag method. Another is crushing the bank slag that flows over into the bank where they run it down into a flat surface in some way and make a large pancake and then break it up. Then there is the machine slag that is run out into a bucket conveyor, and these brick-shaped sections from the bucket are broken up into water. We are trying to find out which ones give the best satisfaction, and what comparison there is between slag and limestone as an aggregate. Our tests will be very complete. We are looking forward to doing quite a business in that line if everything proves out satisfactory. As you know slag has been used to quite an extent around Pittsburg for that par-

ENGINEER'S LIBRARY

BOOK REVIEWS.

Books reviewed in these columns may be secured from the Book Department, Canadian Engineer, 62 Church Street, Toronto.

Alternating Currents Simply Explained.—An Elementary Handbook on Alternating Current Generators, Transformers, and Motors. By Alfred W. Marshall. Published by Spon & Chamberlin, 123 Liberty Street, New York. 82 pages; size 5x7; 32 illustrations; paper 25 cents.

This book is written for those who desire elementary information about alternating electric currents. The reader is assumed to understand continuous currents and to know nothing at all about other branches of electrical work.

The whole book is simply written yet interestingly told.

Contents of chapters:—1. What an Alternating Current is. 2. How Alternating Currents are Produced. 3. How Alternating Currents are Measured. 4. Transformers and Choking Coils. 5. Alternating Current Motors. 6. Rotary Converters. 7. Rectifiers.

Circuits and Diagrams.—Part 2.—By Norman H. Schneider. Published by Spon & Chamberlain, 123 Liberty Street, New York. Pages 80; size 5x7; fully illustrated; paper; price 25 cents.

A handbook showing over 70 wiring schemes, 67 of which are claimed to be original. The following wirings, among others, are given:—Alternating Current Generators and Motors: Single Phase and Polyphase Transformers: Alternating Current and Direct Current Motor Starters and Reversers: Arc Generators and Circuits: Switch-Wiring: Storage Battery: Meter Connections: etc., etc.

"Principals of Sewage Treatment." By Professor Dr. Dunbar (director of the Hamburg State Hygiene Institute), translated by H. T. Calvert, M. Sc., P.H.D., F.I.C. Published by Chas. Griffin & Co., Exeter Street, Strand. (Price $3 net.)

We know of no other work which so particularly deals with the underlying principles of sewage treatment, and here quote from the translators preface: "The excellent and t horough manner in which Professor Dunbar has dealt with the subject, and the absence of an exactly similar work in English, have formed additional inducements for undertaking the translation."

The value of the work to engineers and medical officers consists to a great extent in the method by which it deals with first principles.

Many works on sewage disposal are simply descriptive catalogues of appliances with general data thrown in, and are more useful as reference, than channels of real education.

The author is world famous in the sewage disposal problem. For years he has carried out numerous experiments in methods of removal of suspended matter and purification treatment. Such are referred to more particularly in the "Sanitary Review" columns. The headings of the various chapters are as follows:—Historical development of the sewage problem. Legal measures taken by central and local authorities. Rise and development of methods of sewage treatment. Earlier views of methods of sewage treatment. The characteristics of sewage. Objects for purification works. Description of methods for removal of suspended matters. Methods for the removal of putrescibility. Disinfection of sewage. Supervision and inspection of sewage disposal works. The utility and cost of the various methods of sewage treatment. The above represents a most comprehensive volume of up-to-date information on the subject.

Reservoirs for Irrigation, Water-Power and Domestic Water-Supply. By James Dix Schuyler. Published by John Wiley & Sons, New York. Pages 556. Price $6.

The second edition of this standard work comes to hand with the text of the previous edition practically rewritten and greatly amplified, two entirely new chapters being added, one on reinforced concrete, and the other on steel dams. This edition is further enriched by the introduction of 234 new cuts and photographs which are specially interesting and valuable in view of the fact that only a man of the author's wide influence and experience could have collected them, or have had access to the information contained in the descriptive text.

The contents of the volume, which contains 556 pages of reading matter and illustrations is divided into eight chapters with an appendix, one chapter being devoted to each of the different types of dam construction; namely, rock-fill, hydraulic-fill, masonry, earthen, steel and reinforced concrete. The seventh chapter deals with the formation and utilization of natural reservoirs, and the eighth chapter is added for the purpose of incorporating in the volume a number of illustrations and descriptions which were received too late to be classified under their respective heads.

The appendix contains tabulated data with reference to reservoir capacities and areas and also a long list of American and foreign reservoirs giving information as to type of construction, capacity, total cost, and cost per acre foot of storage. These tables are valuable for comparative reference in making preliminary estimates for dam construction. Another notable feature in this connection is the introduction of three large coloured plates containing profiles of ninety-four of the principal masonry dams of the world drawn to uniform scale to facilitate comparison, and also three plates containing plans and sections of fifteen of the more important foreign and American earthen dams.

Chapter II. on hydraulic-fill dams is undoubtedly a most important and valuable addition to engineering literature and to such as are interested the data given with reference to the recently built Mexican and Brazilian dams and the Croton and Snake Ravine dams, is in itself worth the price of the whole volume. The two chapters on steel and reinforced concrete dams also contain valuable information and cost data in connection with these comparatively new types of construction.

Mr. Schuyler's work has much wider sphere of application than that of a student's text-book and would be a very useful addition to the library of either the engineer, the capitalist or the promoter or indeed anyone who reads for information.

Not the least important section of the book is the introduction, which contains a strong plea for the governmental control of storage basins and sources of supply. It would seem, therefore, that Mr. Schuyler had some part in establishing the trend of public sentiment with reference to the public control of storage and water-power which has recently assumed such significant proportions both in this country and in the United States. H. G. A.

Asphalts, Their Sources and Utilizations. Asphalt for dustless roads, recent improvements in asphalt industries, together with addenda treating on general waterproof construction. By T. Hugh Boorman, civic engineer and asphalt expert. New York: William T. Comstock. One 8vo. vol. Cloth. Price, $3.

This work has been brought out as a manual and general reference on asphalt, its characters and uses.

The author first treats of it in reference to pavements for city streets, but also treats at length its application to country roads to secure a good permanent road bed free from both dust and mud.

This use of asphalt and asphalt oils has grown largely, of late, promoted, no doubt, by the general use of the automobile.

The various specifications for the use of asphalt will be found of great value to the municipal engineer and roadmaster.

The author has not, however, contented himself with treating of these two main uses of the material, but refers to its use in waterproofing, roofing, the manufactures and industries.

One of the earliest waterproofing materials known to man, it still continues to be one of the best.

The book will be found a complete and careful guide in the use of asphalt and of great value to the architect, engineer, manufacturer and municipal owner.

Smoley's Tables: Parallel Tables of Logarithms and Squares, Angular and Logarithmic Functions Corresponding to Given Bevels, together with a Complete Set of Five Decimal Logarithmic Trigonometric Tables, by Constantine Smoley, C.E. Fifth Edition Revised: The Engineering News Publishing Company, New York. Flexible leather, 4½x7 in.; pp. 460; $3.50 net.

This new edition of the well-known tables contains all the matter of the 3rd and 4th editions, together with a new series of tables, now published for the first time. The contents include: Parallel tables of the logarithms and squares of feet, inches and fractions of inches varying by one thirty-second from zero to fifty feet and by one-sixteenth from fifty feet to one hundred feet; table of angles and logarithmic functions corresponding to bevels given to a base of twelve inches and varying by one thirty-second of an inch; multiplication table for rivet spacing for 1 to 30 spaces of from one and one-eighth to six inches advancing by eighths; inches and fractions of inches expressed as decimals of a foot; constants in frequent use in calculations; all in Part I., and logarithms of numbers from one to ten thousand; logarithmic functions for each minute of the quadrant with table of proportionate parts for seconds; natural trigonometric functions varying by ten minutes; and a repetition of the decimal equivalents and constants; all in Part II.

It is understood that parts 1 and 2 are designed to be published separately, but the present volume contains them bound together. Following each of the important tables is a series of examples that illustrate clearly the methods of using them for those who may require such suggestions. The tables cover very thoroughly all that is necessary for calculations in most classes of technical work, and are in a form that is easy to refer to and convenient in use. The accuracy of the tables has been well checked both by the care of the author and the seven years use of the original tables. The book is well bound and lies flat open when in use.

For all classes of engineers who have to deal with dimensions and perhaps for the structural engineer and draftsman particularly this book of tables fills the requirement of a complete and accurate source of data for calculation.

J. M.O.

PUBLICATIONS RECEIVED.

Refractories.—A Selection of Refractories and their Uses in Furnaces employed in the manufacture of iron and steel; size 9 x 12, 8 pp., Harbison-Walker Refractories Co., Pittsburg, Pa.

"The First Engineers" is the title of a beautiful picture of Canadian beavers at work, specially designed for Allis-Chalmers-Bullock, Limited, and reproduced on their calendar, from the original painting by Arthur H. Hider, a well-known Canadian artist. The calendar gives dates for every month from March 1909 to February 1910, inclusive, and its large figures make it a useful addition to our office.

Annual Report.—Twenty-eight annual report of the State Department of Health of New York, 1907, in two volumes; 1,800 pp., size 6 x 9, State Department of Health, Albany, N.Y., U.S.A.

Report of the Chief Engineer of the Board of Estimate and Apportionment of the City of New York on the First International Road Congress at Paris, October 11th to 18th, 1908; 25 pp., size 7 x 10; Nelson P. Lewis, chief engineer.

Architectural Institute of Canada.—Year Book for 1908 and Bulletin for January 1909; 25 pp., size 6 x 9; P.O. Box 259, Montreal, Que.

Portland Cement Sidewalk Construction.—By C. W. Boynton inspecting engineer, Universal Portland Cement Co., Chicago. It sets forth, in an interesting manner, the requirements necessary to obtain the best results in sidewalk construction. The Wm. G. Hartrauft Cement Company, Montreal, Que.

Railway Statistics of the Dominion of Canada, for the year ended June 30th, 1908; 250 pp., size 6 x 9. M. J. Butler, Deputy Minister of Railways & Canals, Ottawa.

CATALOGUES AND CIRCULARS.

Stock List.—The Monthly Stock List issued by Wickes Brothers, Saginaw, Mich., dated February 15th, contains terse descriptions of boilers, engines, dynamos, motors and all kinds of machinery.

Electric Lamps.—The National Electric Lamp Association, 4411 Hough Avenue, Cleveland, Ohio, send a booklet which covers the general uses, illumination, economy, costs, etc., of Tungsten multiple lamps for standard lighting service.

Air Compressors are described and illustrated in a pamphlet sent by Reavell & Co., Limited, Ranelagh Works, Ipswich, England.

Electric Fans are dealt with, the Westinghouse Electric & Manufacturing Co., Pittsburg, Pa., in Circular No. 1165.

Gas Engines.—The Dubois Iron Works, Dubois, Pa., forwarded a booklet which deals at some length with gas engines arranged to operate on natural, illuminating and producer gas. The illustrations are very clear.

Chains of all kinds are described in a book sent by Jones & Glassco, 334 Notre Dame Street West, Montreal. It is well illustrated and contains much interesting matter.

Pumps.—Goulds Pump Co., 513 Coristine Building, Montreal, Que., give, in a concise manner, descriptions and illustrations of pumps of many kinds in a booklet just to hand.

Railway Type Armatures.—Instructions for repairing and rewinding railway type armatures are given in a booklet issued by the Canadian Westinghouse Company, Limited, Hamilton, Ont.

Oil Burning Equipment.—A unique way of advertising has been conceived by Tate, Jones & Co., Empire Building, Pittsburg, who send a number of letters regarding their oil burning equipment in the form of a legal document.

Machinery.—The Garvin Machine Co., Spring and Varick Streets, New York, send a copy of their catalogue. It contains descriptions of milling machines, profiling machines, drill lathes, etc., and the illustrations are profuse. It is printed in English, French and German.

Tools and supplies for machine shops, saw and planing mills, foundries and power transmission appliances are listed in H. W. Petrie's stock list for February, published at Toronto, Montreal and Vancouver.

