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For CIVIL, MECHANICAL, ELECTRICAL and STRUCTURAL ENGINEERS and CONTRACTORS

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Vol. 16. Toronto, Canada, April 30th, 1909. No. 18.

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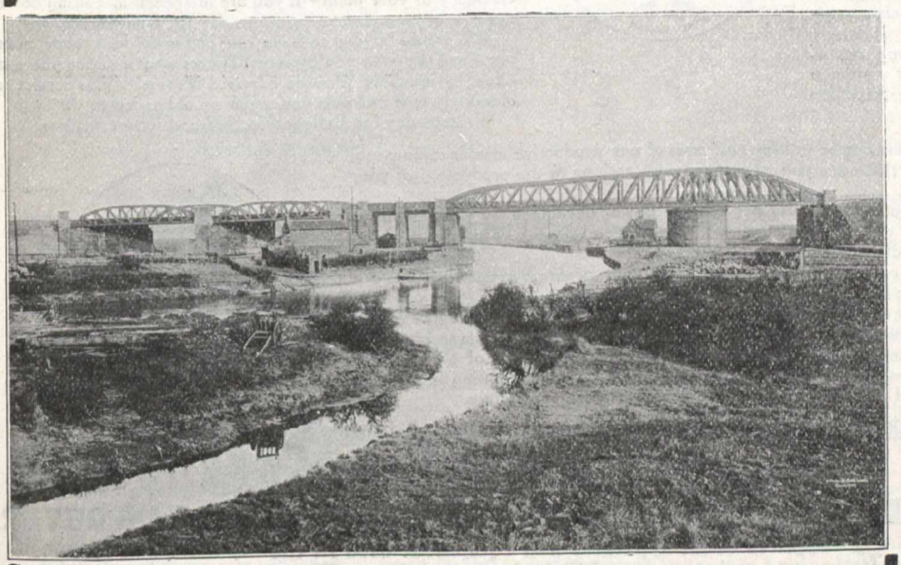
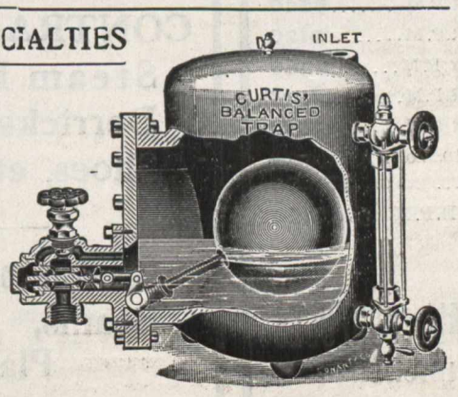
* Every Other Week † Once a Month

CONSULTING ENGINEERS





NEW INCORPORATIONS.

North Portal, Sask.—Portal Light & Power Co.

Abernethy, Sask.—Foster Rural Telephone Co.

Camrose, Alta.—Manning Sutherland Lumber Co.

Vermilion, Alta. — Alberta Western Lumber Co.

Edmonton, Alta.—Imperial Foundry Co. Non-Refillable Bottle Co.

Ottawa, Ont.—Rideau Canal Sand Co., $25,000; A. T. Shillington, J. O. Carss, L. H. Morisset.

Odessa, Ont.—Ernestown Rural Telephone Co., $15,000; J. F. Dawson, A. Snider, P. H. Snider.

Dundas, Ont.—Dundas & Wapak Mining Co., $40,000; C. E. Dingler, A. G. Mefferd, C. T. Kelter.

Berlin, Ont.—Weber Bros, $100,000; E. O. Weber, J. M. Walker, Berlin; P. E. Brown, Toronto.

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The Canadian Engineer

WEEKLY

ESTABLISHED 1893

VOL. 16. TORONTO, CANADA, APRIL 30th, 1909. No. 18

The Canadian Engineer

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Issued Weekly in the interests of the

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

Editor—E. A. JAMES, B.A. Sc.
Business Manager—JAMES J. SALMOND

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NOTICE TO ADVERTISERS

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TORONTO, CANADA, APRIL 30, 1909.

CONTENTS OF THIS ISSUE.

For copies of our issue for April 9th, 1909, we will give one month's extension of subscription. If you do not require your copy, kindly forward it to The Canadian Engineer, Toronto.

THE LEGISLATURE AND THE RAILWAY.

The Ontario Legislature has closed its doors after having created or amended a hundred and sixty-five Acts. Very few of the Acts are radical in their nature or far-reaching in their direct effect, but we think that in the matter of railway charters and extensions the Legislature in its desire to be fair has defeated its own ends.

It is very true that the charter huckster has done a great deal to prevent the extension of railways and the development of new sections of our Province, but with all his faults we doubt if he ever did so much to make difficult the commencement of work on new railways as the clause the Legislature inserted in all railway bills this year, requiring work to commence by May, 1909, and actual construction to commence before July, 1909, and in addition to this only granting an extension of charter for one year.

On April 13th the bills became law, leaving only three weeks for those holding charters to organize, finance and get their parties in the field, and only eleven weeks in which to complete surveys, prepare plans and estimates, again finance, let contracts, and commence actual construction.

