THIS ISSUE CONTAINS { Concrete Stock Pens
Cement Industry in Canada

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, February 26th, 1909. No. 9.

BUYER'S REFERENCE—PAGE 2.

WHERE TO BUY

An Engineering Trades Directory

For the Assistance of Engineers, Contractors and Purchasing Agents

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Air Compressors
Mussens Limited, Montreal, Que.

Anvils
Leslie & Co., A. C., Montreal, Que.

Automatic Railways
Babcock & Wilcox, Ltd., Montreal,

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

Belting
Harpell-Stokes, Limited, Winnipeg and Toronto.
McLaren, D. K., Ltd., Montreal, Que.
McLaren Belting Co., J. C., Montreal.

Boilers, Marine, Stationary and Water Tube
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Canadian Bridge Co., Ltd., Walkerville, Ont.
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Dominion Bridge Co., Ltd., Montreal,
Hamilton Bridge Works Co., Ltd., Hamilton.
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Harpell-Stokes, Limited, Winnipeg and Toronto.
Mussens Limited, Montreal, Que.

Cement, Machinery
Harpell-Stokes, Limited, Winnipeg and Toronto.
Mussens Limited, Montreal, Que.
Senator Mill Mfg. Co., Ltd., Galt,

Coal Crushers
Babcock & Wilcox, Ltd., Montreal,
Senator Mill Mfg. Co., Ltd., Galt,

Coal Handling Machinery
Northern Engineering Works, Detroit, Mich.

(Continued on page 50.)

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* Every Other Week

† Once a Month

CONSULTING ENGINEERS

NEW INCORPORATIONS.

Saskatchewan.—Stoney Beach Rural Telephone Co., Limited, Belle Plaine, Sask.

Alberta.—The Northern Alberta Machinery Co., Limited, Edmonton. The Chicago Alberta Oilfields Co., Limited, Edmonton. Alberta Queen Mining and Development Co., Limited, Raymond. Canadian Development Co., Limited, Calgary.

Quebec.—The Montreal & St. Lambert Terminal Development Co., $350,000; J. A. Smith, F. E. M. Smith, C. E. Huston, Montreal. Thetford Robertson Improvement Co., Limited, $20,000, contractors; A. A. Faucher, Montreal; Geo. J. Delisle, P. Pondrier, Thetford Mines.

British Columbia.—Albion Brick Co., Limited, $50,000. Twin City Transportation Co., Limited, $100,000. Yellow Cedar Lumber Co., Limited, $500,000. Edinboro' Timber Co., Limited, $200,000. The Western Canada Wood pulp & Paper Co., Limited, $1,500,000. Hassam Paving Co. of B.C., Limited, $25,000. Hillis Timber & Trading Co., Limited, $25,000. Pacific Slope Lumber Co., Limited, $250,000. Burrard Land & Improvement Co., Limited, $125,000.

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The Canadian Engineer

WEEKLY

ESTABLISHED 1893

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The Canadian Engineer

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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

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Three Months -	0.75	Three Months -	1.00

ADVERTISEMENT RATES ON APPLICATION.

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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.

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TORONTO, CANADA, FEBRUARY 26, 1909.

CONTENTS OF THIS ISSUE.

BRITISH COLUMBIA IRRIGATION BILL.

Irrigation in Western Canada is becoming more scientific annually. The work done by the Western Irrigation Association is bringing results. The addresses have been instructive. The Association has encouraged united action, and one of the direct results of this educational campaign has been the introduction of the Irrigation Bill recently presented to the Legislative Assembly of British Columbia.

The bill is founded on the Water Clauses Consolidated Act of British Columbia, and is shaped largely on the legislation governing irrigation matters in Colorado, whose Water Rights Act is the most complete and workable in America.

The bill would divide the Province into districts, with a chief water commissioner for the whole Province and commissioners for each district having control over local matters. These water commissioners would have the direction, control, management and charge of the distribution of water.

A Board of Investigation is to be appointed to enquire into existing rights. It will also be part of their duty to examine all claims presented, to determine their priorities; and, in the case of irrigation, to determine the quantity of water which each may be entitled to, and to establish the character of his works.

Having obtained a license under the new system, the licensee is expected to promptly proceed to put himself in a position to commence the necessary works to utilize the water. Having made, as required, a certain examination and survey, if the quantity intended to be used is small, that is to say, it does not exceed four cubic feet per second, he will apply to the Water Commissioner for the purpose of obtaining his approval of the proposed works, and it will be the duty of the Water Commissioner to see that the proposed works are of a character which will safeguard the public interest, and do as little injury as possible to persons whose lands may be adjacent to or crossed by the proposed works.

In the case of licensees using water in any larger quantities than four cubic feet per second, they will have to obtain the approval of the Lieutenant-Governor-in-Council, and supply all the information that is necessary to enable the Executive Council to decide whether the plans as submitted to them are of a character fit for the work intended to be carried out, and also to enable them to adjudicate properly upon the question submitted.

Special care has been taken to protect municipalities desiring to use water for domestic purposes. The Rivers and Streams Act and amendments have been incorporated under the head of clearing streams for driving logs. A great deal of the legislation upon this subject has been recast, as is the case with nearly all the matter contained in the bill, but the powers of the County Court judge have been retained.

Provision is made for the storing of water and the expropriation of land.

In British Columbia there are so many vested rights, and landowners have built irrigation ditches without much governmental inspection, that it may take years to eliminate water waste and adjust existing conditions.

Alberta and Saskatchewan must follow with similar measures.

CANADIAN GOVERNMENT RAILWAYS.

The annual report of the Canadian Department of Railways for the fiscal year ended March 31st, 1908, sets forth the gross earnings of the Government roads for the year as $9,534,569, and the working expenses were $9,595,295, thus showing a loss of $60,726. The Intercolonial Railway's working expenses were $9,157,435, and showed a profit of $16,123, but the heavy operating expenses on the Prince Edward Island road caused the deficit.

Railway subsidies amounting to $2,037,629 were paid during the year.

The expenditures made by or through the Department on its several works of operation, maintenance and construction, and in subsidies of railway enterprises in the Dominion, other than Government roads, aggregated as follows: Total railway expenditure, $35,495,196, of which $23,684,000 was charged to capital, $2,215,895 to income and $9,595,295 to revenue. Capital expenditure included $18,910,449 for the National Transcontinental.

The I.C.R. expenditure was $13,577,491, made up of $4,382,494 on capital and $9,157,435 on revenue; expenditure on the Prince Edward Island Railway was $790,409; on canals, $3,221,984 was spent.

All this information is interesting and valuable, but how much more valuable would it be if it were given out before it was almost a year old.

It cannot be maintained that the information is not at hand. We find that members of Parliament have secured and used in the House information similar to that given in the report, but more recent by nine months.

THE WATER POWERS OF CANADA.

We hear a great deal about Canada's natural resources. Thousands upon thousands of dollars have been spent by the interested departments in exploiting the extent, location and possibilities of our agricultural lands, mineral deposits and forest wealth, but of our waterfalls little definite knowledge is available.

We have a hazy idea that here and there throughout the country there are numerous water-powers. Of the undeveloped waterfalls a few are large, and have already been fairly well "rated." In the settled districts the water powers are well defined as to location and possibilities, but in the great unsettled and sparsely settled districts there are numerous undeveloped power possibilities. Of these, some department of our Government should be informed and prepared to furnish data. Explorers return and tell us of mineral and forest wealth, and "estimate" the water-power close at hand, but these estimates are made under conditions not conducive to the securing of correct information.

We think it would be well for the Government or Governments most directly interested to explore and survey the undeveloped waterfalls of Canada. The whole of the work cannot be done in one season, but by taking it up in sections and continuing from year to year there could be published annually a volume that would be of great interest to investors.

Hand in hand with the development of our water-powers would come the building up of allied interests and the creation of a new interest in our natural resources. We have many large, pressing public questions to-day. The calls on the public treasury are numerous, but through it all there should be enough interest taken in the future to enable this preliminary work being done on our possible power sites.

Electrical Development earnings in January were: Gross, $56,451; net, $45,821. This is equivalent to 106.5 per cent. of the fixed charges.

The annual "time" meeting of the Canadian Pacific Railway was held this week at Montreal, where a number of the officials of the road met to discuss arrangements for the coming summer. The main change of importance made was a decision to start the usual summer double daily transcontinental service about the 15th of March. Mr. J. W. Leonard presided, and amongst others present were Messrs. James Oborne, general superintendent of the Ontario Division, and M. R. L. Thompson, D.P.A., Toronto; Mr. W. B. Howard, D.P.A., St. John; Mr. F. P. Gutelius, general superintendent of the Superior Division, and William Downie, general superintendent, Atlantic Division

COMING MEETINGS OF ENGINEERING SOCIETIES.

Canadian Cement and Concrete Association.—First Annual Convention and Exhibition, March 1-6, 1909, St. Lawrence Arena, Toronto. Secretary, A. E. Uren, 62 Church Street, Toronto. Manager of Exhibition, R. M. Jaffray, 1 Wellington Street West, Toronto.

* * * *

Canadian Mining Institute.—March 3-5, 1909, annual general meeting, Windsor Hotel, Montreal. H. Mortimer-Lamb, secretary, Montreal.

* * * *

Dominion Land Surveyors.—March 2nd, 3rd, 4th, 1909, annual meeting, Ottawa, Ont. T. Nash secretary.

* * * *

Ontario Provincial Good Roads Association.—March 3, 4, 1909, Annual Meeting, County of York Municipal Hall, Adelaide Street, Toronto. J. E. Farewell, Secretary, Whitby, Ont.

* * * *

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

* * * *

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.—March 4th, "Smoker." 96 King Street West.

RAILWAY EARNINGS AND STOCK QUOTATIONS

NAME OF COMPANY	Mileage Operated	Capital in Thousands	Par Value	EARNINGS Week ending Feb. 21		STOCK QUOTATIONS TORONTO				MONTREAL			
				1909	1908	Price Feb 20 '08	Price Feb. 11 '09	Price Feb. 18 '09	Sales Week End'd Feb 18	Price Feb 20 '08	Price Feb. 11 '09	Price Feb. 18 '09	Sales Week End'd Feb 1
Canadian Pacific Railway	8,920.6	$150,000	$100	1,156,000	1,054,000	142½	175	172½	581	143¼ 142½	174½ 173¼	173½ 172¼	600
Canadian Northern Railway	2,986.9			129,500	127,800								
*Grand Trunk Railway	3,568.7	226,000	100	612,304	591,472								
T. & N. O.	305	(Gov. Road)											
Montreal Street Railway	188.3	18,000	100	73,425	65,998					180 177½	208 207¾	209 208½	95
Toronto Street Railway	114	8,000	100	69,483	62,710	100	120	119½	95	100 99	120¼ 119⅝	120½ 120	721
Winnipeg Electric	70	6,000	100				170 169⅝	170 168	615		170 167½	169¼	25

*1st. pref. 104⅛, 3rd pref. 54¾, ordinary 18¾

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

UNION STOCK YARDS FIRE PROOF.

*Edw. O. Fuse, A.M. Soc. C.E.

After the disastrous fire in August, 1908, which destroyed about ten acres of stock sheds and buildings of the Union Stock Yards Company, Limited, West Toronto, including a large two-story sheep building, the shareholders decided that future buildings should be of fireproof construction. It was decided that for immediate needs one, possibly two sheep buildings were required.

The plans submitted for these buildings covered three alternative methods of construction, viz.:—

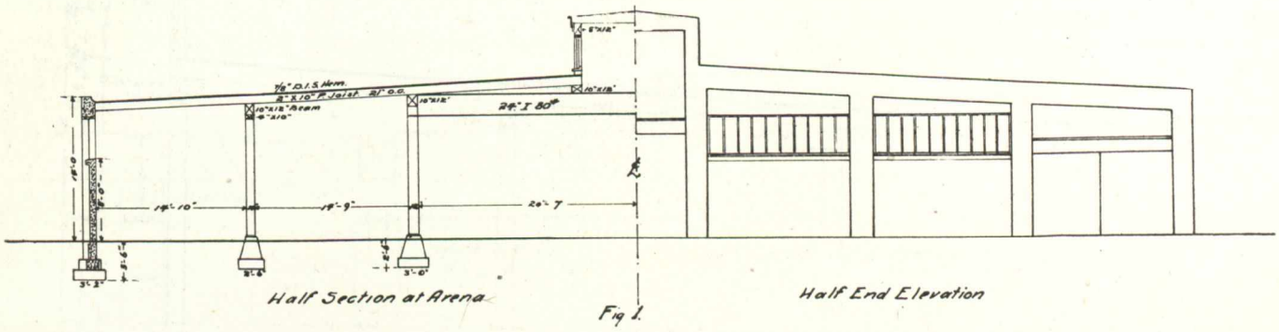


Fig 1.

1. Reinforced concrete construction throughout.
2. Reinforced concrete exterior walls, galvanized iron and steel roof on concrete columns.
3. Reinforced concrete exterior walls with timber roof covered with fireproof or semi-fireproof roofing.

The latter method of construction was adopted and contracts let, one building to be completed by December 15th, 1908.

The buildings are similar in design and are 377 x 104 feet inside measurement, each building.

The outer walls consist of a series of 2'-0" x 1'-2", concrete columns spaced 16 feet centres apart, the space between being filled by a 6-inch curtain wall 8'-0" high. Above the curtain wall there is a 4'-0" x 14'-0" window opening. Above the windows and supported by the columns is a lintel beam 2'-2" in depth, which carries the outer ends of the first span of roof joist. This beam rises 8 inches above the roof to form a fire break and is moulded at the roof to form a channel for the conveyance of roof water to the down pipes.

The columns are reinforced with four vertical rods placed near the four angles of the column. The lintel beam is reinforced with two ¾-inch round rods placed 2 inches above the bottom of the beam.

At every third column provision is made for carrying off the roof water by moulding a 4" x 4" recess in the inner face of the column for the reception of the 4-inch corrugated down pipes. These pipes enter 4-inch tile at floor level by means of which the water is then carried to the sewer running through the centre of the building.

The roof construction, except above the Arena, consists of 2" x 10"-16' pine joists spaced 21-inch on centres, carried by 10" x 12" pine beams. These beams are supported on six rows of 10" x 10" pine posts spaced 16 feet centres parallel to and 15'-8" at right angles to the length of the building, except the centre rows which are 10'-10" on centres at right angles to the building.

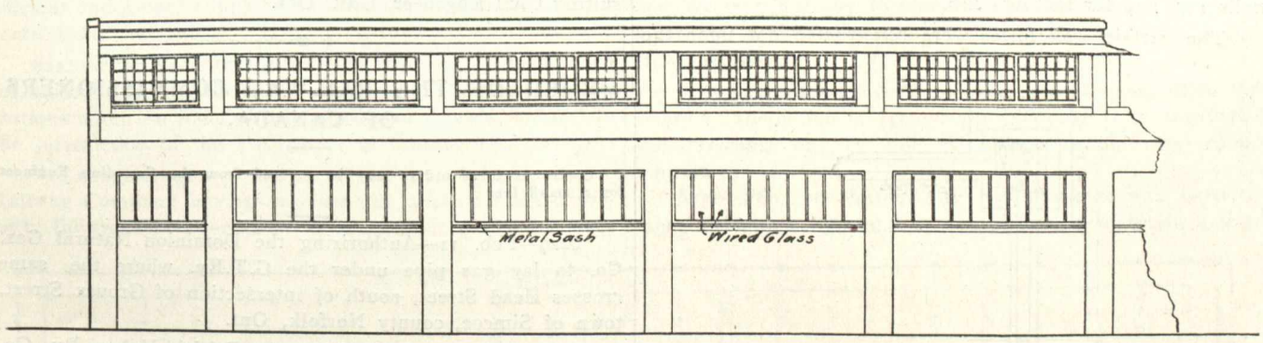
The monitor or ventilator roof is carried on 8" x 8" pine posts, 8' x 12" beams and 2" x 10" pine joist.

The joists are covered with ⅞-inch D.I.S. hemlock sheeting on which is laid a heavy felt and gravel roofing.

One-half of one of the buildings is designed to provide a temporary Arena for show purposes. Here the two centre rows of posts are left out and the roof carried on 24" x 80" I. beams of 42-foot span. This provides a show ring 40' x 175' an ' seating capacity for 1,500 persons.

All windows in the exterior walls are wired glass set in metal frames. Those in the monitor being common glass in wooden sash and frames. There are three sash to each panel the centre one being hung at the centre on a swivel to swing inwards for purposes of ventilation.

Each building has a 10'-0" centre alley and eight foot side alleys running the full length, also three eight foot cross alleys. This provides two rows of pens 16'-0" x 39'-0". There are 40 of these pens in each building, or a capacity of 40 cars of sheep. Each building is fitted with a 12' x 40" scale, and sorting and marking pens, and weighmaster's office. A 12-inch sewer and 2-inch water main run the entire length of the buildings with ¾-inch leads to supply the water troughs and 4-inch tile connections to carry off the overflow.



Part Side Elevation

Fig 2.

The pen divisions are of wire fencing and the buildings are to be brick paved throughout. They are also wired for incandescent lighting.

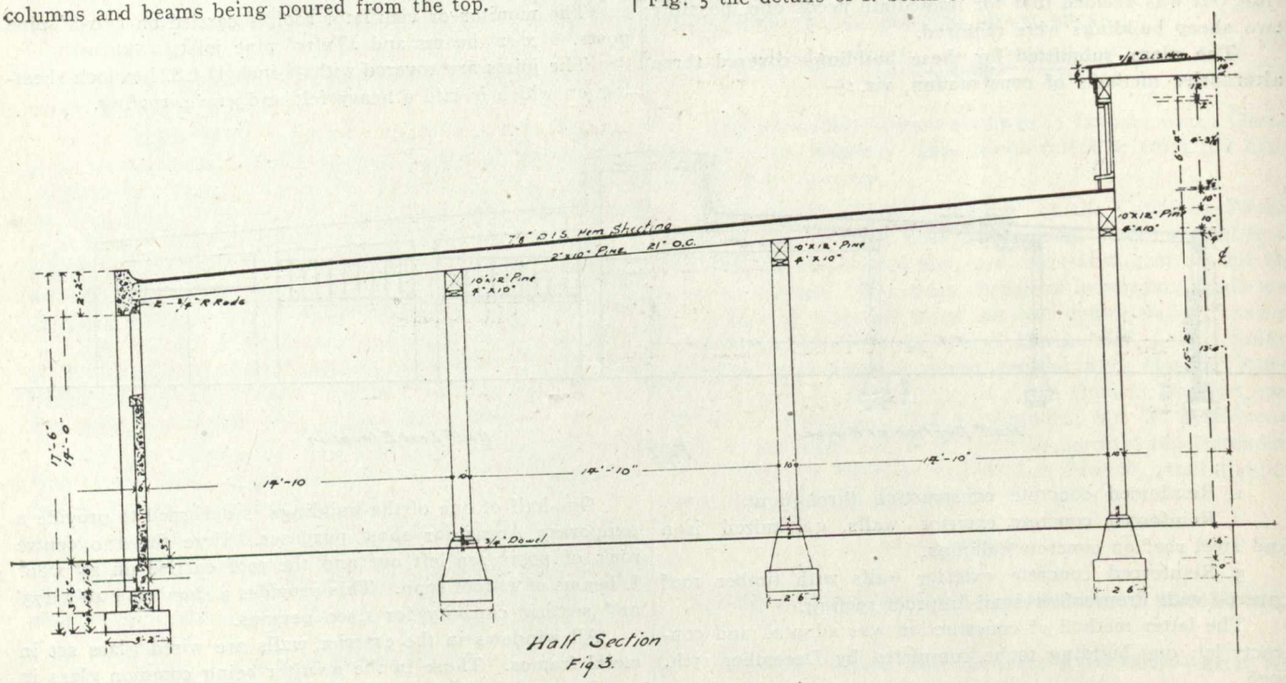
The contractors began work on the excavation on October 15th. The excavating gang was followed closely by a gang of concreters working on the footings and at the same time other gangs were at work framing the posts, beams and joists for the roof and the forms for the concrete columns and beams. When the footings were sufficiently set the work of erecting the forms and constructing the roof was carried on together. The outer ends of the first span of roof joist

*Consulting Engineer of Galt, Ont., who had charge of the design and the supervision of the erection of these buildings.—Ed.

were supported on the forms and the whole roof sheeted before the columns and beams were run.

The materials for the concrete were placed near the centre of one side of the building, and here a hoist was rigged up. The boiler of the hoisting engine also supplying steam to run the concrete mixer. The concrete was mixed at the foot of the hoist, raised to the roof and from there conveyed in barrows and deposited in the forms, all concrete columns and beams being poured from the top.

Fig. 1 shows a half end elevation of one of the buildings and half section at the Arena here the centre rows of posts are left out and the roof supported by 24" x 80" I. beams. Fig. 2 shows a partial side elevation of one of the buildings showing the row of windows in the exterior wall of wired glass in metal frames. Fig. 3 shows a general section of the building with dimensions of footings and roof members. Fig. 4 gives details of columns and curtain walls, etc., and Fig. 5 the details of I. beam construction.

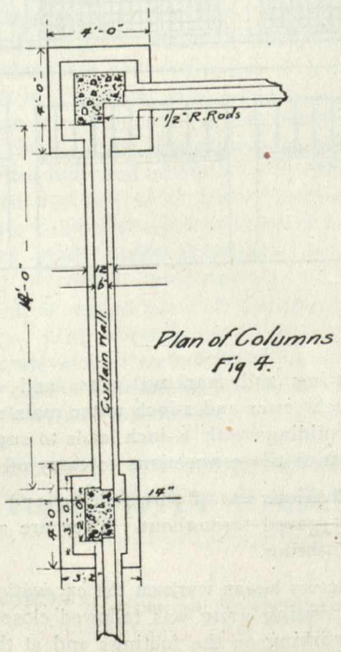


Half Section
Fig 3.

Gravel concrete was intended to be used throughout, but difficulty was experienced in obtaining satisfactory gravel and crushed stone was procured and mixed with the gravel to obtain the required proportions.

All concrete was mixed wet and spaded, and an even surface was procured throughout. The proportions for gravel concrete were, for columns and beams 1:4, for curtain walls 1:5, and for footings 1:6.

The curtain wall forms were constructed flat upon the



Plan of Columns
Fig 4.

ground and the concrete poured in this position. This provided an excellent chance to secure a smooth surface on the outer face. After they were hard set they were hoisted into position, none of them being cracked or damaged in any way in the operation, a neat window sill was moulded and set above the curtain wall.

The Concrete Engneering and Construction Company, Limited, of Toronto, were the contractors for the walls and roof.

G. Duthie and Sons had contracts for roofing and metal sash, and Batts, Limited, for the frame sash.

The buildings were designed by and erected under the supervision of Edw. O. Fuce, A.M. Can. Soc. C.E., Consulting Civil Engineer, Galt, Ont.

ORDER OF THE RAILWAY COMMISSIONERS OF CANADA.

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

6229—Feb. 11—Authorizing the Dominion Natural Gas. Co. to lay gas pipe under the G.T.Ry. where the same crosses Head Street, south of intersection of Grovex Street, town of Simcoe, county Norfolk, Ont.

6230—Feb. 13—Authorizing the British Yukon Ry. Co. to operate its trains and engines over bridge at Caribou, Yukon Territory.

6231—Feb. 11—Granting leave to the C.P.Ry. to construct the Wellington to Alberni branch of its line across highways between mileage 77.97 and 88.83, in the Province of British Columbia.

6232—Feb. 12—Ordering the G.T.Ry. to provide protection by gates at Depot Street, village of Grimsby, Ont.

6233—Feb. 6—Ordering the C.N.Ry., in the city of Winnipeg, to equip its locomotives with appliances to prevent the unnecessary and unreasonable emission of smoke therefrom; also the C.P.Ry. and G.T.P.Ry.

6234—Feb. 8—Refusing application of A. E. Hill, of Griswold, Man., for Order compelling the C.P.Ry. to issue 1,000-mile tickets good to travel over the Western division and branch lines in Manitoba, Saskatchewan and Alberta.

6235—Feb. 8—Ordering the C.N.Ry. and G.T.P.Ry. to provide transfer facilities for the joint handling of traffic between the railway companies at Petrel, Man.

6236—Feb. 8—Dismissing complaint of the Manitoba Grain Growers' Association, of Kelloe, Man., against the C.P.R. removing its agent from that point.

6237—Feb. 8—Ordering the C.P.Ry. to keep their station at Basswood, Man., open permanently and provide an agent therefor.

6238—Feb. 8—Dismissing application of the corporation of the city of Winnipeg, Man., for authority to connect tramway of the city, running from Lac du Bonnet to Point du Bois, with the C.P.Ry. branch, Molson to Lac du Bonnet.

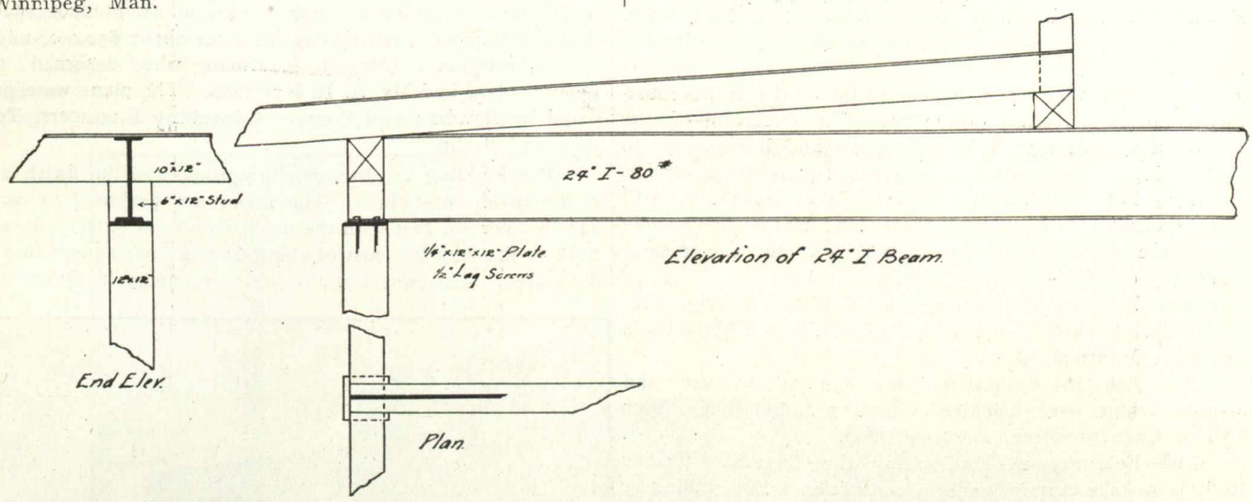
6239—Feb. 8—Dismissing application of the city of Winnipeg for Order directing the C.N.Ry. to provide a proper protection where its railway crosses Pembina Street, Winnipeg, Man.

6244—Feb. 8—Dismissing complaint of Jefferson Caverly, of Bowsman, Man., respecting train service on the Melford branch of the C.N.Ry.

6245—Feb. 16—Dismissing application of the Yorkton-North-West Electric Co. for leave to cross the right-of-way and track of the C.P.Ry. at the west crossing of the town of Yorkton, Sask.

6246 to 6251—Feb. 16—Dismissing application of the Yorkton North-West Electric Co. for leave to cross the right-of-way and track of the C.P.Ry. at various points in the Province of Saskatchewan.