Grinding Machinery.—From Mussens, Limited, of Montreal, Que., we receive bulletins descriptive of conical mill machinery, crushing mills and picks, with illustrations.

Ploughs.—The Wilkinson Plough Co., Limited, Toronto, Ont., send a useful memorandum book.

Heater.—The Harrison Safety Boiler Works of Philadelphia send a leaflet descriptive of an innovation in feed-water heaters from an engineering standpoint.

Facts are given in a booklet sent by Egerton R. Case, Temple Building, Toronto, to prove that much money is made out of good inventions.

Motor Lubrication is dealt with in an intelligent manner by the Joseph Dixon Crucible Co., Jersey City, N.J., in a handsome booklet entitled "Lubricating the Motor." It is divided into chapters which deal with the individual part of motor mechanism—cylinders, transmissions, bearings, etc., while other chapters include many valuable hints.

Rope.—A series of bulletins, in book form, giving information of interest to all rope buyers, is being distributed by the Plymouth Cordage Co., Welland, Ont.

Hoisting Machinery.—Hoisting engines of many kinds, derricks, pile hammers and dump-cars, are described in a finely illustrated catalogue sent by the Georgian Bay Engi-

neering Works, of Midland, Ont., which also contains valuable information regarding steam and steam engines.

Motors.—Harpell-Stokes, Limited, 312 Donald Street, Winnipeg, send a booklet which is devoted exclusively to the merits of single phase motors to which the manufacturers they represent give their entire attention. It includes a good description and numerous illustrations.

Blacksmiths' Tools.—All kinds of tools for blacksmiths and metal-workers are well described in catalogues sent by the Buffalo Forge Co., Buffalo, N.Y.

Refractories.—A handsome volume published by the Harbison-Walker Refractories Co., Pittsburg, Pa., gives valuable information regarding silica, magnesia, chrome, fire clay brick and various refractories. It contains 150 pages, and is well indexed.

Conveying and Transmission is a monthly publication devoted to methods for handling materials and power transmission. It is published by Stephens-Adamson Manufacturing Co., Aurora, Ill., who are represented in Canada by Mussens Limited, Montreal, Que.

Grinding Wheels and Machinery are dealt with in a 160 pp. catalogue issued by the Norton Company, Worcester, Mass., which also contains tables of speeds, rules for obtaining speeds, and other interesting information.

Coal Handling Machinery for power plants is well illustrated in Catalogue 32A, published by the Jeffrey Manufacturing Co., Columbus, Ohio, and Montreal, Que.

Wire Screening.—The B. Greening Wire Company of Hamilton, Montreal and Winnipeg, send a copy of their catalogue for 1909, which is descriptive of their products—wire screening, wire cloth, perforated metals.

Reinforced Concrete Construction.—Describes the Turner system of reinforced concrete construction for bridges and buildings of all kinds. It contains many illustrations of works executed in this new type of construction, including municipal buildings, office buildings, factories and bridges. C. A. P. Turner, 816 Phoenix Building, Minneapolis, U.S.A.

Oil Vs. Coal is the title of a booklet issued by Tate, Jones & Company, Empire Building, Pittsburg. It is devoted entirely to a description of fuel oil equipment and contains numerous illustrations.

Gas Engines and Generators.—Bulletin No. 1063 of Allis-Chalmers-Bullock, Limited, Montreal, Que., describes, at some length, gas engines and generators. The illustrations are superb.

A COMPRESSED AIR TRACTION SYSTEM.

John A. Damon.*

The application of compressed air to the transportation of merchandise is shown very fully in the Plymouth Cordage Company works. The buildings, on account of their extent—a length of 2,500 feet and breadth of 1,000 feet—can only be served to advantage with some sort of surface track scheme. This service is attained by compressed air locomotives, hauling small flat top cars on a narrow gauge track.

Five locomotives are in use. These locomotives have 5 x 10-inch cylinders, two coupled 24-inch drivers, a single storage tank four by eleven feet, with a capacity of 132 cubic feet, and weigh 8,500 pounds each. There are twenty-six cars with five by twelve foot tops, which are carried by four twenty-inch wheels, and weigh 2,000 pounds each. The track is run about the yard, into or through buildings, many of which are filled with inflammable material, with no danger from fire. A consideration of this single feature has convinced the owners that the steam locomotive is barred and the electric motor has a serious handicap in comparison.

The locomotives are charged at various points about the plant. The charging valves are located particularly with the idea of having the tanks filled at the same time that the cars are being loaded or unloaded, thus minimizing the load in the brief time taken for charging. Some of the runs are quite long, the longest being 2,400 feet, and the round trip under favorable weather conditions, is made with one charge. On this run a net load of 8,500 pounds is carried and the cost of air figures .04 of a cent per ton per 100 feet. Other runs figure .08 of a cent per ton per 100 feet.

This cost is based on a cost of one-half cent per 100 cubic feet of free air and includes all charges up to delivering the air into the mains at 200 lbs. pressure; these figures are on the conservative side.

The system as a whole, taking lump figures, moves one ton, net load, one hundred feet for approximately one cent. This includes the air used for all other purposes, fixed charges on all the rolling equipment as well as compressing apparatus, and all atendance.

* Master Mechanic of the Plymouth Cordage Company, Plymouth, Mass.

RELATIONS OF TEMPERATURE TO TIME OF SET AND STRENGTH OF CONCRETE.

The text-books have plenty to say regarding the time required by concrete to set under normal temperatures, but very little indeed as to the conditions when the temperatures vary. In a word little has been published which bears directly upon the builders problem of determining how long to leave centres under concrete.

To assist in providing some definite information regarding this subject the Aberthaw Construction Company of Boston, Mass., through the courtesy of the Quincy Market Cold Storage Warehouse Company, and with the assistance of Mr. H. L. Sherman, cement chemist, both also of the same city, have undertaken a series of tests under controlable temperature conditions. Publicity has already been given to some of the results covering a relatively short period. In the following table are now given the results at the end of three months:—

Temperature of air and materials	Mixture	Average tensile strength in lbs. per sq. in. at end of three months
72 deg.	Neat	759
	1:3	305
41 deg.	Neat	660
	1:3	303
34 deg.	Neat	567
	1:3	249
41 deg. (room—7 deg.)	Neat	29
	1:3	9

It will be noted that at a temperature of 72°, the cement showed a decrease in strength from 7 days to 28 days on the neat tests, while on the mortar tests, the strength was the same. On the tests at 41°, there was a good increase between these periods on both sand and neat tests, and at 34°, a better percentage increase on both. In the opinion of the chemist this is an illustration of the importance of water on the early strength of cement. At 72°, the excess water contained in the briquettes was evaporated rather quickly, while at the lower temperatures, the rate of evaporation was very slow. Between 28 days and three months, the briquettes at 72° showed a very good increase, those at 41°, a less decided increase, and those at 34° still less. Apparently, cement at low temperatures (above freezing, however) attains less strength than at a normal temperature but its increase in strength in short times is greater.

It is interesting to note that the cement kept at the very low temperatures, finally set and attained a very little strength. It would be interesting to discover whether there would be any increase in strength at later times.

An examination will be held by D. Fraser, a duly appointed Inspector of Steam Boilers for the Province of Alberta at:—Fort Saskatchewan, March 22nd; Millet, April 12th; Strathcona, April 14th, fire hall; St. Albert, March 16th; Stony Plain, March 19th; Bruderheim, March 23rd; Leduc, April 13th; at 9 o'clock, for the purpose of giving engineers and apprentices an opportunity of qualifying for certificates under the provisions of the Steam Boilers Act, 1906. Application for examination should be made to the above-named Inspector, or to John Stocks, Deputy-Minister, Department of Public Works, Edmonton, Alta.

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.

New Brunswick.

DORCHESTER.—Tenders for coal will be received until the 20th March, 1909. Address—S. Edgar Wilson, secretary.

RICHIBUCTO.—Tenders will be received by the chairman of school trustees up to March 20th, 1909, for the construction of a public school building of wood in the town of Richibucto, N.B.

MONCTON.—The City Council will receive, until March 20th, tenders for an electric turbo pump. This is an extension of time. Address, Major Willett.

Quebec.

MONTREAL.—Tenders are invited for laying 155,000 granite blocks for the roadway of the Montreal & Southern Counties Railway. Address—E. A. Mumford, secretary-treasurer, Montreal and St. Lambert Terminals Development Company.

VILLE EMARD.—Tenders will be received until 16th March for the construction of an education house on Sixth Avenue. A. M. Ligouin, architect, 240 Ontario Street, Montreal. M. Jodoin, secretary-treasurer of School Commissioners of Ville Emard.

Ontario

BERLIN.—The Sewer Commission of the town of Berlin decided at a recent meeting to call for tenders for sewer pipe, cement and manhole castings, and another meeting will be held next Tuesday to award the contracts.

BROCKVILLE.—Tenders will be received to 13th March for the purchase and removal of one storey frame building, 9 feet by 20 feet, also for the excavation and removal of about four hundred yards of earth. B. Dillon, architect.

HAILEYBURY.—Tenders will be received up to the 20th March, 1909, for the several trades required in the erection and completion of an eight-roomed brick Public School, in the town of Haileybury, Ont. Address—Paul A. Cobbold, Secretary Haileybury Public School Board.

OTTAWA.—Tenders will be received until March 23, 1909, for the construction of three Ice Piers, for the Annapolis River at Annapolis Royal, Annapolis County, N.S. Address—Napoleon Tessier, Secretary Department of Public Works.

OTTAWA.—Tenders for Steamboat of about the following dimensions: 80-foot keel, 20-foot beam, 8-foot draft; speed about 10 knots, will be received up to 17th March, 1909. Address—A. L. Jarvis, Secretary Department of Agriculture.

OTTAWA.—Tenders will be received until 25th March for the fiscal year 1909-1910 for coal, coal-oil, cordwood, forage, hardware, leather, oils and paints, Portland cement, sole leather and tinware. Address—Douglas Stewart, Geo. W. Dawson, Inspector of Penitentiaries, Department of Justice.

OTTAWA.—Tenders for Timber will be received up to Wednesday, 21st March, 1909, for the supply and delivery of British Columbia or "Douglas Fir." Dimensions required for the Rideau Canal. Address—L. K. Jones, Secretary, Department of Railways and Canals.

OTTAWA.—Tenders for Wiring Public Building, Dauphin, Man., will be received until Monday, March 15, 1909. Napoleon Tessier, Department of Public Works.

OTTAWA.—Tenders will be received for the construction of a reinforced concrete grand stand to cost about $85,000. This is a new call. Address—E. McMahon, Secretary, Exhibition Association.

TORONTO.—Tenders will be received until March 19th for the plastering of St. Helen's R.C. Church, Dundas Street and St. Clarens Avenue, Toronto. J. P. Hynes, 199 Yonge Street.

TORONTO.—Tenders will be received until Monday, March, 22nd, for all trades required in the erection of a building for the Faculty of Education, University of Toronto, corner of Bloor Street and Spadina Avenue. Address: Darling & Pearson, architects.

TORONTO.—Tenders for the several contracts mentioned below will be received up to 16th March, 1909:—Excavating, weeping drains, concrete, brick work, cut stone work, tile work, grading, and other work, carpenter work, iron and steel work, galvanized iron work, ventilating apparatus, painting and glazing, and other work, felt and gravel roofing, plastering, plumbing. Address—Joseph Oliver (Mayor), Chairman Board of Control.

TORONTO.—Tender will be received up to 12 o'clock noon on Wednesday the 17th March for the following works: 1. Engine House and Machine Shop at Cochrane. 2. Locomotive Foreman's Office and Petty Stores Building at Cochrane. 3. Heating Plant for Cochrane Roundhouse and Machine Shop. 4. One 75 ft. Turntable complete at Cochrane. 5. Coal Shed and Trestle at Cochrane. 6. Culvert near Mileage 22½. 7. Five ft. Arch Culvert near Mileage 50¾. 8. Twenty ft. 1 Beam Span near Mileage 62½ 9. Twenty ft. Reinforced Concrete Arch Culvert near Mileage 222½. 10. One 8 ft. Reinforced Concrete Arch Culvert near Mileage 221. 11. One 11 ft. Reinforced Concrete Arch Culvert near Mileage 218½. Plans and specification may be seen at the office of the Sec.-Treas., 25 Toronto Street, Toronto, or at the office of the Chief Engineer, North Bay. A. J. McGee, Secretary-Treasurer.