No doubt it is very necessary to do something to prevent those holding charters from delaying the development of certain districts, or to prevent other companies from coming through the same territory, but it seems to us unnecessarily severe to require so much in so short a period. Such legislation can have but one effect, and that will be to make it impossible for any but the three large companies to build lines throughout Ontario.

Had they thought it wise to give a two years' extension, something might have been done, and we have no doubt that many of the schemes which have been hanging in the balance for the past year or two would be shortly under way. To expect the promoters to be able to finance with a charter that has only one year to run is to expect too much.

THE NORTH AMERICAN CONSERVATION CONFERENCE.

The conference which met in Washington in February to consider the conservation of the natural resources of this continent have stated clearly their position in the "Declaration of Principles" which have been issued by the secretaries of the conference.

We have heard so much of the conserving of natural resources that one received the impression that "to conserve" means not to use. With that view we entirely disagree. It is very necessary and desirable to prevent waste, but to attempt to prevent the use of our natural resources would be a most undesirable movement.

The great natural wealth of this continent is for the use and pleasure and profit of this age and the succeeding ages, and it is our duty to guard this great heritage, but "to conserve" has so long been used in other connections that we think it an unfortunate phrase to use in dealing with this specific question.

It is pleasing to note that the conference have placed first things first, and that public health is considered a first essential. Preventative legislation in connection with stream pollution has been too long neglected on this

continent, and it is worthy of note that such a question should receive consideration by this body, and that their first recommendation should deal with this matter.

A better technical and practical field instruction for men engaged in afforestation and reafforestation is suggested as one of the best means to secure the most from the great timber wealth of the continent. Forests have so much to do with the regulation of stream flow, and indirectly with hydraulic development, that the maintaining of growing forests should be encouraged, and their destruction by fire and unwise and improvident cutting guarded against.

Great emphasis is placed upon water as a primary resource. The monopoly of waters and water power by private individuals is not in the best interests of the public, either in the matter of public safety or for the securing of complete and economical development.

Several other natural resources are referred to, and the Declaration of Principles places the findings clearly before those interested.

This campaign must first be an educational campaign, and too much encouragement cannot be given to those men who give freely of their time and best thought to this question, which has so much to do with the pleasure, comfort and happiness of coming generations.

THE INTERCOLONIAL OUT OF POLITICS.

It is almost as impossible to think of Canada without Confederation as to dis-associate the Intercolonial Railway and Canadian politics.

Much interest centres in the announcement of the Minister of Canadian Railways that he proposes placing the Intercolonial under a board of commissioners. The success of the scheme will depend entirely upon the scope and power of the board. The business is there, the road and its feeders are in fair condition, and the commissioners appointed have the courage and ability to rescue this railway system. They cannot do so unless they are given a free hand, nor are they likely to accomplish it in the one year which, report says, is the limit set wherein the scheme has to be tested out.

The Minister has been most happy in his selection of men for this difficult work. Two of the appointees are men of years of experience in Intercolonial management. They know all the mistakes of the past, and will likely be the first to be anxious to remove from party politics. A third member of the commission, the probable chairman, is a man of wide experience and strong executive ability, while a fourth has been a successful general superintendent on the most difficult section of our largest railway system.

That these men will in one year justify their appointment we are quite certain. But it will take many years to rid the Intercolonial of the dead timber that has made it a byword in Canada, or to place the Government railway system upon a paying basis.

In the early days of our country it may have been necessary, for national reasons, to operate this road at a loss. But surely those days have passed, and the Government railways should, and can, be operated as successful business ventures.

EMPLOYERS' LIABILITY.

At the last session of the Ontario Legislature the member for Renfrew succeeded in placing upon the statute books a law which provides that men employed in lumber or construction camps shall have the privilege of prosecuting their employers for violation of contract or suing for non-payment of wages in the place where the contract was made.

This is a provision that is quite just, and perhaps necessary. From time to time, modifications of our laws are necessary, and the peculiar conditions because of large construction works being carried on may make this new modification desirable.

Taking this measure as a text, in peevish moments, much unnecessary and unjust criticism has been levelled at the contractor by persons forgetting or overlooking the fact that this question is a stick with two ends.

Mr. McGarry, in presenting the measure in the House, submitted the following statement as showing the account of a man who had been in camp sixty-one days:—

Sept.	19.	To fare, $7.45 ; expenses, $3.55	$11 00
		Doctor fee	50
Oct.	1.	To doctor fee	50
	15.	To Order 25	10 10
Nov.	3.	To doctor fee	50
	14.	To Order 76	10 10
		To Bowett (photograph)	35
Dec.	1.	To charges (strike)	3 00
		Doctor fee	50
Dec.	1.	To Order 49 (settlement)	1 29
		Credit.	
Dec.	7.	By 61½ days at $16	$37 84
			$37 84 $37 84

We have no doubt that this statement shows the actual conditions in a particular camp for a patricular man. But along with this we should like to give a few figures from the other side:—

Aug.	29.	To fare, $6.80; expenses, $3.25 $10 05
Aug.	31.	To store 4 50
Sept.	1.	To board 1 50
		Total $16 05
		Less five hours work at 20 cents 1 00
		Total loss $15 05

In this case the contractor paid the men's fares from the city and some expenses in connection with their leaving town and while travelling on the road. The party of ten reached the camp on a Saturday night, and as is usually the case with such workmen, they had to be fitted out with boots and some clothing before they could be put on the grade. Monday they could not work. Tuesday five of them got weary and moved along the line. By Thursday only one of the ten was left, or, on the five a clear loss of $45.15. This is not a fictitious table, but just one example out of several that every contractor could give.