6252—Feb. 15—Dismissing application of the Brandon Saskatchewan and Hudson's Bay Railway Co. for approval



Details of Roof Construction over Arena
Fig 5

6240—Feb. 8—Dismissing complaint of H. H. Shields, of Melton, Man., against excessive rates charged by the C.N.Ry. for warehousing carload of wheat consigned to their warehouse at Port Arthur, Ont.

6241—Feb. 8—Dismissing complaint of Geo. Steel, of Glenboro, Man., of failure of the C.P.Ry. to furnish an efficient and proper supply of cars for the movement of grain traffic from that point.

6242—Feb. 8—Ordering that the following form be used for release of responsibility for freight shipped to flag stations upon the lines of all railways in Canada, subject to the jurisdiction of the Parliament of Canada:—

"In consideration of the..... Railway Company having received the above-described property for transportation from..... Station to .....Station..... do hereby release said Company from all loss or damage that may occur to any of the above-mentioned property after it has been unloaded from the cars at..... Station, the said station being a flag station without Agent."

6243—Feb. 8—Ordering the G.T.P.Ry. to construct a suitable and proper crossing for farm purposes over their line at Section 29, Township 13, Range 25, Manitoba.

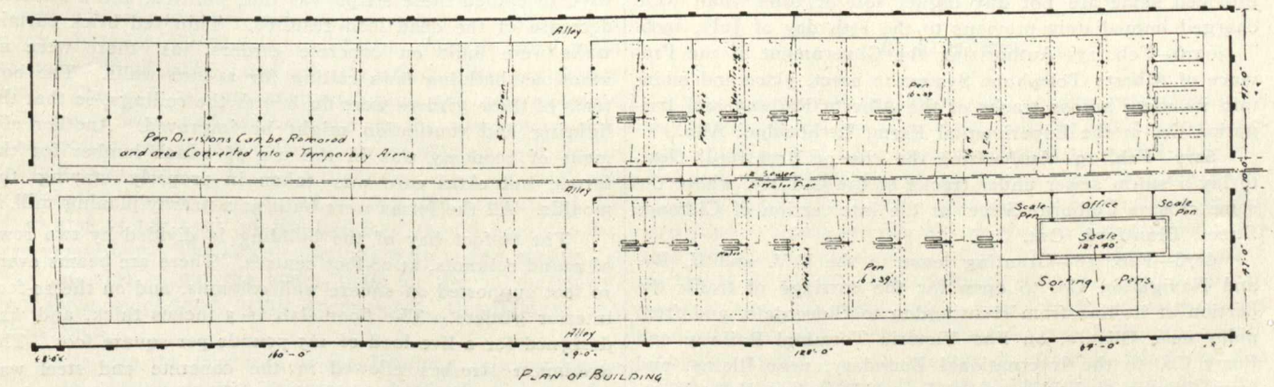
of location of its line of railway within the city limits of the city of Brandon, Man.

6253—Feb. 15—Granting leave to the Atlantic, Quebec and Western Railway to construct its railway across eleven highways in the county of Bonaventure, Province of Quebec.

6254—Feb. 15—Granting leave to the Atlantic, Quebec and Western Railway to construct its railway across seven highways in the municipalities of L'Anse aux Gascons and Newport, Quebec.

6255—Feb. 10—Forbidding every railway subject to the Board's jurisdiction to remove the planking from any highway crossing on its line of railway during the winter months.

6256—Feb. 16—Authorizing the Saskatchewan Government Telephone System to erect, place and maintain a telephone line across the C.P.Ry. between Sections 14 and 15, Township 8, Range 7. west second meridian, Saskatchewan.



PLAN OF BUILDING

6257—Feb. 16—Authorizing Dr. Quinlan, of Stratford, Ont., to erect, place, and maintain telephone wires across the track of the G.T.Ry. between Concessions 4 and 5, Township of Ellice, County Perth, Ont.

6258—Feb. 16—Authorizing the Dunwich and Dutton Telephone Co., Limited, to erect, place, and maintain its

wires across the track of the G.T.Ry. Co. at public crossing west of station at Middlemiss, Ont.

6259 and 6260—Feb. 10—Granting leave to the Hawthorn Hill Rural Telephone Co. to erect, place, and maintain its wires across the track of the G.T.Ry. (Wiarton and Owen Sound), 4th Concession, Township of Minto, Ont.; also at the 2nd Concession of Township of Minto, Ont.

6261—Feb. 11—Authorizing the C.P.Ry. to construct, maintain and operate branch lines to premises of Soo Line Milling and Elevator Co., Weyburn, Sask.

6262—Feb. 11—Authorizing the G.T.Ry. to construct, maintain and operate branch line to the premises of the United Factories, Limited, Newmarket, Ont.

6263—Feb. 2—Directing the Ingersoll Electric Light and Power Co. to re-erect twelve wires erected across the C.P.Ry. in the town of Ingersoll, Ont., on the east side of Thames Street.

6264—Feb. 8—Dismissing complaint of the Wallaceburg Sugar Co. to the effect of the operation of certain of the Canadian Car Service Rules are unfair and burdensome to large shippers, and applying for average plan of car service.

6255—Feb. 8—Granting leave to the Hawthorn Hill Rural Telephone Co. to erect, place and maintain its wires across the G.T.R. (Durham branch) on 4th Concession, Township of Minto, County Wellington, Ont.

6266—Feb. 16—Authorizing the C.P.Ry. to construct bridge over Lachine Canal, near Ogilvie Flour Milling Co.'s premises, Montreal, Que.

6267—Feb. 16—Authorizing the C.P.Ry. to use and operate bridge over Lachine Canal, near Ogilvie Flour Milling Co.'s premises, Montreal, Que.

6268—February 16—Authorizing the Canadian Pacific Railway to take certain lands in connection with its Windsor St. yards and station facilities at Montreal, P.Q.

6269—February 13—Dismissing application of William Hoskin, Jas. Butler, and others for order requiring the Canadian Pacific Railway to provide a crossing over the railway company's yard at Twentieth Street, Saskatoon, Sask.

6270—Feb. 17—Authorizing the Farmers' Long Distance Telephone Co., of Blenheim, Ont., to erect, place, and maintain its wires across the track of the P.M.R.R., one-half mile north of Fargo, Ont.

6271—Feb. 4—Amending Order No. 5672, authorizing G.T.P.Ry. to carry traffic from Fort William to end of track by substituting mileage 0.00 to 188.77 for mileage 0.5 to 188.2, where it appears in the said Order.

6272 to 6274—Feb. 17—Authorizing the Government of the Province of Alberta to erect, place, and maintain its wires across the tracks of the C.P.Ry. at three points near the city of Lethbridge, Alta.

6275—Feb. 17—Temporarily approving some agreements of the Bell Telephone Co. with other telephone companies, provided same are not any higher toll or tolls than were charged immediately previous to the 13th day of July, 1906.

6276—Feb. 17—Authorizing the Government of the Province of Alberta Telephone System to erect, place and maintain its wires across tracks of the Alberta Railway and Irrigation Co. at the Experimental Farm, Lethbridge, Alta.

6277—Feb. 19—Authorizing the city of Brantford, Ont., to lay a storm sewer under tracks of the G.T.Ry. where the same crosses Colborne Street at the intersection of Clarence Street, Brantford, Ont.

6278—Feb. 18—Granting leave to the V.V. and E. Ry. and Navigation Co. to open for the carriage of traffic the portion of its line from Huntingdon to Cloverdale, and from point near Olivers, on line Victoria Terminal Railway and Ferry Co. to the International Boundary, near Blaine, and from Olivers to bridge over Fraser River at New Westminster, in the Province of British Columbia.

6279—Feb. 19—Authorizing the Bell Telephone Co. to erect, place, and maintain its wires across the tracks of the C.P. Ry. at public crossing two miles north of St. Faustin, Quebec.

6280—February 19—Authorizing the Bell Telephone Co. to erect, place, and maintain its wires across the tracks of the C.P.Ry. at a point 1¼ miles west of Farnham, Quebec.

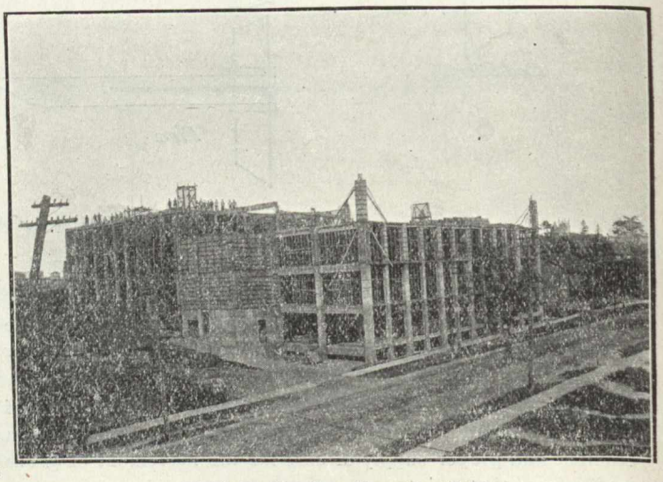
CONCRETE FACTORY CONSTRUCTION.

A. W. Connor, B.A.*

The illustrations show a reinforced concrete factory-building recently erected at Berlin, at a very low cost.

This building is entirely of concrete, except for the wooden floors and red brick curtain walls. At the rear of the building is a reinforced concrete chimney 125 feet high. The stairways and elevator shafts are also of reinforced concrete. The building is of skeleton construction, the red brick curtain walls and ample windows giving the structure a very light and attractive appearance. It is a five storey and basement, L-shaped structure, 120 ft. x 200 ft., with a 60 ft. bay, and contains about 78,000 sq. ft. of floor space. The building was built by day labor for about $50,000, under the supervision of Mr. J. Kaufman, who designed the general plan, and Mr. A. R. Kaufman. The plans were prepared by Bowman and Connor, Consulting Engineers, Toronto and Berlin.

The building is absolutely fireproof, and the finish and workmanship first-class. The floors are designed to carry 125 lbs. per sq. foot with the usual factors of safety. It was built at the very low cost of about 64 cents per square foot of floor area. This was largely due to economy in the design



Factory During Construction.

in taking into account the added strength of the beams due to their being continuous over the columns. A saving was also effected by the method of laying the wood floor. The nailing strips were laid direct into the floor slab immediately after it was poured. The strips were nailed to frames, and set in place in sections and leveled up. The concrete usually used to embed these strips was thus omitted, and a material decrease of the dead load resulted. Thin red brick curtain walls were built on concrete girders, as there were no vexatious building laws calling for 14-inch walls. The bottoms of these girders were flush with the ceilings, so that the lighting and ventilation might be improved. Another element of economy was in the use of 1-inch lumber for the forms, but extra care was taken in properly staying the moulds. All the forms were built at a nearby planing mill.

The 60-foot bay of the building is divided by two rows of round columns, at 20-foot centres. There are beams every 10 feet supported on square wall columns, and on the 20-foot interior girders. The floor slab is 5 inches thick, and was designed for a live load of 125 pounds per square foot. The maximum stresses allowed in the concrete and steel was 500 and 16,000 lbs. per square inch. The concrete was mixed in the proportion of 1:2:4 except in the columns where it was 1:1½:3.

As before stated, the main feature in the design of the beams and slab is the fact that they are calculated on their actual bending moments at all points, considering the beams

*Bowman & Connor, Consulting Engineers, Toronto, and Berlin, Ont.

as continuous over their supports. A considerable saving in steel and concrete was thus effected. The intermediate beams of a series have a bending moment at the centre varying from 1-3 to 1-5 of that for a similar non-continuous beam, but there is a larger negative bending moment over the supports. The failure to reinforce beams over the supports against this latter moment, has resulted in large cracks and unsightly deflections in many buildings. While theoretically all the beams of the continuous series would vary, both in depth and in amount of reinforcing steel, it would be complicated and expensive to build them all different. The end and intermediate beams form a natural grouping, and this division was used throughout. For convenience in building the forms, it was thought best to make all the intermediate beams of the same depth as the end ones, but to decrease the steel reinforcing. All the beams and slabs are reinforced by bars over the supports to provide for the negative bending moments. The result has been entirely successful, no cracks appearing in any part of the building.

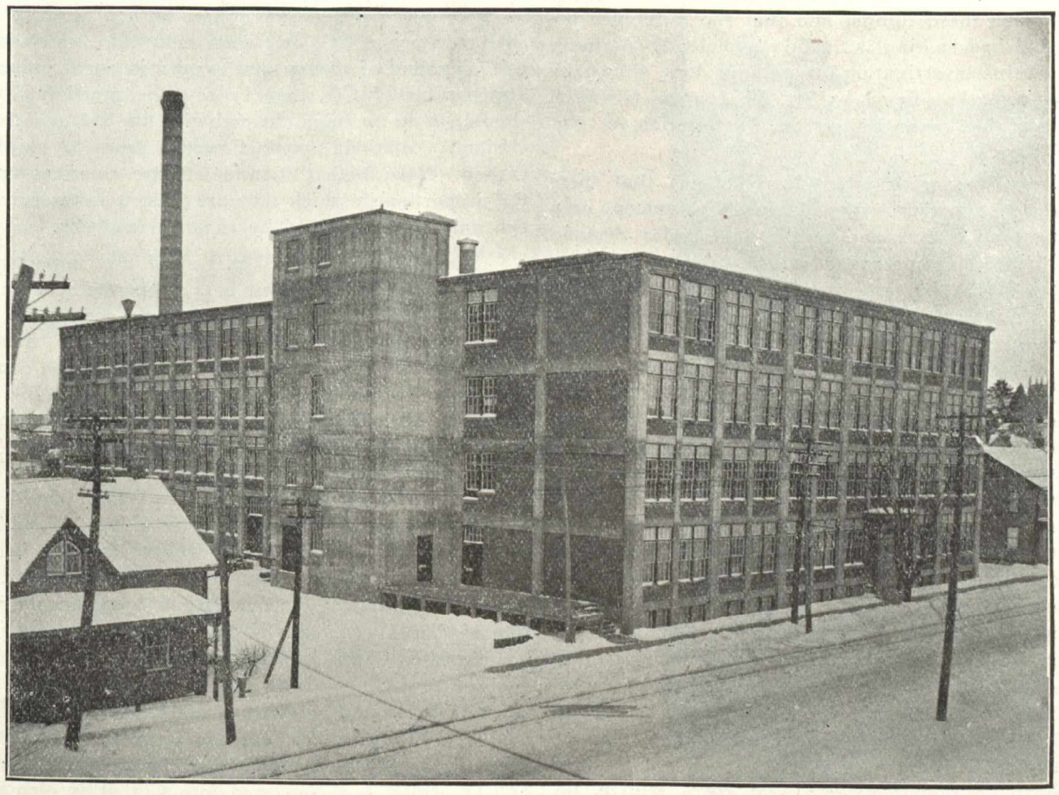
diameter. The inside forms were cylindrical, and were added one on top of the other until eight were in place. The lower ones were then transferred in turn to the top, the lower portion of the chimney being then entirely free of wood work. The adhesion of this inner form was sufficient to hold up the weight of men and materials.

The concrete was raised from an over-hanging support by means of a motor.

The forms for the interior round columns were built similarly to the outside chimney mould, but all in one length.

The elevator shaft is built separate from the main building, as shown in the photograph.

The beams, girders and slabs were all reinforced with open hearth square twisted steel bars. These were all bent into proper shape, and heavy wire stirrups were tightly bound to them on the ground. The steel was supplied by the Jones and Laughlin Steel Company, of Pittsburgh, about 200 tons being used.



Completed Building Showing Concrete Chimney.

The interior columns of the building are round, reinforced with round bars and hooped with heavy wire, at a pitch of ⅛ of the diameter. These columns vary from 12 inches to 26 inches, and are to carry 900 lbs. per square inch. The wall columns are rectangular and are reinforced with round bars, and are carrying 350 lbs. per square inch. The footings of all the columns are reinforced with square twisted steel bars. As the foundations were on sand and gravel, the footings are spread so that the pressure of the dead and 75 per cent. of the live load should be 3,000 lbs. per square foot. The largest footings were 11 feet square. It was intended to put the boiler room in the sub-basement, but some quick-sand being encountered, this feature was abandoned.

Built into the rear wall of the building is a reinforced concrete chimney, 5 feet in interior diameter, and 125 feet high. This chimney varies in thickness from 12 inches to 6 inches, and is reinforced with twisted square bars. This makes a light structure, which saves also in the cost of the foundations.

Its method of erection may be of interest. The outside form was built like a cistern with a slight taper. Four feet of concrete were added each day, and the form raised, and one stave taken out each time to gradually reduce its

SCIENTIFIC BOILER CONTROL.*

C. A. H. Binz.

Science, as you are aware, has in later years forced its way gradually into many of those fields of engineering practice which we had been formerly content to regard as purely and entirely practical, and we cannot deny that the movement in favor of scientific guidance and assistance in the execution of practical tasks has resulted in increased economy and efficiency in many ways. This general desire to abolish as much as possible rule-of-thumb methods and to turn to good account the many and valuable fruits of more recent scientific research is unquestionably responsible to a considerable extent for the amount of attention which is just at present being bestowed upon steam boilers and their furnaces. But few who have studied the subject will disagree with me when I say that steam boilers really needed this attention more than any other portion of a power plant. I go further to affirm that, although the boilers and furnaces themselves have been very much improved of late, there is still considerable scope for improvement in the methods

* Before the Institute of Marine Engineers.

adopted to convert the coal or other fuel thrown upon the grate into steam; it is to this special phase of the subject that I propose to devote my subsequent remarks. For years past the great bulk of steam users, with few notable exceptions, has been content to leave the problem of stoking almost entirely in the hands of the fireman, who was (and is by many to-day) supposed to be fully capable of dealing with so complex a material as coal undoubtedly is, entirely by virtue of his experience, which consists principally of following more or less faithfully in the footsteps of those before him, if it were possible, knew even less about what actually takes place within a boiler furnace than himself. Nobody would ever seriously suggest that a good stoker should be able to tell his steam pressure without the use of a pressure gauge, and yet the idea is pretty general that this same stoker should be able to judge whether he is using the correct draught pressure and the right thickness of fire, whether he is feeding coal at the proper rate and whether he is obtaining the correct furnace and exit temperatures simply by looking at his fire. That experience without guidance cannot teach these things, and that the difference between good and bad stoking is anyhow sufficiently alarming to warrant careful investigation, is perhaps best shown by the following remarks offered by Mr. W. Francis Goodrich in a paper read last year before the Association of Engineers-in-Charge.

He said: "Many trials have clearly shown that there is a vast difference in the results obtained by firemen, even when burning similar fuel and meeting a similar demand for steam. Firing the same boiler in turn, burning a similar fuel, and evaporating the same weight of water, it has been shown that the most inefficient of five different men has burned 29 per cent. more fuel than the best of the five firemen, there being such a marked difference in the results obtained between the best of the five and the four others that the only possible course was to discharge the latter, who had demonstrated that they would waste or lose far more than they earned every week." This is an experience which will no doubt be borne out by many of you who daily handle firemen, and could possibly relate similar or even more striking instances, such as, for instance, the winning of stoking competitions on the leading English railways by mere novices against old, experienced men, and many others. Granting, therefore, that some scientific guide or indicator would be of real value to the man in charge, our next point is to investigate in what direction this is most likely to be found, and found in a shape which will be really practical and also simple in its application. As the burning of fuel in a furnace is purely a chemical process, it is not surprising that those in search of a remedy for existing conditions should have turned to chemistry for it, where it has, indeed, been found in a continuous and automatic analysis of the products of combustion.

I am fully aware that the practical engineer is not anxious to be led into a labyrinth of chemical terms and symbols, which mean nothing to him—and I cannot myself confess to any particular affinity for them. I propose, therefore, to deal with the chemical side of the subject only in so far as it is necessary to explain the methods which I wish to bring to your notice, and as far as it forms a necessary part of the practical side of the matter. I mentioned just now that the remedy I wish to advocate is a continuous and automatic analysis of the products of combustion, and you will have gathered from this that I do not suggest that you should erect a laboratory in your stokehold and install therein a "full-blown chemist" to teach you what to do with your boilers. This would, of course, be impracticable, and it is not necessary; there are now to be had so-called Co_2 recorders, instruments which produce automatically a certain number of records per hour of at least one of the products of combustion, and the most important one, that which the chemist is pleased to term CO_2. You have heard of these CO_2 recorders, and you have probably wondered whether they are of any practical value to the firemen and engineers-in-charge. I hope to show you that they are, and what is more, that they must be considered, to use the words of a recent lecturer before the Institution of Civil Engineers, "quite as indispensable to the working of boilers as a steam engine indicator is to the care of engines." To prove my case I must needs explain first the meaning of the term CO_2, and the bearing of this constitutent of the furnace gases upon the degree of efficiency of combustion. CO_2 stands for carbon dioxide; i.e., a compound of carbon = C, and oxygen = O, in chemical union in the proportion of one part of carbon to two of oxygen. We need not stop to fathom exactly what chemical union embodies; suffice it to say that CO_2 is formed when carbon, such as, for instance, the principal constituent of coal, is brought into intimate contact with a sufficiency of oxygen, as is done by forcing air over the grate in a boiler furnace, in the presence of a sufficiently high temperature. This chemical union is nothing more nor less than combustion, and this of itself explains the importance of reliable information about the percentage of this CO_2 gas present in the exit gases which pass to the stack. But let us examine further: The carbon in the coal (I do not deal with its many other constituents, as they do not affect us materially here) is not always burned to CO_2; it may be changed only to CO, or carbon monoxide, which is a chemical compound of carbon and oxygen in equal proportion. Or any particle of CO_2 may be re-transformed into CO, if it should, in its passage through the fire-bed and flues to the chimney, come in contact with atoms of highly-heated carbon. Now, both CO_2 and CO are colorless gases, and the proportion in which they are present in the furnace gases can only be determined by chemical analysis.

The following figures will show how important it is to those who would have their boilers operate economically and efficiently that such analyses be made constantly. A pound of dry carbon burned entirely to CO_2 gives us heat equal to 14,000 B.T.U., whereas the same weight of the same carbon burned to CO only yields 4,450 B.T.U. It follows at once that if we discover a low percentage of CO_2 in our exit gases, we must be losing a lot of the heat which should be transmitted to the water in the boiler, and inversely a high percentage of CO_2 should mean that we have secured the transmission of most of the heat generated by the combustion of the fuel to CO_2. Generally speaking, this has been proved to be true in practice. Two factors must, however, be taken into consideration if the conclusions formed from an estimation of the CO_2 contents of the exit gases are not to mislead us slightly. These are the presence of CO, when the percentage of CO_2 is high, and the temperature of the gases at the stack. Considering, as shown by above figures, that CO is a heat-absorber, appropriating as a matter of fact some 10,150 B.T.U. per pound of carbon from every particle of CO_2 which is reconverted into CO, it is obvious that it would be little use to produce a set of conditions which, whilst securing a high percentage of CO_2, also has a tendency to encourage the presence of CO in appreciable quantities. Although it is not at the present moment practicable to construct continuous recording machines for the estimation of CO—and occasional snap tests are of little value—this danger of CO may be readily guarded against.

As mentioned, CO is formed in the first place where sufficient oxygen is not available to complete the oxydizing or burning process, and form CO_2. It follows that all we have to do to prevent this initial formation is to admit sufficient air to ensure an ample supply of oxygen. As the rate of combustion in average plants in our present-day furnaces already demands an excess of air, if steam is to be kept up, cases of too little air are comparatively scarce. Moreover, where the formation of CO is due to a shortage of air supply, the fact will be indicated by a low percentage of CO_2 shown by the CO_2 recorder. There remains the question of a transformation of CO_2 back to CO in its passage to the stack. This possibility has been shown to be comparatively remote, so long as the percentage of CO_2, as shown by the recorder, is not more than 14-15 per cent. The formation of CO under these conditions is most probably due to a low velocity of the gases in the furnace at a high temperature, which encourages contact of particles of CO_2 with highly-heated carbon. Such conditions are decidedly undesirable; they are, however, very

rare in practice, as they are only possible where the duty on the boilers is very light. We have thus established that we may safely accept the guidance of the CO_2 record, provided that we do not strive to attain results averaging more than 14-15 per cent. of CO_2.

Before showing now what it really means in figures to have a low, or, on the other hand, to have a high percentage of CO_2 showing on the chart of a CO_2 recorder, I must add a few remarks regarding the temperature of the stack gases. Since economizers have become popular, at least with land installations, it is often erroneously considered an advantage to show a high temperature in the flues leading to the economizer. It is pointed out that this will mean a higher temperature for the water in the economizer, and the fact is quite overlooked that had the heat been utilized in the boiler itself, the total efficiency would have been much greater. I use this illustration to emphasize the importance of continuous records of the temperature of the exit gases, which temperature should be kept at the lowest obtainable limit consistent with a good draught, for this reason. A high temperature at the stack, which shows that a large proportion of the heat which should have been transmitted to the boiler is being wasted. is due either to conditions unfavorable to complete combustion of the fuel and the gases given off by it immediately over the grate, or to too high a draught pressure, causing the gases to travel at so high a velocity as not to allow the boiler sufficient time to absorb all or most of the heat carried in them. As far as the first cause is concerned, this would in all cases be clearly indicated on the CO_2 recorder by a bad record, but the latter possibility, though comparatively remote, renders it desirable for me to advise consideration of the temperature of the exit gases in addition to the analysis of their percentage of CO_2.

Let us now consider the losses actually occasioned in a boiler furnace in relation to the greater or less attention paid to the CO_2 contents, and the temperature of the exit gases. The following are figures computed from actual experiments by Mr. O. L. Peard in one of the large London power plants. Mr. Peard assumes an average coal to yield 14,000 B.T.U., which you will probably consider a little high; however, this will not affect the value of the figures for purposes of comparison:—

With 5 per cent. of CO_2 at 500° F. the loss is 35 per cent.; at 400° F., loss is 28 per cent.

With 7 per cent. of CO_2 at 500° F. the loss is 25½ per cent.; at 400° F., loss is 20 per cent.

With 10 per cent. of CO_2 at 500° F. the loss is 18 per cent.; at 400° F., loss is 14½ per cent.

With 12 per cent. of CO_2 at 500° F. the loss is 15½ per cent.; at 400° F., loss is 12½ per cent.

With 14 per cent. of CO_2 at 500° F. the loss is 13½ per cent.; at 400° F., loss is 10½ per cent.

Briefly, this shows that if an engineer can by the use of a CO_2 recorder increase the percentage of CO_2 in the exit gases from 5-14 per cent., he will have effected a clear saving on his coal bill of 21½ per cent. If he can succeed in reducing his temperature at stack by a hundred degrees at the same time, the saving will amount to 24½ per cent.