WINDSOR.—Tenders will be received up till Friday, 12th March, for one Steel Boiler, and one 250 horse-power Cross Compound Engine. Address—Stephen Lusted, Clerk.

OTTAWA.—Tenders, addressed to the undersigned, for electric fixtures, Guelph Armoury, will be received until 4.30 p.m. on Wednesday, March 17th, 1909. Napoleon Tessier, Secretary, Department of Public Works.

WINDSOR.—Tenders will be received by the undersigned up till noon on Friday, the 12th March inst., for:—One steel boiler, 72-inch diameter by 18 feet long; 140 pounds working pressure; half-inch plate; 74 four-inch tubes; manhole plate in front below tubes; eclipse type, with mud drum 16-inch diameter by 9 feet long; horizontal steam dome, 30-inch diameter by 5 feet long; best quality of shaking grates; angle valve in steam pipe; safety valve connected to present steam pipe. One 250 horse-power Cross Compound Engine, 200 to 225 revolutions per minute, with extended base and shaft for direct connected generator, with drive-wheels 24-inch diameter, 14-inch face, to drive the present line shaft 350 revolutions per minute. Engine must be centre crank type. Stephen Lusted, Clerk.

HAILEYBURY.—Tenders will be received up to 20th March, 1909, for the several trades required in the erection and completion of an eight-roomed brick public school in the town of Haileybury. Address: Paul A. Cobbold, secretary, Haileybury Public School Board.

OTTAWA.—Tenders for heating apparatus, Public Building, Kincardine, will be received until Friday, March 19th, 1909. Address, Dept. of Public Works, Ottawa.

TORONTO.—Tenders will be received up to noon on March 16th, for the supply of cast iron water pipe for the year ending April 1st, 1910. Also for the laying and jointing of pipes, valves, hydrants, special castings, etc., up to 31st

of December, 1909. Address: Joseph Oliver, Mayor, Chairman Board of Control, City Hall, Toronto.

Manitoba.

WINNIPEG.—Tenders will be received up to Thursday, April 15th, 1909, for the manufacture and delivery at Winnipeg of two testing transformers, viz.: One 30 k.w. at 80,000 volts, and one 200 k.w. at 200,000 volts, also for control equipment therefor. Copies of the instructions to bidders, specifications and forms of tender may be obtained at the power engineer's office, Carnegie Library building, Winnipeg, Manitoba. These specifications may also be seen at the office of Smith, Kerry & Chace, Confederation Life Building, Toronto, Ontario. M. Peterson, secretary, office of the Board of Control, Winnipeg, Man.

BRANDON.—Tenders for cement will be received until April 16th for the supply of one thousand to two thousand barrels of Portland cement. W. H. Shillinglaw, City Engineer; Harry Brown, City Clerk. (Advertised in the Canadian Engineer.)

CLEARWATER.—Tenders will be received up to March 30, 1909, for a supply of plank, bridge timber and lumber required by the municipality for the year 1909, to be delivered at the following places: Pilot Mound, Crystal City, and Purves. W. Cranston, Clerk, Clearwater, Manitoba.

MINNEDOSA.—Tenders will be received up to March 15, 1909, for the erection of a six-room school building in the town of Minnedosa, Manitoba. Plans and specifications are on file at the office of E. Bailey Fisher, secretary-treasurer, Minnedosa, and the office of William Wallace Blair, Architect, 414-16 The Nanton Building, Winnipeg.

WINNIPEG.—Tenders for supply of quantity of valves and hydrants for domestic and high pressure waterworks system will be received up to Saturday, March 13. Address—M. Peterson, Secretary, Board of Control Office.

WINNIPEG.—Tenders will be received up to March 10th for the purchase and removal of buildings and for the general excavation work for a new building to be erected. Address—J. H. G. Russell, Architect, Silvester-Willson Building.

WINNIPEG.—Tenders for supply of quantity of valves and hydrants for domestic and high pressure waterworks system, will be received up to Saturday, March 13. M. Peterson, Secretary, Board of Control.

Saskatchewan.

PRINCE ALBERT.—Tenders for road machinery will be received until Thursday, March 18th, for one stone crusher, one elevator and screens, one electric motor, one steam road roller. Information will be forwarded on application to F. A. Creighton, Esq., city engineer, Prince Albert, Sask. (Advertised in The Canadian Engineer.)

WEYBURN.—Tenders will be received until April 7th, 1909, for pipe-laying, water tower, cast iron pipe, and fire hydrants and valves for the town of Weyburn. Geo. H. Ross, secretary-treasurer; Willis Chipman, chief engineer. (Advertised in The Canadian Engineer.

British Columbia.

VANCOUVER.—Mr. G. A. McNicholl, purchasing agent of the Grand Trunk Pacific, is calling for tenders for the supply of three hundred thousand cross and switch ties, and four thousand telegraph poles.

Foreign.

ADELAIDE, AUSTRALIA.—Tenders addressed to the undersigned will be received until April 28th, for the supply of one bucket dredger, one tug, and two hopper barges. Address, Engineer-in-Chief's Department, Adelaide, South Australia.

BRISBANE, AUSTRALIA.—Tenders will be received until May 31st for installing in the general post office a switchboard, consisting of one trunk line section, three subscribers sections, cable turning and string sections, frames, racks, power plant, etc. Address: Captain R. M. Collins, Australian Commonwealth Offices, 72 Victoria Street, Westminster, S.W., London, England.

CONTRACTS AWARDED.

Quebec.

MONTREAL.—The Grand Trunk Railway has received an order from the Montreal and Southern Counties Railway for six electric tram cars to be built in the G.T.R. shops at Point St. Charles, and delivered in sixty days. The cars are wanted for bridge service.

MONTREAL.—The Stanstead Granite Company have been awarded the contract for 155,000 granite blocks for paving the roadway of the Montreal and Southern Counties Railway.

Ontario.

BRANTFORD.—The Board of Works recommended the acceptance of the following tenders for supplies for 1909:—Paving Brick, Louis H. Gipp, Buffalo; "Bessemer Block." Lumber—contract being divided between Mickle, Dyment & Son, and Schultz Bros. Company, Ltd., Special Castings, Hartley Foundry Company. Cement, Ontario Portland Cement Company. Sewer Pipe, T. A. Cowan.

GANANOQUE.—The Roads and Bridges Committee have accepted the tender of Taylor & Green for 200 pieces 3x12x18 red pine for bridge purposes, at $25.35 per thousand board measure, free on board Gananoque.

Alberta.

CALGARY.—The City Commissioners have awarded the contract for the steel poles required for the street railway to the Standard Supply Company at $32.50 each for 28 ft. poles. The optional price was $41 each for poles of 30 feet in height.

British Columbia.

VICTORIA.—The Streets Committee at a recent meeting recommended that 2 tons of calcium chloride be purchased from R. C. Taylor, to be used on the street, to prevent the dust arising. Price, 92 cents per 100 pounds.

VICTORA.—Tenders for clearing the site of the proposed new school on Fairfield Road were opened and considered. The following were received: Henry Callow, $100; Frank F. Smith, $74.50; E. A. Carlow, $59; T. Horold, $350; William Durt, $72.35; Albert Smith, $65; Charles C. Smith, $89; William Symons, $100. The contract will be awarded to Mr. Carlow.

Foreign.

LAWRENCE, MASS.—The contract for engineering for the new Ayer Mill, of the American Woolen Company, has been placed with Charles T. Main, Boston, and that for the construction of the buildings with E. W. Pitman Company, Lawrence, Mass. The work will cover the construction of a worsted spinning mill of about 44,000 spindles. The main building will be about 600 ft. long by 123 ft. wide, with six storeys and a basement. A wool sorting and wool scouring building will be built, probably four storeys high and measuring 300 ft .long by 123 ft. wide, also a dye house for slub dyeing. A power plant of approximately 4,000 k.w. capacity will be installed, and the power transmission will be electrical. Work is to begin immediately.

PITTSBURG.—The Westinghouse Electric Company has started work on a $5,000,000 contract given by the Pennsylvania Railroad for the electrification of its New York ter-

Statement of Tenders, with prices worked out, received in connection with Banff, Alta., Sewer Extensions—Successful Bidder, Dominion Sewer Pipe Co.

Material.		Dominion Sewer Pipe Company, Swansea, Ont.		Evans, Coleman, and Evans, Vancouver, B.C.		Ont. Sewer Pipe Company, Mimico, Ont.		Standard Drain Pipe Company, St. Johns, Que.		Blackwer and Post Pipe Co., St. Louis, Mo.		Lyth Tile Company, Buffalo, N.Y.	
Pipe, etc.	Quantity.	Tender Price.	Amount.	Tender Price.	Amount.	Tender Price.	Amount.	Tender Price.	Amount.	Tender Price.	Amount.	Tender Price.	Amount.
		$	$	$	$	$	$	$	$	$	$	$	$
Pipe, 8"	282'	.31¼	88.12	.32	90.24	.33	93.06	.34	95.88	.34	95.88	.28	78.96
Pipe, 9"	1,810'	.37½	678.75	.40	724.00	.40	724.00	.40	724.00	.38	687.80	.33 3-5	608.16
Pipe, 15"	600'	.96¼	580.50	.89	534.00	.99	594.00	1.03	618.00	1.03½	621.00	.75 3-5	453.60
Junctions, 15" x 6"	30'	2.78½	83.55	2.70*	81.00	2.99	89.70	2.92	87.60	5.17½	155.25	4.92 4-5	147.84
Junctions, 9" x 6"	90'	1.12½	67.50	1.20*	72.00	1.65	99.00	1.52	91.20	1.71	102.60	2.18 2-5	131.04
			1,498.42		1,501.24		1,599.76		1,616.68		1,662.53		1,419.60

*Calculated at 2 ft. lengths.

Above prices quoted for "Even carload lots."

minals. This contract will result in a resumption in full of work at the company's plants in East Pittsburg.

PITTSBURG, PA.—Chardles W. Leavitt, jr., New York, architect and engineer of the grand stand that is to be erected at Schenley Park, Pittsburg, for the Pittsburg Base Ball Association, has awarded the Raymond Concrete Pile Company of New York and Chicago the contract for placing Raymond concrete piles in the foundations of the structure.

LIGHT, HEAT, AND POWER.

New Brunswick.

ST. JOHN.—On the recommendation of Mr. John B. McRae, Messrs. Smith, Kerry and Chace, have been retained as consulting engineers on the Grand Falls power work .

Ontario.

GUELPH.—The financial report of the Light and Heat Department shows a net profit for the year of $34,179.64, showing a profit rate of 11¾ per cent. on the capital outlay. The present prices for gas are $1 net, and for electric light 10 cents per k.w.

LONDON.—In a report to the special power committee last Friday, Mr. E. I. Sifton, city electrical engineer, advised the city to build and equip a power plant of its own to cost about $235,000. The committee decided to engage a consulting engineer to go over Mr. Sifton's figures and report on them.

ORANGEVILLE.—It is expected that within a month tenders will be called for the construction of the power house of the Dufferin Light & Power Company. The power house will contain three 150 k.w. hydraulic units with step-up transformers to a transmission voltage of 22,000 volts. The work is under the direction of Smith, Kerry & Chase, consulting engineers, Toronto, Ont.

Alberta.

EDMONTON.—The corporation have recently ordered from the Robb Engineering Company, Amherst, two 600 horse-power Robb-Armstrong engines of the vertical enclosed high speed type for direct connection to electrical generators.

British Columbia.

VERNON.—Mr. J. C. Kennedy, engineer-in-charge of the Slave Lake Power Company, Vancouver, recently visited Okanagan for the purpose of going over the site of the Coteau Power Company, and to verify the plans of their engineer, Mr. A. E. Ashcroft, with whom he agrees that arrangements may safely be made for the development of 5,000 horse-power required to operate a system of tramways in this district.