It is all very well to talk about "simply slavery," but there should be some method of protecting the employer from the touring laborer, whose one object in life appears to be to beat his employer.

RAILWAY EARNINGS AND STOCK QUOTATIONS

NAME OF COMPANY	Mileage Operated	Capital in Thousands	Par Value	EARNINGS Week of Apr. 21		STOCK QUOTATIONS TORONTO				MONTREAL			
				1909	1908	Price Apr 23 '08	Price Apr. 15 '09	Price Apr. 22 '09	Sales Week End'd Apr 22	Price Apr. 23 '08	Price Apr. 15 '09	Price Apr. 22 '09	Sales Week End'd Apr 22
Canadian Pacific Railway	8,920.6	$150,000	$100	1,401,000	1,306,000	154½	176	175	177 175¾	533	155	154½	175½ 175½ 176¾ 176½	2383
Canadian Northern Railway	2,986.9	.....	.....	189,300	181,100	.....	.....	.....	.....	.....	.....	.....	.....	.....
*Grand Trunk Railway	3,568.7	226,000	100	724,631	682,775	.....	.....	.....	.....	*1st. pref. 109½, 3rd pref. 49¾, ordinary 20½	.....	.....	.....	.....
T. & N. O.	334	(Gov. Road)	.....	34,098	15,746	.....	.....	.....	.....	.....	178½	178	209½ 209 209½ 209	127
Montreal Street Railway	138 3	18,000	100	67,714	67,065	.....	125	124	123 100	101	99¾	124½	124 124 123¾	1112
Toronto Street Railway	114	8,000	100	67,824	65,734	.....	170	170	182	.....	.....	.....	167¾	125
Winnipeg Electric	70	6,000	100	.....	.....	143½	.....	.....	.....	.....	.....	.....	.....	.....

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

RELATIVE ECONOMY IN COST OF CULVERT CONSTRUCTION.*

The question of relative economy in the cost of construction of various types of drainage openings often arises. Below are estimates of the cost of four types of construction for the same drainage opening on the Madisonville, Hartford & Eastern R.R., now under construction in Western Kentucky. The unit prices used in these estimates are those paid by the railroad company to the contractors doing the construction work. Therefore the cost estimates are on the basis of cost to the railroad company having the work done, and not on the basis of actual cost of contractors.

The general character of the surrounding country at the opening in question is hilly and covered with thick woods. The opening itself is in a fill containing 48,000 cubic yards of material, there being 33 feet of fill'ng at the culvert, the total length of fill from grade point to grade point being about 1,000 feet. The water passing through the culvert is normally a small brook, which empties into Rough River about 300 yards below the railroad fill.

The estimates of cost are now taken up in detail.

Estimate No. 1.

Structure:—A 9-ft. concrete arch culvert of cross-section, as shown in Fig. 1. This is the structure that has been built by the railroad company. The concrete in the foundation or below plan C-D and in the wings and head walls was mixed in the proportion of 1:3:6. The concrete in the

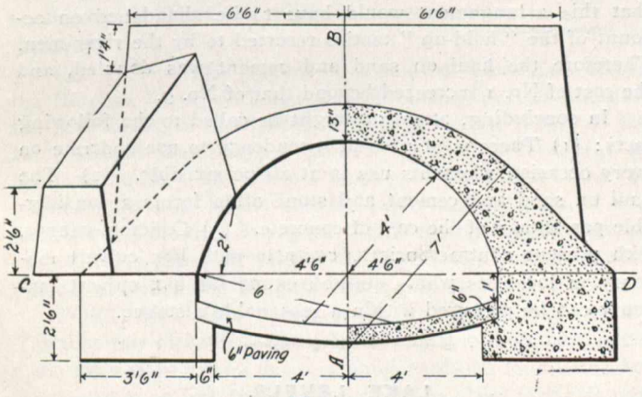


Fig. 1.

arch or above plane C-D was mixed in the proportion of 1:2½:5 in order to obtain additional strength in the arch wing.

Foundation: The foundation for the culvert was not altogether satisfactory. The soil at the opening was underlaid by a mixed stratum of dirt and gravel, and under this ordinary clay. It was thought best to place the foundation on the gravel strata instead of moving the same and greatly increasing the cost of structure by digging to rock or using piles. To aid in distributing the pressure an offset of 1 foot wide and 1 foot deep was made on the outside of each bench wall for 18 feet each side of the centre of the track (this in order to "take up" the greater pressure directly under the roadbed). The paving for this culvert was also increased from a thickness of 6 to 12 inches, and arched downwards, as shown in the sketch. Reinforcing of paving by wire fencing running from wall to wall was also considered.