Even if only 12 per cent. can be maintained it will be worth doing, for the saving will amount to over 20 per cent. It is well known that temperatures of the stack gases, considerably higher than those given here, are frequently met with, when the loss is, of course, also proportionately greater; the figures given may, however, be taken as a fair average in up-to-date plants. I have chosen 5 per cent. as the lowest figure, because where reasonable care is taken lower percentages are not often encountered, but it must be said that where CO_2 recorders are not in constant use, an average of more than 7 per cent. is very seldom obtained. This is true even of those plants where the value of flue gas analysis has been to some extent recognized, and where occasional snap tests are made—although these tests may show better results. Occasional tests cannot be expected to provide a reliable indication of the average conditions, as the firemen are well aware when they are taken, and there is no guarantee that the good results shown at the moment are maintained throughout the day and night. Such a guarantee can only be furnished by a CO_2 continuous recorder. Now, it might be said that it is one thing to show up bad results, but quite another to remedy them, and it must, of course, be realized that a tell-tale—for that is what a CO_2 recorder really is—cannot automatically remedy the defects which it points out. However, it is not difficult to see that such a machine is, nevertheless, of great value, when one remembers that stoking consists after all of but a few in themselves very simple manipulations; and given the means to know what is going on, good results can be obtained in a very short time, even by the stokers themselves. The success with which CO_2 recorders have met during the last few years in land installations—there are probably now some 800 of various types in use in Great Britain, they are working in the dockyards at Chatham, Devonport, Portsmouth, Sheerness, Pembroke, Gibraltar, Malta, and Simonstown, and are employed by the United States Naval Department in their various test stations used to select firemen—is alone

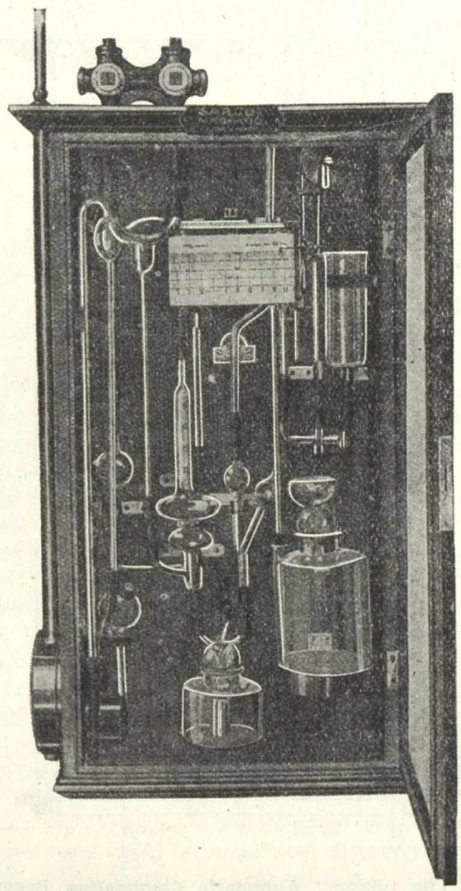


Fig. 1—The "Sarco" Automatic Combustion Recorder. Type "B." General View.

sufficient to prove this. Before referring in detail to the various ways in which a CO_2 recorder can assist in the improvement of the conditions of combustion, let me draw your attention to one of its functions, which is not generally recognized as important, but which has in my opinion a very great practical value—I mean its moral effect upon the men. In the words of an American engineer: "A machine which will show up attention as well as neglect, and waste of money at all times, night and day, which cannot be bribed or intimidated, meddled with or changed, giving a just and true record without favor or bias, is a good-paying investment beyond all doubt." To this must be added that an intelligent stoker cannot help developing an interest in the records of his work, as made on the recorder, with the result that he will at once set about improving them somehow; and you may be sure that he will do it, even though he may not be able to tell you afterwards exactly how it was accomplished. Especially where a number of stokers are engaged on one plant, a friendly rivalry will be set up between them; each man will do his best to outstrip his rival; there will

even be bets on the best CO_2 chart—all to the benefit of the employer. Let us now examine into the various manipulations which affect the CO_2 contents of the exit gases. There is first of all the air supply. This is undoubtedly the most important factor. I have already said that we cannot in practice feed only the quantity of air which would furnish no more than the required volume of oxygen, we must have an excess; but this excess should, as you know, be kept down as low as possible, for every pound of excess cold air that we admit to a furnace not only lowers the temperature of the furnace, but in addition it must be heated to the temperature of the exit gases, which is an obvious waste. Particularly with forced draught furnaces the danger of furnishing a large excess of air is very great. In addition to the CO_2 recorder, which shows this excess, draught or pressure gauges to guide the stoker will be found extremely

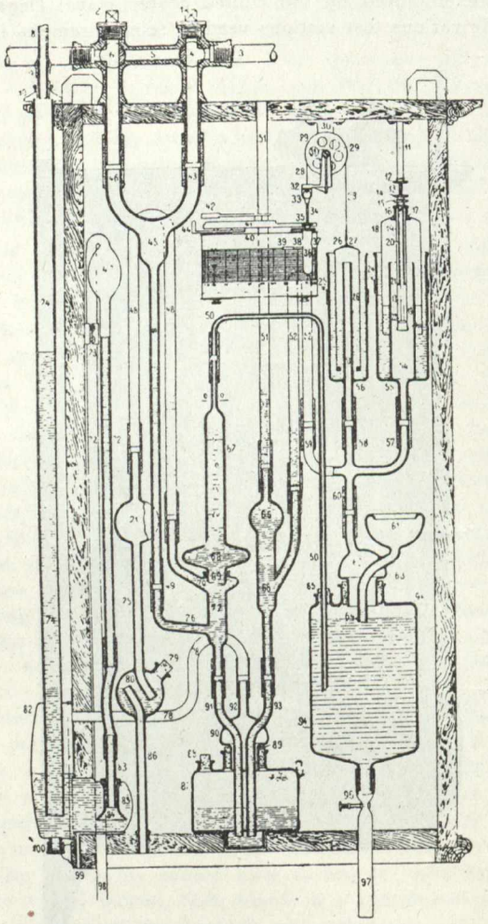


Fig. 2—The "Sarco" Automatic Combustion Recorder. Type "B." Sectional Elevation.

valuable, especially on ships, where the conditions of load are comparatively constant, and are, of course, already in pretty general use.

The points next in importance are the thickness of the fire and the intervals between stoking, speaking of hand-fired furnaces, which concern you chiefly. The thickness of the bed varies considerably with the draught available, the duty required of the boiler and the class of fuel used, but the general rule applies that it should be as even as possible and free from holes through which great jets of air enter. Its thickness should be in any case so adapted to the periods of stoking that the fire is not on the one hand allowed to burn too low, and on the other hand it should not be so heavy that considerable time must elapse before the fresh fuel thrown on can be properly ignited. Considerable improvements have further often been made by accelerating the process of cleaning the fires (or clinkering), avoiding as much as possible the inrush of cold air when the fire doors are open. Finally, there are such considerations as repairs to the settings, cleaning of the boiler shell, alterations to the grate, fire-bars or flues, stopping of excessive radiation and many others. Each adds its little share to the general improvement, with the inevitable result that after a month or two the CO_2 record, and with it the coal bill, will show that efficiency and economy have been very considerably increased, and this without material structural alterations or additions, and without any considerable outlay. All this is perfectly well known to you, but every stoker does not know it, and if he has some ready means of verifying the results of his actions he will quickly improve in his work. The CO_2 recorder is a sort of automatic calculator or ready reckoner. It adds, divides, subtracts, and shows the result of a man's work, whether good or bad, which is what one really wants. It might be added that CO_2 recorders are quite inexpensive to maintain, costing only a few shillings per month, and their life is an exceedingly long one. Provided they are given a little attention, say as much as is bestowed upon a feed-water heater, an oil separator or other saving appliance, they can be relied upon to give accurate and reliable results.

I will now describe as briefly as possible one design of recorder, that known as the "Sarco," which was one of the first on the market, and is, I believe, the one most generally used. It is the only one of which, as far as I am aware, an adaptation for marine purposes will be shortly available.

Description of "Sarco" Recorder, Type B.

The apparatus is erected in the stokehold itself or engine-room, preferably as near to the boilers as is convenient, so that the firemen can have it in continuous view. It does not, however, interfere with the accuracy of the records to have the machine any convenient distance away from the boilers. A pipe of preferably ¾-inch diameter is inserted in the smoke-box or combustion chamber of each boiler, and these branches are fitted each with a cock and run into a main pipe, which, after passing a special filter, takes the gases to the recorder, the connection being made at 3 (Fig. 2). Another pipe is taken off the opposite cock 6 at 7 and taken to the base of the funnel or the suction side of the forced draught fan. This pipe serves to provide a continuous flow of gas from the boilers across the top of the machine, the cocks 4 and 6 being set as shown in the illustration; i.e., making a passage from 3 through 4, 43, 45, 46, and out by 6 through 7. From this stream constantly flowing, the machine secures samples at frequent intervals automatically in the following manner: A fine stream of water from a small supply tank erected about 2 feet above the instrument enters the tube 74 through injector 9. It gradually fills the vessel 82, compressing the air in the same above the water-level. This air pressure is conveyed to vessel 87 through tube 78, and as 82 fills, the air forces the liquid in 87 downwards and up in the tubes 91 and 93 and their various branches. The liquid in 87 is water with a little glycerine added to prevent evaporation. This water, as will be seen, does not come in contact with that used for driving. Communicating with vessel 82 is the syphon 72, and the water rising in the larger tube 74 naturally also moves upwards in this syphon 72. When it reaches the bend of the syphon this begins to operate, syphoning out the whole of the water contained in 82 rapidly, the outlet of the syphon being much larger than the inlet of injector 9. The effect upon the liquid in 87 and its connecting tubes of the syphon emptying is to cause the liquids to recede once more and to fill the vessel 87. This downward stroke acts as a gas pump in the case of the tube 49. In that tube the water rises on the upward stroke to the stirrup 43, 45, 46, and on the downward stroke a supply of gas is drawn in and enters the measuring tube 67 as soon as the water-level has dropped below the inlet 76. As soon as the power vessel 82 begins to fill again the liquids rise once more in the various tubes issuing from 87, and when the level reaches the point 69 in the measuring tube a certain definite quantity of flue gas is shut off in the same. As the liquids rise further this sample is forced along tube 50 and through the solution of caustic potash contained in vessel 94. In bubbling through this solution any carbon dioxide (CO_2) which may be contained in the sample will be eagerly absorbed. The residue will

(Continued on Page 313).

THE MAKING OF CONTRACTS.*

J. E. Parsons, B.A

A contract is shortly defined as "an agreement enforceable at law," and as the definition itself indicates the term "contract" is a much narrower signification than the term "agreement."

There are, of course, a multitude of agreements which are not enforceable at law; an engagement to attend the theatre, or a promise to take a friend for an automobile ride are agreements of an entirely social character and they do not rise to the dignity of a contract. In the earliest times it was found to be essential that each citizen should know whether he could rely upon the promises of his neighbor or not, and now that our civilization has become so complex in the fabric of commercial and social life, so intensely intricate, it is absolutely essential that you be able to depend on such undertakings as are solemnly given and that you have some legal means of enforcing your rights. The essence of all contracts is this:—That at some **particular moment the minds** of the two or more parties **were one** as to some proposition then mooted between them and the existence of a contract pre-supposes certain essentials. There must be at least two capable parties one of whom makes an offer which the other accepts. There must be some consideration, some gain or at least some fancied gain to each party, and the object and purpose of the agreement must be in conformity with the laws of the land.

Infants cannot contract, not but what some youths at twenty are of sound reason and possibly more capable of considering their own interests than others at thirty, but our forefathers found it necessary to draw a line between childhood and manhood, and in their discretion, draw the line at twenty-one. The unfortunate, idiot, born without a mind, is not capable of contracting for the very obvious reason that whereas consent to a particular proposition is of the essence of a contract, he has no sound mind to give consent. The lunatic is a little more fortunate for he may have lucid intervals and he may be a party to a contract formed during one of these intervals. Along with the infant and the idiot, we venture to think rather undesirable company, the law used to class married women. They were not able to contract because by fiction of the law, the identity of the wife was merged in that of the husband. Our Legislature has seen fit to remove the disability and a married woman can now contract of her own accord.

Offer and acceptance are elements always present and essential to a contract. In the case of weighty matters and between pretentious persons, they are, of course, plainly traceable. The one party makes the writer offer, the other one accepts it, but in the case of less important transactions both will probably be verbal and in the case of minor affairs, they are not even spoken. It perhaps does not occur to one that there is any contract involved in taking the car from his place of business to his home, but the matter is nevertheless one of the same sort. The company's car upon the line is undeniably an offer to everyone upon the street, "we will carry you if you promse to pay the fare," and when the passenger steps upon the car, his conduct is an acceptance. The law regards it as such and the company can force him to pay the fare.

Silence does not give consent. It is not sufficient that you decide to accept the offer made to you. You must accept and communicate that acceptance to the offerer either by your words or your conduct. It is a point worthy of notice that when an offer is received by mail and an answer mailed as an acceptance, the contract is complete when that letter is handed to the Postoffice, and though it does not reach the offerer till some days later.

It is a principle of British law that a man is not bound unless he gets some benefit in return, a quid pro quo, is of the essence of contract. Not indeed that the law enquires as to whether the contractor receives full value for the services he renders or for the materials he supplies. If the courts were charged with the duty of enquiry as to the value of lands and houses, and railways and works, and bridges, and materials, their tasks would indeed be a difficult one and the judge would require to have a mind a little short of deity. The consideration called for by the law is by way of proof that the parties intended to affect their legal relations. It does not matter whether the amount changing hands be $1,000 or $1. The law makes no enquiry as to the adequacy of the return. The mere fact that something of value passes between the parties is clear evidence that they intended to create new rights and liabilities as between themselves and that each should be able to rely upon the other for the carrying out of the agreement made between them. The seal upon a contract may almost be considered a relic of mediaeval times, but is considered to be evidence of such solemnity that the parties must have given due consideration to the proposition before them, and where a man has placed his seal to a writing he will be bound although the instrument does not show that he is to get any consideration in return. The seal in the case of such private persons appears to be a relic and the practice of using it is more or less archaic, but the matter is entirely different with regard to corporations. In the early times, companies were few but the engineer well knows that to-day their name is legion, and it is necessary that each should have some way of indicating that the entire corporation is bound, and this may be appropriately done by the use of a seal. When the engineer undertakes to work for the municipality on the strength of a letter signed by some official, he runs the risk of not being able to collect his pay as his retainer should bear the seal of the **corporation.**

A kind of offer of very frequent interest to the engineer or contractor is that which purports to be open up to a certain date. Everyone is familiar with the ordinary advertisement for tenders and it might be supposed that the municipality or person calling for tenders was bound to hold his offer open up to the time indicated, but in the light of the cases, the matter appears to be otherwise. As soon as the advertiser has received a tender which he regards as satisfactory, he is free to accept that tender and call the matter closed.

It a man undertakes to do that which is physically impossible, he will not be bound. A contract to make water run up hill is void for it is contrary to the course of nature, and neither party is deceived for both must be fully aware of the impossibility. But a matter is not to be deemed impossible simply because it has never yet been done. A man may have such faith in some new discovery or in some scientific principle that he undertakes to warrant the possibility of such a thing although others do not believe as he does. An interesting case is recorded against the city of London when it became necessary to pull down the old Black Friars Bridge and replace it by another, the city engaged an engineer. He made surveys of the locality, and plans of the old bridge which must be removed, as also plans and specifications for the new bridge. The engineer in his discretion abandoned the use of coffer-dams, and his plans were based upon the use of caissons. The contract stated that the information embodied in the plans was believed to be correct, but the contractor must satisfy himself as to the nature of the ground and must estimate the quantity of materials to be removed. The successful tenderer relied upon the plans and constructed the caissons according to the drawings, but in carrying out the work, they were too weak to stand the current from up stream with the result that being able to work only at low tide, he was put to a great deal of additional expense and loss of time. The contractor brought action for the amount of his loss contending that the city of London was liable for the insufficiency of the plans and drawings prepared by their engineer. The Privy Council decided that the city of London did not warrant feasibility of the works thus outlined and that when he chose to rely upon these draw-

*An address delivered before the Engineers' Club, Toronto, Ont.

ings, he did so at his own risk as to whether the work could be successfully carried out as indicated in them.

The written agreement is not the contract. It is merely a statement by the parties of the facts which have been agreed upon, and the contract, is, of course, still in existence though this written evidence is burned or otherwise lost. However it must be borne in mind that the writing is a much more formal, and deliberate setting out of what the parties have agreed upon, and that the negotiations being prior to the writing are either merged in the written agreement or dropped. It may be that many terms were discussed or particulars agreed upon before executing the writing, but which the parties have neglected to have inserted in this writing. In this case these provisoes, made during negotiations, are entirely lost. The courts take the stand that when parties come to the formality of placing their agreement upon paper it must be supposed that they place the matter there in its final state and will not allow you to show that there were other terms agreed upon beforehand, but not put into writing.

Where specifications and plans are referred to in the writing, these are read into the contract and become a part of the contract. Where there are discrepancies between a detailed drawing and one which is smaller or less minute, the detailed drawing is the greater authority. If there is difference between the plans and specifications, the specifications prevail and if between the specifications and the written body of the contract, the latter prevails for it takes precedence over all the rest.

In a reported case the specifications for a house covered in detail the roof, the joists, the walls, in short, everything but the flooring, while the contract was for " a house to be completed by August 1st." The contractor did everything about the house except put in the flooring, and this he refused to do without extra remuneration. The courts reviewed the facts, that this item was clearly omitted from the specifications, but was none the less clearly called for by the contract for a finished house, and decided against the contractor.

The efficiency of the rivets varies inversely as the thickness of the steel, and also inversely as the pitch of the rivets.

GENERAL REGULATIONS AFFECTING HIGHWAY CROSSINGS IN CANADA AS AMENDED AT A MEETING OF THE BOARD OF RAILWAY COMMISSIONERS, HELD JANUARY, 1909.

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

2. That a strong, substantial fence, or railing, four feet six inches high, with a good post-cap (four inches by four inches), a middle piece of timber (1½ inches by 6 inches), and a ten-inch board firmly nailed to the bottom of the posts to prevent snow from blowing off the elevated roadway, be constructed on each side of every approach to a rural railway crossing where the height is six feet or more above the level of the adjacent ground,—leaving always a clear road-surface twenty feet wide.

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

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

DESTRUCTIVE EFFECTS OF A FLAT WHEEL.

The enormous energy developed by a flat spot in a wheel has been estimated by Prof. Hancock, of Purdue University, Lafayette, Ind. He finds that a flat spot 2½ inches long on a 33-inch wheel, carrying a load of 6,000 pounds at 30 miles per hour, will deliver a blow to the rail of more than a 1,000-foot pounds. The same flat wheel supporting a 55-ton interurban car running at 60 miles per hour, would deliver a blow with an energy of 9,500 foot pounds. Such a flat spot would be produced by wearing off less than 0.05 inch of metal.

WINNIPEG ELECTRIC RAILWAY.

Annual Report.

The Winnipeg Electric Railway was incorporated in 1904 under the laws of Manitoba as a consolidation of the Winnipeg Electric Railway Company and the Winnipeg General Power Company. The company still control all the street railway, gas, electric light and power business of Winnipeg and St. Boniface. They serve a population of about 100,000, and operate some 70 miles of track (single). The street railway franchise is absolute in Winnipeg until 1927, and in St. Boniface until 1934.

During 1908 the percentage of earnings shows an increase of 28.08 per cent. compared with last year, while the operating expenses show an increase of 40.36 per cent., as compared for the same period. The net earnings show an increase of 18.01 per cent. over those of last year.

Seventeen large double truck closed cars equipped with air brakes, heaters in the motorman's vestibule, and other modern appliances, were constructed in the company's Winnipeg shops and put into service. 12.963 miles of track were constructed; 3.381 miles of this being surface track with ballast; 1.935 miles track in wood block pavement; .887 miles track in macadam pavement, and 6.758 miles track with concrete foundation. 1,334 new poles were erected in the extension of power and electric lighting lines, with 302,049½ pounds of wire.

The statistical statement shows some interesting results. As the city grew the earning power per capita has steadily increased, while the per cent. of earnings has remained almost stationary.

STATISTICAL STATEMENT—YEARS 1904-1908.

	1908.	1907.	1906.	1905.	1904.
Gross Receipts	$2,206,094.88	$ 1,722,406.69	$1,416,305.04	$1,119,768.85	$831,736.58
Operating expenses	1,088,872.50	775,731.02	701,963.72	575,747.29	427,754.20
Operating expenses per cent. of earnings	49.35	45.05	49.56	51.42	51.47
Net earnings	1,117,222.38	946,675.67	714,341.32	544,021.56	403,982.38
Net income per cent. of capital, 13	13.14	12.01	11.17	9.86	12.77
Net income (average)	5,669,541.00	4,664,200.00	4,144,480.00	4,000,000.00	2,099,723.00
Passengers carried	22,019,507	20,846,317	17,229,554	13,081,249	9,504,051
Transfers	7,777,315	5,954,067	3,109,094	1,682,685	2,497,952
Railway earnings per capita	9.80	9.84	8.30	6.80	5.51

RAILROAD STOCK ISSUES.

Canadian Pacific's Fifty Million Increase—Grand Trunk Consolidated—Dividend Declarations.

Both Canadian Pacific and Grand Trunk stock issues have been discussed in the Dominion House. Hon. Geo. P. Graham, Minister of Railways, has tabled a copy of the Order-in-Council, authorizing the C.P.R. to issue an additional $50,000,000 in capital stock.

The order provides that the issue of stock authorized will not have any effect on the Government's power to regulate rates, and is not to be included in the amount charged up to the cost of the construction of the railway. None of the new stock is to be issued at less than par. No part of the capital to be raised is to be offered to the construction of any works outside of Canada.

Not to be Deemed Construction Capital.

"The Minister further recommends," says the order, "that the said $50,000,000 shall not, nor shall any part thereof, nor shall any moneys arising therefrom, no matter how disposed of, be deemed capital expended in the construction of the railway within the meaning of Section 20 of the Company's Act of Incorporation, and the power of the Parliament of Canada or the Governor-General-in-Council to reduce the tolls upon the railway of the company shall in no wise be affected by any such increase of capital stock, in whole or in part, nor by the expenditure of any such moneys in the construction of the railways, or otherwise, but the same shall be excluded from consideration in determining the amount of capital actually expended in the construction of the railway."

Attached to the Order-in-Council is a letter from Sir Thomas Shaughnessy, setting forth that the money is required for necessary extensions.

Grand Trunk Consolidated Debenture Stock.

The Railway Committee considered on Tuesday an Act giving the Grand Trunk Railway power to issue perpetual consolidated debenture stock to be known as "Grand Trunk Consolidated Debenture Stock."

This stock will bear interest at the rate of four per cent. Mr. W. Wainwright, on behalf of the G.T.R., said the money would be used in making general improvements.

Hon. Mr. Graham said the Government would be responsible if the authority to raise debentures was being given by Order-in-Council, but in the case of a Federal bill, the Railway Committee was responsible.

A clause was inserted providing that the money should be used for improving the roadbed, double-tracking, reduction of grades, siding, and terminal facilities, and increasing of elevator capacity.

The clause providing that the new stock shall rank equally and be consolidated with debenture stock issued or to be issued was not opposed.

Another clause provided that the company may create and issue additional 4 per cent. guaranteed stock provided that the total amount of guaranteed stock does not exceed twelve million five hundred pounds sterling. Objection was taken by Mr. Lennox to the declaration in clause 8 to the effect that the Act shall not take effect until it has been submitted to a general meeting of the company. No company, he said, should be given power to say whether or not an Act of Parliament should come into force.

Mr. Graham, to meet the views of the committee, suggested an amendment declaring that the Act would be brought into force by an Order-in-Council.

Canadian Pacific Dividend.

At the meeting of the board of the Canadian Pacific Railway Company held at Montreal last week, a dividend of two per cent. on the preferred stock and three per cent. on the common stock was declared for the half year ended December last, payable April 1st next. It was also decided that at the same time a further sum equal to one-half of one per cent. be paid on common stock, to be paid out of the interest of the land sales. After the payment of working expenses, fixed charges and the dividends now declared, there is a surplus for the half year of $4,813,232.

A Canadian Associated Press cable reports the net earnings of the Grand Trunk for the half year ending December 31st, as £443,000 available for dividends which is less by £80,000 than the figures for the corresponding half years in 1906 and 1907.

This, it is stated, will suffice to pay the dividend for the half year on the four per cent. guaranteed stock, and the entire annual five per cent. dividend on the first preferred, which it will be remembered had to go without dividend for the previous half year, for the first time in many years. This omission is now made up to it, but there is still no dividend on the third preference stock, which has earned dividends from 1905, and the second preference is only given half the annual dividend, of 2½ per cent. A balance of twelve thousand pounds is carried forward, as against sixteen hundred pounds last half year. The second preference stock was expecting a full declaration, and the market has consequently slumped heavily.

Wants of Quebec Oriental Railroad.

The Quebec Oriental Railway Company will apply to the Dominion Parliament for an Act, providing that the head office of the company may be either in Canada or in England; prescribing that the number of the directors of the company shall be not less than three nor more than seven, and authorizing the company to fix the number thereof by by-law; changing the date of the annual meeting to the last Wednesday in October in each year; fixing and extending the times for the commencement and the completion of its lines of railway; increasing the bonding powers of the company to $45,000 per mile; authorizing the company to construct, equip, maintain and operate a line of railway from a point on its line at or near Riviere du Loup, Quebec, thence in a southeasterly direction, by the shortest and most feasible route, through the County of Temiscouata, to a point of junction with the Grand Trunk Pacific Railway, in either the County of Temiscouata or the County of Kamouraska at or near the boundary line between the said counties; and empowering the company to buy from the Royal Trust Co., or from the owner or owners for the time being, the railway lines from Matapedia to Caplin and from Caplin to Paspebiac, Quebec, and heretofore known as the Baie des Chaleurs Section of the Atlantic and Lake Superior Railway Company, and by providing for the mode and manner of payment for the purchase price and for the issue of bonds on the said railways. D. R. Murphy, Montreal, is solicitor for the applicants.

THE STRENGTH OF "BLED" PINE.

The United States Government Forestry Department makes the following summary of the results of 1,325 tests of the weight and strength of pine from which the resin has been bled and not bled. The results are more uniform than one would expect.

Longleaf pine.	No. of tests.	Specific weight of test pcs., Per cent.	Strength, per sq. in. Bending, lbs.	Strength, per sq. in. Comprs'n, lbs.
Unbled trees	400	0.74	12,358	7,166
B'ed and recently abandoned	390	79	12,961	7,813
Bled and abandoned 5 years	535	76	12,586	7,575

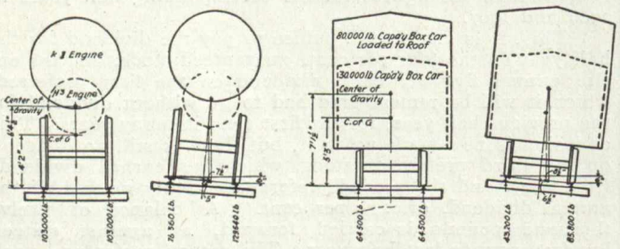
SUMMARY OF OPERATING REVENUE AND OPERATING EXPENSES FOR STEAM ROADS IN THE UNITED STATES FOR THE YEAR ENDING JUNE 30th, 1908.

The Interstate Commerce Commission in their last annual report give some interesting information as to the ratio of expenses to revenue:

	Operating revenue.	Maintenance of way and structures.	Maintenance of equipment.	Traffic expenses.	Transportation expenses.	General expenses.	Total.	Ratio of operating expenses to operating revenues.
Total for the year	2,424,640,637.01	331,851,543.87	372,220,062.54	48,400,635.92	879,757,247.61	56,092,068.93	v1,695,101,878.53	69.91
Per mile of line	10,722.75	1,467.58	1,646.11	214.05	3,890.65	248.06	7,496.43	.....
Ratio to total operating revenue		13.69	15.35	2.00	36.28	2.31	69.91	.....

EFFECT ON TRACK OF RAISING CENTRE OF GRAVITY OF ROLLING STOCK.