RAILWAYS—STEAM AND ELECTRIC.

New Brunswick.

WOODSTOCK.—At a meeting held on March 1st at Woodstock it was decided to build the St. John Valley Railway from St. John to Grand Falls.

Quebec.

MONTREAL.—The Canadian Pacific Railway has four survey parties out locating a route for a branch line to Gow Ganda. It is expected that actual construction will commence early in summer.

MONTREAL.—The Montreal and Southern Counties Railroad has awarded several important contracts, including granite blocks for pavements. The tubular steel poles have been bought, and tenders will shortly be called for the electrical apparatus. Operations will be begun at once on the St. Lambert sub-station car barns.

SHERBROOKE.—The Canadian Pacific Railway is preparing plans for improvements to its property here, which will cost $100,000. A new station and roundhouse are included.

British Columbia.

NELSON.—The City Council have accepted the offer of the Electric Tramway Company to sell their plant for $10,000. No cars have been operated since the car barns and rolling stock were burned last May. It is probable the city will now operate the road itself as its own hydro-electric plant puts it in a good position.

VANCOUVER.—J. A. L. Waddell, bridgebuilder, recently stated that he had secured a contract for undertaking all the engineering work in Alberta, on the railway from Edmonton to Fort McMurray. With branch lines it will have a length of about 350 miles. Mr. Waddell says this season will see construction work well advanced from the Edmonton end.

SEWERAGE AND WATERWORKS.

Ontario.

BERLIN.—During 1908, the town of Berlin constructed nearly 1½ miles of sewers which cost $12,988.69. The King Street sewer, which is 18 feet deep in places, accounts for the high cost, the others averaging only $1.03 a foot.

TELEPHONY.

Nova Scotia.

SYDNEY.—Antoine A. Richard, McLeod's Mills; J. Telesphore Lambert, St. Ignace; Rev. J. Emery Dufour, Acadieville; Mrs. Lucie Richard, McLeod's Mills; and Jacques B. Goguen, Acadieville, Kent County, are applying for incorporation as the Acadia Telephone Company, to construct and operate a telephone system in Kent and Northumberland counties.

FINANCING PUBLIC WORKS.

Ontario.

GUELPH.—The city of Guelph is offering 4½ per cent. pavement debentures, amounting to $65,156.48.

ST. CLEMENTS.—Drainage debentures bearing 4½ per cent. interest are offered by the village of St. Clement's. Address, A. B. Robertson, Reeve, Wellesley P.O., Ont.

CURRENT NEWS

Quebec.

LACHINE.—Mr. Wm. H. White has commenced the manufacture of hinges, taps and spiles here.

Ontario.

BROCKVILLE.—Brockville is considering the advisability of amalgamating the light and water plants, in view of extensive improvements being urgently needed in both departments. It has been decided to employ the services of an expert engineer for a report, including the question of the transmission of cheap power from Iroquois.

HAMILTON.—At a recent meeting of the Board of Works a sub-committee was named to report to the council on the purchase of a stone crusher to cost about $2,000.

OTTAWA.—The Minister of Railways recently stated that the old material of the Quebec bridge, which is now lying at the bottom of the St. Lawrence and on the bank, will not be used in rebuilding the bridge.

British Columbia.

NANAIMO.—The municipality requires a city engineer, salary $125 a month. Applications to reach here March 20th. State qualifications. S. Gough, City Clerk.

Foreign.

NEW YORK.—The New York Central Railroad has arranged to buy 101,000 tons of steel rails for 1909 delivery. This is the most important contract placed with the steel companies since the rate war began. The Algoma Steel Company of Canada were given a contract for 5,400 tons, to be delivered before August 1st.

PERSONAL.

W. D. BARCLAY has been appointed general manager of the Canadian Northern lines in the Province of Quebec.

He will continue to be the general manager of the Halifax and Southwestern Railway and the Inverness Railway.

MR. G. A. McCARTHY, who has just resigned his position as chief engineer of the Temiskaming and Northern Ontario Railway, is well known throughout the engineering profession in Eastern Canada, having occupied several positions of great professional responsibility, and the carrying out of the works which he has undertaken to construct for Messrs. Smith, Kerry & Chace, in the neighborhood of Cobalt, will afford his opportunity to add to a well established reputation.

It is understood that Mr. McCarthy will be in complete charge of the construction of the works for the new power company, which has been organized by Messrs. Smith, Kerry & Chace, and which proposes to furnish about 10,000 horsepower to the mines of Cobalt and the Cobalt district.

Mr. McCarthy was born in New Brunswick, and received his engineering training as a member of the staff of the Intercolonial Railway, with headquarters at Moncton, N.B. After seven years' service on this well-known line, Mr. McCarthy decided to give himself the advantage of a thorough training in the technique of his profession, and resigned his position to become a student in the Civil Engineering course at McGill University. Four years later, in 1898, he completed his University training, graduating with distinction, and with University honors in many subjects.

Immediately after graduating, Mr. McCarthy joined the Maintenance-of-way staff of the Canadian Pacific Railway, and worked on the Lake Superior division of that road during 1898 and 1899, and in 1900, he was appointed engineer and acting manager for the Port Hood Coal Company, Cape Breton. Mr. McCarthy left this last position to become assistant engineer of the Algoma Central Railway.

In 1901, Mr. C. B. Smith, who, as a member of the teaching staff of McGill University, had had a good opportunity to measure Mr. McCarthy's ability, accepted the position of engineer-in-charge of the construction of the works of the Canadian Niagara Power Company, at Niagara Falls, Ontario, this being the first of the great developments to be undertaken at Niagara Falls on the Canadian side, Mr. McCarthy accepted the position of principal assistant under Mr. Smith, and remained connected with the Canadian Niagara Power Company throughout the construction of its well-known station, this work, occupying his attention in all for nearly four years.

In the spring of 1905, Mr. McCarthy joined the staff of Temiskaming and Northern Ontario Railway, and was promoted to the position of Chief Engineer of that work in May of the same year. The construction of this railway of the junction of the National Transcontinental Railway at Cochrane, Ontario, being now practically completed, and there being little more than maintenance-of-way work to be undertaken on the line in the immediate future, Mr. McCarthy considered it wise to connect himself with new work that will be actively prosecuted, and has therefore accepted the position above-mentioned, for which his intimate knowledge of the growth of Cobalt industries, and of the facilities which are necessary to their most successful development, makes him singularly adapted.

Mr. McCarthy has already entered on the work of his new position, and has, at present, a considerable staff of engineers at work on preliminary surveys.

OBITUARY.

MR. ETIENNE DUSSAULT, a well-known contractor of Levis, died on Sunday. He was head of the firm of Dussault & Company, and among the works he undertook and carried out were the Levis Water Works, Government wharf, Levis, two lightships in the Traverse, and the last couple of years has been working on the extension of the breakwater in this port. Besides these contracts, Mr. Dussault had a contract in partnership with Mr. Powers on a branch of the Quebec Central Railway. For several years he was an alderman of the town of Levis, and also an ex-president of the Board of Trade.

ALBERTA KEEN ON RAILROADS.

Legislature Guarantees Bonds—Western Notes—Brantford Street Railway Affairs.

(The Monetary Times.)

The Alberta Legislature's important railway programme has become law. The programme includes the guaranteeing of bonds of the C.N.R. and G.T.P. and other branch lines totalling 1,681 miles and total guarantee $27,433,000, including 850 miles of Canadian Northern branches guaranteed at $13,000 per mile—$11,050,000; 491 miles of G.T.P. branches at $13,000 per mile—$6,300,000; and 350 miles Alberta and Great Waterways Company at $20,000 per mile—$7,000,000 with additional guarantee of $400,000 for terminals at Edmonton.

Government Will Take First Mortgage.

As security for guaranteeing the bonds, the Government takes a first mortgage on the lines, rolling stock, equipment and tolls of all lines guaranteed.

The bonds of guarantee of the G.T.P. and C.N.R. will bear interest at 4 per cent., and on the line to Fort McMurray at 5 per cent., as the companies state they are prepared to commence construction this spring.

The Kootenay & Alberta Railway Company's application for a charter has been refused. Though from the decision of the committee it would appear that unless the South East Kootenay Company, which holds a parallel charter, builds by next session, the charter will be granted.

Three hundred and sixty-five miles of the Hudson's Bay Railway have been surveyed out of a total of 465 miles.

Street Railway Deposited Bonds.

Under the recent agreement the Brantford Street Railway Company was required to deposit with the city by March 1st a bond of $25,000 as evidence of good faith that it will fulfil its obligations. These, in brief, consist of rebuilding the existing eight miles of street railway within one year from May 1st, and making eight miles additional extensions in the city within two years. Certain bonds were deposited by the company on Monday, together with personal guarantees on the part of the financiers, that the work will be completed. Had the company not deposited the bond the city could have revoked the franchise of the company, which still has forty-two years to run.

Bonds to the extent of thirty-five thousand dollars put up by the Street Railway Company proved later to be Grand Valley Radial Company bonds, whereas the agreement calls for twenty-five thousand dollars of bonds with a guarantee company. While it is likely these will be satisfactory to the city, as they are backed by the guarantee of the directors of the company and other capitalists, no announcement has been made.

The Minnesota & International Railway which is a part of the Northern Pacific Railway system, is to build a bridge connecting Fort Frances and International Falls, Minnesota, next summer.

(Continued from Page 359.)

B. J. Redfern, R. G. Rittenhouse, J. S. Robinson, Alfred Rogers, John Scott, C.E., M. R. Shaw, J. C. Siemon, F. Slack & Co., F. Smallwood, L. J. Street, John L. Stuart, W. G. Swan, Clifford Taylor, R. G. Taylor, E. D. Weber, C. Weltz, McKenzie Williams (Deer Park), Wm. D. Wilson, C. R. Young; Trenton, E. James; Warner, V. Bartlett; Waterford, Thos. D. Brock; West Toronto, J. H. Hoover; Windsor, C. W. Cadwell.

Alberta.—Calgary, D. J. Moore.

United States America.—Akron, N.Y., F. M. Jackson; Boston, Mass., Fred. A. Norris; Buffalo, N.Y., J. P. Griffin, B. H. McEwen; Chicago, Ill., S. H. Beard, Wm. M. Kinney, G. E. Lavelle, J. E. Moore; Cleveland, Ohio, C. D. Watson; Dayton, Ohio, H. C. Beard; Depew, N.Y., R. Taylor; Kendallville, Ind., Cyrus S. Wert; La Grange, Ind., W. E. Snyder; Mt. Gilead, Ohio, Jos. Hickson; New York, N.Y., Merrill Watson; Philadelphia, Pa., Richard L. Humphrey, E. G. Perrott; Rochester, N.Y., O. C. Wolcott; Rome, N.Y., E. G. Cotlin; South Bend, J. A. Smith; Wilkes Barre, Pa., Hugh J. Duffy; Youngstown, Ohio, M. W. Boerema.

MARKET CONDITIONS.

Montreal, March 10th, 1909.

Advices from Pennsylvania are to the effect that the pig-iron business has practically been suspended. It is certain, however, that furnaces would take less for their iron than they would a week ago. The result is that buyers are still holding off, awaiting lower prices. The market is down 25c. as compared with a week ago, and 50c. as compared with two weeks ago. The prices of billets have declined to $25, from $26.20, delivered, and bars are now quoted $1.42, delivered, against $1.45, last week, It was thought that reductions in wages and cheaper scrap would probably put the market in much better shape for business.

The English market is in sympathy with the pessimistic reports from the United States. Lack of orders from continental points, coupled with the quiet home trade, and increased stocks, all tend to the reduction in prices. As a matter of fact, selling prices are to-day so close to cost, that there is little likelihood of further reductions, but there is much speculation, the result of which is difficult to forsee. Stocks of foundry iron, in store, February 25th, amounted to 171,000 tons, as against 88,000 tons the same day last year. This is not a heavy stock as compared with many previous years, but coupled with the quiet tone prevailing, it is not reassuring to makers. Consumers are only buying to cover present requirements.