The experience of the chief engineer, Mr. George W. Feagin, has been that culverts founded as this one fail somewhat in the following manner: First, the building of such a high fill puts an enormous weight on the original ground surface immediately beyond each bench wall. The earth at this opening is of a rubber-like description, and the great stresses imposed on the earth surface on either side of the fill are transmitted somewhat as in water pressure or hydraulics where pressure is equal in all directions. In the failure of a culvert this pressure goes down under the bench walls carrying the weight of the fill, and pushes upward on the paving. If the paving is not strong enough it cracks; and this cracking of the paving destroys the homegeneity of the structure and throws additional weight to one of the bench walls. This additional weight in a case of complete failure causes the wall to settle, and thereby cracks the arch above. The actual cost to the railroad company of building the 9-ft. arch of concrete is as follows:—

238	cubic yards of concrete masonry, at $8.50	$2,023.00
387	ton-miles of concrete hauled, at 60c	232.20
656	yards-miles of sand hauled, at 60c	393.60
418	cubic yards of dry excavation, at 40c	167.20
	Total	$2,816.00

Therefore the total cost to cost per cubic yard of concrete equals $11.83. Also an additional sum of probably 50c. per yard for inspection should be charged to this masonry. This inspection charge is for one man in addition to the regular residency force. This man's time at the culvert was about two months. The cement used was a Portland cement made in St. Louis and hauled from the nearest railroad station on the Illinois Central R.R. In calculating cement and sand hauled, one mile is considered free haul. The total distance from the railroad station to the culvert is 8.4 miles, or 7.4 miles pay haul. The length of the culvert from face to face of head wall is 95 feet. The sand for the concrete was also hauled from the railroad station 8.4 miles distant. All of this hauling was done on dirt roads during October and November, 1907, when the roads were in very bad condition. (The roads of this part of Kentucky are as bad as can be found anywhere.) The total number of sacks of cement used was 1,101. The sand used amounted to 89 yards. The item of dry excavation was bid by the contractors for all excavations for pipe and culvert foundations and such excavation for bridge foundations as would not be classed "water excavation." The work was done by a subcontractor in November and December, 1907, under very bad weather conditions. The contractor was not allowed to lay or mix any concrete in freezing weather, and was required to quit work on afternoons at least 1½ hours before the time at which it was estimated the temperature would reach the freezing point.

Estimate No. 2.

Below is tabulated an estimate of the cost of a 4 × 8 reinforced concrete box culvert for the same opening as above:

1.	72 cubic yards of reinforced concrete (1:2½:5), at $9	$ 648.00
2.	122 cubic yards of plain concrete (1:3:6), at $8.50	1,037.00
3.	18 cubic yards of stone paving (cobbles), at $3.50	63.00
4.	6,560 lbs. of iron in reinforced concrete, at 5c.	328.00
5.	577 yards-miles of sand hauled, at 60c	346.20
6.	310 ton-miles of cement hauled, at 60c	186.00
7.	400 yards of dry excavation, at 40c	160.00
	Total	$2,768.20

Reinforced concrete in the above estimate includes all concrete in the culvert top or above a horizontal plane 3½ feet above the paving. (See sketch Fig. 2.) Plain concrete includes all concrete below this plane and in head walls and wing walls. The sand and cement hauls in the above were, of course, calculated from the same railroad station as in estimate No. 1.

Estimate No. 3.

The structure in which the cost is estimated in estimate No. 3 is an ordinary 4 × 8 box culvert, with a reinforced top, as shown in Fig. 3 (paving cobblestone).

* Paper by E. W. Cooper, read before the Engineering Association of the South.

1.	74 cubic yards of reinforced concrete (1 : 2½ : 5) at $9	$ 666.00
2.	118 cubic yards of box culvert masonry at $6	708.00
3.	19 cubic yards of paving (cobblestone), at $3.50	66.50
4.	6,560 lbs. of iron in reinforced concrete, at 5c.	328.00
5.	220 yard-miles of sand hauled, at 60c	132.00
6.	105 ton-miles of cement hauled, at 60c	63.00
7.	400 yards of dry excavation, at 40c	160.00
	Total	$2,123.00

No haul on stone is estimated in the foregoing estimates, for the reason that a suitable stone for concrete and walls is within 3,000 feet of the opening. A quarry was

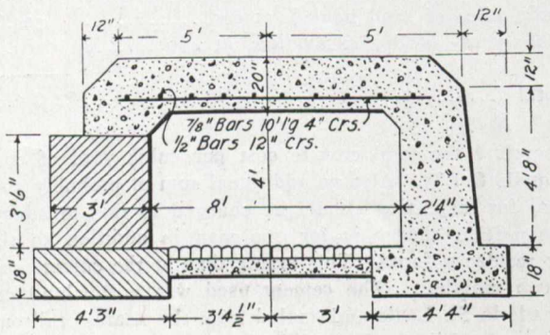


Fig. 2.

opened at this place, and the stone for concrete was crushed by a portable jaw crusher running 40 yards of crushed stone per day.

Estimate No. 4.

An ordinary double 4 × 4 box culvert (as shown in Fig. 4) is the structure in estimate No. 4.

220 yards of box culvert masonry, at $6	$1,320
24 yards of paving, at $3.50	84
100 yard-miles of sand hauled, at 60c	60
50 ton-miles of cement hauled, at 60	30
400 yards of foundation excavation, at 40c	160
Total	$1,654

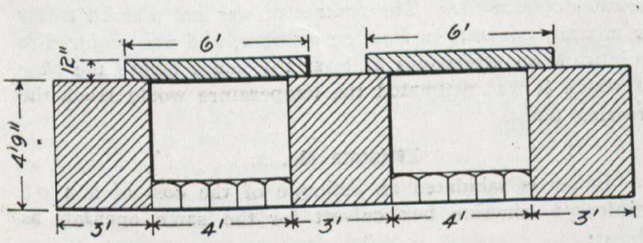


Fig. 4.