Mr. Edward Laas, engineer maintenance of of way, of the Chicago, Milwaukee & St. Paul Railway, has been making a study of the effect on track of the higher centre of gravity of modern rolling stock. Both locomotive and freight cars are taken into consideration, and the accompanying diagram, which is one of several prepared by Mr. Laas, shows



Kind of Engine in working order Box Car loaded to roof with 80% Cap'y.	Total Weight	Height of centre of Gravity above rail	Effect due to 6 in. elevation of outer rail of curve. Centre of Gravity is perpendicularly from centre of gr.	Wt on high rail	Wt on low rail	Per. Cent of wt on low rail
K-1 Engine	206000	7½ in	7½ in.	76360	129640	63
C-1 "	177000	7½ "	7½ "	66500	110500	62
H-3 "	70000	50 "	3" "	29000	41000	59
80000 lb Box Car	129000	8½ "	8½ "	43800	85800	67
30000 " "	58300	63 "	6½ "	22400	35900	62

Data of Effect on Rolling Stock by Curve Elevation.

graphical comparisons in this direction. It is noteworthy that while locomotive weights have been largely increased and the height of the centre of gravity has been raised more than 2 feet, yet with this road the height of driver has remained practically the same for the last 30 years. In the "H-3" type of locomotive the centre of gravity is 4 feet 2 inches high above top of rail, and comes between the driving wheels, whereas in the type "K-1" locomotive the centre of gravity is 6 feet 4½ inches high, and comes considerably above the wheels. The old-type locomotive weighed 70,000 lbs. total, whereas the new one weighs 206,000 lbs.

Punishment to the inner rail of curves suggested that such might, in some degree, be the result of excess load bearing upon that rail by reason of the leaning tendency of the higher locomotives hauling trains up-grade at slow speed, when but little centrifugal force is developed to throw weight upon the outer rail. In the case of the locomotives of the old design ("H-3") on a curve elevated to 6 inches, a vertical line passing through the centre of gravity stands over 5 inches from the centre of the track, and 59 per cent. of the weight is distributed upon the inner rail. Comparing this with the modern locomotive ("K-1" type), the vertical line passing through the centre of gravity is 7½ inches laterally from the centre of the track, and 63 per cent. of the weight falls upon the low rail, or in the ratio of 76,360 lbs. on the high rail to 129,640 lbs. on the low rail.

With loaded box cars of the old and new designs the contrast is even more remarkable, as may be seen by the diagram, the vertical line passing through the centre of gravity of a loaded box car of 80,000 lbs.' capacity, being 8½ inches from the centre of the track. In this instance 67 per cent. of the weight falls on the low rail, or more than twice as much as is carried by the high rail.

The result of these studies is the conclusion that the part of the track which, after all, takes the burden of the load, is the tie. It seems no wonder that, with the excess weight liable to fall upon either rail by reason of elevation of track on curves, whereby the lower rail receives the greater punishment at slow speed, and the high rail at high speed; and either rail on tangent at any speed, where the track is out of surface; as stated in our editorial of January 23rd—it is no wonder that the maintenance of track surface has become very expensive under heavy rolling stock. Notwithstanding the unequal distribution of the load on the two rails, longer ties would tend to distribute such excess load farther from the centre of the track and would provide a wider base whereon to stand.—The Railway Review.

The total exports of coal, coke, and patent fuel from Great Britain amounted in 1908 to 65,180,649 tons, compared with 66,063,258 tons in 1907.

SPECIFICATIONS FOR WALKS.

The National Association of Cement Users have issued a revised set of Standard Specifications for Portland cement sidewalks. They are as follows:—

Materials.

The cement shall meet the requirements of the specifications for Portland cement of the American Society for Testing Materials, and adopted by this Association (Specification No. 1), January, 1906.

Sand shall pass a No. 4 screen and be free from foreign matter, excepting loam or clay, which will be permitted if the quantity does not exceed five (5) per cent. and when these ingredients do not occur as a coating on the sand grains.

Not more than 40 per cent. shall be retained on a No. 10 sieve.

Or 35 per cent. pass a No. 30 and be retained on a No. 20 sieve.

Or 35 per cent. pass a No. 20 and be retained on a No. 30 sieve.

Or 35 per cent. pass a No. 30 and be retained on a No. 40 sieve.

Or 35 per cent. pass a No. 40 and be retained on a No. 50 sieve.

Not more than 20 per cent. shall pass a No. 50 sieve.

Or 70 per cent. pass a No. 10 and be retained on a No. 40 sieve.

Or 70 per cent. pass a No. 20 and be retained on a No. 50 sieve.

Stone shall be crushed from clean, sound, hard, durable rock, be screened dry through a ¾-inch mesh, and be retained on a ¼-inch mesh.

Screenings from the crushed stone specified above which shall meet the requirements for sand, may be substituted for sand if so approved.

Gravel shall be clean, hard and vary in size from that retained on a one-quarter (¼) inch mesh to that passing a three-quarter (¾) inch mesh.

Unscreened gravel shall be clean, hard and contain no particles larger than three-quarters (¾) inch. The proportions of fine and coarse particles must be determined and corrected to agree with the requirements for concerte.

Water shall be reasonably clean, free from oil, sulphuric acid and strong alkalies.

Forms.

Forms shall be of lumber, free from warp, and not less than one and three-quarters (1¾) inches thick. All mortar and dirt shall be removed from forms that have been previously used.

The forms shall be well staked to the established lines and grades, and their upper edges shall conform with finished grade of the sidewalk which shall have sufficient rise from the curb to provide proper drainage; but this rise shall not exceed one-quarter (¼) of an inch per foot, except where such rise shall parallel the length of the walk.

At each block division, cross forms shall be put in the full width of the walk and at right angles to the side forms.

A metal parting-strip one-half (½) inch thick shall take the place of the cross-forms at least once in every fifty (50) linear feet of sidewalk. When the sidewalk has become sufficiently hard, this parting-strip shall be removed and the joint filled with suitable material prior to opening the walk to traffic. Similar joints shall be provided where now sidewalks abut curbing or other artificial stone sidewalks.

All forms shall be thoroughly wetted before any material is deposited against them.

Size and Thickness of Blocks.

In business districts blocks shall be so divided that no dimensions shall be greater than six (6) feet; thickness of sidewalk shall correspond directly with the greatest dimensions of the walk as follows:—

Block 6 x 6 feet; thickness 6 inches.
Block 5 x 5 feet; thickness 5½ inches.
Block 4½ x 4½ feet; thickness 5 inches.
Block 4 x 4 feet; thickness 4 inches.

In residence districts the thickness shall be as follows:—

Block 6 x 6 feet; thickness, 6 inches.
Block 5 x 5 feet; thickness, 5 inches.
Block 4 x 4 feet; thickness, 4 inches.
Block 3 x 3 feet; thickness, 3 inches.

In residence sidewalks it shall be permissible to lay sidewalks with a thickness at the edges twenty-five (25) per cent. less than the thickness at the centre.

In no case shall the thickness of the walk be less than three (3) inches.

Sub-Base.

The sub-base shall be thoroughly rammed, and all soft spots removed and replaced by some suitable hard material.

When a fill exceeding one foot in thickness is required, it shall be thoroughly compacted by flooding and tamping in layers of not exceeding six (6) inches in thickness, and shall have a slope of not less than one to one and a half.

The top of all fills shall extend at least 12 inches beyond the sidewalk.

While compacting the sub-base shall be thoroughly wetted and shall be maintained in that condition until the concrete is deposited.

Base.

The concrete for the base shall be so proportioned that the cement shall overfill the voids in the sand by at least five (5) per cent., and the mortar shall overfill the voids in the stone or gravel by at least ten (10) per cent. The proportions shall not exceed one (1) part of cement to eight (8) parts of the other materials.

When the voids are not determined, the concrete shall have the proportions of one (1) part cement, three (3) parts sand or screenings and five (5) parts stone or gravel. A sack of cement (94 pounds) shall be considered to have a volume of one (1) cubic foot.

(a) Hand Mixing.—The sand shall be evenly spread on a level water-tight platform, and the cement spread upon the sand. After thoroughly mixing, dry, to a uniform color, water shall be added in a spray, and the mass turned until homogeneous mortar of even consistency is obtained. To this mortar shall be added the required amount of stone or gravel previously drenched, and the whole shall then be mixed until the aggregate is thoroughly coated with mortar.

Where unscreened gravel is used, the cement and gravel shall be thoroughly mixed, dry, until no streaks of cement are visible. Water shall be added with a spray in sufficient quantity to render, when thoroughly mixed, a concrete equivalent to that specified above.

Water may be added during the process of mixing, but the concrete shall be turned at least once immediately after its addition.

(b) Mechanical Mixing.—Machine mixing will be acceptable when a concrete equivalent in quality to that specified above is obtained. The mixing of mortar and concrete shall be thorough and satisfactory.

Retempering will not be permitted.

The concrete shall be deposited within sixty (60) minutes after being mixed, and shall be transferred to the forms in water-tight wheelbarrows. The wheelbarrows shall not be filled so full as to permit mortar to slop out, and shall not be run over the freshly laid concrete.

The concrete shall be spread evenly and tamped until water flushes to the top.

Separation of the blocks should be done with a tool not over six (6) inches wide and one-quarter (¼) inch thick and to insure complete separation the groove should be cut through into the sub-base. Fill the groove with dry sand before the top coat is spread, and the top coat should be cut through to the sand after floating and troweling and a jointer run in the groove, then again draw a trowel through the groove so as to insure a complete separation of the block.

Workmen shall not be permitted to walk on freshly laid concrete, and where sand or dust collects on the base it shall be carefully removed before the wearing surface is applied.

(Continued on Page 303.)

THE CEMENT INDUSTRY IN CANADA.

Of the materials of construction cement is one of the most important. It first found its field in heavy construction, but to-day it may be found used in the lightest designs.

In 1887 the manufacture of Canadian cement was commenced, and for many years natural cement was the only product. In 1891 for one barrel of Portland cement produced there were twenty-three barrels of natural cement. In 1895 Portland cement took the lead. The following table gives the production for the last twelve years:—

	Natural cement.		Portland cement.		Avg. price $ per bbl.	
Year.	Bbl.	Value.	Bbl.	Value.	Natural.	Portland.
1897	85,450	$65,893	119,763	$209,380	.771	1.748
1898	87,125	73,412	163,084	324,168	.842	1.987
1899	141,387	119,308	255,366	513,983	.843	2.012
1900	125,428	99,994	292,124	562,916	.797	1.927
1901	133,328	94,415	317,066	565,615	.708	1.783
1902	127,931	98,932	594,594	1,028,618	.773	1.729
1903	92,252	74,655	627,741	1,150,592	.809	1.834
1904	56,814	50,247	910,358	1,287,992	.884	1.414
1905	14,184	10,274	1,346,548	1,913,740	.724	1.421
1906	8,610	6,052	2,119,764	3,164,807	.703	1.493
1907	7,239	5,097	2,436,093	3,777,328	.704	1.555
1908*	Ontario		2,022,877	2,417,769	....	1.190

The above table shows clearly the gradual increase in output of cement in Canada, the increase in output of Portland cement over the natural cement and, with the exception of 1903, the gradual drop in the price of cement since 1898. The increase in output of cement has increased almost tenfold in ten years, while the price has dropped almost 25 per cent.

The total daily capacity of the twenty companies is 14,400 barrels.

Of these producing companies thirteen use marl and clay; four use limestone and clay, and one uses blast-furnace slag.

Very little cement is exported from Canada. On the other hand the imports are large although growing less annually both in total volume and ratio to the quantity of Canadian manufacture.

The following table gives the number of barrels of cement, Canadian and imported, used in Canada during the last seven years:—

Year.	Canadian.	Imported.
1901	317,066	555,900
1902	594,594	544,954
1903	627,741	773,678
1904	910,358	784,630
1905	1,346,548	917,558
1906	2,119,764	694,503
1907	2,436,093	672,630

A chemical analysis of good portland cements will show wide variations, so too will an analysis of the raw materials used in its manufacture. The raw materials used in the various mills frequently vary several per cent.. from each other as to silica, lime and alumina, yet the finished products appear of equal strength and value as a building material.

It is more as a matter of curiosity than as a table of much value that we publish below an analysis of the raw material used by several plants. To fix the proportions of cement mixtures by any definite rule appears impossible. Each plant must calculate its own mixture, and this mixture will often vary with the deepening of the beds.

*Furnished by Bureau of Mines, Ontario.

THE PORTLAND CEMENT COMPANIES OF CANADA

COMPANY	CHARTER OBTAINED	BUSINESS COMMENCED	AUTHORIZED CAPITAL	PAID-UP CAPITAL	PRESENT ANNUAL DIVIDEND	BRAND	PROCESS	DIRECTORS	OFFICERS	HEAD OFFICE
Alberta Portland Cement Co., Ltd.	1905, Oct. 27	1907, July	$ 1,000,000	$ 500,000 Common 328,000 Preferred	Nil	Buffalo	Dry	†E. R. Wood ‡R. P. Butchart ‡J. M. Kilbourn ‡W. H. E. Bravender §J. W. Campbell	J. W. Mitchell (Sec.) W. H. Hoyner (Treas.)	26 King St. East, Toronto
Belleville Portland Cement Co., Ltd.	1903, July 31	1905, April	1,000,000 Pref. 1,500,000 Common	530,000 Common	Preferred 7%	Belleville A.A.	Dry	†A. Ansley ‡J.M. Treble G. D. Forbes §J. W. McNab	.....	Belleville, Ont.
Brant Portland Cement Co., Ltd.	1908, Mar. 20	.....	500,000	.....	.....	Brant	Dry	†T. Elliott J. H. Fisher, M.P.P. M. H. Robertson	W.C. Boddy (Treas.) E.Y. Jackson (Supt.)	Brantford, Ont.
Canadian Portland Cement Co., Ltd.	1900, May	1900, June	1,500,000	1,489,100	Preferred 7%	Star	Wet	†M. J. Haney ‡J. Dobson ‡W. D. Matthews §F. G. B. Allen	R. Richardes (Sec.-Treas.)	506 Temple Bldg., Toronto, and 203 B'd of Trade Bldg., Montreal
Colonial Portland Cement Co., Ltd.	1901, Dec.	Recently	800,000	500,000	.....	Colonial	Wet	†R. M. Piper ‡D. A. Wright J. A. Morton Dr. W. J. Teasdale J. T. Webster Dr. W. W. Whittier C. A. Buhrer	J. Tolton (Sec.)	Wiarton, Ont.
Grey & Bruce Portland Cement Co.	1900	.....	500,000	.....	.....	Hercules	Wet	†Jas. McLaughlin ‡§Jno. G. Lynd	A. D. Creasor (Sec.-Treas)	Owen Sound, Ont.
Hanover Portland Cement Co., Ltd.	1900, Dec. 7 1903, Mar. 27	1898	200,000 7% Preferred 300,000 Common	48,700 Preferred 200,000 Common	Preferred 7% Common Nil	Saugeen	Wet	†D. Knechtel ‡J. E. Knechtel J. G. Reiner M. J. Muter H. Gruetzner	J. E. Knechtel (Sec.-Treas.)	Hanover, Ont.
Imperial Cement Co., Ltd.	1899	1900	300,000	49,850 Pref. 209,950 Ord.	.....	Imperial	Wet	†Hon. A. G. Mackay ‡M. Kennedy	H. W. Wood (Mgr.) A. C. Maitland (Sec.-Treas.)	Owen Sound, Ont.
International Portland Cement Co., Ltd.	1902, Oct. 2	1905, June	1,250,000	1,250,000	10%	.....	.....	†Sir Sandford Fleming ‡A. F. MacLaren §J. S. Irwin D. P. McKinnon	Dr. D. Jamieson (Treas.) C. A. Irwin (Sec.)	Ottawa, Ont.
Lakefield Portland Cement Co., Ltd.	1900	1900	1,000,000	1,000,000	7%	Monarch	Wet	†J. M. Kilbourn ‡R. P. Butchart ‡W. H. E. Bravender F. H. Kilbourn H. B. Smith	.....	Owen Sound, Ont.
Ontario Portland Cement Co	1901	.....	450,000	385,000	.....	.....	Wet	†E. L. Goold ‡W. S. Wisner	S. H. J. Reed (Sec.)	Paris, Ont.
Owen Sound Portland Cement Co	1888	.....	500,000	240,000	.....	Samson	Wet	J. M Kilburn ‡W. H. Pearson §D. M. Butchart	G. S. Kilburn (Sec.-Treas.)	Owen Sound, Ont.
***Manitoulin Portland Cement Co., Ltd.**	1904	Plant not constructed	350,000 7% Preferred 650,000 Common	.....	.....	.....	.....	†H. G. Field ‡J. McGibbon J. Carter W. Sherwood Capt. T. G. Ellis	E. A. Cleary (Sec.-Treas)	Windsor, Ont.
National Portland Cement Co., Ltd.	1901, Feb. 15	1903	1,000,000	1,000,000	Not declared	National	Wet	†R. H. Mc.Williams ‡W. H. Hoyle (1st) ‡V. Ratz (2nd) S. G. McKay C.W. Dyer A. F. MacLaren	G. McKechnie (Treas.) C. R. Lavelle (Sec.)	Durham, Ont.
Raven Lake Portland Cement Co.	1902, July	.....	500,000	500,000	....	Superior	Wet	†G. Shortreed T. McLaughlin D. Robertson	J. D. Johnson (Sec.)	Raven Lake, Victoria Rd., P.O., Ont.
Sun Portland Cement Co., Ltd.	1901	1902	200,000 Preferred 300,000 Common	198,555	.....	Sun	Wet	†W. P. Tetford ‡J. Armstrong J. S. Pinch W.T. Piggott J. M. Ponnell	T. L. Dates (Sec.-Treas.)	Owen Sound

NATURAL ROCK CEMENT

Superior Portland Cement Co.	1905	.....	500,000	435,000	.....	Superior	Wet	†W. D. Wilson ‡J. H. Mathieson §D. B. Brown	Geo. McIntyre (Sec.-Treas.)	Orangeville, Ont.
Sydney Cement Co., Ltd.	1905, Jan. 9	1905, June	500,000	395,000	Preferred 7%	Rampart	Dry	†Major H. J. Madocks ‡H. C. Burchell Hon. J. S. Pitts A. Johnson Dr. J. K. McLeod J. A. Young	A. C. Ross (Treas.) H. S. Ross (Sec.)	Sydney, N.S.
Vancouver Portland Cement Co., Ltd.	1904, March (Brit. Col.) 1906, (Dom.)	1905	1 500,000	500,000	7%	Vancouver	Dry	†E. R. Wood ‡J. E. Murphy ‡G. G. S. Lindsey §R. P. Butchart	J. W. Mitchell (Sec.) H. A. Ross (Treas.)	26 King St. East, Toronto
Western Can. Cement & Coal Co., Ltd.	1905, June	1908, April	1,250,000	1,250,000	First year of operations	Exshaw	Dry	†Sir Sandford Fleming ‡C. A. Irwin §J. S. Irwin	Hugh Fleming (Sec.-Treas.) D. P. MacKinnon (Sales-Mgr.)	9 Hope Bldg., Ottawa, Ont
Western Ont. Portland Cement Co., Ltd.	1903	1907	500,000	105,000	.....	Maple Leaf	Wet	†S. McAllister §J. S. Meyers	T. L. McCauley (Sec.-Treas.)	Attwood, Ont.
Queenston Cement Works	1887	.....	20,000	20,000	.....	.....	Dry	†§I. Usher F. M. Usher H. H. Shaw W. Bonewell	.....	Queenston, Ont.

*This Company desires to sell its rights. † President. ‡ Vice-President. § Managing Director

Name.		Carbonate of lime.	Silica.	Alumina and iron.	Magnesia.
Canadian Portland	Marl	97			
Cement Co.	Clay	4.6	51.6	26.2	
Hanover Portland	Marl	90			
Cement Co.	Clay	13	45	17.5	4
Imperial Portland	Marl	89			
Cement Co.	Clay		50	19	7
National Portland	Marl	88			
Cement Co.	Clay	3.25	62	22.5	1.5
Raven Lake Port-	Marl	92			
land Cement Co..	Clay	8.8	44.7	25	4.7
Sun Portland	Marl	50.7	1.6	0.8	1.7
Cement Co.	Clay	70.2	41.4	15.3	2.8
	Cement	62.8	22.2	9.3	2.7
Western Ont. Port-	Marl	85			
land Cement Co.	Clay	5	42	14	7
Vancouver Portland	Lime stone	97.5	1.5	0.8	0.2
Cement Co.	Clay	3.5	62	28	

The Portland cement industry is of growing importance, and just now in Canada prices are not satisfactory to the mill manager, but still cement plants, when properly financed, located, constructed and managed, give good returns to stockholders. New enterprises will yet spring up in Canada. The competition is keen—it will be keener. New machinery, new methods and lighter transportation charges will make it hard for some of the older companies to hold their present stand in the market. The manufacture of cement is a legitimate industry and will grow in output in the near future in Canada.

(Continued from Page 301.)

Wearing Surface.

The wearing course shall have a thickness of at least three-quarters (¾) of an inch.

The mortar shall be mixed in the same manner as the mortar for the base, but the proportion of one (1) cement to two (2) of sand or screenings, and it shall be of such consistency as will not require tamping, but will be readily floated with a straight-edge.

The mortar shall be spread on the base within thirty (30) minutes after mixing, and in no case shall more than fifty (50) minutes elapse between the time that the concrete for the base is mixed and the time that the wearing course is floated. A thin coat of mortar shall be floated on to the base before spreading the wearing surface.

After being worked to an approximately true surface, the block markings shall be made directly over the joints in the base with a tool which shall cut clear through to the base and completely separate the wearing courses of adjacent blocks.

The blocks shall be rounded on all surface edges to a radius of not less than one-quarter (¼) inch.

When partially set, the surface shall be trowled smooth.

On grades exceeding five (5) per cent., the surface shall be roughened. This may be done by the use of a grooving tool, toothed roller, brush, wooden float or other suitable tool; or by working coarse sand or screenings into the surface.

If color is desired, only mineral colors shall be used, which shall be incorporated with the entire wearing surface.

Single coat work shall be composed of one part of cement, two parts of sand and four parts of gravel or crushed stone, and the blocks separated as provided for in the specifications for two-coat work.

The concrete shall be firmly compacted by tamping and evenly struck off and smoothed to the top of the mold. Then, with a suitably grooved tool the coarser particles of the concrete tamped to the necessary depth so as to finish the same as two-coat work.

When completed, the sidewalk shall be kept moist and protected from traffic and the elements for at least three days. The forms shall be removed with great care, and upon

their removal earth shall be banked against the edges of the walk.

Grading after the walks are ready for use should be on the curb side of the sidewalk, one and one-half (1½) inches lower than the sidewalk, and not less than one-quarter (¼) inch to the foot fall toward the curb or gutter. On the property side of the walk the ground should be graded back at least two (2) feet and not lower than the walk; this will insure the frost throwing the walk alike on both sides.

EDUCATION OF INSPECTORS AT THE CONTRACTORS' EXPENSE.*

By Jas. Forrest.†

Usually papers presented before meetings of this kind are technical treatises about recently advanced theories on design or methods of construction and uses of materials, or else they are descriptions of a design, manner of prosecuting work, or a write-up of some new-fangled machine. But, in a measure to be original and to present a subject of much vital financial interest and importance to contractors and those paying for work done and of some benefit to young engineers, and old ones, too, for that matter, it has been decided to present this for your attention, discussion, and approval or disapproval.

It is not the intention to tell you something that you do not already know. It is to bring before you, as a sort of a reminder, this very important question of inspection which in the past seems to have been entirely overlooked and neglected.

The up-to-date contractor, in looking up new work, always endeavors to procure certain information aside from material prices and labor conditions. The first and most important being the pay, if it is sure and prompt. The next to be looked after are the hazards, risks and obstacles that are liable to be met with and must be overcome. The next to be learned, if possible, is, who the inspector is to be. Here the enumeration will stop as he is to be the subject matter of this paper.

The probabilities are that the inspector, engineer in charge, superintendent of construction, or supervising engineer, whichever his vanity leads him to designate himself, will be one of the following: A recent technical graduate; an under-graduate staying out a year to replenish his wallet; an old retired engineer; a personal friend of some politician; a political heeler who controls some votes and must be on the pay-roll, or, if the job and the contractor are lucky or fortunate, he might possibly be an engineer of ability, experience and judgment, who was temporarily out of employment, or a contractor's foreman or superintendent in the same predicament.

Now any of these may be dishonest and eager of pollution, which, if taken advantage of by the contractor, will cause him no loss as it would return many fold in decreased costs. However, very few, if any, contractors who intend to stay in business will stoop to buying inspectors as they generally get stung for it later. This phase of the question need not be discussed here as the part intended to be covered by this paper is that where the contractor suffers through the ignorance, lack of judgment, overconscientiousness, or bull-headedness on the part of the inspector.

If all the contractors get wise that they are liable to get the worst of it all through the work the bids will be higher than necessary. In that case the remedies to be mentioned later could be applied and those paying for the work would be greatly benefited. Again this paper is digressing as it is from the contractors' standpoint that the question is supposed to be discussed.

Consider the condition that nothing has been added to take care of the shortcomings of the inspector and see what is liable to happen, first describing generally the present specifications and the method of obtaining them.

Years ago it was customary to let contracts on very primitive plans and specifications, sometimes both entirely lacking, relying on the honesty and experience of the contractor for results. The great opportunity offered by this condition developed a class of avaricious contractors whose sole object seemed to be to skin a job, doing as little for the pay they got as was possible. This crookedness became so evident that plans and specifications were made more specific and exacting with varying amounts of superfluity and impossibilities until there exists to-day specifications that cannot be followed to the letter. If bids were based upon strict adherence to them they would be much higher. And if made to live up to the absolute letter of them a badly bent contractor would be the result. Specifications as they are to-day place the contractor's money entirely at the mercy of the engineer who, too often is unfit to be entrusted with anything. It must be borne in mind that often plans and specifications are prepared by incompetent engineers, and to follow all of them would be to return to many old and worn-out theoretical ideas and practices that have long since been discarded by the prominent and up-to-date engineers and contractors.

The customary duties of an inspector or engineer in charge are to furnish all engineering data consisting of lines, grades, etc., and to see that plans and specifications are followed honestly, using judgment in their interpretation. He should deviate from them when the welfare and progress of the work are at stake, allowing the contractor extra compensation for any extra work, should there be any, and when any unforseen difficulties arise that absolutely prevent them from being followed. An example of the first would be the specification requiring the plastering of any exposed concrete surfaces. This should always be disregarded. An example of the latter would be the one met with in river foundations, work requiring that no concrete be placed in water. This is a fair and legitimate specification, but if the work should happen to be in quick-sand it is almost impossible to get all the water out of the cofferdams and an inspector with judgment and experience knows that concrete can be placed in water successfully if the proper methods and precautions are used and he should permit it. He must, of course, see that it is properly done, permitting no slighting of the work. Failure to permit a deviation similar to this letter would work an unnecessary hardship on the contractor without any particular gain in the quality of the work.

Some examples of the lack of judgment, experience and fairness on the part of inspectors might well be mentioned to show the financial and time losses and inconveniences necessarily suffered by contractors in being made to live up to the absolute letter of the specifications and carry out patent and new-fangled ideas both in regard to finished work and methods of obtaining it, invented by the inspectors and insisted upon by them. In some cases enmity toward the contractor, selfishness in prolonging the job, possibly some fear because of the lack of experience and an inflated opinion of their own prowess and intelligence are the probable causes. Piles 2 inches short of specified length were rejected, even though 2 feet were cut off after being driven in the foundation pits. Specifications called for stone with dust screened out. Many cars of stone were rejected because in shipping the friction of the pieces of soft limestone on each other produced a little dust. Longitudinal expansion joints of freak design were ordered placed in the skew-backs and arch haunches, the reasons for which were not given, except that they wanted them. The furnishing of the levels as soon as asked was refused because the specifications required that the inspector be notified a certain length of time before any lines or grades were desired. It was insisted that piers be washed and rubbed down to the footings 6 feet below low water. After a day's concreting in a pier footing it was insisted that the pump run till 9 o'clock at night, and it was a sad sight to see the good cement being pumped out. But

*A paper presented at the convention of the Iowa Association of Cement Users, February, 1909.