In the local market, the pig-iron situation is not materially effected by the uncertainty of prices in the United States, excepting as that is reflected on the English and Scottish markets from where considerable supplies are purchased for importation into Canada. Demand at present continues good, particularly for delivery after navigation opens, and it is expected that several good round lots will be closed very shortly by the large consumers. In fact, some heavy tonnage has been closed during the past week. Stocks in store are practically nil, and some lots are being taken at winter freight to take care of immediate requirements. Canadian furnaces are not pressing sales of pig to the extent that they have been during the year 1908. The situation is, generally speaking, hopeful, and heavy business is expected to develop during the next few weeks. The feeling among importers is that the declines in the United States were partly brought about to influence the tariff commission. Notwithstanding the statement credited to some of the iron and steel makers, that wages would be maintained, it is possible that a reduction may be brought about within the next few months in order to further influence the action of the commissioners.

The local market is marking time and awaiting further developments in the United States. No prices have been changed, officially, during the past few weeks; and the past week has been as unproductive of results as its predecessors, although the general idea appears to be that sellers are prepared to shade prices somewhat.

Antimony.—The market is steady at 9 to 9½.

Bar Iron and Steel.—Prices are steady all round, and trade is dull. Bar iron, $1.90 per 100 pounds; best refined horseshoe, $2.15; forged iron, $2.05; mild steel, $2.00; sleigh shoe steel, $1.90 for 1 x ½-base; tire steel, $1.95 for 1 x ⅜-base; toe calk steel, $2.40; machine steel, iron finish, $2.10; smooth finish, $2.75.

Boiler Tubes.—The market is steady, quotations being as follows:—2-inch tubes, 8½c.; 2½-inch, 10c.; 3-inch, 11½c.; 3½-inch, 14½c.; 4-inch, 19c.

Building Paper.—Tar paper, 7, 10, or 16 ounces, $1.60 per 100 pounds; felt paper, $2.40 per 100 pounds; tar sheathing, No. 1, 55c. per roll of 400 square feet; No. 2, 35c.; dry sheathing, No. 1, 45c. per roll of 400 square feet, No. 2, 28c. (See Roofing; also Tar and Pitch).

Cement.—Quotations are for car lots, f.o.b., Montreal. Canadian cement is $1.55 to $1.65 per 350-lb. bbl., in 4 cotton bags, adding 10c. for each bag. Good bags re-purchased at 10c. each. Paper bags cost 2½c. extra, or 10c. per bbl. weight. English cement is $1.65 to $1.85 per 350-lb. bbl. in 4 jute sacks (for which add 8c. each) and $2.20 to $2.40 in wood. Begian cement is $1.60 to $1.65 in bags—bags extra—and $2.10 in wood.

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

Copper.—The market is about steady at 14¾ to 15c. per lb. Demand continues limited.

Explosives and Accessories.—Dynamite, 50-lb. cases, 40 per cent. proof, 18c. 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, 30c. per lb. Fuses, platinum, single strength, per 100 fuses:—4-ft. wires, $3.50; 6-ft. wires, $4; 8-ft. wires, $4.50; 10-ft. wires, $5. Double strength fuses, 1$ extra, per 100 fuses. Fuses, time, double-tape, $6 per 1,000 feet.

Galvanized Iron.—The market is steady. Prices, basis, 28-gauge, are:—Queen's Head, $4.40; Comet, $4.25; Gorbal's Best, $4.25; Apollo, 10¼ oz., $4.35. Add 25c. to above figures for less than case lots; 26-gauge is 25c. less than 28-gauge. American 28-gauge and English 26 are equivalents, as are American 10¼ oz., and English 28-gauge.

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

Iron.—Prices are rather higher, and the outlook is steady. The following prices are ex-store: Canadian pig, $18.50 to $19.50 per ton; No. 1 Summerlee, $21 to $22; No. 2 selected Summerlee, $20.50 to $21.50; Carron soft, $20.25 to $20.75; No. 3 Clarence, $19 to $20 per ton.

Laths.—See Lumber, etc.

Lead.—Trail lead is firmer, at $3.75 to $3.85 per 100 pounds, ex-store.

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

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

Nails.—Demand for nails is moderate, but prices are steady at $2.30 per keg for cut, and $2.25 for wire, base prices.

Pipe—Cast Iron The market continues steady at $33 for 8-inch pipe and larger; $34 for 6-inch pipe; $34 for 5-inch, and $34 for 4-inch at the foundry. Pipe, specials, $3.10 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

Pipe.—Wrought and Galvanized.— The market is steady, moderate-sized lots being: 1-4-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. The discount on the following is 60 per cent. off for black and 59 per cent. off for galvanized; ½-inch, $8.50; 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

Rails.—Quotations on steel rails are necessarily only approximate and depend upon specification, quantity and delivery required. A range of $31.50 to $32.50 is given for 60-lb., 70-lb., 80-lb., 85-lb., 90-lb., and 100-lb. 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, 64c. per roll; three-ply, 86c. per roll of 100 square feet. (See Building Paper; also Tar and Pitch).

Rope.—Prices are steady, at 9 1-2c. per lb. for sisal, and 12c. for Manila. Wire rope, crucible steel, six-strands, nineteen wires; 1-4-in., $2.75; 5-16, $3.75; 3-8, $4.75; 1-2, $6; 5-8, $7.25; 3-4, $8.50; 7-8, $10; 1-in., $12 per 100 feet.

Spikes.—Railway spikes are in dull demand and prices are steady at $2.40 per 100 pounds, base of 5½ x 9-16. Ship spikes are also dull and steady at $3 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.

Steel Plates.—The market is steady. Quotations are: $2.15 for 3-16; $2.25 for ⅜, and $2.15 for ¼ and thicker; 12-gauge being $2.30; 14-gauge, $2.15; and 16-gauge, $2.10.

Telegraph Poles.—See lumber, etc.

Tar and Pitch.—Coal tar, $4 per barrel of 40 gallons, weighing about 500 pounds, roofing tar, $3.15 per barrel; roofing pitch, No. 1, $1 per 100 pounds; and No. 2, 50c. per 100 pounds; pine tar, $8.50 per barrel of 40 gallons, and $4.75 per half-barrel; pine pitch, $4 per barrel of 180 to 200 pound. (See building paper; also roofing.)

Tin.—Prices are 32c. to 32½c.

Zinc.—The market is steady at 5½ to 5¾c.

* * * *

Winnipeg, March 9th, 1909.

There is no doubt in the minds of the dealers and contractors but that this spring will be an exceptionally busy one in the building trades in Winnipeg and Western Canada, and from present indications it is very evident that this will be the case. The dealers are making every preparation for a busy season, and the number of projected buildings and structures are very large. There is no particular change in the prices on the local market as yet, but a sale of cement was put through last week to the city of Winnipeg of 20,000 barrels at a very low figure. The brick yards supplying the Winnipeg demand report that their capacity will be taxed this season. Their output is estimated at from 45 to 50 million brick. The brick yards are a very accurate thermometer of the building situation, and it is felt that 1909 will be the greatest building year in the history of Winnipeg, surpassing the banner year of 1906. The instrument dealers report active demand for transit and levels, and Messrs. E. R. Watts & Sons are kept very busy in their Winnipeg branch, with repair work, as theirs is the only place in Western Canada where instruments can be repaired and adjusted.

The prices on the local market are as reported below:—

Anvils.—Per pound, 10 to 12 1-2c.; Buckworth anvils, 80 lbs., and up, 10¾c.; anvil and vise combined, each, $5.50.

Bar Iron.—$2.50 to $2.60.

Beams and Channels.—$3 to $3.25 per 100 up to 15-inch.

Building Paper.—4½ to 7c. per pound. No. 1 tarred, 84c. per roll; plain, 60c.; No. 2 tarred, 62½c.; plain, 56c.

Bricks.—$11, $12, $13 per 1,000, three grades.

Cement.—$2.65 to $2.75 per barrel.

Chain.—Coil, proof, ¼-inch, $7; 5-16-inch, $5.50; ⅜-inch, $4.90; 7-16-inch, $4.75; ½-inch, $4.40; ⅝-inch, $4.20; ¾-inch, $4.05; logging chain, 5-16-inch, $6.50; ⅜-inch, $6; ½-inch, $8.50; jack iron, single, per dozen yards 15c. to 75c.; double, 25c. to $1; trace-chains, per dozen, $5.25 to $6.

Dynamite.—$11 to $13 per case.

Hair.—Plaster's, 80 to 90 cents per bale.

Hinges.—Heavy T and strap, per 100 lbs., $6 to $7.50; light, do., 65 per cent.; screw hook and hinge, 6 to 10 inches, 5½c. per lb.; 12 inches up, per lb., 4¾c.

Iron.—Swedish iron, 100 lbs., $4.75 base; sheet, black, 14 to 22 gauge, $3.75; 24-gauge, $3.90; 26-gauge, $4; 28-gauge, $4.10. Galvanized—American, 18 to 20-gauge, $4.40; 22 to 24-gauge, $4.65; 26-gauge, $4.65; 28-gauge, $4.90; 10-gauge, $5.15 per 100 lbs. Queen's Head, 22 to 24-gauge, $4.65; 26-gauge English or 30-gauge American, $4.90; 30-gauge American, $5.15; Fleur de Lis, 22 to 24-gauge, $4.50; 28-gauge American, $4.75; 30-gauge American, $5.

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

Pipe.—Iron, black, per 100 feet, ¼-inch, $2.50; ⅜-inch, $2.80; ½-inch, $3.40; ¾-inch, $4.60; 1-inch, $6.60; 1¼-inch, $9; 1½-inch, $10.75; 2-inch, $14.40; galvanized, ½-inch, $4.25; ¾-inch, $5.75; 1-inch, $8.35; 1¼-inch, $11.25; 1½-inch, $13.60; 2-inch, $18.10. Lead, 6½c. per lb.

Picks.—Clay, $5 dozen; pick mattocks, $6 per dozen; clevishes, 7c. per lb.

Pitch.—Pine, $6.50 per barrel; in less than barrel lots, 4c. per lb.; roofing pitch, $1. per cwt.

Plaster.—Per barrel, $3.

Roofing Paper.—60 to 67½c. per roll.

Lumber.—No. 1 pine, spruce, tamarac, British Columbia fir and cedar—2 x 4, 2 x 6, 2 x 8, 8 to 16 feet, $27.25, 2 x 20 up to 32 feet, $38.

Nails.—$4 to $4.25 per 100. Wire base, $2.85; cut base, $2.90.

Tool Steel.—8½ to 15c. per pound.

Timber.—Rough, 8 x 2 to 14 x 16 up to 32 feet, $34; 6 x 20, 8 x 20 up to 32 feet, $38; dressed, $37.50 to $48.25.

Boards.—Common pine, 8-inch to 12-inch wide, $38 to $45; siding, No. 2 white pine, 6-inch, $55; cull red or white pine or spruce, 6-inch, $24; No. 1 clear cedar, 6-inch. 8 to 16 ft., $60; Nos. 1 and 2 British Columbia spruce, 6-inch, $55; No. 3, $45.

* * * *

Toronto, March 11th, 1909.

The slow movement of a between-seasons time characterizes several branches of the building trade. Timber and lumber, cement and brick, metal goods, are all affected in this way. In lumber, spruce and hemlock continue to supply the market in many directions where coarse pine was formerly used, and both are held fairly firm. British Columbia shingles are held firmer; white pine lath of 48 inches, scarce, and higher, the 32-inch are in market, as quoted in our prices current.

Advices from the United States respecting the drop in base price of structural steel are not yet definite. Matters still seem in a nebulous state, according to one account there has been a drop of $4 per ton, another authority says only $2.50. Boiler plates and boiler heads are lower here. No change in boilef tubes yet, but there will be, we are told. While there was a drop in pipe a few days ago, it is predicted that it must go up again before long.

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

Antimony.—Price lower, at 9½c. Movement quite limited.

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

Boiler Plates.—1-4-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate.