Summary of Estimates.

Below are summarized the four estimates:

No. 1. 9-ft. concrete arch culvert.
No. 2. 4 × 8 ft. reinforced concrete box culvert
No. 3. 4 × 8 ft. box culvert, with reinforced top.
No. 4. 4 × 4 ft. double box culvert.

Number of Estimate.	Area of Water-way Opening —Sq. Ft.	Shape of Water-way Opening.	Total No. Cu. Yds. of Masonry Required.	Total Cost of Railroad Company.	REMARKS
1	33	Semicircle	238	$2,816.00	Structure used actual cost
2	32	Rectangle	212	2,768.20	Estimated cost
3	32	Rectangle	211	2,123.00	Estimated cost
4	32	Rectangle	244	1,654.00	Estimated cost

On inspecting the above summary, it is seen at once that the double box culvert of estimates No. 4 would have cost the railroad company less than any of the other structures estimated. The use of a 4 × 4 box was contemplated, but abandoned on account of the inability to find suitable cover stone. The difference between estimates No. 1 and No. 2 is very small, indicating that either structure could have been used in so far as regards first cost. It should be noted, however, that No. 1 provides a semicircular opening, and, therefore, gives greater discharging capacity than No. 2, a rectangular opening. Therefore, No. 1 would probably be preferable to No. 2.

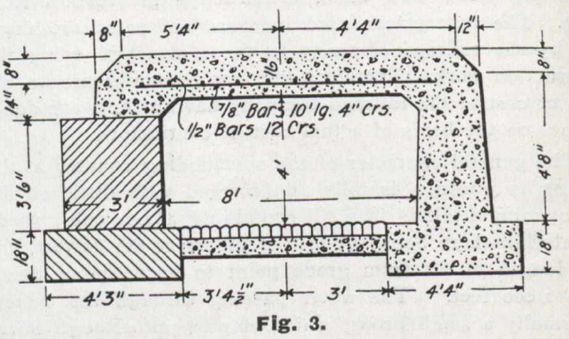


Fig. 3.

We now come to a comparison between No. 1 and No. 3. As shown in the summary of estimates, No. 3 is $693 cheaper than No. 1. With the present information as to cost of No. 1, there is not much doubt but that No. 3 would have been more economical and should have been used. The haul on sand and cement for No. 1 was before beginning work, figured from a point four miles pay haul from the opening. It was contemplated to deliver material at that point by boat from Evansville, Ind. It was found after beginning work that this arrangement would have to be abandoned on account of the "hold-up" tactics resorted to by the river men. Therefore the haul on sand and cement was doubled, and the cost of No. 1 increased beyond that of No. 3.

In concluding, attention might be called to the following facts: (1) There is at present a tendency to use concrete on every occasion where its use is at all permissible. (2) The haul on sand and cement and stone often forms a considerable percentage of the cost of concrete. (3) Concrete cannot, with present contract prices, compete with box culvert masonry in localities where suitable stone for box culvert masonry can be procured within a reasonable distance.

LAKE LEVELS.

During the month of March all the lakes except Lake Superior were on the rise. The United States Lake Survey reports as follows: Since last month Lakes Michigan and Huron have risen 1¼ inches, Lake Erie has risen 4½ inches, and Lake Ontario has risen 5 inches. The stages for the month were:

	Feet above tide water, New York.
Superior	601.39
Michigan-Huron	580.05
Erie	571.75
Ontario	245.70

During April, Lake Superior is likely to remain about stationary, Lakes Michigan and Huron should rise 3¼ inches, Lake Erie should rise 6¾ inches, and Lake Ontario should rise 8½ inches.

Lake Ontario is 7½ inches lower than the average March stage of the past ten years and 20¾ inches lower than in March last year.

BRANDON.—The newly-formed National Elevator Company, organized in Buffalo, is expected to commence operations in the North-West at once. A hundred elevators are to be constructed right away, and the work will be given to local contractors. J. B. Brodie has been in Buffalo for the purpose of promoting the company, and will make final arrangements for the buildings immediately on his arrival.

CURRENT NEWS

Quebec.

MONTREAL.—The St. Louis Council have considered the question of building the proposed tunnel under the Canadian Pacific Railway tracks on St. Lawrence Street. The town engineer's report places the cost at $135,000. The Council adopted a motion to call for tenders for construction.

SHERBROOKE.—The by-law granting the Structural Steel Co. a free site for the erection of a factory and exemption from taxation was passed by the ratepayers. The company will erect a plant valued at $25,000. The manufacture of bridges and boilers will be the main industry.

Ontario.

GODERICH.—H. W. Bell, secretary of the Public School Board, is advertising for plans for an eight-room brick school, to be erected here.

TORONTO.—Mr. G. G. Shortreed, of Barrie, who was interested in the Norland power plant on the Gull River and the Raven's Lake Cement Works, has sold the works to the Scarboro' Securities for about $500,000. The power plant supplies power to the cement works. The interesting part of this sale lies probably in the fact that behind "Scarboro' Securities" are the Mackenzie & Mann interests.