†Des Moines, Iowa.

as it cost a little extra it was demanded, when every one knows, or should know, that concrete sets the best under still water. It seemed in some cases that the specifications were deviated from only when it cost the contractor more, even to the detriment of the bridge. They were strictly adhered to whenever the expense remained great with no particular gain to the bridge. An inspector on a steel building would permit no painting of steel in frosty weather. This was not because he was afraid the paint would be frozen, but because the frost in the steel, when it came out, would crowd off the paint. He was not well posted as to the porosity of steel but well enough posted to control the destiny of a steel building. There are inspectors who have required field rivets, which have been battered by driving, to be cleaned of rust by hand with a piece of emery paper. Some inspectors have graduated from colleges many years ago, and more is expected from them, but it seems that they are rather cut out for street car conductors.

Many other very unpleasant things come up on large work where one or more inspectors are working under a head inspector or engineer, each with their special duties to perform. A sub-inspector will instruct the contractor to proceed with a certain part of the work in a certain manner. As soon as he is rigged up and well started, along comes the "big chief" inspector and orders it done in an entirely different manner.

A very frequent case where both the structure and the contractor suffer is when piles are required to be driven till the final penetration is the same as that mentioned in the specifications. The point at which to cease hitting a pile is a very difficult one to determine. It is entirely a matter of judgment. If specifications are strictly adhered to in regard to the amount of the final penetration a badly shattered, broomed, or sheared pile with a consequent weakened foundation and a greatly inconvenienced contractor often result.

There seems to be no recourse from the unreasonable demands of an inspector as he is nearly always empowered to discharge any man on the work. Consequently there is nothing for the contractor to do but to take his medicine and grin. It is mysterious that there have not been a great many charges of assault and battery with intent to do great bodily injury filed by inspectors against contractors' foremen and superintendents or even the contractors themselves.

Here is an example of an engineer who was reasonable and fair, and used judgment, when he could have caused a lot of trouble if he hadn't. A concrete slab bridge of several spans was built. The plans and specifications called for a certain number of steel rods in the bottom of each slab. One road was accidentally omitted in one of the slabs and was only discovered when an extra one was found after the bridge was done. The number of rods had been checked when they arrived and there were no extras, so one must have been left out. Now if the plans and specifications had been insisted upon to the letter when this rod was discovered the bridge could have been ordered torn down till the slab which was lacking one rod was located and then rebuilt before being accepted. But the engineer was fair enough to know that it was not omitted maliciously and well enough posted and educated to know that the bridge was still absolutely safe, so he accepted it. Would not a contractor have been in a fine boat had some ignorant inspectors been on the job?

One of the causes of all these troubles lies in the fact that too many novices prepare plans and specifications. This can be remedied by employing only competent engineers experienced in the lines of the proposed work, and paying them their price. By doing this a much better structure or work in every particular will result and the specifications will be more easily followed, relieving the inspector of nearly all call upon his judgment.

Another of the causes is that too small salaries are paid inspectors to procure competent ones. To overcome this the salaries should be increased enough to attract the attention of capable and experienced men now employed by leading engineering and contracting firms. The importance of the position of the engineer in charge must be appreciated and realized, and salaries commensurate therewith paid.

As long as the present salaries are paid a few suggestions for those who may be attracted by them might help. If he is experienced he ought to learn the reputation of the contractor as to honesty, experience and ability, and watch him or his representatives for a while to see if he intends to maintain that reputation on this new work. If he is satisfied, he can furnish the engineering data and pass only on finished work. Let him keep his mouth shut and eyes open and trust to the experience of the contractor to do the work in the proper manner. He must always bear in mind that specifications were not intended to be and cannot be followed to the letter and keep his eye open for any sign of dishonesty or slighting. By doing this, if he is properly constructed, he will become, after being on two or three pieces of work, too valuable to act longer as an inspector and will be gobbled up by some contractor.

An inspector does not need to be inexperienced and afraid of dishonesty on the part of the contractor to work many hardships on the latter. He can be mean and unfair and insist upon the letter of the specifications. That will do it. But if he tries to be mean and overbearing he might discover that the contractor was wiser and sharper than he was and could and would skin the job right under his nose without him being able to detect it. The inspector and contractor must work in harmony to produce a first-class piece of work at minimum cost and the former bear in mind that he is more interested in results than in the methods of obtaining them and that the contractor can usually use his own established methods much more advantageously, economically and effectually than he can another's.

If an experienced inspector does not conduct himself as pointed out in the foregoing, when the job is completed he will be much better educated as an inspector, but oh my! at what a great expense to the contractor.

SPECIFIC COSTS IN CONCRETE CONSTRUCTION.

M. C. Tuttle.*

A general understanding of the relative costs of the items that go to make up the total cost will throw some light on the temptations to slight concrete work. These items are presented with regard to an eight storey office building, which was recently constructed by his company.

This building is 175 feet long, 80-foot front, is of concrete frame with brick walls carried upon the frame. The percentage of the items entering into the cost of the reinforced concrete part of this building was as follows: Labor, 38 per cent.; cement, 15 per cent.; stone and sand, 9½ per cent.; steel, 21 per cent.; lumber, 10 per cent.; power, 1½ per cent.; miscellaneous unclassified, 5 per cent. The large items of material costs were in this job the labor, the cement, the steel, and the lumber. Roughly the same percentage of costs might well hold through the construction of a factory and there would be the same chance, of a saving in the amount of the cement, the amount of the steel, and the amount of the lumber. The saving in the lumber would come from quick removal of forms and from economical design of these. The danger of too close saving on this would be on the contractor. The saving on the other items would be made at the expense of the owner. This means that the amount of the expensive items can be varied more easily in this sort of construction than in most others, and that it is well to look to the reputation of the man or firm with whom one contracts for concrette work. Experience in concrete construction is obtained slowly and competent men are rare, as fourteen years' experience in reinforced concrete construction has taught the writer's company.

* Secretary of the Aberthaw Construction Company, Boston, Mass.

DECAY IN TIMBER.

C. M. B. Dyer.*

I was asked how we are to stop decay. The best method to adopt would be to impregnate the wood with a solution which would make it impossible for bacteria and fungi to live in or upon it, and which would not directly or indirectly weaken or destroy the cellulose, this being the skeleton or framework of all kinds of wood, and on its permanent soundness the strength and elasticity of wood depends. I have already stated that the chief and obvious attributes necessary to any compound or substance used for the infusion into or impregnation of insulating timber are: it should be odorless and non-evaporable; it should lessen the ignitibility of the wood and if possible rended it non-inflammable; it should be non-corrosive, or otherwise the fabric of an insulation might become unstable although the wood remained sound; it should be capable of easy application without requiring special plant or skilled workmen; and, finally, the completed process should be at a cost low enough to produce direct economies through the increased life and soundness it imparts to insulations. A compound of fluorine called Hylinit was mentioned by Mr. Balfour as having been under

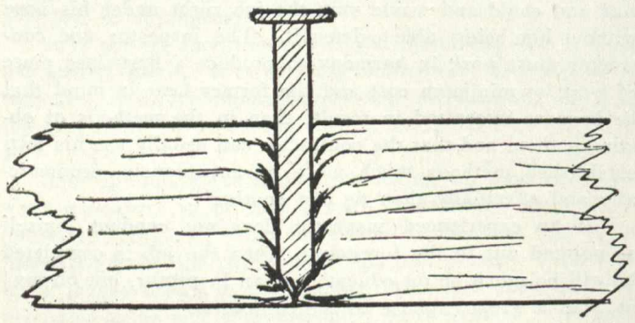


FIG 1.

discussion at the recent International Refrigerating Industries Congress at Paris, but I cannot trace that it has yet been practically tested for the preservation of insulating timber, or for analogous purposes from which its suitability might be deduced. I have recently had my attention called to a compound which it is stated renders wood, impregnated with solutions of it, immune to the depredations of the numerous insects which infest wood in tropical and semi-tropical countries, such as borers, white ants, etc., and I have seen testimony from Indian Government Forest Officers and others of its proved efficacy. I have also evidence that it is used with good effects on ships' decks, which it hardens in the process of cleaning; that in Japan it is now generally applied to the structural timber, of which the numerous cotton and other factories are now entirely constructed, to lessen ignitibility and impart non-inflammability; and that it is generally used for these purposes on mining timber in South Africa. I am also informed that it is now being applied to a large quantity of India timber destined for the construction of railway carriages and trucks. I therefore feel justified in submitting for your inspection some small samples of treated wood, which are evidently odorless, and it may fairly be assumed are non-evaporable. I will make an experiment to test its non-inflammability. Taking an ordinary bunsen burner, the temperature of which of course is considerably higher than that of an ordinary flame, I will submit to its action this strip of wood stated to have been treated with the preparation, and a similar piece of wood untreated. (Mr. Dyer then submitted the strips to the action of the flame). As you see, the untreated material readily ignites and burns, whilst the treated material appears to be only charred. Taking a second pair of strips and suddenly removing the flame it will be found that the untreated wood continues to burn, while the treated remains black, thus conclusively proving that as far as inflammability is concerned it answers very well, or as well as we could hope for. I am told the preparation is easily applied. Fence posts as used in Calcutta, after being immersed in a 25 per cent. solution for thirty-six hours and then dried and fixed in the ground, have remained immune from the attacks of insects and white ants during a period of two years; and what a white ant refuses to eat must be something very indigestible. Its cost, I am informed, is very moderate considering the advantages it appears to possess. As to whether the rotting is confined to white pine. I do not think white pine, which term is used to denote what is known as pinus strobus, and which is grown chiefly in North America, is more immune than the red pines, white firs, or deal timber which comes from Norway, Sweden and Russia, and which, on account of their cheapness, are more largely used. Certainly they do not always get the seasoning they should have. One to two years' seasoning under shelter roofs, allowing free ventilation, is necessary to evaporate the water and dry the liquids contained in the cellular structure, as timber, like most organic substances, contains a considerable proportion by weight of water free and combined. About eight or nine years ago 30 per cent. of the white pine cut in America was imported here; to-day, in many places, it is practically unobtainable. With regard to the remarks, that the bruising and tearing of the fibres by the use of nails was one of the causes of deterioration in their vicinity, as the bruising allowed of the freer admission of moisture, I qute agree that this is a probable cause. We have to ask ourselves, why does a nail hold in wood, i.e., why does it require more force to withdraw a properly driven nail than was used in driving it? Of course I am not speaking of the old cut nail which was wedge-shaped and crushed the fibres apart the deeper it was driven, but of the ordinary modern nail known as the French nail, which, although a beautiful production, smooth, highly polished and burnished and parallel throughout its length excepting the extreme point, yet holds very well. Mr. Milton explains it as follows:—

The nail on being forced in, tears and draws the adjacent fibre in its progress as shown, and by the elasticity of the timber a series of barbs press on the surface of the nail, which thus becomes locked in the same way as if a series of pawls were acting on a capstan wheel, or as an arrow or fish-hook head when once it has struck in. This, although a very minor point, becomes in the aggregate a large factor when the number of fastenings used for constructional purposes is considered, and the point is worthy of attention, without mentioning the effects of the finishing taps of the hammer on the surface of the wood. We can thus see that wherever a nail is driven, the wood adjacent is torn and rended, and makes a nest or breeding-place for the spores to start in. The drip from brine pipes causes decay. I think we might confine that entirely to the moisture due to thawing off, or where higher temperatures are carried as in the cheese chambers. In all installations leaky brine pipes can never be tolerated, as they would destroy any cargo if they came above it, but the thawing-off is responsible for most of the rapid decay which is prevalent in the outer linings, especially in the first layer of outer linings where the air cannot get at it to dry it. To properly thaw off and clear up a refrigerated compartment is work that requires considerable attention and labor. The snow as it falls from the brine grids must not be allowed to accumulate on the hold floor. Although a certain quantity of sawdust may be laid to absorb it, the sawdust speedily gets saturated and communicates the moisture to the linings. Every particle of snow should be cleared away. There is a solution of the unemployed question which has received so much attention of late, and one which will afford employment to a large number of unskilled laborers under the direction of a few experts, a method which is free from that objectionable form of work of which we have seen so many examples of late as a temporary respite, such as excavating model lakes and work of that description. I refer to the afforestation of the large tracts and areas of waste lands we have in our country.

*Abridged from a discussion before the Institute of Marine Engineers.

LEGAL NOTES.

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

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

DRAINAGE—ASSESSMENT.

Re Townships Harwich and Raleigh.—The evidence at trial showed that the township of Harwich had constructed a great many drains by reason of which it caused more water to flow upon the adjoining township of Raleigh than would naturally have flowed there and that the ordinary flow of water was, by these drains, brought down much more rapidly upon Raleigh than it would naturally have come.

The Council of Raleigh finding that their neighbor was getting rid of its surface water to their detriment took upon themselves to remedy the evil. They constructed an artificial drain to carry off the excess of waters, and to pay for same undertook to assess the neighboring lands in Raleigh townships which, they claimed, were the lands directly benefited. The defendants objected to the assessment in general and also to the fact that a large number of lots were assessed uniformally. The engineer employed, expressed his view that this mode of assessment was the most fair and just one which could be arrived at, and the court, which appears to have relied upon his skill and experience, thought that the question was one pre-eminently resting with the surveyor and that the decision should be arrived at in accordance with his opinion, which had not been materially contradicted. It was held that the township of Harwich had a right to construct such a drain and to assess the neighboring lands for the cost of same, since the water flowed upon and injured the lower lands and would have continued to do so if the outlet had not been made.

DANGEROUS OPENING IN ICE—FAILURE TO GUARD SAME.

Pennoch vs. Mitchell.—In December 1906 the defendants brought a tug and a scow into the harbor at Gananoque, Ontario. It was already late in the season and the harbor covered with ice, so that it was necessary for them to cut a channel in order to reach the docks. In the outer waters a single channel sufficed, but as they neared the mooring place, the tug and the scow were separated and different channels being cut towards the side of the harbor, left a triangular shaped area of ice along the shore between the spots where the two vessels were to be moored.

The jury at trial concluded that this triangular piece of ice had been broken up by the swell of the tug as it drew the scow and came itself into position, thus leaving an area of open water which had previously been covered by substantial ice. The harbor was an open one and at this time of the year frequented by the public, sometimes as a highway and often for the purpose of skating. The daughter of the plaintiffs, without warning, skated over the unprotected area before any considerable thickness of ice had formed, and was drowned.

By section 287 of the Criminal Code of Canada, it is provided that "any person making any hole or opening through the ice on any navigable water open to or frequented by the public, large enough to endanger human life, and who leaves such hole or opening while in such dangerous state not enclosed by bushes or trees, and unguarded by fence of sufficient strength to prevent persons from accidentally driving, skating or falling into same, is guilty of an indictable offence and if any person loses his life by accidentally falling therein, the person who left the opening thus unguarded is guilty of manslaughter." The plaintiffs sued for damages for the death of their daughter who was drowned and were successful in obtaining a verdict. The defendants appealed from the verdict, but were still held liable. The main plea sent up by the defendants was that the right of navigation was paramount, and that they were entirely within their rights in cutting the passages. The decision does not interfere with this contention at all, but is an application of the maxim "that one must exercise his own rights in such manner as not to interfere with the rights of his neighbor." The right to cut the passage through the ice for purposes of navigation is admitted, but where the public has the right to use that ice as a highway or for other lawful purposes, and people are in the habit of so using it, there is imposed upon these who make openings, a duty of protecting them so that there shall not be traps in which the unwary may fall. O.R.

VERBAL AND WRITTEN CONTRACTS.

A written contract is not legally more binding than a verbal one, but in view of the greater formality attending the signing and delivery of a written document. A written paper is presumed in law to contain all that the parties intended to agree upon and that this has been put into final and mature shape., while all merely verbal propositions and suggestions leading up to the same have been cast aside. Therefore, when a contract has been made and signed evidence showing verbal propositions during the course of negotiations, will not be allowed, because they are superseded by the written instrument.

A rule at law is, that when one person signs a contract, which places some responsibility upon him, he must receive something in return for the obligation thus placed upon him. If it is not shown by the written agreement that the person upon whom an obligation is cast is to receive something of value in return therefor, the agreement, though perfect in form, does not rise to the dignity of what the law calls "a contract," and such person cannot be compelled to comply with the obligation out-lined. There is, however, an exception as to contracts under seal: If a person has signed a written document and attached his seal thereto, he is bound by the terms of the writing, notwithstanding that he received nothing in return. It appears to have been thought by the makers of the law, that when he did an act with such solemnity as to attach his seal, there was no doubt that he had duly weighed the matter and was in no danger of being imposed upon.

BUILDING CONTRACT—SPECIFICATIONS—DRAINING QUICKSAND.

Stees vs. Leonard.—A firm of architects in a Minnesota city furnished plans and specifications and contracted to build a mercantile building on a certain lot. The specifications gave widths of footings, etc., but no other particulars about foundations. When the matter of building was talked about, the question of draining the subsoil of the lot was mentioned, and the owners said that they did not think it would need draining, but if any draining should be needed, they would do it. The contract, as finally entered into, was under seal. In it the contractors agreed to build, erect and complete a three-story business house on a certain lot, in accordance with plans and specifications, which formed part of the contract. On uncovering the subsoil, after the signing of the contract, quicksand appeared, which the contractors had no previous knowledge of, and could not have known anything about. The defendants' claimed that, on the discovery of

the quicksand, the owners, finding that the subsoil would not, unless drained, sustain the proposed building, "promised that they would cause the land to be well and thoroughly drained; but that they failed to drain the land or any part thereof." The contractors went on with the building, without seeing that the subsoil was put in proper condition. When it was nearly completed, it fell, the quicksand beneath having become saturated with water. The contractors began to rebuild, and had nearly completed the building a second time, when it fell again, from the same cause as before. They then refused to proceed further with the work under their contract, and the owners brought suit to recover back the money which they had already paid on account of the contract, with damages for loss of the use of the lot during the unsuccessful attempts to build upon it, and for injury to the adjoining building, also owned by them, and to the goods in it, by the fall of the new structure.

The Supreme Court of Minnesota decided in favor of the owners on all points brought up. In regard to the alleged promise made by them, before the signing of the contract, to drain the land, the court said that evidence of this was inadmissable to vary the rights and obligations of the parties under the subsequent sealed contract. As to the subsequent promise of the owners, made after the discovery of the quicksand, to "cause the land to be well and thoroughly drained." The court said that this mere promise, being without consideration, was not binding, but what is known to lawyers as a "nudum pactum," on which the contractors had no right to rely, and which was inoperative to vary the sealed contract. In regard to what the agreement required the contractors to do, the court held that the defect in the soil did not excuse the defendants from the performance of their contract; that for their failure to perform it they were liable in damages to the owners, and that it was no defence to the action that the building, so far as it was erected, was constructed in accordance with the plans and specifications.

20 Minn. 484.

DEATH OF CONTRACTOR.

Where two persons sign a building contract the death of the contractor, unless some provision has been made in the writing to the effect of its being completed by his executors, terminates the contract. Where no such provision has been made in the contract and the contractor dies, it is, therefore, very unwise for sub-contractors to do further work or supply materials until some later agreement has been arrived at with the owner, for they may not be able to collect their pay. The death of the owner, on the contrary, does not, except by special previous agreement, terminate a building contract, but it remains in full force; the contractor can finish the work and enforce his claim for payment against the owner's estate. The contractor's undertaking may be viewed from the standpoint of personal services, and not infrequently he does obtain the contract because of the owner's reliance upon his skill or integrity. Therefore, when the contractor dies the contract is rightly ended, because that upon which the other party relied no longer exists; but when the owner dies his estate is ample to fulfil his part of the obligation as his executors can pay the contractor.

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, C. H. Mitchell; Secretary, T. C. Irving, Jr., Traders Bank Building.

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, A. F. VanNostrand; 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.

The Grand Trunk report for the half year to Dec. 31, 1908, shows receipts of £3,382,800; working expenses, £2,422,400; net receipts, £960,400; revenue charges, less credits, £478,700; after deducting the deficiency on the Canada Atlantic and Detroit, Grand Haven and Milwaukee affiliated lines, there is a surplus of £443,000 available for dividends, which will admit of the payment of a dividend for the half year of four per cent. on the guaranteed stock, a full five per cent. on the first preferred, and 2½ per cent. for the year on second preferred carrying forward £12,000.

CEMENT SPECIFICATIONS.

The most unsatisfactory tests that are made, dealing with materials of construction, are those for Portland cement. The standard for Portland cement in Canada has been that set by the Canadian Society of Civil Engineers. In The Canadian Engineer, Vol. XV., page 757, we pointed out a few deficiencies in these standard specifications. Since that article appeared the committee of the Canadian Society of Civil Engineers on Standard Specifications have presented their report, which is given in part below.

(1) Definition.—This term is applied to a hydraulic cementing material manufactured from approximately 1.7 parts of lime by weight, to 1 part of soluble silica alumina, iron oxide, finely ground, intimately mixed, calcined to incipient fusion, and again finely ground. To this product not more than 3 per cent. of other material shall be added for particular purposes.

(2) Weight.—Unpacked Portland cement weighs approximately 84 lbs. per cubic foot, and when hard packed approximately 116 lbs. per cubic foot. One hundred pounds of cement should be considered as one cubic foot, as a basis of measurement for mixing mortar and concrete.

(3) Inspection.—All cement shall be inspected, and at least 12 days shall be allowed for testing and inspection of the cement before it is used in the work.

(4) Testing.—All tests should be made in accordance with the standard methods hereinafter detailed, and should be made by an experienced person, having proper means for making the tests. Where field tests give results which leave reasonable doubt as to the quality of the cement, it is recommended that samples be submitted for laboratory check tests, to an experienced tester of recognized ability and standing, before final acceptance or rejection under these specifications. Cement failing to meet the seven-day requirements may be held awaiting results of the 28-day tests.

(5) Storage.—On all work where so demanded by the engineer, the contractor or other person in charge of the work, shall provide a suitable weather-tight building for the storage of cement, and the cement shall be stored in such a manner as to allow easy access for sampling and identification of each shipment.

(6) Packages.—All cement shall be delivered in cement-tight packages, with the name of the manufacturer, the brand, and the net weight, plainly marked thereon.

Sampling.

(7) Selection of Sample.—The selection of the sample for testing is a detail that must be left to the discretion of the engineer. The number and the quantity to be taken from each package will depend largely upon the importance of the work, the number of tests to be made, and the facilities for making them.

(8) The sample shall be a fair average of the contents of the package; it is recommended that, where conditions permit, one package in every twenty-five be sampled.

(9) Samples should be passed through a sieve having twenty meshes per lineal inch, in order to break up lumps and remove foreign material. This is also a very effective method for mixing them together in order to obtain an average. For determining the characteristics of a shipment of cement, the individual samples may be mixed and the average tested. Where time will permit, however, it is recommended that they be tested separately.

Chemical Analysis.

(10) Requirement.—The cement shall contain not more than 4 per cent of magnesia (MgO), nor more than 2 per cent. of anhydrous sulphuric acid. (SO_3).

(11) Significance.—Chemical analysis may render valuable service in the detection of adulteration of cement with considerable amounts of inert material, such as ground limestone. It is of use also in determining whether certain constituents, believed to be harmful when in excess of a certain percentage, as magnesia, and sulphuric anhydrid, are present in admissible proportions.

(12) The determination of the principal constituents of cement (silica, alumina, iron oxide, and lime) is not conclusive as an identification of quality. Faulty character of cement results more frequently from imperfect penetration of the raw material or defective burning than from incorrect proportions of the constituents. Cement made from very finely ground material, and thoroughly burned, may contain much more lime than the amount usually present, and still be perfectly sound. On the other hand, cements low in lime, may, on account of careless preparation of the raw material, be of dangerous character. Further, the ash of the fuel used in burning may so greatly modify the composition of the product as largely to destroy the significance of the results of analysis.

(13) Method.—The method to be followed for the analysis of cement shall be in accordance with that proposed by the Committee of Uniformity in Analysis of Materials for the Portland Cement Industry, of the New York Section of the Society for Chemical Industry.

Specific Gravity.

(14) Requirement.—The specific gravity of the cement, ignited at a low red heat, shall not be less than 3.10, and shall not show a loss on ignition of over 4 per cent.

(15) Significance.—The specific gravity of cement is lowered by underburning, adulteration, and hydration, but the adulteration must be in considerable quantity to affect the results appreciably.

Inasmuch as the differences in specific gravity are usually very small, great care must be exercised in making the determination.

(16) Apparatus and Method.—The determination of specific gravity is most conveniently made with Le Chatelier's Apparatus. This consists of a flask of 120 cu. cm. (7.32 cu. in.) capacity, the neck of which is about 20 cm. (7.87 ins.) long. In the middle of this neck is a bulb, and above and below the bulb are two marks, the volume between which is 20 cu. cm. (1.22 cu. in.). The neck has a diameter of about 9 mm. (0.35 in.), and is graduated into tenths of cubic centimeters above the upper mark.

(17) Benzine (62 degrees Baume Naphtha), or kerosene free from water should be used in making the determination.

(18) The specific gravity can be determined in two ways:

(a) The flask is filled with either of these liquids to the lower mark, and 64 gr. (2.25 oz.) of powder, cooled to the temperature of the liquid, is gradually introduced through the funnel (the stem of which extends into the flask at the top of the bulb) until the upper mark is reached. The difference in weight between the cement remaining and the original quantity (64 gr.) is the weight which has displaced 20 cu. cm.

(b) The whole quantity of the powder is introduced, and the level of the liquid rises to some division of the graduated neck. This reading, plus 20 cu. cm., is the volume displaced by 64 gr. of the powder.

The specific gravity is then obtained from the formula:

$$\text{Specific gravity} = \frac{\text{Weight of cement in grammes}}{\text{Displaced volume in cu. cm.}}$$

(19) The flask, during the operation, is kept immersed in water in a jar, in order to avoid variations in the temperature of the liquid. The results should agree within 0.01. The determination of specific gravity should be made on the cement as received, and should it fall below 3.10, a second determination should be made on the sample, ignited at a low red heat.

(20) A convenient method for cleaning the apparatus is as follows:—The flask is inverted over a large vessel, preferably a glass jar, and shaken vertically until the liquid starts to flow freely. It is then held still in a vertical position until empty; the remaining traces of cement can be removed in a similar manner by pouring into the flask a small quantity of clean liquid and repeating the operation.

(21) More accurate determination may be made with the picnometer.

Fineness.

(22) Requirement.—It shall leave by weight a residue of not more than 8 per cent. on the No. 100 sieve, and not more than 25 per cent. on the No. 200 sieve.

(23) Significance.—It is generally accepted that the coarser particles in cement are practically inert, and it is only the extremely fine powder that possesses adhesive or cementing qualities. The more finely cement is pulverized, all other conditions being the same, the more sand it will carry and produce a mortar of a given strength.

(24) The degree of final pulverization which the cement receives at the place of manufacture is ascertained by measuring the residue retained on certain sieves. Those known as the No. 100 and No. 200 sieves are recommended for this purpose.