Boiler Tubes.—Orders continue active. Lap-welded, steel, 1 1-4-inch, 10c.; 1 1-2-inch, 9c. per foot; 2-inch, $8.75; 2 1-4-inch, $10; 2 1-2-inch, $10.60; 3-inch, $12.10; 3½-inch, $15; 4-inch, $18.50 to $19 per 100 feet.

Building Paper.—Plain, 30c. per roll; tarred, 40c. per roll. A moderate demand can be now reported, for shipment about 1st April.

Bricks.—Common structural, $9 per thousand, wholesale, and the demand moderately active. Red and buff pressed are worth, delivered, $18; at works, $17.

Cement.—Price in 1,000-barrel lots $1.70 per barrel, including bags, or $1.30 without bags. Smaller quantities, $1.55 to $1.60 per barrel, in load lots delivered in town, and bags extra. No marked activity.

Coal Tar.—Nothing doing, price maintained at $3.50 per barrel.

Copper Ingot.—Movement rather active; price lower. We quote 14 to 14½c.

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

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

Roofing Felt.—Still quiet on account of coarse climatic conditions. Price maintained at $1.80 per 100 lbs.

Fire Bricks.—English and Scotch, $30 to $35; American, $27.50 to $35 per 1,000. The demand has become quite active.

Fuses.—Electric Blasting.—Double strength, per 200, 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. Bennett's double tape fuse, $6 per 1,000 feet.

Galvanized Sheets—Apollo Brand.—Sheets 6 or 8 feet long, 30 or 36 inches wide; 10-gauge, $3.05; 12-14-gauge, $3.15; 16, 18, 20, $3.35; 22-24, $3.50; 26, $3.75; 28, $4.20; 29, $4.50; 10¾, $4.50 per 100 pounds. Fleur de Lis—28-gauge, $4.30; 26-gauge, $4.05; 22-24-gauge, $3.50. Queen's Head—28-gauge, $4.50; 26-gauge, $4.25. Sheets are in very active request.

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

Bar Iron.— $1.95 to $2, base, from stock to wholesale dealer.

Iron Pipe.—Black, ¼-inch, $2.03; ⅜-inch, $2.26; ¾-inch, $2.63; ¾-inch, $3.16; 1-inch, $4.54; 1¼-inch, $6.19; 1½-inch, $7.43; 2-inch, $9.90; 2½-inch, $15.81; 3-inch, $20.76; 3½-inch, $26.13; 4-inch, $29.70; 4½-inch, $38; 5-inch, $43.50; 6-inch, $56. Galvanized, ¼-inch, $2.86; ⅜-inch, $3.08; ½-inch, $3.48; ¾-inch, $4.31; 1-inch, $6.19; 1¼-inch, $8.44; 1½-inch, $10.13; 2-inch, $13.50. Makers are holding prices stiff, and talk of an advance.

Lead.—Prices steady outside. Price here lower at $3.80 to $3.90.

Lime.—In adequate supply and slow movement. Price for large lots at kilns outside city 22c. per 100 lbs. f.o.b., cars; Toronto retail price 25c. per 100 lbs. f.o.b. car

Lumber.—We quote dressing pine $32 to $35 per thousand; common stock boards higher at $26 to $30.00; cull stocks, $20; sidings, $17.50. Norway pine is neglected in favor of Southern, which is much stronger in fibre and the price well maintained. Hemlock continues to sell pretty freely, and in car lots brings $16.50 to $17.00. Spruce flooring is worth $22.00 in car lots with stiffer feeling. Shingles firmer, price for British Columbia, $3.20. Lath higher at $4.25 for No. 1 and $3.75 for No. 2 white pine 48-inch; the 32-inch are now in market and bring $1.30 per thousand. Spruce laths are scarcer in this market and prices keep up. More spruce and hemlock have moved than pine. Prices are maintained all over the list.

Nails.—Wire, $2.25 base; cut, $2.70; spikes, $3. The usual demand.

Pitch.—Demand is flat; price, 70c. per 100 lbs.

Pig Iron.—Business continues quiet; prices are fairly well maintained. Clarence quotes at $20.50 for No. 3; Cleveland, $20.50 to $21.00; in Canadian pig, Hamilton quotes $19.50 to $20.

Plaster of Paris.—Calcined, wholesale, $2; retail, $2.15. Trade quiet.

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

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

(Continued on Page 45).

RAILROAD ORDERS.

(Continued from Page 363.)

6346—February 22—Authorizing the Winnipeg Electric Railway Company to place its wires across the C.P.R. tracks near Molson, "cut-off" in Sec. 17, Tp. 12, Manitoba.

6347—February 22—Authorizing the city of Winnipeg to lay a sewer under the tracks of the C.P.R. at Barton Avenue, Winnipeg, Man.

6348—February 25—Authorizing the Manitoba Government Telephone System to cross with its wires the tracks of the C.N.R. at the spur to the Rat Portage Lumber Company north of Marion Street, Norwood, Manitoba.

6349 to 6352, inclusive—February 26—Granting leave to the Manitoba Government Telephones to erect, place, and maintain its wires across the tracks of the Canadian Pacific Railway at various points in the Province of Manitoba.

6353 to 6356, inclusive—February 26—Granting leave to the Canadian Northern Ontario Railway Co. to erect, place, and maintain its telegraph wires across the wires of the G.N.W. Telegraph Co. at various points in the Province of Ontario.

BETTER RAILS.

The Wall Street Summary.—When conferences were held least year between steel rail manufacturers and railroads, the latter insisted that the discard from the end of the "bloom" was not sufficient. The bloom, or dough, of metal is the term used to describe the roughly prepared mass, nearly square in section and short in proportion to its thickness, which later is hammered or rolled into bars. The discard formerly was 12 per cent., but the Pennsylvania Railroad Co. insisted that a discard of 25 per cent. was required to insure sound rails. From an announcement by that company, regarding certain specifications placed with rail manufacturers for new rails, we learn that "a sufficient discard to insure a sound rail" has been agreed to; and that inspectors from the railroad are to receive free access to the works where the rails are being manufactured in order to satisfy themselves that the specifications are being followed. From this we may infer that the carriers have won their point, and that better rails will be turned out in future.

COMING MEETING

Canadian Electrical Association.—Annual Convention at Quebec, June 16th, 17th, 18th, 1909.

TENDERS CALLED FOR

TOWN OF WEYBURN

Province of Saskatchewan.

TENDERS WANTED

Sealed Tenders will be received by the Secretary-Treasurer of the Town of Weyburn until 8 p.m. on Wednesday, April 7th, 1909, for the following sections of proposed System of Waterworks:—

"A"—Pipelaying.
"C"—Water Tower.
"D"—Cast Iron Pipes.
"E"—Fire Hydrants and Valves.

Plans and Specifications may be seen at the office of the Secretary-Treasurer, Weyburn, or at the office of the Chief Engineer, Toronto, on or after March 8th.

SAMUEL MURRAY, Esq.,
Chairman W.W. Committee,
Weyburn, Sask.
GEORGE ROSS, Esq.,
Secretary-Treasurer,
Weyburn, Sask.
J. R. FOX, Esq., Mayor,
Weyburn, Sask.
WILLIS CHIPMAN, C.E.,
Chief Engineer, 103 Bay Street,
Toronto, Ont.

6357—February 26—Granting leave to the Manitoba Government Telephones to erect, place, and maintain its wires across the tracks of the C.P.R. at railway crossing 2¾ miles east of Plum Coulee, Man.

6358—February 26—Granting leave to the Canadian Northern Ontario Railway Co. to erect, place, and maintain its wires across the wires of the G.N.W. Telegraph Co. and the B.T. Co. on Lot 3, Concession 1, Township of Cumberland, County of Russell, Ontario.

6359 to 6363, inclusive—February 26—Granting leave to the Government of the Province of Alberta, to erect, place, and maintain its wires across the tracks of the C.P.R. at various points in that province.

6364—February 26—Granting leave to the C.N.O. Railway to erect, place, and maintain its telegraph wires across the wires of the G.N.W. Telegraph Co. and the B. Tel. Co. at Longueuil St. L'Orginal, Ont.

6365—January 27—Authorizing the C.P.R. and the C.N.O. Railway to construct branch lines in the town of Parry Sound, Ontario.

6366—February 22—Extending until May 1st, 1909, Order of the Board No. 6167, dated the 4th February, 1909, directing express companies subject to the Board's jurisdiction in Canada to accept and carry acetylene gas under rules and regulations prescribed in connection therewith in the official Express Classification No. 18, and at the rating therein provided; and that a supplement be issued to Express Classification No. 16, as now in effect, to provide for the said changes becoming effective not later than March 1st, 1909.

6367—February 25—Authorizing the C.N.O. Railway to take part of Lot 32, Concession 11, Township of Mara, County of Ontario, Province of Ontario, for the purpose of diverting a highway.

6368—February 22—Varying Order No. 5869, dated December 16th, 1908, and the C.N.O. Railway is granted leave to construct its railway across highway on Lot 20, Concession 2, Township York, County of York, Ont. Also rescinding Order 6192, dated the 4th February, 1909, dismissing the application.

6369—February 27—Authorizing the C.P.R. to cross with its Sudbury-Kleinburg branch highways in the town of Vespra, County of Simcoe, Province of Ontario, and amending Order of Board No. 6139, dated the 27th of January.

6370—February 13—Authorizing the town of Indian Head to construct and maintain a ten-inch water pipe across the property and under the tracks of the C.P.R. in the town of Indian Head, Sask.

6371—February 17—Authorizing the city of Calgary to lay a twelve-inch water main under the tracks of the C.P.R. at Fourth Street West, Calgary, Alta.

6372—February 17—Dismissing application of Sidney Ottewell, of Clover Bar, Alta., for permission to allow his cattle to run under the bridge of the G.T.P. Railway at S.W. 13.53-23 West 4th meridian.

6373—March 5—Authorizing the C.P.R. to use and operate bridge at mileage 4.2 Guelph branch of the Ontario division of its line of railway.

6374—February 26—Authorizing the C.P.R. (B.C. So. Railway) to construct, maintain, and operate branch line of railway, or spur, to and into the premises of F. Dailey, situate on Lot 3063, Group 1, east of Kootenay district, B.C.

6375—February 26—Approving of plan showing bridge over highway near Highlands in the Province of Quebec, submitted by the C.P.R.

(Continued on Page 47.)

CITY OF BRANDON

TENDERS FOR CEMENT.

Sealed tenders, endorsed "Tenders for Cement," will be received by the undersigned until 4 o'clock p.m., Friday, April 16th, 1909, for the supply of One Thousand to Two Thousand barrels of "Portland" Cement, for the City of Brandon for the coming season.

Specification and form of tender may be obtained on application to W. H. Shillinglaw, City Engineer, Brandon.

The lowest or any tender not necessarily accepted.

HARRY BROWN, City Clerk.

Office of City Clerk, March 4, 1909.

TOWN OF NORTH TORONTO.

TENDERS are invited for the erection of a Timber Bridge in the Town of North Toronto for the Erie Realty Co., Limited, Equity Chambers, Toronto. Plans and specifications can be seen, and full particulars obtained of the undersigned, on, and after the 13th inst. No pledge is given to accept the lowest or any tender.

WALTER SCOTT BROOKE,
Assoc. M. Inst. C.E.,
EQUITY CHAMBERS, Engineer.
24 Adelaide Street East, Toronto.
11th March, 1909.

CONTRACTOR'S SUPPLIES

To know where to look for what you want, to know where to dispose of what you don't want is a great convenience. You require special equipment. This department will enable you to get in touch quickly with reliable men who wish to dispose of that which you require. Whether a buyer or a seller, you will find this department an aid to business.

RATES FOR THIS DEPARTMENT ARE VERY SPECIAL. BETTER SEND FOR THEM.

FOR SALE

FIRE BOX BOILERS.

1 refitted 48" x 20' containing 52-3" tubes.
1 refitted 44" x 18' containing 48-3" tubes.
1 refitted 44" x 18' containing 46-3" tubes.
1 new 39" x 14' 8" containing 36-3" tubes.
1 refitted 36" x 12' 11" containing 43-2½" tubes.