TORONTO.—Mr. C. H. Fullerton, engineer of the Provincial Public Works Department, left last week to survey the route of the new Gowganda road from Charlton to Gowganda. An appropriation of $50,000 was passed for this work at the recent Legislative session. The awarding of the contract for the work will follow immediately on the determination of the route, as the Government hopes to have construction commenced by June 1st. The estimated distance of the road is thirty-two miles.

Ontario

LONDON.—The placing of a dam for Lake Erie across the Niagara River, with the idea of raising and maintaining the lake levels, is to be dealt with in a special report of the International Waterways Commission, which will appear in about a month. The project is part of the larger plan to maintain the lake levels, and for two years the work of collecting complete data in regard to this matter has been going on. Various plans for raising the lake levels have been suggested, of which the Niagara River dam is one.

PORT ARTHUR.—Good progress is being made on the Thunder Bay elevator. The pile driving is completed. Some 6,000 piles were driven down, a good hard-pan foundation being found at 30 feet on the average. The sheet piling is now going down and that too will be finished in about ten days. For the purpose of bringing in cement (of which 15,000 barrels will be required), and other materials, a temporary dock out to deep water about in a line with the blast furnace docks has been built. The elevator will be entirely of concrete. It is to be of 1½ millions bushels capacity and will cost in the neighborhood of $600,000.

THORNBURY.—The town of Thornbury have passed without a dissenting vote a by-law to loan by way of bonus $10,000 to the Thornbury Transportation & Reduction Co. to establish works. In addition they also give a free site for twenty years with harbor and water privileges. This company, besides employing a line of steel vessels, intend operating an iron smelter. It is composed largely of Meaford and Toronto capitalists.

TORONTO.—Darling & Pearson, architects, have been advertising for tenders for the erection of a bank building at the corner of College Street and Dovercourt Road.

TORONTO.—The Provincial Cabinet met on April 15th to approve of the final draft plans for the enlargement of the Parliament Buildings. It was decided to advertise for tenders and commence the work at once. The central portion of the present buildings will be extended northward as far as the driveway across the Park. The boiler-house now in operation will be lowered to permit of the carrying out of the new portion of the building. It is the intention to provide accommodation for the Education Department, Hydro-Electric Commission and staff, and T. & N. O. Railway Commission. The sum of $750,000 has been set apart for the building.

TORONTO.—The Board of Railway Commissioners will meet in the City Hall on Tuesday, April 27th, at 10 o'clock, to consider the viaduct question. Other matters to be taken up are: High-level bridge at Queen Street East crossing, protection at railway crossings at Sunnyside, Ellis Avenue, and Windermere Avenue. The city has also asked for an order compelling the railways to issue commutation tickets to and from towns near Toronto.

PRESCOTT.—The new C.P.R. roundhouse, completed last fall, was totally destroyed by fire at 3 a.m. on April 12th, together with a freight engine and a shunter, which were in the building. General Superintendent Murphy stated that the loss would be about $25,000 or $30,000.

OTTAWA.—On April 7th a deputation from Guelph placed before the Board of Railway Commissioners the claims of the City of Guelph for a new railway station. As a result the former order was practically reaffirmed. The passenger station is to be started not later than September 1910, and a subway asked for will be built before it.

FORT WILLIAM.—The C.P.R. is considering a proposition to establish a plant here, the by-products of which will furnish material for the creosoting of millions of railroad ties annually. The mayor has also reported to the council that a wireworks and a car factory are negotiating for sites.

OTTAWA.—Nine tenders have been received for the National Transcontinental Railway Bridge at Winnipeg. The tenderers are: J. J. Collins; V. W. Geroux; T. Kelly & Sons; Faulkner, McDonald & Bender; Haney, Quinlan & Robertson; Toronto Construction Company; William Newman & Company, Ltd.; J. D. McArthur; Canada Foundry Company, Ltd.; Dominion Bridge Company, Ltd. The award will not be made for probably a week.

MISCELLANEOUS

Nova Scotia.

NEW GLASGOW.—The Harris Forge Co. have been incorporated for $25,000, with James A. Stairs, president, and Geo. E. Harris, vice-president and general manager. The company will undertake shape and drop forgings in all its branches. Mr. Harris, the general manager, was formerly superintendent for the Nova Scotia Steel and Coal Co. and for A. Finkl Sons & Co., of Chicago, Ill.

Ontario.

PORT ARTHUR.—The city council have been calling for tenders for the construction of all sidewalks during the present year.

GUELPH.—A number of cement sidewalks and sewer extensions will be constructed this year. Included in the estimates are: Board of Works, $14,990; markets and public buildings, $4,309; fire and light, $19,000; sewerage, $600.

HAMILTON.—The Hamilton Ferry Co. have commenced the construction of a dock.

LONDON.—By-laws to construct asphalt pavements, with cement curbs and gutters, were passed at a recent meeting of the city council.

ST. CATHARINES.—The City Council have recommended the construction of concrete curbs on a number of streets.

Manitoba.

WINNIPEG.—The erection of a reinforced concrete elevator, capacity 300,000 bushels, will be commenced early in May by the Ogilvie Milling Co. The contract has not yet been let.