(25) Apparatus.—The sieves should be circular, about 20 cm. (7.87 ins.) in diameter, 6 cm. (2.36 ins.) high, and provided with a pan 5 cm. (1.97 ins.) deep, and a cover.

(26) The wire cloth should be of brass wire having the following diameters:—

No. 100, 0.0045 in.; No. 200, 0.0024 in.

(27) This cloth should be mounted on the frames without distortion, the mesh should be regular in spacing, and be within the following limits:—

No. 100, 96 to 100 meshes to the lineal inch.
No. 200, 188 to 200 meshes to the lineal inch.

(28) Fifty gr. (1.76 oz.) or 100 gr. (3.52 oz.) should be used for the test, and dried at a temperature of 100° Cent. (212° Fahr.) prior to sieving.

(29) The thoroughly dried and coarsely screened sample is weighed and placed on the No. 200 sieve, which, with pan and cover attached, is held in one hand in a slightly inclined position, and moved forward and backward, at the same time striking the pan gently with the palm of the other hand, at the rate of about 200 strokes per minute. The operation is continued until not more than one-tenth of one per cent. passes through after one minute of continuous sieving. The residue is weighed, then placed on the No. 100 sieve and the operation repeated. The work may be expedited by placing in the sieve a small quantity of large steel shot. The results should be reported to the nearest tenth of one per cent.

Time of Setting.

(30) Requirement.—It shall not develop initial set in less than thirty minutes, and must develop hard set in not less than one hour, nor more than ten hours.

(31) Significance.—The object of this test is to determine the time which elapses from the moment the water is added until the paste ceases to be fluid and plastic (called the "initial set") and also the time required for it to acquire a certain degree of hardness (called the "final" or "hard set"). The former is the more important, since, with the commencement of setting, the process of crystallization or hardening is said to begin. As a disturbance of this process may produce a loss of strength, it is desirable to complete the operation of mixing and moulding, or incorporating the mortar into the work, before the cement begins to set.

(32) It should be borne in mind that chemical action begins as soon as water is added to the cement, and that a very quick setting cement may be killed by prolonged mixing or disturbance, also that the time of setting may be greatly prolonged by gauging with excess of water and excessive working when preparing the test pat, that that if care is not taken in making the test, a dangerously quick setting cement may be wrongly accepted.

(33) The time of setting is also materially affected by temperature. Care should therefore be taken to have the room, cement, and gauging water as near to 70° Fahr. before starting the test as possible. In damp weather the cement should be dried before weighing and gauging for setting test.

(34) With a view to detecting dangerously quick setting cement, it is recommended that a definite percentage of water should be used in gauging, as follows:—For a cement 75 per cent.. of which will pass a No. 200 sieve, 22 per cent. of water, and an additional 1 per cent. of water, for each extra 5 per cent. of cement that will pass the No. 200 sieve.

(35) In preparing pats for this test, mixing should be done on a non-absorbent surface, preferably plate glass. The dry cement should be carefully weighed, and placed on the glass with a crater formed, so that the water can be placed in the centre. When adding the water, accurately note the time. Then with a small trowel mix the cement and water into a paste, working rapidly and thoroughly with the side of the trowel, for a period of ONE MINUTE. Form quickly into a ball with the hands and place on the glass, flattening down with the trowel into a circular pat about 3-inch. diameter, ½-inch. thick in the centre, tapering to a thin edge (this pat may also be used for soundness test). The time from adding the water to the finished pat, should not be less than 7› seconds, nor more than 80 seconds. Place a damp cloth over the pat, but not in contact with it. The cement shall be considered as having taken "initial set" when a wire 1/12-inch diameter, loaded to weigh ¼ lb., shall leave a distinct mark on the pat but not appreciably penetrate the surface, and the "final" or "hard set" when a wire 1/24-in. diameter, loaded to weigh 1 lb., shall leave a distinct mark, but not appreciably penetrate the surface.

Standard Sand.

(36) Natural sand* from Ottawa, Illinois, screened to pass a sieve having 20 meshes to the lineal inch, and retained on a screen having 30 meshes to the lineal inch, is recommended in preference to the standard quartz sand generally used.

(37) For field tests, good, sharp river or bank sand, screened to pass a sieve having 20 meshes to the lineal inch, and retained on a sieve having 30 meshes to the lineal inch, may be used. This sand should in all cases be washed clean before being used. As sand obtained in this way cannot be considered standard, results should be considered as approximate only.

Mixing and Moulding.

(40) All proportions should be stated by weight. The quantity of water to be used should be stated as a percentage of the dry material.

(41) The metric system is recommended because of the convenient relation of the gramme and the cubic centimeter.

(42) The temperature of the room and the mixing water should be as near 21° Cent. (70° Fahr.) as it is practicable to maintain it.

(43) The sand and cement should be thoroughly mixed dry. The mixing should be done on some non-absorbing surface, preferably plate glass.

(44) The quantity of material to be mixed at one time depends on the number of test pieces to be made; about 1,000 gr. (35.28 oz.) makes a convenient quantity to mix, especially by hand methods.

(45) In making briquettes for tensile tests, use just sufficient water to make a stiff paste or mortar, which can be sufficiently well pressed into the moulds with the thumbs to make a dense briquette, and with just sufficient moisture on the surface to show bright when the briquette is troweled off.

(46) A sand-glass is recomended as a convenient means of noting the time of mixing, and rubber gloves should be used when mixing with the hands.

(47) Weigh the material and place on the mixing table, forming a crater in the centre, into which the proper percentage of clean water is to be poured. Add the water, carefully noting the time, or setting the sand-glass, then quickly turn the material from the outer edge into the crater with the aid of a trowel, thoroughly incorporating the water with the other material, taking one minute from the time of adding the water to perform this part of the work. Then complete the operation by vigorously kneading the mixture with the hands for an additional period of one and one-half

*This sand may be obtained from the Sandusky Portland Cement Company, of Sandusky, Ohio.

minutes. Place carefully into the mould, pressing in firmly with the thumbs, heaping the mortar slightly above the mould. The trowel should then be drawn over the mould in such a manner as to exert a moderate pressure on the excess material. Reverse the mould, and trowel the other surface of the briquette in the same manner, leaving the surface truly level with the face of the mould.

(48) A check upon uniformity of mixing and moulding is afforded by weighing the briquette just prior to immersion, or upon removal from the moist closet. Briquettes which may vary in weight more than 3 per cent. from the average should not be tested.

Storage of Test Pieces.

(49) During the first 24 hours after moulding, the test pieces should be kept in moist air to prevent them from drying out.

(50) A moist closet or chamber is so easily devised that the use of the damp cloth should be abandoned if possible. Covering the test pieces with a damp cloth is objectionable, as commonly used, because the cloth may dry out unequally, and in consequence, the test pieces are not all maintained under the same condition. Where a moist closet is not available, a cloth may be used, and kept uniformly wet by immersing the ends in water. It should be kept from direct contact with the test pieces by means of a wire screen or some similar arrangement.

(51) A moist closet consists of a soapstone or slate box, or a metal-lined wooden box—the metal lining being covered with felt, and this felt being kept wet. The bottom of the box is so constructed as to hold water, and the sides are provided with cleats for holding glass shelves on which to place the briquettes. Care should be taken to keep the air in the closet uniformly moist.

(52) After 24 hours in moist air the test pieces for longer periods of time should be immersed in water maintained as near 21° Cent. (70° Fahr.) as practicable. They may be stored in tanks or pans, which should be of non-corrodible material.

Tensile Strength.

(53) Requirement.—The minimum requirements for tensile strength for briquettes one inch square in section shall be within the following limits, and shall show no retrogression in strength within the periods specified:—

Neat Cement.

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

One Part Cement, Three Parts Standard Sand.

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

(54) If the minimum strength is not specified, the mean of the above values will be taken as the minimum strength required.

(55) The tests may be made on any standard machine. A solid metal clip, as shown in Fig. 3, is recommended. This clip is to be used without cushioning at the points of contact with the test specimen. The bearing at each point of contact should be ¼-inch wide, and the distance between the centre of contact on the same clip should be 1¼-inch.

(56) Test pieces should be broken as soon as they are removed from the water. Care should be observed in centering the briquette in the testing machine, as cross-strains produced by improper centering tend to lower the breaking strength. The load should not be applied too suddenly, as it may produce vibration, the shock from which often breaks the briquette before the ultimate strength is reached. Care must be taken that the clips and the sides of the briquette be clean from grains of sand or dirt, which would prevent a good bearing. The load should be applied at the rate of 600 pounds per minute. The average of not less than three briquettes of each sample tested should be taken as the test, excluding any results which are manifestly faulty.

Constancy of Volume.

(57) Significance.—The object is to develop those qualities which tend to destroy the strength and durability of a cement. As it is highly essential to determine such qualities at once, tests of this character are, for the most part, made in a very short time, and are known, therefore, as accelerated tests. Failure is revealed by cracking, checking, swelling or disintegration, or all of these phenomena. A cement which remains perfectly sound is said to be of constant volume.

(58) Methods.—Tests for constancy of volume are divided into two classes: (1) Normal tests, or those made in either air or water, maintained at about 21° Cent. (70° Fahr.), and (2) Accelerated tests or those made in air, steam or water at a temperature of 45° Cent. (115° Fahr.), and upward. The test pieces should be allowed to remain 24 hours in moist air before immersion in water or steam, or preservation in air.

(59) For these tests, pats about 7½ cm. (2.95 in.) in dia., 1¼ cm. (0.49 ins.) thick at the centre, and tapering to a thin edge should be made upon a clean glass plate about 10 cm. (3.94 in.) square. These pats are to be prepared in the same manner and with the same percentage of water as pats for setting tests.

(60) Normal Test.—A pat is immersed in water maintained as near to 21° Cent. (70° Fahr.) as possible for 28 days, and observed at intervals. A similar pat after 24 hours in moist air is maintained in air at ordinary temperature and observed at intervals.

(61) Accelerated Test.—A pat is exposed in any convenient way in an atmosphere of steam, above boiling water in a loosely closed vessel for five hours. The apparatus recommended by the Committee of the American Society of Civil Engineers for making these determinations is also recommended by your Committee.

(62) To pass these tests satisfactorily the pats should remain firm and hard, and show no signs of cracking, distortion or disintegration.

Should the pat leave the plate, distortion may be detected best with a straight-edge applied to the surface which was in contact with the plate.

(64) In the present state of our knowledge it cannot be said that cement should necessarily be condemned simply for failure to pass the accelerated tests, nor can a cement be considered entirely satisfactory simply because it has passed these tests.

ONTARIO LAND SURVEYORS.

The seventeenth annual meeting of the Association of Ontario Land Surveyors was held in the Parliament Building, Toronto, January 23rd, 24th and 25th, 1909. The programme was wider than usual in that it took up questions of interest to the various branches of engineering as well as those problems peculiar to the surveyor.

The president, Mr. A. J. Van Nostrand, presided, and in his presidential address dealt with many of the questions of immediate interest to the profession.

Mr. Van Nostrand said in part:

Since we last met the world has seen many changes, the saddest of all being the disaster which overtook our fellow beings in Sicily and within a few hours gave a shudder of horror to the whole of the civilized world. The advancement of science and human invention, however, did much to mitigate the sufferings of the survivors as the cry for aid was at once transmitted by electric despatches to every part of the habitable globe, and never was the universal brotherhood of man better exemplified than by the prompt response from all creeds and nations.

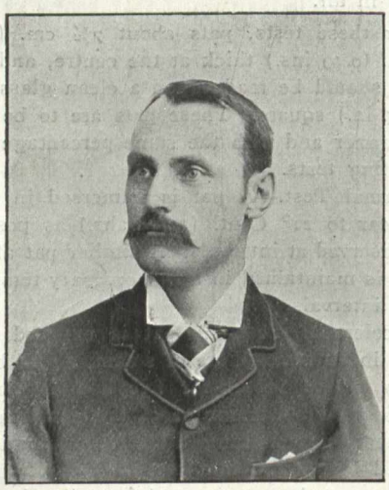
Another instance of the progress of science was witnessed in the case of the recent collision between the steamships Republic and Florida, when the Marconi system—which but

yesterday was regarded in the light of a tale from the Arabian Nights—was the chief agent, ably seconded by the sub-marine signal system, in averting what might have been one of the most awful disasters in the history of navigation.

Among other notable events of the year which concern us directly as Canadians was the Tercentenary celebration, held at Quebec in August last, which showed our young nation to be a close union of races forming a most important unit in the great empire to which we are proud to own allegiance.

In our own province, we have seen inaugurated a policy of administering our mineral assets for the benefit of the people at large, the natural heirs of the natural assets of the country, instead of solely for the profit of the fortunate few, as has been the custom of all countries in the past, and this has been effected without entailing hardship on those whose capital and energy have been devoted to the development of our resources.

The husbanding of our timber resources has also become, not only a national but a patriotic subject and wilful



Mr. A. J. Van Nostrand,
President Ontario Land Surveyors.

waste of the products of the forest is regarded by all thinking Canadians as an offence against themselves, both collectively and individually. While in the past, the disastrous results of forest fires occasioned by carelessness was lightly passed over by those not immediately affected, any person now guilty of causing fires is deemed a felon by all right-minded citizens.

By the recent division of the unoccupied territory in the northern part of the Dominion a considerable addition has been made to the area of Ontario, and its exploration in the near future must fall to such members of this Association as may be considered by the Cabinet best fitted for the task. Those of us who have had little or no experience in surveys in the wilds have but a slight conception of the responsibilities devolving upon the surveyor, and the dangers to which he and his party are exposed, when he enters upon a work of this nature, trusting in Providence to guide his ripened experience and cutting adrift from all extraneous aid for months at a time.

Our relations with our brethren, the engineers, continue cordial, and there is every reason that they should long remain so. At a recent gathering of members of the Canadian Society of Civil Engineers, I was agreeably surprised to note amongst their prominent members the familiar faces of no fewer than four of our own past presidents and, in addition, at least half a dozen others whom we all are proud to include in our list of members. It is to be regretted that up to the present, that Society has not succeeded in obtaining statutory recognition of a standard to be required of every man who seeks to practise as an engineer. Apart from the fact that the professions are already robbing the community of many whose energies and capabilities would be of more service as direct producers, the public safety demands that those entrusted with public works shall have shown themselves capable of ensuring that safety. While the keeping of the landed property of the public of Canada, has for more than a century been legally entrusted to land surveyors, who have complied with certain standards, fixed from time to time, the safe guarding of the property and lives of the public is still liable to fall into the hands of men posing as engineers, but whose qualifications grade from the highest order down to absolute incompetence. If, at any time, the opportunity should arise, I hope every member of our profession will give his individual aid to the engineers in obtaining statutory requirement for a reasonable standard of fitness.

As to the relations between the board of examiners for land surveyors in this province with the other boards of examiners for land surveyors throughout the Dominion, the situation remains unchanged. Some years ago the Dominion Board decided that the requirements of the Ontario Board were not sufficiently similar to their own to entitle an Ontario land surveyor to the limited examination which had previously been accorded by each of those boards, and notice was sent from Ottawa that the reciprocal relations had been abrogated. There remained nothing for the Ontario Board but to accept the position in which this placed them and developments in the interval seem but to have confirmed this board in their opinion as to the desirability of our board requiring of a candidate the full examination included in its curriculum.

From the financial statement, which will be placed before you, it will be seen that that part of the affairs of the Association is in a satisfactory condition, and as the annual contribution of each number is only equivalent to a average half day's earnings no hardship would seem to result from the statutory obligation to pay annual dues, even if the advantages of the interchange of ideas and the information contained in the "Proceedings" and Exchanges be left out of the question.

For the purpose of testing the usefulness or otherwise of the "Act respecting Disputes concerning Boundary Lines" (Chap. 64, R.S.O. 1897) it is suggested that each member employed as a court referee should report the fact to the secretary before the close of each Association year. A number of such references were made during the early part of the existence of this Act, but we are not kept informed as to whether the advantages offered by this very desirable piece of legislation are being made use of or overlooked.

The summary appended to the list of members as published in our latest annual "Proceedings" is as follows:

Active members subject to dues	228
Active members exempted from dues	17
Withdrawn from practice (including 9 "associates")..	70
Dead	67
Total number enrolled since incorporation.....	382

We have to report with regret that since our last annual meeting, we have lost by death five of our brethren, including, James A. Gibson, of Oshawa; Edgar Bray, of Oakville; T. W. Dobbie, of Tillsonburg; W. H. Holland, of Toronto, and Henry Strange, of Rockwood. The last named gentleman had held a commission as a land surveyor in Ontario for seventy years.

A feature of this year's meeting is the re-union of the past presidents, who have held office since the inception of the original Association of Provincial Land Surveyors of Ontario, twenty-three years ago, and while some of those may find it impossible to be present with us it is pleasing to note that only one of the absentees has gone to the great beyond. I refer to the late Major Villiers Sankey, whose active interest in behalf of the Association and profession is well-known to each member, and the sad death, by drowning, which overtook him while at the post of duty on 10th July, 1905, is, and will long remain, fresh in the memories of those of us who best knew him and his work.

Amongst the items of business which will be brought before you is the report of the Committee on Legislation, whose duties it will be remembered were to include the preparation of a draft of suggested alterations in the Survey Act shortly to be revised by the Legislature. While these suggested

changes are chiefly in reference to cases of re-surveys not covered by the existing Act, and the simplifying of the Act as it has stood for the last decade, it has been more than ever impressed upon this committee that no Act which will provide for the requirements of even nearly all the cases arising from surveys in Ontario will admit of a wording which will render it intelligible to a student not practically familiar with the Crown Surveys made during the last hundred and twenty years. The suggestion made at a former meeting that some enterprising member thoroughly conversant with the Act in all its phases should prepare a digest, to serve as a text book thereon, has apparently not yet been acted upon, and the opportunity still remains open.

Following the president's address committee reports were received. The Board of Examiners reported the following as having passed the final examination: Messrs. J. W. Pierce, M. A. Baker, C. R. McColl, E. W. Neelands. The following passed the preliminary examination: Messrs. W. G. Webster, F. P. Adams, D. A. Niven, R. M. Goulay, J. R. Gill, O. R. Blandy, F. C. Lane.

The various papers presented, a list of which appeared last week, will appear later in the Annual Report published by the Society.

SCIENTIFIC BOILER CONTROL.

(Continued from Page 293).

collect under the floats 18 and 26; of these 18 is larger and much lighter, and will consequently be raised first. Its travel is limited by an arrangement of thumb-screws 14 and 15, which define the length of its stroke. When it has come to rest the remainder of the gas will collect under the float 26, driving this up and causing the pen 36 to travel downwards on the diagram.

The adjustments of the instrument are so made that the pen will travel the whole length of the chart to the zero line if only atmospheric air has been forced through the potash and nothing has been absorbed. As float 18 will always require the same volume of gas to perform its stroke, any CO_2 absorbed in the potash will cause a correspondingly less volume of gas to reach float 26, which cannot then cause the pen to travel down the whole length of the chart, but will force it to stop higher up, according to the percentage of CO_2 absorbed in the potash. In this way the ends of the vertical lines made by the pen on the chart will indicate the percentage of CO_2 absorbed in the potash, and, therefore, that contained in the gas analyzed. The moment the syphon begins to operate, all the liquids recede, and when the passage 52 is cleared, the gas under the two floats will be drawn out and escape to atmosphere through vessel 56 and tube 51. A fresh charge of gas will bubble into the measuring chamber 67 as soon as the levels free the inlet 76, and the whole process of analysis and recording will be repeated when the levels rise once more.

THE VALUATION OF A STEAM-POWER PLANT.

Chas. T. Main, Boston, Mass.

The determination of the value of an operating power plant involves the consideration of many factors.

The value of a steam-power plant will depend upon its character and its condition; and its condition depends very largely upon the service which it has rendered.

With good water and good care, running about twelve hours a day, the life of a boiler should be about twenty years, or the depreciation five per cent. a year. Slow-speed engines, running ten hours a day, can be estimated as having a life of about twenty-five years, or a depreciation of four per cent. a year. High speed engines are much shorter lived, and will not average over fifteen years, or a depreciation of about seven per cent. a year; and often times it is greater when run ten hours a day. The depreciation when run twenty to twenty-four hours a day is correspondingly greater. Boiler settings and piping should be included with the boilers, and engine foundations and piping with the engines.

The life of economizers varies with the initial temperature of the entering water from about ten years up to forty.

The proper type of engine to use depends upon the use which can be made of the steam after passing the engine; and if the most economical plant commercially is not installed, the purchaser must make such allowances as will make good to him the difference in running expense over and above what a new plant would cost him to run. If steam is to be used for power exclusively, the compound or triple expansion engines of proper designs are the most economical, and for mill work the compound is the more common of the two.

If more or less low-pressure steam is required for other purpose than power, this type in a special form can be used to advantage, except in such cases as require nearly or quite the same amount of low-pressure steam as would be exhausted from an engine producing the amount of power required. Such a condition as this might exist where small amounts of power and large amounts of low-pressure steam are required, as in a dyehouse or printery, or in case a portion of the power is produced from water, and the other portion from steam, the power of the latter being such as to supply the required amount of exhaust steam for the various purposes to which it is put.

In such cases as these it would be absurd to add a condensing cylinder to the engine, and then supply the low-pressure steam direct from the boilers, through reducing valves. The proper type to use here would be the simple or compound non-condensing engine.

Between these two extremes, of steam used for power only, and an amount of low-pressure steam used equivalent to the whole amount exhausted from the engine, lie nearly all the cases of ordinary practice.

If an amount of exhaust steam can be constantly used up to about 75 per cent. of the whole amount exhausted from a high pressure cylinder of a compound condensing engine, the most economical plant to put in would be a special form of compound condensing engine taking this steam from the receiver; but if more than 75 per cent. of the exhaust could be used for heating purposes, then the proper type would be the non-condensing.

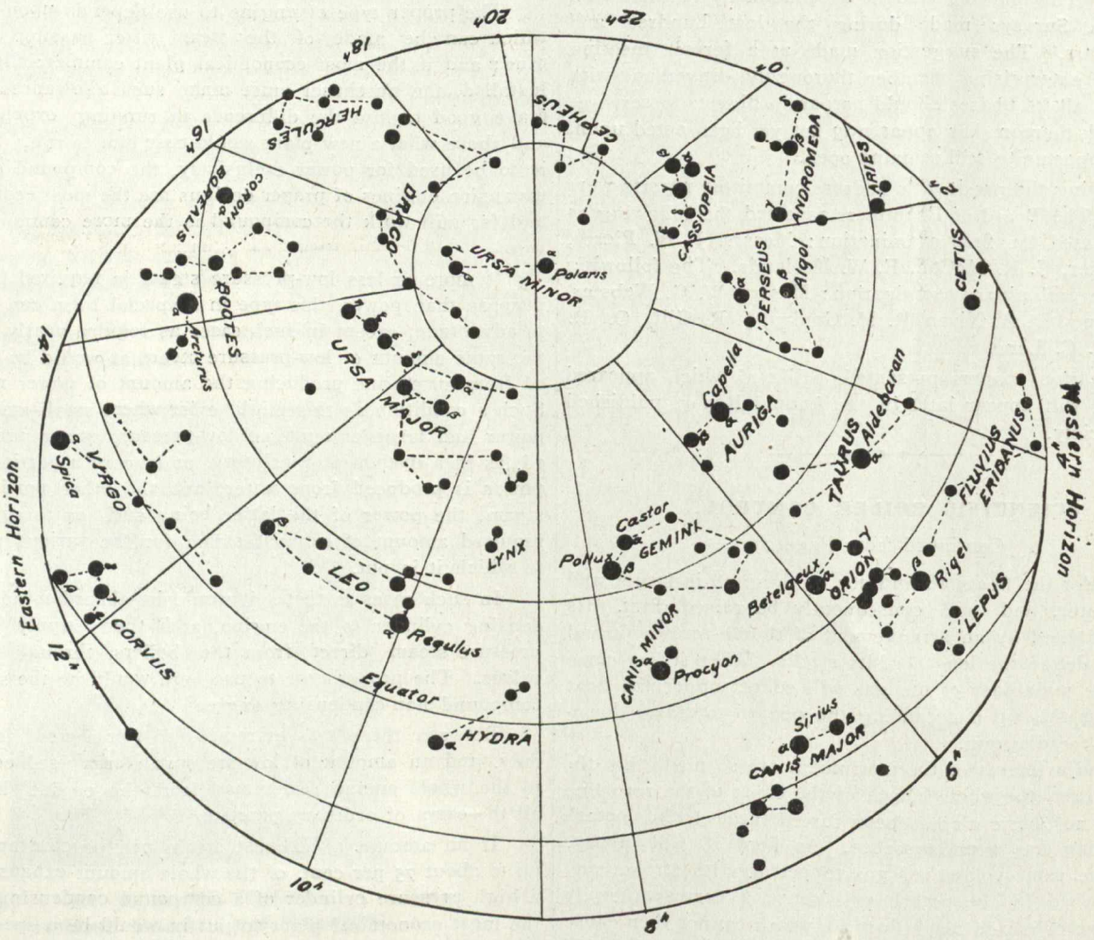
If the amount of exhaust steam used were a variable amount, but averaged more than would allow for equal cylinders on a compound engine, the proper type of engine to use would still be the non-condensing. If the average of the variable amount fell below that amount, which would allow for equal cylinders on a compound, then the proper type to use would be the compound condensing engine.

There is one advantage of the compound condensing over the non-condensing engine with variable amounts of exhaust steam used; viz., the low-pressure cylinder, being arranged for a variable cut-off, can control the variation, thus making use of all the steam, decreasing the amount used in the high-pressure cylinder, and preventing any wasteful and unpleasant blowing-off of exhaust steam.

The practical limit of the average proportion of exhaust steam which can be used and still employ the compound system, when the quantity required is variable, is when that proportion requires equal cylinders on the compound engine; and this limit is established by the ability to control the steam exhausted from the high-pressure cylinder.

The Grand Trunk Pacific has so far this year placed orders for additional equipment, as follows:—Ten colonist cars, five parlor cafe cars, sixteen first-class coaches, eight sleeping cars, eight second-class coaches, and three dining cars. This makes an aggregate of fifty new cars that will be placed in service in the coming summer on the new transcontinental line between Port Arthur and Edmonton.

ASTRONOMICAL PAGE



STAR MAP, SHOWING THE PRINCIPAL STARS, VISIBLE AT 10 P.M. MARCH 1st IN LATITUDE 45° N.

L. B. Stewart, D.T.S.

The table below gives the apparent places of the brightest of these stars for March 15th at transit across the meridian of 5h W. of Greenwich.

Star	Mag.	R. A. h. m. s.	Decl. ° ′ ″
β Cassiop	2.4	0 04 16.0	+ 58 38 47
α Cassiop	2.5	0 35 17.5	+ 56 02 15
γ Cassiop	2.3	1 00 09.4	+ 60 13 26
α Ursæ Min. (Polaris)	2.1	1 25 26.8	+ 88 49 21
α Tauri (Aldebaran) ..	1.1	4 30 41.0	+ 16 19 35
α Aurigæ (Capella) ...	0.2	5 09 57.0	+ 45 54 31
β Orionis (Rigel)	0.3	5 10 09.3	— 8 18 31
α Orionis (Betelgeux).	1.0	5 50 14.4	+ 7 23 23
α Canis Maj. (Sirius).	—0.4	6 41 08.1	— 16 35 38
α Geminorum (Castor)	2.0	7 28 48.0	+ 32 05 25
α Canis Min. (Procyon)	0.5	7 34 32.5	+ 5 27 26
β Geminorum (Pollux)	1.2	7 39 45.2	+ 28 14 51
α Leonis (Regulus) ..	1.3	10 03 32.4	+ 12 24 41
β Ursæ Maj.	2.4	10 56 23.4	+ 56 52 15
α Ursæ Maj.	2.0	10 58 09.7	+62 14 35
γ Ursæ Maj.	2.5	11 49 04.9	+ 54 12 00
δ Ursæ Maj.	3.4	12 10 57.9	+ 57 32 13
ε Ursæ Maj.	1.8	12 50 03.8	+ 56 27 06
ζ Ursæ Maj.	2.1	13 20 17.7	+ 55 23 52
α Virginis (Spica).....	1.2	13 20 24.6	— 10 41 16
η Ursæ Maj.	1.9	13 43 58.9	+ 49 45 51
α Bootis (Arcturus)....	0.3	14 11 31.3	+ 19 39 10

Determination of Azimuth by the Pole Star.