AUTOMATIC ENGINES.

1 13" and 23" x 30" R.H. compound, Wheelock.
1 13" and 23" x 30" L.H. compound, Wheelock.
1 refitted 14" x 34" R.H. Wheelock.
1 refitted 13" x 30" R. or L.H. Corliss.
1 refitted 12" x 30" R.H. Corliss.
1 refitted 12" x 10" Westinghouse Junior.
1 refitted 10" x 10" C.C. Leonard-Peerless.
1 new 10" x 15" R.H. No. 8 Jewel.
1 refitted 9½" and 14½" x 12" C.C. tandem.
1 refitted 10" x 24" L.H. Brown.
1 refitted 8" and 13" x 18" R.H. tandem.
1 rebuilt 7" x 10" C.C. Leonard-Ball.

STEAM PUMPS.

1 refitted No. 6 pulsometer pump, 300 gals. per min.
1 new 8" x 5" x 12" duplex, 224 gals. per min.
2 refitted 7½" x 4½" x 10" duplex, 172 gals. per min.
1 refitted 7" x 4½" x 8" duplex, 150 gals. per min.
2 new 6" x 4" x 7" duplex, 114 gals. per min.
1 refitted 5¼" x 3½" x 5" duplex, 100 gals. per min.
1 new 4½" x 2¾" x 60" duplex, 60 gals. per min.
7 new 4½" x 2¾" x 4" duplex, 40 gals. per min.
1 refitted 3" x 2" x 4" duplex, 22 gals. per min.
10 new 3" x 2" x 3" duplex, 20 gals. per min.

A copy of our supply catalogue or machinery stock list for the asking.

H. W. PETRIE, Ltd.

Toronto Montreal Vancouver

JARDINE UNIVERSAL CLAMP RATCHET DRILL

Indispensable for Machine Repairs, Factories, Machine Shops, Bridge Builders, Track Layers, Structural Metal Workers, have use for it. Send for description.

A. B. JARDINE CO.,

HESPELER, ONT.

Steam Shovels, Locomotives, Cars, etc.

Contractors' and Railway Equipment

Telegraph, Telephone or Write Us.

A. C. TORBERT & CO.

547-548 Monadnock Block, CHICAGO.

WRITE FOR PRICES.

Water Wheel Equipment

CHEAP FOR CASH.

48" "VICTOR," Complete, Cast Iron Bridge-trees.
40" "JENCKES," Vertical, Gears & Shafting.
44" "LITTLE GIANT," Gears and Shafting.
33" "LITTLE GIANT."
Pair 35" "TRUMP," Horizontal Setting, Shafting, Bearings and Pulleys.
100 H.P. "DODGE" Friction Clutch.

A. F. FIFIELD,

ST. CATHARINES - ONTARIO

NEW INCORPORATIONS.

(Continued from Page 7)

Ontario.—McGregor & McIntyre, Ltd., $300,000; structural steel; J. H. McGregor, R. L. McIntyre, Toronto. Canadian Automatic Transportation Company, $1,000,000; H. P. Strang, R. W. Hart, O. H. King, Toronto. Automatic Electric, Limited, $200,000; O. H. King, R. W. Hart, H. P. Strang, Toronto. Purity Ware, Limited, $400,000; mining, smelting, etc.; G. Noble, G. H. Noble,

(Continued on Page 48.)

FOR SALE. Great Bargains if you act promptly in D.C.

MOTORS

1—500 volt, 15 Kilowatt 900 R. 1—250 volt, 11 Kilowatt, 1150 R. 2—250 volt, 8 H.P. 1—250 volt, 10 H.P. 600 R. Built Specially for Hoisting Purposes.

All in First Class Order and no Reasonable Cash Offer refused.

WRITE, WIRE, OR CALL.

ELEVATOR SPECIALTY CO.

Cor. Lombard and Church Sts., TORONTO

LABOURERS & MECHANICS

Supplied at Shortest Notice.

Railroad Contractors and Engineers

requiring Skilled and Unskilled Help will find it pays to Write or Phone us.

The O.K. Employment Agency

MACK & CO. 88 BAY ST., TORONTO

PHONE—M 617.

FOR SALE

Rails—Newand second-hand

Locomotives—Standard and narrow gauge.

Contractor's Equipment.

JOHN J. GARTSHORE

58 Front Street, West, TORONTO

(Continued from Page 43).

Sewer Pipe.—

	4-in.	6-in.	9-in.	10-in.	12-in.	24-in.
Straight pipe per foot	$0.20	$0.30	$0.60	$0.75	$1.00	$3.25
Single junction, 1 or 2 feet long.	.90	1.35	2.70	3.40	4.50	14.63
Double junctions	1.50	2.50	5.00	....	8.50	.....
Increasers and reducers	....	1.50	2.50	....	4.00	.....
P. traps	2.00	3.50	7.50	....	15.00	.....
H. H. traps	2.50	4.00	8.00	....	15.00	.....

In steady demand; price 73 per cent. off list at factory for car-load lots; 65 per cent. off list retail.

Steel Beams and Channels.—Quiet. We quote:—$2.50 to $2.75, according to size and quantity; if cut, $2.75 to $3; angles, 1 1-4 by 3-16 and larger, $2.50; tees, $2.80 to $3 per 100 pounds. Extra for smaller sizes of angles and tees.

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

Sheet Steel.—Market steady, with fairly good demand; 10-gauge, $2.50; 12-gauge, $2.55; American Bessemer, 14-gauge, $2.35; 17, 18, and 20-gauge, $2.45; 22 and 24-gauge, $2.50; 26-gauge, $2.65; 28-gauge, $2.85.

Tank Plate.—3-16, $2.40 100 lbs.

Tool Steel.—Jowett's special pink label, 10½c. Cyclops, 16c.

Tin.—There is a moderate business passing, prices are firmly held.

Wheelbarrows.—Navvy, steel wheel, jewel pattern, knocked down, $21.35 per dozen; set up, $22.35. Pan Canadian, navvy, steel tray, steel wheel, per dozen, $3.30 each; Pan American, steel tray, steel wheel, $4.25 each.

Zinc Spelter.—Business fairly active, market firm at $5.25 to $5.50, outside market weaker.

A. W. FABER'S

"CASTELL"

PENCILS

The Finest in Existence

16 Degrees 6 B to 8 H.

Unequalled for PURITY, SMOOTHNESS, DURABILITY or GRADING

A. W. FABER'S "CASTELL" Copying Pencil

A. W. FABER

149 Queen Victoria Street

LONDON, E.C.

Manufactory Established 1761

APPLICATIONS WANTED

Applications will be received at the office of the Undersigned and marked "Application for City Engineer" up to and including **Tuesday the 23rd of March, 1909** until 5 o'clock P. M.

J. H. TRUSDALE, City Clerk

Saskatoon, Sask., Feb. 15th, 1909

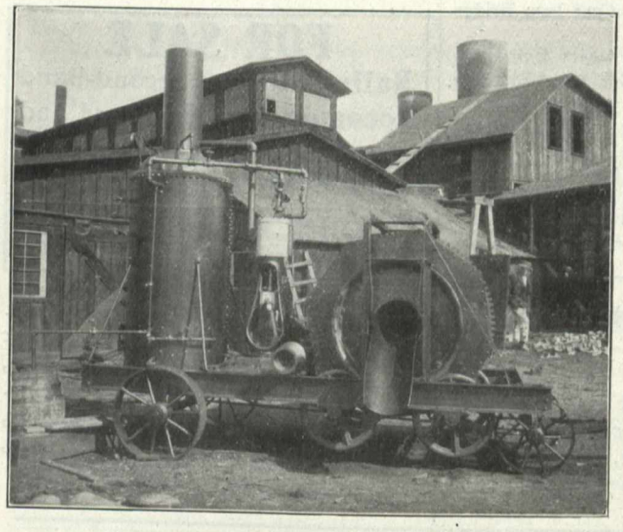
AMONG THE MANUFACTURERS

A department for the benefit of all readers to contain news from the manufacturer and inventor to the profession.

THE HADSEL MIXER.

At the cement show, which closed last Saturday night, the writer interviewed some of the exhibitors as to what they thought of the first show. The Rogers Supply Co., said: "We are highly pleased with the results to date and fully realize what the cement show meant to manufacturers of concrete mixers. We know that all the different mixers on the floor of the cement show were on trial by expert engineers, contractors and architects, and in exhibiting the Hadsel mixer we knew that our machine would be inspected closely, as it was the first appearance of the "Hadsel" in Canada, and we have good reasons to feel pleased on account of the favorable comments made about the strong features of the Hadsel mixer. You may ask any contractor or engineer who attended the show if he saw the Hadsel mixer and what he thought of it. Then, you will understand why we are pleased with the results of the show. One prominent engineer said: "The Hadsel mixer ought to last for an ordinary lifetime because the machine is so simple and strong that there is practically nothing to get out of order."

A strong feature is shown by the accompanying cut, which exhibits our drum supported on four 28-inch chilled



cast iron rollers geared on steel 1-inch beam. Also note large cast iron concave rim riveted to drum ends for drum to revolve on.

A well-known contractor said: "What I particularly like about the Hadsel mixer is that it is the nearest thing to a fool-proof machine that I have seen." Our half yard mixer is capable of discharging one yard per minute, this will give an idea of the value of the mixer for work where expedition is important. The mixer mixes thoroughly every particle of material which enters the drum.

MORE ORDERS FOR "ALLEN" RIVETERS.

There is a brisk demand for "Allen" portable pneumatic riveting machines, judging from sales reported recently by the sole manufacturer of these standard tools, John F. Allen, 370-372 Gerard Avenue, New York City.

Two riveters each have been sold to the Kelly Manufacturing Company, Waterloo, Ia.; Memphis Steel Construction Company, Memphis, Tenn., and Harlan & Hollingsworth Company, Wilmington, Del.

Orders for one riveter each have been received from the Corby Supply Company, St. Louis, Mo.; Dyer Brothers, San Francisco, Cal.; William Scaife & Sons, Oakmont, Pa.; American Steel Company, Matanzas, Cuba; Reliance Motor Truck Company, Owosso, Mich.; Cananea, Yaqui River & Pacific R.R. Company, Senora, Mexico; Houston Structural Steel Company, Houston, Texas.

The orders from the Harland and Hollingsworth Company as the second "Allen" riveter sold them within a period of three weeks.

INDUSTRIAL TURBINE DEVELOPMENT.

The Portland Cement Company, of Portland, Colo., have purchased a 600 k.w. three-phase, 60 cycle Westinghouse turbo generator equipment, with a Le Blanc condenser, a rotary converter and a switchboard. These are to be installed as an addition to their present plant and serve rather as a gain in economy than in output. That will give an increased power capacity to be used on additional grinding machinery. The turbine and condenser are now being built by the Westinghouse Machine Company, and the electrical apparatus by the Westinghouse Electric and Manufacturing Company.

The installation of the Le Blanc condenser makes it possible to utilize for condenser purposes water from an old well which is not now usable with the present type of surface condenser. This will save the company a nice sum on their water supply reservoir and pipe lines.

It is interesting to note that turbines have been adopted in this plant for power extension, rather than Corliss engines, two of which have already been operating for a number of years on surface condensers. Fuel used is a southern Colorado bituminous coal of rather poor quality. With the moderate superheat and high vacuum contemplated, it will thus be possible for the turbine to effect considerable economy in operation. Although direct current is largely used at this plant, an alternating current turbine unit was selected in connection with a rotary converter as providing greater flexibility of operation than obtainable with a direct current turbine unit which was also under consideration.

THE D. P. BATTERY COMPANY, LTD., BAKEWELL.

To cope with their annually increasing output of Storage Batteries the company have reorganized and extended their works, already covering some five acres but preserving ten acres for future requirements, and situated amongst the healthful and delightful surroundings shown by the photographic view on the "D. P." Calendar, 1909. The additional large forming shop recently completed affords faculties for increasing their output by some quarter million of plates annually, which, with the large stock of over 20,000 plates of standard types will enable the company to give prompt delivery. A special feature in the works is their test room and laboratory in which a most careful supervision is exercised over the products in the various states of manufacture and in the analysis of all metal used. The guarantee the firm gives of workmanship and material is consequently substantial and effective.