WINNIPEG.—Plans have been received at the local branch of the Bank of Montreal for a magnificent new building, which is to be erected on the south-east corner of Portage Avenue and Main Street. The building is to be modelled after the head office in Montreal. The cost will be a million dollars. The building will be the finest in Winnipeg.

WINNIPEG.—The Municipal Council have given notice of their intention to make certain local improvements, including plank walks, cedar block pavement, asphalt pave-

(Continued on Page 585.)

THE

Sanitary Review

SEWERAGE, SEWAGE DISPOSAL, WATER SUPPLY AND WATER PURIFICATION

TORONTO'S WATER FILTRATION SCHEME.

"**Audi alteram partem!**"—a fair saying, and the foundation of the British idea of fair play; but Toronto "corporation officialdom" has evidently no use for the phrase.

Like half-smothered growls of subterraneous thunder, the Toronto newspapers intermittently give voice to adverse criticism of Toronto's Health Department scheme of applying about $1,000,000 in order to pass Toronto's water supply through about two feet six of ordinary sand before handling it over to the people.

Last week saw the "Globe" agitating itself in the editorial chair. Captain Mitford, a Toronto citizen, who is reputed to have had experience in connection with Mr. Alex. Hazen's filtration schemes and other public works, waxes indignant in the columns of the press that filtration should be resorted to when there is an alleged abundance of pure water at a greater depth a little distance further into the lake.

As to the feasibility of extending the intake pipe into the lake we have not the data on which to base an opinion. We have no profile of the bottom of the lake before us.

Captain Mitford says this is possible.

City officialdom says it is impossible.

Whether either of these parties base their opinion on data or not, we are unable to say.

Neither do we know whether sand filtration will have the desired effect upon Lake Ontario water or not. We have, and know of, no data affecting this particular water in this direction. If city officialdom has it, we will welcome it, and would like to publish it.

This will be the first "**experiment**" (mark carefully the word experiment) made of treating the Great Lake waters by slow sand filtration.

Slow sand filtration (up to the present) has proved the most efficient method of purifying raw river waters. Up to the present it has been adopted both in the United States and in Europe.

The system (as far as removal of bacteria) depends on the formation of a scum of precipitated matter, which gradually covers the whole surface of the filter and forms a sort of partial germ-proof blanket.

In river waters there is generally sufficient matter to form this scum; where there is not at certain times, as at Harrisburg, U.S.A., clay is added to the water, without which there is practically no removal of bacteria.

At the present time Dr. Amyot (bacteriologist to the Ontario Provincial Board of Health) is about to carry out several experiments at the new experimental research laboratory, in order to find out "**Just what can be done with Lake Ontario water by slow sand filtration.**"

Dr. Amyot's experiments will cost a few dollars. They will, however, be valuable to the whole of Ontario, and will present data on which engineering conclusions may be based in this particular work.

They will show whether or not Lake Ontario water has the necessary constituents for the formation of the germ-proof blanket; also, the character and degree of efficiency of the blanket, if such is formed.

They will, in short, show whether slow sand filtration is of any use with this particular water.

In the meantime Dr. Sheard is about to carry out his own little experiment on the Island, where he will be able to watch it right through the summer. This experiment will equally prove just what Dr. Amyot will prove.

The latter experiment, however, is on a scale more befitting the chairman of the Provincial Board of Health and medical officer of Toronto. It will cost just about $1,000,000, kindly supplied by the taxpayers of Toronto, with the consent and advice of their representatives at the City Hall.

Let us pray that the experiment will be a success, for once more a Canadian "has taken a chance."

We take this stand:—

Inasmuch as there are no data (experimental or otherwise) as a basis for this expenditure, and that such experiments are only about to be made by practically the only man in Ontario capable of scientifically making them, viz., Dr. Amyot, that the Board of Control and aldermen of the city would absolutely fail in their duty if they did not at once stay all proceedings until Dr. Amyot is in a position to report the result of his experiments.

Is it too much to ask that Dr. Sheard stay his hand for a period of a few months?

Let the policy of mystery be succeeded by a policy of open and scientific frankness. Why not take an example from the research methods employed by the hygienic authorities of the United States.

What is there to be afraid of? Why allow a cloak of mystery to inspire the public mind that it is only used as a necessary trapping to a practice of chicanery and deduction based on hypothetical empiricism.

STORAGE OF RIVER WATERS.

In bringing before our readers the conclusions of Dr. Houston's report, we may call attention to the fact, that the storage referred to, is in every case, only such means of storage, natural or otherwise, which are used solely for that purpose. The huge storage reservoirs in vogue in Britain are kept in sacred solitude, and cannot be compared with our lakes, which are the highways of commerce, and which maintain during the summer months a considerable floating population.

Storage reservoirs are generally adopted simply as a means of conserving water to meet periods of drought.

With certain waters, under certain conditions, especially under certain climatic conditions, stored water has a tendency to produce growths of algae. It, therefore, is necessary before concluding to store water in any large quantity for local domestic purposes, to make full enquiries as to whether, collected waters in the district show such tendencies.

Advantages of Storage.

(1) By far the strongest plea in favor of storage is based on the belief that **adequately** stored water is probably incapable of causing epidemic disease. No supersession, however, of filtration is suggested by me; **my plea is for storage plus filtration.**

There are three main lines of reasoning which may be used in support of this belief.