The following table gives the azimuth of Polaris on March 1st, 1909, for places in longitude 5th (=75°) W., and at certain standard times T:

T	Sid. time	L = 44°		L = 48–		L = 52°	
P.M.		A	a	A	a	A	a
	h. m. s.	° ′ ″	″	° ′ ″		° ′ ″	
8 00	6 36 43.8	358 23 37	— 5	358 16 20	— 6	358 07 15	— 6
8 30	7 06 48.7	21 59	— 2	14 36	— 2	05 25	— 2
9 00	7 36 53.6	22 02	+ 1	14 42	+ 1	05 35	+ 2
9 30	8 06 58.8	23 46	+ 5	16 37	+ 5	07 42	+ 5
10 00	8 37 03.5	27 08	+ 8	20 16	+ 8	11 43	+ 9
10 30	9 07 08.4	32 04	+11	25 36	+12	17 33	+13
11 00	9 37 13.4	38 29	+14	32 30	+15	25 05	+16
11 30	10 07 18.3	46 15	+17	40 52	+18	34 11	+19
12 00	10 37 23.2	55 14	+19	50 32	+21	44 41	+22

In this table azimuths are reckoned from the N. in the direction E.S.W. The quantity a is the error in the azimuth resulting from an error of 1m. in the time. It will serve to show the best time to observe if the watch correction is not well determined. The azimuth for any other latitude may readily be found by interpolation.

The standard time corresponding to any azimuth given in the table for a place whose longtitude differs from 5h, and for some other date, may be found by the formula:—

$$T' = T + (L - 5h)\ (1 - 0s.16) - d \times (3m\ 55s.9).$$

Where

T′ = the required time.
T = the time for March 1st.
L = the longitude.
d = number of days elapsed since March 1st.

CUT OUT FOR REFERENCE.

The difference L—5h must be algebraic, and in multiplying by os.16 it must be expressed in minutes of time.

To illustrate this, take the following example:—At a place in latitude 49° 20′ N., longitude 80° (= 5h 20m) W, an observer wishes to take an observation for azimuth between 8 and 9 p.m., on March 8th.

Here the interpolated value of the azimuth for 8h 30m is 358° 11′ 44.5″, interpolating by second differences, and the corresponding time for the given longitude and date is:—

8h 30m 00s
+ 19 56.8 (= 20m — 20 × os.16)
— 27 31.3 (= 3m 55s.9 × 7)
=8h 22m 25s.5.

To determine the meridian the observer then points to the pole star at the above computed time, after setting his vernier at a reading equal to the above azimuth, clamps the horizontal circle, and then turns the vernier to zero.

If the direction of the meridian is known approximately, the correction of a watch on standard time may be found by observing the watch time of transit of a star. The star's R.A. is then the sidereal time of transit, and the corresponding standard time may be found as follows:—First find the sidereal time corresponding to one of the standard times of the above table for the date and place of observation by the formula:

$$S = S' + d \times (3m - 56s.555) - (L - 5h).$$

Where

S = the required sid. time.
S′ = the tabular sid. time,

and d and L have the same meanings as above. Then the required standard time of transit of the star follows by the formula:—

$$T = T' + (\alpha - S)\ (1 - os.16).$$

Where

T = the required standard time of transit of the star, and
T′ = the tabular time corresponding to S′.
α = the star's R.A.

To illustrate the use of these formulae, let us assume that the meridian transit of the star Sirius is observed at the watch time, 7h 58m 12s.7; to find its correction on standard time:—

	h. m. s.
Sidereal time, 8 p.m. (table)	= 6 36 43.8
7 × (3m 56s.555)	= 27 35.9
	7 04 19.7
Difference of longitude	= 20 00
S	= 6 44 19.7
R.A. of star	= 6 41 08.1
α—S	= — 3 11.6
3.19 × os.16	= 0.5
Equivalent mean time interval	= — 3 11.1
T′	= 8 00 00
T	= 7 56 48.9
Watch	= 7 58 12.7
Watch fast	= 1 23.8

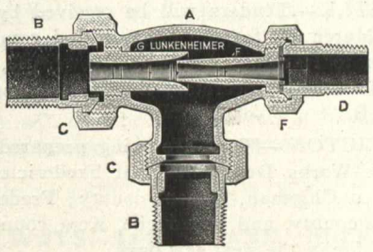
The methods described above do not take account of changes in the star places, but with ordinary field instruments and for short periods of time these are negligible.

AN IMPROVED EJECTOR.

The Lukenheimer Company, of Cincinnati, Ohio, manufacture the ejector shown herewith, which they claim cannot be surpassed or even equalled for raising water from deep wells, mines, or pits, filling or emptying tanks, raising and transferring liquids (either hot or cold).

The superiority of this ejector lies in the construction of the tubes, which are made of a very hard grade of bronze especially adapted for the severe service to which ejectors are generally subjected. These tubes are screwed in the body, and are not loosely placed therein and held by the unions only, which latter is the method usually employed; consequently, there is no possibility of losing the tubes in this improved ejector, when the unions are removed.

The above company claim that this ejector is more economical than any heretofore produced. This feature is obtained by the improved shape of the tapers inside the tubes which require a less amount of steam for a required quantity of water than does any other make on the market. It is claimed that the ejector will lift water at a greater



height and will force it higher than other make, and will take water at a higher temperature.

Those parts subjected to wear consist of the tubes only, and these can readily be renewed at small cost when necessary. It is only necessary to turn the steam on full to operate the same, and after getting the flow of water established, the steam can be throttled to a very low degree.

The following tables give the amount of lift, together with the height that the ejector will force when placed about five feet above the water-level.

Lift of Ejector given in feet. Feed water 75 Degrees F.

Pressure, lbs.	5	10	15	20	25	30	40	50	60	70	80	90	100
Lift, feet	3	7	11	15½	21	21	20	19	18	17½	16½	15½	14½

Height (in feet) Ejector will force when placed five feet above water level. Feed water 75 Degrees F.

Pressure, lbs.	20	30	40	50	60	70	80	90	100
Height, feet	18	28	36	46	57	66	74	84	92

Table of Capacities.

Size, Letters.	Pipe Connections. Steam.	Suction and Delivery.	Capacity, gallons per hr. Feed water 75 Degrees F. Lift, 20 ft. Steam pressure 50 pounds.
A-Brass	⅜	½	250
B-Brass	½	¾	500
C-Brass	¾	1	960
D-Brass	1	1¼	1,300
E-Brass	1¼	1½	2,000
F-Iron	1¼	2	4,000
G-Iron	1½	2½	8,000
H-Iron	2	3	11,000

The Canada Wire Goods Manufacturing Company, of Hamilton, are at present engaged on an order from the city of Fernie, B.C., covering their entire metal equipment cells, bunks, doors, and heavy window gratings. They have equipped many villages and towns throughout Ontario, Quebec, and the western provinces with jail cells which are all fitted with patented jump lock device which secures the door at top, centre and bottom by merely shutting it, and it can only be released by the proper key. They recently sent a repeat order to the Royal North-West Mounted Police at Regina. They are well equipped to take care of this class of business, and at the present are busy in the iron department.

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.

NEWCASTLE.—Tenders will be received by the undersigned until March 1st for the erection and completion of a stone addition to Harkins' Academy, Newcastle, Miramichi, N.B. J. E. T. Lindon, Secretary Board of School Trustees, Newcastle, N.B.

FREDERICTON.—Plans are being prepared at the Provincial Public Works Department at Fredericton for new steel bridges at Chipman, Queens county; Fredericton Junction, Sunbury county, and Buctouche, Kent county. Tenders will be asked for in the next few days.

Quebec.

MONTREAL.—Tenders will be received until March 9th, for general supplies and materials for permanent sidewalks and pavements. For further information address the City Surveyor, City Hall, Montreal.

MONTREAL.—Tenders will be received up to 1st March, 1909, for timber, sand and stone for concrete. Specifications may be obtained upon application to Mr. F. W. Cowie, chief engineer, Harbor Commissioners, 57 Common Street.

Ontario.

BURLINGTON.—Tenders will be received until March 23rd, 1909, for the proposed waterworks system. Plans may be seen after March 1st at the office of the chief engineer. Willis Chipman, C.E., 103 Bay Street, Toronto. (Advertised in The Canadian Engineer.)

OTTAWA.—Tenders for electric wiring and fittings for the examining warehouse, Winnipeg, Man., will be received until 4.30 p.m. on Tuesday, March 2nd, 1909. Napoleon Tessier, secretary, Department of Public Works, Ottawa.

OTTAWA.—Tenders for shops, will be received at the office of the Commissioners of the Transcontinental Railway at Ottawa, until 12 o'clock noon, of the 10th day of March, 1909, for the construction and erection complete, in accordance with the plans and specifications of the Commissioners, of shops east of Winnipeg. Plans, details and specifications may be seen at the office of Mr. Hugh D. Lumsden, chief engineer, Ottawa, Ont., and Mr. S. R. Poulin, district engineer, Winnipeg, Man. P. E. Ryan, Secretary.

OTTAWA.—Tenders for boundary monuments will be received at the Department of the Interior, Ottawa, up to noon of March 6th, 1909, for the supply of one hundred cast-iron monuments for use in marking the international boundary. W. W. Cory, Deputy Minister of the Interior.

OSHAWA.—Tenders will be received until March 4th, 1909, for the entire capital stock, save certain shares, of the Oshawa Electric Light Company, Limited. This company owns its own steam generating plant and water-power in the town of Oshawa. This company also owns the property and assets of the Bowmanville Electric Light Company, Limited, having steam and water-power generating plant and transmission system in the town of Bowmanville. E. R. C. Clarkson, 33 Scott Street, Toronto.

WINDSOR.—Tenders addressed to the undersigned for wiring postoffice building at Windsor, Ont., will be received until March 8th, 1909. Napoleon Tessier, secretary, Department of Public Works, Ottawa.

WINNIPEG.—Tenders, addressed to the chairman of the Board of Control, for the supply of from 2,500 to 3,500 tons of asphalt for street paving for the city of Winnipeg, will be received until Wednesday, March 10th. M. Peterson, secretary, Board of Control office, Winnipeg.

WINNIPEG.—Tenders will be received until March 2nd, 1909, for the supply insulators, supply of material and erection of telephone line, erection of transmission line and certain repair shop equipment. M. Peterson, secretary, Board of Control. (Advertised in The Canadian Engineer.)

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.)

SASKATOON.—Tenders will be received until March 1st, 1909, for certain material for waterworks and sewerage works. For details see advertisement. Willis Chipman, C.E., chief engineer, 103 Bay Street, Toronto. (Advertised in The Canadian Engineer.)

Alberta.

CALGARY.—Tenders will be received until March 1st, 1909, for the supply of material and labor necessary for the construction of a coal and ash conveyor. H. E. Gillis, City Clerk. (Advertised in The Canadian Engineer.)

LETHBRIDGE.—Tenders will be received until March 1st, 1909, for a Municipal Power Plant at Lethbridge. Fuller particulars will be found in the advertisement in The Canadian Engineer. George W. Robinson, Secretary.

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 March 29th for a supply of ironwork, insulators, and iron, bronze and covered wire. Address: Controller of Stores, General Post Office, Brisbane, 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.

GUAYAQUIL, ECUADOR.—Tenders will be received until May 1st for the execution of drainage, water supply, paving, asphalting and sanitary works at Guayaquil. Address: Junta de Canalizacion y Proveedora de Agua, Quayaquil, Ecuador.

LA PALOMA, URUGUAY.—Tenders addressed to the undersigned will be received until April 2nd, for the construction of a port. Ministerio de Obras Publicas, Monte Video.

CONTRACTS AWARDED.

New Brunswick.

ST. JOHN.—The contracts for the interior work on the new Seamen's Institute have been awarded as follows: A. E. Hamilton, carpenter work; Mooney & Son, mason work; J. E. Wilson, sheet metal work; G. & E. Blake, plumbing.

Ontario

OTTAWA.—Tenders for the new grand stand at the Exhibition grounds were opened February 16th. They were called mainly for the purpose of finding out costs, as no authority for the expenditure has yet been given. The tenders were as follows: Ottawa Construction Company, $83,868; E. A. Wallberg, Montreal, $86,950, according to one

plan, $78,950 with wooden roof on steel columns; Rexford-Bishop, Limited, Montreal, $91,200 or $3,000 less if wooden roof be allowed; General Contracting Company, Toronto, $73,000 without roof, with roof of gravel $74,200, all concrete, including roof, $81,000; Ottawa Supply Company, $94,000 or with a change in roof $90,600; Courtney & Brown, Ottawa, three prices according to design, $74,900, $78,800 and $68,600; Byers and Anglin, Montreal, $100,000. The bid was irregular, no check being enclosed; Hamilton Bridge Company, $46,000 for the steel framework, alone; Morrison & Company, Montreal, three prices, $85,700, $88,500 and $84,600, according to design; International Marine Signal Company, Ottawa, $3.66 per hundred pounds for steel material, $3.97 for material and erection. No check.

HAMILTON.—The city of Hamilton has awarded the contract for this year's supply of cement to the Lakefield Portland Cement Company, whose price is $1.23½ a barrel, as compared with $1.67 last year. There were five tenders, the highest being $1.44 and the lowest $1.23½.

HAMILTON.—The following contracts were let by the Board of Works last week: Lumber, W. J. McAllister, at $26.45; asphalt, California Asphalt Company, $26 a ton; gravel, E. New, at prices twenty per cent. lower than paid last year. L. H. Gibb, Buffalo, tendered at $25.75 a thousand for paving brick, and the United States Block Company at $1.75 per square yard for wood blocks, but these contracts were not let.

TORONTO.—Tenders amounting to $750,000 were accepted by the Hydro-Electric Power Commission on Tuesday for the equipment of distributing and transformer systems. The Canadian General Electric Company will supply two-thirds of the equipment, while the remainder will be furnished by the Canadian Westinghouse Company. The contracts include the equipment of twelve stations. The Commission have entered into agreements for the right to erect towers on the casement plan, covering 85 per cent. of the total length of line. Already the contractor for the erection of the line has commenced drawing material to convenient points, and the rolling of the steel for the towers will be put in operation shortly.

British Columbia.

VICTORIA.—Three tenders were received for cement for the municipality during 1909: R. P. Rithet & Company, $2.51½ per barrel; Robert Ward & Company, lowest price, $2.65 per barrel; Bostock & Company, $2.51¼ per barrel delivered at Smith's Hill and $2.41⅞ per barrel delivered elsewhere in the city. R. P. Ritchet's tender was accepted.

LIGHT, HEAT, AND POWER.

New Brunswick.

ST. JOHN.—With the idea of harnessing the world-famous tides of the Bay of Fundy and utilizing the latent power therein contained for mechanical purposes, a company has been organized and will petition the Dominion Parliament for an act of incorporation. Its purpose is to develop electric power and to construct dams across a large number of rivers in New Brunswick and Nova Scotia.

Quebec.

LEVIS.—The municipal council has just closed a contract with the Canadian Electric Light Company for the operation of its system of waterworks. The actual cost to the town by working its steam plant is in the vicinity of some seven or eight thousand dollars. The company supplies one thousand horse-power to the north shore by means of a powerful cable laid across the St. Lawrence, oppposite Quebec. The company is exclusively Canadian.

Ontario.

WINGHAM.—The electric light plant here is to go under new management on March 1st, when L. B. Ramsden, of Port Colborne, will take charge of it.

LISTOWEL.—Tenders will be received by A. St. George Hawkins, chairman of the fire, water and light committee, Listowel, for the equipment of the municipal electrical system of Listowel. The plant will include steam-driven generators and both commercial and street lighting. It is proposed to install over 250 Tungsten lamps on the streets. C. H. and P. H. Mitchell, Toronto, are the consulting engineers for the town.

Saskatchewan.

SASKATOON.—A contract has been entered into, providing for the construction of an electric power transmission line two hundred and fifty-two miles in length, all or the greater part of which will, it is expected, be completed by the end of the year. Within the last two months upwards of thirty-five municipalities have voted in favor of procuring power from the Hydro-Electric Commission.

British Columbia.

VICTORIA.—The B.C. Electric Company are seeking an agreement with the city by which the city is to agree to take over the company's equipment if they ever decide on a municipal lighting plant. If such an agreement is reached the company will then proceed to erect a 10,000 horse-power plant at an estimated cost of $1,500,000.

RAILWAYS—STEAM AND ELECTRIC.

Quebec.

MONTREAL.—President Sir Thomas Shaughnessy and General Manager McNicol, of the Canadian Pacific Railway, will make their annual tour of inspection of the lines in March. It is stated that they will order important changes at London, Ont., where the company's yards will probably be greatly enlarged.

Ontario.

TORONTO.—It was given out recently that the C.P.R. will construct a branch line from St. Mary's to Stratford. The distance is 23 miles. It is understood that the work of laying the tracks will be commenced early this spring.

OTTAWA.—The Minister of Railways recently stated that up to January 31st, 1909, the amount expended by the Government in the construction of the National Transcontinental Railway was $48,265,129. During the twelve months ending January 31st slightly over $26,000,000 was spent. He also said that 667 miles of the Western division of N.T.R. are completed and in operation.

OTTAWA.—The plans of the Canadian Pacific Railway for the enlargement of Windsor station and the opening of a new right-of-way for entry into Place Viger station, Montreal, were approved by the Board of Railway Commissioners, after a short special session held last week.

GUELPH.—The proposed extension of the C.P.R., seven miles long, from Weisenburg, on the Guelph and Goderich line, to Elora, where it will join the Credit Valley line, is said to have been surveyed, and construction will probably commence shortly.

TORONTO.—An official test of the Simmen system was conducted by the head officials of the Santafe, Salt Lake and Southern Pacific Railroads. A telegram was received at Toronto, wired to their Canadian head office, to the effect that the system proved successful in its operation. A special train of five cars was put on; all doubts are said to be removed as to the working of the system. The company, it will be remembered, started to install this system on the York Radial lines west of the city of Toronto, the work is progressing favorably and would be nearer completion but for the interception of poles of the Stark Electric Light Company, and those of the radial. Despite these hindrances, however, it is expected that the company will have an official test on this line at an early date. From present conditions it looks as though the Simmen system should be a success.

COBOURG.—The G.T.R. may make extensive changes in this district the coming summer, and a staff of engineers will probably be engaged during April and May surveying a line from near Garden Hill, on the Midland Railway, to Cobourg. This will be a continuation of the proposed short line from Lindsay to the main line. It is stated that a new station and freight shed will be constructed here and the yards re-constructed.

ONTARIO.—Mr. Schell, of Oxford, stated to-day in committee that the Tillsonburg, Lake Erie & Pacific line had been acquired by the Canadian Pacific, and they now wanted authority to build from Ingersoll to Collingwood.

Manitoba.

WINNIPEG.—A bill for the incorporation of the Great Northern Railroad of Manitoba has been introduced in the Provincial Legislature by the Hill interests. One clause asks for power to construct a line from Winnipeg to Brandon, thence to Elkhorn and the westerly boundary of the Province. Five years to commence construction and ten for completion are asked.

WINNIPEG.—The new Canadian Western Railway, whose charter was granted a few days ago, will build a line from Calgary to Butte, Mont. A general survey has already been made, and the final survey will probably be completed in spring. O. L. Boynton, general manager of the Minor Lumber Company, Winnipeg, is one of the promoters.

Saskatchewan.

INDIAN HEAD.—Word was recently received by the town council from Superintendent Taylor that the new $17,000 depot will be built and completed this summer.

MOOSE JAW.—The Board of Trade has received word that the G.T.P. will probably construct a branch to Moose Jaw this year.

Alberta.

CALGARY.—The Canadian Western Railway is the first to obtain a new charter from the present Parliament. The company propose to build a line from the international boundary to Calgary with a branch touching the C.P.R. near Michael. The railway will be 140 miles long and construction will be commenced at once.

EDMONTON.—Mr. E. J. Chamberlin and Chief Engineer Kelliher, of the G.T.P. Railway, visited Edmonton last week. Mr. Chamberlin says the steel will reach Edmonton thirty days after spring opens and will be laid right through to the Pembina River. The contract for the section west of the Macleod River will be let in March. Supplies are now being taken out there ready for work in the spring.

British Columbia.

PRINCE RUPERT.—In December 2,800 men were at work on the G.T.P. grade between Prince Rupert and the mouth of Copper River—100 miles. Midsummer should see the grade from Prince Rupert to Aberdeen so far completed that work trains may be operated to advantage.

KAMLOOPS.—All the property east of Eighth Avenue and across Peterson creek in the eastern outskirts of the city has been reserved by Mackenzie & Mann, of the Canadian Northern Railway, and will in all probability furnish the site for the shops and roundhouses of their transcontinental line. This action was the result of a conference between D. D. Mann and the officers of the Townsite Company at Victoria. The Canadian Northern will come down the east side of the North Thompson River and cross the South Thompson a little to the west of the Industrial school. From Kamloops the line will go south through Quilchena and Aspen grove to the head of the Tulameen, thence over the Hope mountains to Vancouver.

VICTORIA.—The location of the Duncan-Shawinigan Lake branch of the C.P.R. has not yet been decided upon. The company is now running a second survey line two miles away from the first in the hope of finding a better grade and a more suitable right-of-way.

VICTORIA.—Some delay has been experienced in the final survey of the Alberni branch of the C.P.R., but it is expected that tenders for its construction will shortly be called for.

Foreign.

OMAHA, NEB.—The Union Pacific Railway believes it has a sure preventive of collisions on its road in a wireless signal system invented by one of the electrical engineers in its Omaha shops. It is claimed that the invention has been so far perfected that it will send a wireless message 180 miles and register a signal in the cab of any specified locomotive on the line. The signal in the cab consists of a red light and a bell. If practical installation proves as satisfactory as the experiments lead the inventor to believe, it will be possible for station agents to signal trains anywhere between stations and warn the engineers of danger.

SEWERAGE AND WATERWORKS.

Saskatchewan.

YELLOW GRASS.—Among the undertakings of the Saskatchewan Department of Public Works is the draining of the Yellow Grass marsh. In places the work will be done by teams, but for the marsh a small dredge, built in 1903 and refitted last year, is to be used. Piles have been driven ahead on its channel this winter and everything is in readiness to resume work in the spring. Mr. Rand, C.E., is in charge.

YORKTON.—At a recent meeting of the Council the sub-committees submitted their estimates for the current year and all of them were adopted. The water and sewerage committee recommended the extension of the sewerage and water systems to cover the whole town at an estimated cost of $50,000 and the sinking of a new supply well at $1,800. These were unanimously passed.

INDIAN HEAD.—The Council are asking the Railway Commission for power to take the town water mains and sewers across the C.P.R. tracks.

FINANCING OF PUBLIC WORKS

Ontario.

HAILEYBURY.—Until February 22nd, offers will be received for $26,000 30-year waterworks; $22,000 30-year school; $8,000 20-year school; $15,000 20-year street improvement; $15,000 20-year waterworks extension debentures. Interest 5 per cent. P. A. Ferguson, town clerk.

Saskatchewan.

ASQUITH.—Until March 1st, the town of Asquith will receive offers for $12,600 6 per cent., 20-year debentures. The secretary-treasurer is Dr. N. G. Cooper.

TELEPHONY.

Ontario.

VELLORE.—About 75 farmers and others turned out to attend at the township hall last week for the purpose of arranging for a telephone service for the Township of Vaughan, villages of Richmond Hill and Woodbridge, and adjoining municipalities. Ed. W. Brown, Woodbridge, was appointed secretary pro tem. Those present were very enthusiastic and $2,000 in stock was promised as a starter for the new company. These provisional directors were selected:—Messrs. D. C. Longhouse, J. S. McNair, and H. C. Bailey, for Vaughan Township; Thomas Trench and Wm. H. Pugsley, for Richmond Hill, and Dr. P. D. McLean and C. L. Wallace for Woodbridge. A charter will be applied for as soon as possible and the work proceeded with at an early date. Before 1910 500 phones will be in use in these and the neighboring municipalities. The first meeting of the provisional directors will be held at Maple next week.

ST. THOMAS.—The capital stock of The Erie Telephone Company has been increased from ten thousand to fifty thousand dollars.

Saskatchewan.

CARIEVALE.—A meeting held last week resulted in the formation of a local telephone joint stock company. Much interest was taken, and most of the capital required was subscribed.

BELLE PLAINE.—The incorporation of the Stoney Beach Rural Telephone Company, Limited, is announced in a recent issue of The Saskatchewan Gazette.

MISCELLANEOUS

Ontario.

PORT ARTHUR.—The Government has started to get matters into shape for the erection of the dams at Dog Lake. To this end Mr. H. G. Acres, hydraulic engineer for the Hydro-Electric Commission, arrived here last week on his way to Dog Lake to make the necessary concluding surveys preparatory to starting the work. Mr. A. L. Russell, who already has done the preliminary work and furnished the Commission with plans and detailed information with respect to the lake, river and grounds surrounding, will accompany Mr. Acres and participate in the work now to be done. In addition to building the dam, the outlet of the lake will be lowered, by blasting out the channel to a depth of some three feet, thus enabling the drawing off of considerably more water. We understand that instructions have been given to have the necessary roads cut out for taking in supplies to the site of the work.

Saskatchewan.

YORKTON.—At a recent meeting of the council, property and market estimates for $1,500; street improvements for $20,000, necessitating the conversion of the present plank sidewalks to cement as well as the crossings, and fire and lighting for $4,500, including the erection of a hose tower, were unanimously passed.

SASKATOON.—The erection of a large brick and concrete addition to George Sparling's block will shortly be commenced, while a large central site has been purchased by the A. Carruthers Company, Limited, who will build in the near future.

Alberta.

EDMONTON.—A delegation from the Peace River country, waited on Premier Rutherford a few days ago to urge on him the necessity of railway facilities, roads, bridges and ferries in the great country to the north. They asked for better roads and bridges, and the Government's well boring outfit to bore for water. The Premier promised them immediate assistance. He informed the House that the Alberta and Great Waterways Railway Company will construct a line from Edmonton north-easterly to a point near the west end of Lac Labiche, thence to a point near Fort McMurray. The leading promoters of the company are W. R. Clark, B. R. Clark, bankers of Kansas City, and Wm. Bain, Winnipeg. The company is a private one, and the line will not be a branch of the G.T.P. The Bill was given a second reading, and referred to the Railway Commission.

British Columbia.

PRINCE RUPERT.—A most successful blasting operation in connection with the construction of the G.T.P. Railway a few days ago, moved 80,000 cubic yards of rock, most of which rolled into the harbour, while the remainder was broken up so fine that steam shovels will be able to handle it without difficulty.