Both in the home and foreign trade the firm's output has been a record in the past year of 1908, and from the increasing number of enquiries it is apparent that the general depression in trade is not seriously affecting the demand in this industry.

The Ontario Lime and Clay Company have been formed to work a lime, clay and cement proposition on the Mohawk Indian Reserve, Township of Tyenindaga, near Shannonville, Ont. Hydrated lime will be their first product. The provisional board of directors include F. R. Lingham, L. E. Allen, C. I. White, and John W. Walker.

(Continued from Page 44.)

6376—February 17—Dismissing complaint of Charles Knight, of Calgary, Alta., against the C.P.R., alleging discrimination in live stock rates from Strathmore to Hochelaga; also from Calgary et al and Winnipeg, and alleged discrimination between the complainant and R. Burns & Co.

6377—February 17—Authorizing the city of Calgary to lay at its own expense water pipe under tracks of the C.P.R. at First Street West, Calgary, Alta.

6377 (a)—February 26—Granting leave to the Toronto Electric Light Company to erect, place and maintain temporarily, certain wires for the conveyance of electricity over and across the right-of-way and tracks of the G.T.R. at a point near Lansdowne Avenue, Toronto, Ontario.

6378—February 27—Granting leave to the B.T. Co. to erect, place, and maintain its aerial wires and cables across the tracks of the G.T.R. at Station St., Lennoxville, P.Q.

6379 to 6385, inclusive—March 1—Granting leave to the rural municipality of Argyle to erect, place, and maintain its wires across the tracks of the C.N.R. at various points in the Province of Manitoba.

6386—January 18—Dismissing complaint of Geo. E. Barber Co., Limited, Hall & Fairweather, Limited, C. H. Peters & Sons, A.C. Smith & Co., and the W. F. Hathaway Co., Limited, and the city of St. John, N.B., complaining against an arrangement with the C.P.R., the I.C.R., and the Seely Packet Line, for handling grain products from the West for ports on the Bay of Fundy from stations on the Dominion Atlantic Railway in the Province of Nova Scotia.

6387—February 27—Authorizing the G.T.R. to refund to And. Baile, of the City of Montreal, the amount of overcharge, namely, twenty cents a ton on the carload of coal shipped by the complainant from Huntingdon, P.Q., to Ottawa, Ontario.

6388—February 26—Granting leave to the Bell Telephone Co. to erect, place, and maintain its wires under the tracks of the G.T.R. Co. at siding at corner of 7th Concession and Crowland Road, Crowland township, Ontario.

(Continued from Page 45)

H. G. Hocken, Toronto. Western Dry Dock & Shipbuilding Company, $1,000,000; J. H. Spence, C. E. H. Freeman, A. Singer, Toronto. The McPhail & Wright Construction Company, $50,000; D. P. McPhail, J. A. McPhail, K. McK. Wright, Sault Ste. Marie, Ont. Gow Ganda Transport Company, $100,000; A. C. McKenzie, Beaverton; R. B. Henderson, A. H. Royce, Toronto.

The general manager of the Bessemer & Lake Erie Railroad, in his annual report, has the following to say regarding the use of set ties on that road, which is more extensive than on any other raill road in the country: "The use of the steel tie continues to increase our confidence in its utility and I think it is within reasonable bounds to assert that within the next three years the Bessemer road will be double-tracked between Conneaut Harbour and North Bessemer with steel ties, and that by that time the price of first-class white oak wooden ties will be considerably over $1 each, whereas the steel ties are selling to-day at about $2, and that the management of the Bessemer road can feel that, aside from the few ties that may be destroyed by reason of derailments (and which have a scrap value of at least half of their purchase price), for the next 20 to 40 years the question of tie renewals will not enter into calculations of expenses for maintenance of way."

WHERE TO BUY.

(Continued from page 2.)

Contractors
Cleveland Bridge & Engineering Co., Ltd., Darlington, England.
Metcalf Engineering Co., Ltd., Montreal, Que.

Converters, Rotary
Toronto & Hamilton Electric Co., Hamilton, Ont.

Conveyors
Babcock & Wilcox, Ltd., Montreal.

Cranes
Dominion Bridge Co., Ltd., Montreal.
Mussens Limited, Montreal, Que.
Northern Engineering Works, Detroit, Mich.
Pennsylvania Steel Co., Steelton, Pa.
Structural Steel Co., Ltd., Montreal, Que.

Damper, Regulators
Babcock & Wilcox, Ltd., Montreal.
D'Este Co., Julian, Boston, Mass.

Derricks
Dominion Bridge Co., Ltd., Montreal,
Mussens Limited, Montreal, Que.
Northern Engineering Works, Detroit, Mich.
Structural Steel Co., Ltd., Montreal, Que.

Draughting Supplies
Berger & Sons, C. L., Boston, Mass.,
Hart Co., John A., Winnipeg, Man.

Drawing Material.
Keuffel & Esser Co., Hoboken, N. J.

Drills
Canadian Buffalo Forge Co., Montreal and Toronto.
Mussens Limited, Montreal, Que.

Dust Separators.
Canadian Buffalo Forge Co., Montreal and Toronto.

Drying Apparatus.
Canadian Buffalo Forge Co., Montreal and Toronto.

Dynamos and Motors
Toronto & Hamilton Electric Co., Hamilton, Ont.

Economizers
Babcock & Wilcox, Ltd., Montreal.

Electric Apparatus
Hill Electric Mfg. Co., Montreal, Que.
Toronto and Hamilton Electric Co., Hamilton, Ont.

Electrical Supplies
Hill Electric Mfg. Co., Montreal, Que.
Phillips, Eugene F., Electrical Works, Ltd., Montreal, Canada.

Elevators
Northern Engineering Works, Detroit, Mich.

Engineers, Consulting
Beaubien, Gaspe de, Montreal.
Francis, W. J. Montreal, Que.
Fuce, Ed. O., Galt.
Metcalf Engineering Co., Ltd., Montreal, Que.
Mitchell, C. H., C.E., Toronto, Ont.
Nold, Henry N., Hamilton.
Richmond, J. Stanley, Toronto.
Standard Inspection Bureau, Limited, Toronto, Ont.

Engineering Instruments.
Keuffel & Esser Co., Hoboken, N. J

Engines
Canadian Buffalo Forge Co., Montreal and Toronto.
Mussens Limited. Montreal, Que.
Northern Engineering Works, Detroit, Mich.
Reavell & Co., Ltd., Ipswich, Eng.
Petrie, H. W., Ltd., Toronto, Montreal, Vancouver.

Fans and Blowing Apparatus
Canadian Buffalo Forge Co., Montreal and Toronto.

Feed Water Heaters and Purifiers
Babcock & Wilcox, Ltd., Montreal.

Fence, Fencing, Wire
Owen Sound Wire Fence Co.

Fire Brick and Clay
Leslie & Co., A. C., Montreal.

Forgings, Drop
Coghlin & Co., B. J. Montreal, Que.

Foundry Supplies
Mussens Limited, Montreal, Que.

Generators, Alternating and Direct Current
Toronto & Hamilton Electric Co., Hamilton, Ont.

Heating and Ventilating Machinery.
Canadian Buffalo Forge Co., Montreal and Toronto.

Hoists, Electric and Pneumatic
Northern Engineering Works, Detroit, Mich.

Hydraulic Machinery.
Canadian Buffalo Forge Co., Montreal and Toronto.

Iron Bar, etc.
Leslie & Co., A. C., Montreal

Inspections
Standard Inspection Bureau, Limited, Toronto, Ont.
Dominion Bureau, Montreal, Que.

Ladles
Northern Engineering Works, Detroit, Mich.

Mechanical Draft Motors.
Canadian Buffalo Forge Co., Montreal and Toronto.

Motors
Mussens Limited, Montreal, Que.
Toronto & Hamilton Electric Co., Hamilton, Ont.

Patent Attorneys
Budden, Hanbury A., Montreal, Que.
Ridout & Maybee, Toronto, Ont.

Planer Tools
Armstrong Bros. Tool Co., Chicago, Ill., U. S. A.
Mussens Limited, Montreal, Que.

Poles, Telegraph and Telephone.
Sterling, W. C. & Son Co., Monroe, Mich.

Portland Cement
Hartranft Cement Co., Wm., Montreal, Que.

Preservatives
Carbolite Carbolineum Co., Toronto,

Presses, Hydraulic and Power
Mussens Limited, Montreal, Que.
Wood & Co., R. D., Philadelphia, Pa.

Pressure Regulators
D'Este Co., Julian, Boston, Mass.

Pulleys
Mussens Limited, Montreal, Que.

Pumps—Steam and Power.
Canadian Buffalo Forge Co., Montreal and Toronto.
Mussens Limited, Montreal, Que.
Petrie, H. W., Ltd., Toronto, Montreal, Vancouver.
Reavell & Co., Ltd., Ipswich, Eng.
Wood & Co., R. D., Philadelphia, Pa.

Purifiers
Babcock & Wilcox, Ltd., Montreal,
Wood & Co., R. D., Philadelphia, Pa.

Railway Supplies
Coghlin & Co., B. J. Montreal, Que.
Mussens Limited, Montreal, Que.
Koppel Co., Arthur, New York City.

Railways, Industrial and Portable
Koppel Co., Arthur, New York City.

Ratchet Drills, Universal
Armstrong Bros. Tool Co., Chicago, Ill., U.S.A.
Mussens Limited, Montreal, Que.

Rock Crushers
Mussens Limited, Montreal, Que.

Rope, Manilla and Wire
Mussens Limited, Montreal, Que.

Separators, Steam
Babcock & Wilcox, Ltd., Montreal,

Sewage Disposal
Cameron Septic Tank Co., Chicago, Ill., U.S.A.

Sewer Pipe
Hamilton & Toronto Sewer Pipe Co.

Sheet Metal Work.
Canadian Buffalo Forge Co., Montreal and Toronto.

Shovels, Steam
Mussens Limited, Montreal, Que.

Springs
Coghlin & Co., B. J., Montreal, Que.
Montreal Steel Works, Montreal, Que.

Steel, Speedicut High-speed
Montreal Steel Works, Montreal, Que.

Steel, Structural
Cleveland Bridge & Engineering Co., Ltd., Darlington, England.
Dominion Bridge Co., Ltd., Montreal,
Hamilton Bridge Works Co., Hamilton, Ont.
Pennsylvania Steel Co., Steelton, Pa.
Structural Steel Co., Ltd., Montreal,

Steel, Tool
Montreal Steel Works, Montreal, Que.
Mussens Limited, Montreal, Que.
Allen & Co., Edgar, Sheffield, Eng.

Stokers, Mechanical
Babcock & Wilcox, Ltd., Montreal,

Stone Crushers and Screens
Mussens Limited, Montreal, Que.

Surveying Instruments
Berger & Son, C. L., Boston, Mass.
Gurley & Co., W. & L. E., Troy, N.Y.
Hart Co., John A., Winnipeg, Man.

Tanks, Steel and Iron
Structural Steel Co., Ltd., Montreal,
Wood & Co., R. D., Philadelphia, Pa.

Tool Grinders
Armstrong Bros. Tool Co., Chicago, Ill., U.S.A.

Track Jacks
Montreal Steel Works, Montreal, Que.
Mussens Limited, Montreal, Que.

Transformers
Toronto and Hamilton Electric Co., Hamilton, Ont.

Transmission Machinery
Mussens Limited, Montreal, Que.
Toronto and Hamilton Electric Co., Hamilton, Ont.

Trucks
Northern Engineering Works, Detroit, Mich.

Valves
Babcock & Wilcox, Ltd., Montreal,
Wood & Co., R. D., Philadelphia, Pa.

Waterworks Supplies
Wood & Co., R. D., Philadelphia, Pa.

Wire
Coghlin & Co., B. J., Montreal, Que.

Wire Rope
Coghlin & Co., B. J., Montreal, Que.
Mussens Limited, Montreal, Que.