VANCOUVER.—H. Mooer & Company, of Kingston, Ont., are asking the city council for assistance by exemption from taxation and guarantee of bonds for the erection of a terminal elevator to cost $400,000. It is not likely that their request will be granted, as the C.P.R. and Dominion Government contemplate the erection of elevators themselves.

CHILLIWACK.—Work upon the big reclamation scheme undertaken by the British Columbia Electric Railway Company, upon which nearly 100 surveyors and helpers have been engaged, has been suspended until the beginning of March, when R. W. LeBaron will assume charge. It is the intention to develop power for the operation of the new tram line. The surveyors will complete their work early this spring and construction of the pipe lines and dyke will probably commence before highwater time.

CURRENT NEWS.

New Brunswick

ST. JOHN.—The city council will ask the New Brunswick Legislature at its session, which opens on March 18th, for authority to erect a bridge across St. John harbor, and also to construct and maintain a railway from the western end of the bridge to the winter port terminus at West St. John. The bill limits the cost of the bridge to $750,000, the city to contribute in stock or otherwise not exceeding $300,000 towards building the bridge and railway, the city to have full power to grant running rights to any railway or street railway, on such terms as may be agreed upon. There is provision for railway, street railway, foot passengers and teams to use the bridge.

ST. JOHN.—The development of the harbor to the south of Sand Point has been commenced. The Maritime Dredging and Construction Company, acting under instructions from the Department of Public Works, have placed the dredge Iroquois to work on the Beacon Bar. It is understood that this dredging is part of the company's contract to remove some 800,000 cubic yards of material under the scheme of E. T. P. Shewan, for the construction of additional wharves and terminal facilities.

Nova Scotia.

SYDNEY.—The Dominion Railway and Plaster Co. will commence operations shortly toward the exploration of their plaster areas at East Bay. These properties are located about eleven miles from Sydney and about three miles this side of the head of East Bay. A gasoline engine and drill have been shipped to the first point of exploration and will be in operation this week. Mr. Banks, a Government engineer, arrived a few days ago, and will probably visit the properties to superintend the work.

Ontario.

COBOURG.—Indications point to a speedy commencement of work at the steel works. The machinery has now arrived, and is being placed in position. An 80-foot crane is in operation and used in placing the machinery. The big chimney, which is to be 110 feet high, is in course of erection.

NIAGARA FALLS.—Work on the Niagara-Fort Erie boulevard will be recommenced within the next six weeks, and it is expected that about the same time a decision will be made as to whether the plans for the electric railway belt line paralleling the boulevard, touching this city, Fort Erie, Port Colborne and Welland, will be made. The proposed belt line would connect with the Niagara, St. Catharines and Toronto Railway, and would open up one of the most fertile sections of the province. The work on the boulevard is in an advanced stage for nearly half its length, and the coming summer will see great work done if the plans of the Queen Victoria Park Commission mature.

OTTAWA.—The Hamilton Bridge Company, for $46,000, offers to supply the steel frame work for a grand stand at the Exhibition grounds here. Tenders on different designs, from Ottawa, Montreal and Hamilton firms have been received, but no contracts have been awarded yet.

PORT ARTHUR.—Mr. Dix-Fraser, superintendent of the blast furnace plant here, has just returned from a trip to some industrial centres in the United States. He says his company intend to operate their plant again this spring.

ST. CATHARINES.—Natural gas was struck here last week at a depth of 200 feet by men boring for pure water on the Kinleith Paper Company's property on the old canal bank. This is the first strike of natural gas at or near St. Catharines. The boring will continue.

Alberta.

WETASKIWIN.—Applications will be received until March 15th, by E. Roberts, city clerk, for the position of city engineer. Applicants are to furnish references and state experience respecting sewers, waterworks, street paving and concrete sidewalks. Applicants to state salary required. Services to commence about April 1st.

Saskatchewan.

INDIAN HEAD.—The rural municipal council will ask the Saskatchewan Government to purchase a railroad grader and loan it to them.

INDIAN HEAD.—Plans for the construction of a fire escape annex to the school building have been adopted, and tenders will be called for right away.

REGINA.—Trains are now busy on the Parliament Buildings spur track transporting large quantities of materials, including lumber, brick, cement, etc., for use in the construction of the buildings, and already a large portion of the supplies required for early spring construction is on the ground. An average of about two trains per week are handled by the men. As soon as the weather permits, the work will be commenced.

SASKATOON.—J. H. Trusdale, city clerk, Saskatoon, will receive applications for position of city engineer until March 23rd.

British Columbia.

NEW WESTMINSTER.—The B.C. Electric Railway Co. have now commenced work on the large order for this year, which includes sixteen passenger cars and one observation car for Vancouver, six cars and a large shunter for New Westminster, six box cars and a heavy locomotive for the Chilliwack line, seven box cars, a locomotive and two flat cars for the Lulu Island branch. In addition to these, several powerful locomotives have been ordered from the East.

VICTORIA.—Undermined by the dredging of the entrance to the harbor, three hundred feet of the stone wall beneath the new dock of R. P. Rithet & Company at the outer wharf here was carried away, and, as a result, the dock itself for about the same distance has sagged and settled. The damage will amount to about $25,000.

VANCOUVER.—At a recent meeting of those interested in the shipping facilities of this port a committee was appointed to confer with the harbor committee of the city council in regard to improvements to the habor. That the most urgent and pressing need of the port is the dredging and widening of the narrows was the conclusion arrived at. A delegation will visit Ottawa at the end of this month and urge the need of improvement on the Government.

Foreign.

PITTSBURG.—The United States Steel Corporation has decided to introduce the Heroult electric furnace.

PERSONAL.

MR. EDWARD B. COLEMAN, Taunton, Mass., has been appointed traction manager, to succeed G. B. Blanchard, who resigned at the end of the year.

MR. ANDREW F. MACALLUM, C.E., who has been recently appointed city engineer of Hamilton, Ont., is a graduate of the Faculty of Applied Science and Engineering, Toronto University, receiving his degree of B.A. Sc from the University in 1894. Later he received the professional degree of C.E. from the same institution. Mr. Macallum is an engineer of wide and varied experience, and was formerly associated with the late W. T. Jennings, at one time city engineer in Toronto, and afterwards became identified with many railroad and municipal undertakings throughout Canada. Mr. Macallum has had charge of construction work for the C.P.R., Grand Trunk Railway and Algoma Central Railway, and latterly was division engineer on the National Transcontinental west of Quebec. He also visited Alaska in the interest of the bondholders of the Alaska Central Railroad. Two years ago Mr. Macallum returned to Toronto and established a consulting practice. He will take up the duties in connection with his new appointment on May 1st, after a visit to Europe. Mr. Macallum is at present associated with M. T. Aird Murray, C.E., in sewerage and sewage disposal work, and they will continue to co-operate in this class of work.

OBITUARY.

ALEX. MONRO, of Vancouver, for many years roadmaster of the C.P.R., died on February 8th. He went to British Columbia in 1882.

MR. W. J. CORDOCK, superintendent of dredging for the Maritime Provinces, and one of the best officials of the Public Works Department in Eastern Canada, died February 23rd, 1909, aged 78 years. He had been in public service 38 years.

MARKET CONDITIONS.

Montreal, February 24th, 1909.

There have been important developments in the iron and steel markets of the United States during the past week. Considerable reductions have been made in the prices of finished and semi-finished material. Practically all lines have been affected, save heavy sections of steel rails. Pig-iron producers, however, do not anticipate any reduction in the price of pig as the result of this action on the part of makers of finished material. The idea prevails in many minds that the reduction will result in a largely increased output, and occasion the consumption of an easier tonnage of pig, and that, consequently, present prices should be maintained, stocks become depleted and conditions improve all along the line in connection with pig-iron and base materials. Of course it is too early as yet to make any very positive statement as to how this will work out, but there is every reason to believe that the action referred to will result in at least a temporary improvement in the volume of business done. As to whether such volume will be maintained is a question for the future to determine.

English market conditions show no improvement. As a matter of fact, warrant iron is slightly on the down grade. This, coupled with the increase in stocks and small exports, makes present conditions rather discouraging. Reports of home trade, however, show an improvement. More steel is being used for shipbuilding purposes and heavy founders are in the market for greater supplies. The fact is, United States market conditions tend to further depress the English market, and it may be that recent reductions there will result in causing prices of English and Scotch finished lines to drop.

Trade is better in the local market, and improvement is taking place gradually. The tonnage of pig-iron contracted for is, however, satisfactory, and the outlook is good. Practically all the structural material, etc., used in Canada, comes from the United States, England, or Germany, and it is the belief that the lower prices which are likely to prevail during the next few weeks will have the tendency to bring to a head many of the projects now under contemplation.

At the moment, rolling mills are doing nothing and purchasers of finished and semi-finished material are holding off in order to see what is going to take place. Quotations are consequently nominal. Practically no one is paying them, yet holders are not making reductions till the true situation in the United States discloses itself. Price changes will not unlikely develop in a few days. Prices on common bar iron were reduced at Pittsburg from $1.50 to $1.30.

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 ½-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, 14¾c.; 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 1½c. 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 14½ 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, 50c. 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, 10¾ oz., $4.35. Add 25c. to above figures for less than case lots; 26-gauge is 25c. less than 28-gauge. American 28-gauge and English 26 are equivalents, as are American 10¾ oz., and English 28-gauge.

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

Iron.—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 69 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 5⅝ 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 5⅛ to 5¾c.

* * * *

Toronto, February 25th, 1909.

Dulness is general. There are enquiries for prices, but few transactions. In every department of the building trade the same waiting attitude appears. Some building is always going on in the city, but outside in the province waiting for spring is general.

In the United States the reduction of prices of iron and steel products by the United States Steel Company is a prominent feature. But it has not greatly affected consumption as yet. In bar iron it can make no difference to the Canadian market. As regards sheets, plates, beams, boiler tubes, the purpose of the United States Steel Company as to prices for export has not yet been made known.

COST AND COST KEEPING.

Engineering Contracting.—As Mr. Wason truly says, these data are of the kind that the contractor usually keeps under his own hat. They seldom get beyond a few of the highest officials of the construction company. For breaking away from this policy Mr. Wason deserves the thanks of engineers and contractors, despite the fact that he deprecates the generosity of his action by claiming pure selfishness as his motive.

To our minds the motive is of deeper root than selfishness even. It goes down to the beginning of the knowledge that the special process, the secret ingredient and all their kin are in greater or less degree "pure bluff" as accounting for success in contracting. There is no secret process for successful concrete work, except honest work and good management—these are qualities free to any one to attain. As Mr. Wason pointedly remarks, "the older firms in the field have little to fear from the beginner because so much depends on personal ability as well as experience." The novice is a danger, however, when through ignorance and inexperience he bids less for work than it costs and so loses out or resorts to "skinning," which perhaps leads to accident and so discredits concrete construction in the sight of the architect and the owner.

TENDERS CALLED FOR

VILLAGE OF BURLINGTON

PROVINCE OF ONTARIO.

WATERWORKS — TENDERS WANTED

Sealed Tenders will be received by the Village Clerk until 8 p.m. on Tuesday, March 23rd, 1909 for the following sections of the proposed Waterworks System:—

"A"—Pipelaying.
"B"—Pump House.
"C" Water Tower.
"D"—Cast Iron Pipes.
"E"—Hydrant Valves.
"G"—Electrically Operated Pumping Machinery.
"I"—Pump Well.

Plans and specifications for "A," "C," "D," and "E" may be seen at the office of the Clerk, Burlington, or at the office of the Chief Engineer, Toronto, on or after March 1st.

M. C. SMITH, Esq., Reeve, Burlington, Ont.

O. T. SPRINGER, Esq., Clerk. Burlington, Ont.

WILLIS CHIPMAN, C.E., Chief Engineer, 103 Bay Street, Toronto, Ont.

TENDER

Tenders will be received up till noon March 1st, 1909, by the City Commissioners addressed to the undersigned for the supply of material and labor necessary for the construction of a Coal and Ash Conveyor for the City of Calgary.

Plans and specifications can be obtained at the City Engineer's Office.

The lowest or any tender not necessarily accepted.

H. E. GILLIS, City Clerk.

Dated at Calgary, February 10th, 1909.

CITY OF PRINCE ALBERT

TENDERS

"Tenders for Road Machinery" will be received until 8 p.m. on Thursday, March 18th, for the following:—

1. One Storm Crusher.
2. One Elevator and Screens.
3. One Electric Motor.
4. One Steam Road Roller.

Specifications and other information will be forwarded on application to F. A. Creighton, Esq., City Engineer, Prince Albert, Sask.

C. O. DAVIDSON, Sec.-Treas.

TENDERS

LISTOWEL ELECTRICAL SYSTEM

LISTOWEL, ONTARIO.

Tenders will be received by A. St. George Hawkins, Esq., Chairman, Fire, Water & Light Committee, Listowel, Ont., up to noon of Monday, March 8th, 1909, for boiler, engines, generators, switchboard, distribution and street lighting material, etc.

Lowest or any tender not necessarily accepted. Specifications may be obtained from

CHARLES H. MITCHELL,
PERCIVAL H. MITCHELL,
Consulting and Supervising Engineers,
1005 Traders Bank Building, Toronto.

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

Antimony.—Unchanged at 9 3-4c. Not much doing.

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

Boiler Plates.—1-4-inch and heavier, $2.40. 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.—We do not change our quotation from 15c. to 15 1-2c. Matters have quieted down, and there is but slight movement at unchanged prices.

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, $2.25; ½-inch, $2.63; ¾-inch $3.56; 1-inch, $5.11; 1¼-inch, $6.97; 1½-inch, $8.37; 2-inch, $11.16; 2½-inch, $17.82; 3-inch, $23.40; 3½-inch, $29.45; 4-inch, $33.48; 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, $4.71; 1-inch, $6.76; 1¼-inch, $9.22; 1½-inch, $11.07; 2-inch, $14.76. Makers are holding prices stiff.

Lead.—Quiet and unchanged at $3.90 to $4.00 here. Excitement abroad quieted.

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 quoted at $22.00 in car lots. The season being practically over for shingles, there is but little movement in them, but prices are suddenly strong at $3.20 for British Columbia. White pine lath are scarcer, No. 1 especially, and stiff in price. No. 1 are $4, and No. 2 $3.50. 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. There is a fair supply and no especial activity.

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, 9¼c. per lb.; pure Manila, 12¼c., Base

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. trans	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.

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

GENERATORS.

1, 100 K.W. alternating current, with switchboard and exciter.
2, 100 K.W. direct current with switchboards.
1, 30 K.W. direct current, 250 volts.
1, 1,200 light, Westinghouse incandescent dynamo.
1, 350 light, Brush incandescent dynamo.
1, 150 light, Sprague incandescent dynamo.
1, 75 light, Eddy incandescent dynamo.
1, 35 light, Ball arc dynamo with 32 lamps.

MOTORS.

1, 92 H.P. Westinghouse, alternating current, 200 volts, with transformers.
1, 50 H.P. Jones & Moore, alternating current, 220 volts, with transformers.
1, 15 H.P. Jones & Moore, direct current, 250 volts.
1, 12 H.P. Consolidated, direct current, 250 volts.
1, 8 H.P. Consolidated, direct current, 500 volts.
1, 8 H.P. Jones & Moore, direct current, 250 volts.
1, 8 H.P. Consolidated, direct current, 250 volts.
1, 5 H.P. Gee, direct current, 250 volts.
1, 5 H.P. Three Rivers, direct current, 240 volts.
1, 3 H.P. London, direct current, 250 volts.
1, 2 H.P. Jones & Moore, direct current, 500 volts.
2, 2 H.P. Jones & Moore, direct current, 250 volts.
1, 2 H.P. Three Rivers, direct current, 240 volts.
1, 2 H.P. Jones & Moore, direct current, 110 volts.

CENTRIFUGAL AND ROTARY PUMPS.

1, 8" horizontal centrifugal sand pump.
1, 900 gallon Northey, vertical centrifugal pump.
1, 735 gallon Morris, vertical centrifugal pump.
1, 470 gallon Morris, vertical centrifugal pump.
1, 260 gallon Morris, vertical centrifugal pump.
1, 150 gallon Taber, bronze rotary pump.
3, 100 gallon Taber, rotary pumps.
1, 100 gallon Lobee, rotary pump.
1, 30 gallon Taber, rotary pump.

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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.

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" EVENING CALL—N 3146.

NEW INCORPORATIONS.

(Continued from Page 7)

Ontario. — Dominion Silver Mines, Limited, $2,000,000; S. H. Martel, H. J. Murphy, J. F. McKenzie, Ottawa. W. H. Cox Coal Co., Limited, $10,000; W. H. Cox, I. S. Underhill, T. Wisker, Toronto. Cobalt Electric Power Co., Limited, $500,000; F. W. Baillie, S. Johnston, O. J. Thomson, Toronto. The Brantford Foundry & Development Co., Limited, $40,000; W. B. Burrill, John B. Rouse, John Moffat, Brantford. The Maryborough Telephone Co., Limited, $10,000; Alex. Malcolmson, P. Richardson, A. C. Munns, Moorefield.

Dominion. — Mexican Transportation Co., Limited, $1,000,000; J. S. Lovell, W. Bain, R. Cowans, Toronto. H. W. Petrie of Montreal, Limited, $40,000, machinery; W. Laurie, T. P. Altimas, M. A. Phelan, Montreal. Montreal Wire Bound Box Co., Limited, $100,000; A. J. Brown, R. C. McMichael, R. O. McMurtry, Montreal. The National Navigation Co., Limited, $300,000; I. Montreuil, S. Martel, N. Mercier, Quebec. Harvard Shipping Co., Limited, $36,000; C. A. McCollough, New York City; N. M. Ward, Orange, N.J.; G. I. Dewar, Ottawa.

LABOR CONDITIONS THIS WINTER

The Labor Gazette for January on the condition of the labor market in various sections of the country, does not show a falling off in the demand for labor generally. The construction work on the railways and the general activity in

(Continued on Page 48.)

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 20-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.

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

Tin.—The tone of outside markets is firmer, some authorities still think the price must go up. The production has increased. No change in price here, 30 to 31c.

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 strong at $5.25 to $5.50, and more enquiry.

* * * *

Winnipeg, February 22nd, 1909.

The local market has nothing of interest to record in the way of activity in any particular line. Small hardware supplies and plumbers material is having a strong demand at present, being used in finishing a number of apartment blocks and other structures on which interior work is being done.

The Union Depot is being pushed ahead rapidly and the steel work being put up by the Dominion Bridge Company, is now well advanced.

During the past week a number of bodies have been met in Winnipeg in annual convention, such as, lumber-dealers, agricultural societies, and the lumbermen particularly, are looking forward to a strong demand for all classes of lumber in the coming season.

Western cities and municipalities are making great preparations for municipal work during the present year as will be seen by the number of tenders called for.

The local quotations are as follows:—

Anvils.—Per pound, 10 to 12 1-2c.; Buckworth anvils, 80 lbs., and up, 10¼c.; anvil and vise combined, each, $5.50.

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.

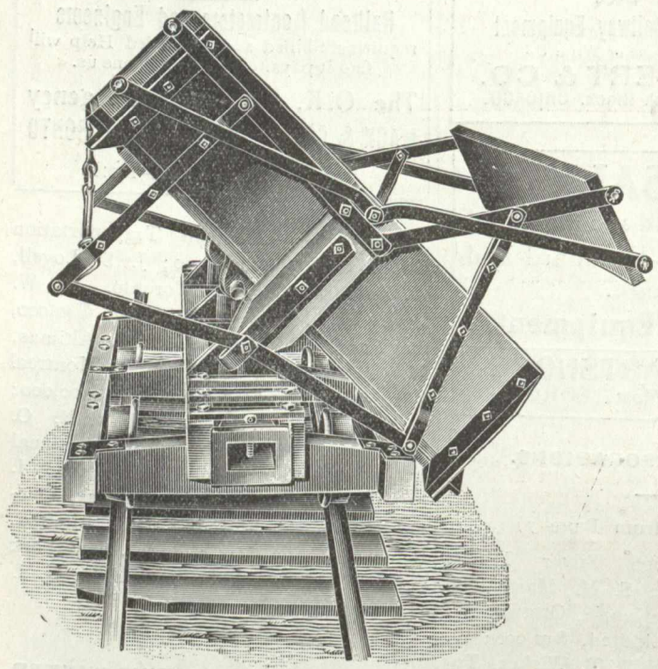
J. H. TRUSDALE, City Clerk

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 Toronto Pressed Steel Company, Limited, have sent in catalogues containing information about their dray and wheel scrapers, railway dump cars, wheelbarrows, dump carts, dump wagons, contractors' ploughs, cement mixers, and wagons and trucks. These catalogues are neatly printed and well illustrated, one of the cuts shows a double dump car in operation. This car dumps on both sides of the track. The side boards are pivoted to the side arms and braces, and these irons are also pivoted where attached to car bed. By this method of construction the side boards are moved outward and upward away from the load as soon as the bed is tipped, so that no part of the load strikes or bears against the side boards. There is, consequently, no danger of the car being thrown off the track in dumping.



Beds are made of the best white oak plank, bolted at the ends to angle iron sills, and in the centre to white oak beams of great strength. The bed is loosely attached to the truck by flat pins pivoted in hinge castings, which enter socket castings on the trucks, but are not fastened there. The bed is held in position by a chain on each side, connecting with the truck. This chain is provided with spike and ring fastening, which is easily released. The whole box of the car is, therefore, connected to the truck loosely by the pins and side chains, and, in the event of derailment, the box automatically separates from the truck, causing less damage to the car, and making it easier to replace on the track.

The simple chain fastening can be released by the foot and the car dumped while in motion.

INTERESTING GAUGE TESTS WITH "ALLEN" RIVETERS.

Some interesting gauge tests with Allen riveters have recently been made at the works of the manufacturer, John F. Allen, 370-372 Gerard Avenue, New York City.

The result of these tests in tonnages as given below cannot but be of decided benefit to users of riveting machines. Heretofore the general claims made for the Allen tools have been based on calculations which, to a certain extent, could not be entirely reliable. Shown on a gauge, the result is indisputable.

Air pressure. Pounds.	Tonnage.	Spring in frame. Inches.
60	53	¼
65	59	¼
70	60	5/16
75	62	5/16
80	66	5/16
90	72	5/16
100	80	3/8

"As far as we have been able to determine," states the manufacturer, "such tests have never been equalled. Some makers have approached them by means of larger diameter cylinder, but this we have endeavored to avoid, the reduced friction in the mechanism of our design enabling us to get better results."

It is noted that the Cambria Steel Company recently put in two large Allen riveters on the strength of the above tests, and which are receiving the consideration of several other prominent concerns who have become interested in the showing made by the Allen machines.

TRADE INQUIRIES.

A manufacturers' agent at Vancouver, B.C., wishes to secure agencies of United Kingdom firms.

Inquiry has been received from a firm at Toronto for the names of United Kingdom chemical manufacturers requiring representation in Canada.

From the City Trade Branch, 73 Basinghall Street, London, E.C. :—

A South of England firm which is conducting a general import and export business asks to be placed in touch with Canadian importers of British goods of all kinds. They are also prepared to act as agents for Canadian manufacturers and shippers seeking representatives.

A London firm wish to appoint an agent in Montreal for the sale of their teas.

A West of England manufacturer of carriages, and also of carts for agricultural and business purposes, would like to obtain a share of Canadian trade.

An Italian firm who are buyers of dry and wet codfish, in bulk or in casks, desire the addresses of Canadian curers and shippers.

A Winnipeg firm, the members of which claim an established connection among buyers of grocery, confectionery and hardware lines in Western Canada, are commencing business as manufacturers' agents, and wish to represent a few United Kingdom manufacturers desiring to develop trade in their market.

A firm in Halifax, N.S., ask for the addresses of manufacturers of refined peanut oil.

A Canadian company seek a market for quantities of bugle, blade, thigh and other bones suitable for the manufacture of toothbrush, knife and similar handles, and wish to get into correspondence with United Kingdom buyers.

A Montreal firm seek additional agencies in fancy goods, art and metal goods, and glassware.

A Canadian firm manufacturing turned goods, such as rolling-pins, ironing-boards and various domestic novelties and specialties made of wood, invite correspondence from United Kingdom buyers of these lines.

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, 50c.: 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, $4.00; 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; ¼-inch, $8.50; jack iron, single, per dozen yards 15c. to 15c.; 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, 5¼c. per lb.; 12 inches up, per lb., 4¼c.

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

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, $11.35; 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.

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the building trades have given employment to much labor, both skilled and unskilled. Altogether conditions in this respect seem to be better than for the corresponding period last year. The mild winter which we are having will create a demand earlier than usual. Unskilled labor, which locates in cities as a rule, feels the lack of demand earlier. The cry of the unemployed this season has not been heard from all points as in the past.

CANADIAN STEEL IN BRITISH MARKETS.

The Commercial Intelligence.—The Dominion Iron and Steel Company threatens to become a formidable competitor of British rail manufacturers in the markets of the Empire. A short time ago this Canadian Company carried off an important order for steel rails for an Indian railway, despite the competition of the United Kingdom rail manufacturers, and they have now scored another success in obtaining from the Government of New South Wales an order for nearly 18,000 tons of rails. The British manufacturers evidently are handicapped by their membership of the International Rail Combination in competing against this outsider, and have called a meeting to consider how the situation is to be met. A serious factor in the situation is the fact that the Dominion Company receives a Government bounty on the iron used in the manufacture of rails for export.

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.
Harpell-Stokes, Limited, Winnipeg and Toronto.
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,
Harpell-Stokes, Limited, Winnipeg and Toronto.
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.
Harpell-Stokes, Limited, Winnipeg 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
Harpell-Stokes, Limited, Winnipeg and Toronto.
Toronto & Hamilton Electric Co., Hamilton, Ont.

Economizers
Babcock & Wilcox, Ltd., Montreal.

Electric Apparatus
Harpell-Stokes, Limited, Winnipeg and Toronto.
Hill Electric Mfg. Co., Montreal, Que.
Toronto and Hamilton Electric Co., Hamilton, Ont.

Electrical Supplies
Harpell-Stokes, Limited, Winnipeg and Toronto.
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.
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
Harpell-Stokes, Limited, Winnipeg and Toronto.
Mussens Limited, Montreal, Que.

Generators, Alternating and Direct Current
Harpell-Stokes, Limited, Winnipeg and Toronto.
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
Harpell-Stokes, Limited, Winnipeg and Toronto.
Mussens Limited, Montreal, Que.
Toronto & Hamilton Electric Co., Hamilton, Ont.

Motors
Harpell-Stokes, Limited, Winnipeg and Toronto.
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
Harpell-Stokes, Limited, Winnipeg and Toronto.
Mussens Limited, Montreal, Que.

Pumps—Steam and Power.
Canadian Buffalo Forge Co., Montreal and Toronto.
Harpell-Stokes, Limited, Winnipeg and Toronto.
Mussens Limited, Montreal, Que.
Petrie, H. W., Ltd., Toronto, Montreal, Vancouver.
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
Harpell-Stokes, Limited, Winnipeg and Toronto.
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
Hamilton Brick Works Co., Ltd. Hamilton.
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.
Harpell-Stokes, Limited, Winnipeg and Toronto.
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
Harpell-Stokes, Limited, Winnipeg and Toronto.
Toronto and Hamilton Electric Co., Hamilton, Ont.

Transmission Machinery
Harpell-Stokes, Limited, Winnipeg and Toronto.
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.
Harpell-Stokes, Limited, Winnipeg and Toronto.
Mussens Limited, Montreal, Que.

Wire, Switchboard
Harpell-Stokes, Limited, Winnipeg and Toronto.