The Triple Plea in Favor of the Safety of Stored Water.

(a) The microbes of water-borne disease rapidly perish in river water under storage, so far as this may be judged by

the results of artificial laboratory experiments with the typhoid bacillus and the cholera vibrio.

In a previous report* it was shown that if typhoid bacilli be added artificially in large number to **raw** river water the great majority of them die within one week. In a future report it will be shown that what is true as regards the typhoid bacillus is equally true as regards the less hardy cholera vibrio. The microbes, then, which are associated with the cause of the two most important water-borne diseases soon perish in river water under storage in the laboratory.

(b) The microbes of water-borne disease are probably never present in raw river water in like number with B. coli.

The probable truth of this statement will perhaps be conceded. However this may be, no pains have been spared in attempting to demonstrate its truth. Thus, in a previous report† it was shown that a prolonged search for the typhoid bacillus in samples of raw river water yielded negative results. It is not, however, contended that the typhoid bacillus is never present in river water. What is maintained is that it is unlikely to be uniformly present, unless in sparse number, and that it is never likely to be present in as great a number as B. coli.

(c) The marked reduction in the number of B. coli when river water is stored for a sufficiently long period affords a fair basis for inferring a still more marked reduction (if not the total elimination) of the less hardy and less numerous microbes of water-borne disease.

In Addendum C it is shown that it takes (under laboratory conditions of experiment) on the average ten days for B. coli to disappear from 10 c.c. of **raw** river water (Thames and Lea). Ten days would suffice for the destruction of the vast majority of typhoid bacilli even if these were artificially added to river water in enormous numbers; but it is hardly to be imagined that the typhoid bacillus, or indeed any other microbe capable of causing water-borne disease, could ever be present in river water in greater abundance than B. coli. Even in the serious event of typhoid epidemics occurring at one or more of the towns which discharge their sewage into the Thames and Lea above the "intakes" it is hardly conceivable that the number of typhoid bacilli in any considerable bulk of water in these rivers could ever exceed the number of B. coli. It has already been shown that B. coli is not only nearly always absent from 10 c.c. of the Lea stored water, but that it is frequently absent even from 100 c.c.

It will be understood that I do not confine myself to the B. coli test alone as a method of inferring the "safety change" in river water as the result of storage. By chemical, as well as by additional bacteriological, methods it is possible to correlate the time it takes to effect certain definite changes in a river water under storage with the time required for the devitalisation of pathogenic bacteria in water.

The triple plea in favor of the "safety" of stored water is thus based on:—

(a) Proved 99 per cent. reduction within one week of the typhoid bacillus and the cholera vibrio when **artificially** added to raw river water.

(b) Inferred paucity in the number of pathogenic bacteria in raw river water, both actually and relatively to the number of B. coli.

(c) Proof, that it takes, under laboratory conditions of experiment, ten days (on the average) for B. coli to disappear from 10 c.c. of raw river water, an interval of time more than sufficient to eliminate the great majority of pathogenic bacteria assuming these to be present in the river water. It follows that the absence of the more hardy and initially more numerous B. coli from 10 c.c. of a **stored** water affords inferential proof of the relative, if not absolute, absence of the less hardy and initially (presumably) less numerous microbes of water-borne disease.

(2) The next strongest plea, if valid, would be that stored and subsequently filtered waters are not only safer epidemiologically than unstored and filtered waters, but are in a better condition, chemically and physically.

This, however, is a difficult point to establish for various reasons. As stated earlier in this report sand filters possess what may be called a "reserve of purifying ability" which enables them within certain limits to bring waters of quite different character to the same plane of apparent purity. The subject is really much more complex than would appear at first sight, and in connection with the Water Board's works it is difficult to institute valid comparisons. Perhaps the best plan is to concede the ability of sand filters to deal effectively (in a chemical and physical sense) with raw river water under favorable conditions, and to institute a comparison during periods of stress and storm. A single example may suffice. The New River district derives its supply from the River Lea (high up), and receives as well a large proportion of deep-well water. The East London (Clapton) district derives its supply from the River Lea (low down), and receives in addition only a small proportion of deep-well water. The former district has hardly any storage accommodation, the latter district is well off in this respect.

Between December, 1905, and December, 1907 (both inclusive), the monthly average **color** result for the New River filtered water was during four of these months + 837, + 337, + 275, + 137 per cent. above its own average for the year 1907. The worst four results to be recorded against the Lea filtered water during the same period, either during the same months or separate months, were + 57, + 43, + 36, and + 36 per cent. above its own average for the year 1907.

While, therefore, it may be conceded that when the river water is in good condition the use of stored water may not be essential to the delivery into supply of a physically and chemically satisfactory water, it cannot be denied that during periods of stress and storm the use of stored water is most desirable. Indeed, one of the great advantages of storing river water is its "levelling" effect on the quality of the water eventually reaching the filter-beds. Even if storage were powerless to affect the physical, chemical and biological qualities of **raw** river water, this "levelling" process would be an important gain from many points of view. To take a single example, any sudden accidental pollution of the river water near the "intakes" instead of reaching the filter-beds in a concentrated condition would be so diluted in a storage reservoir as to be rendered (apart from the "time element") possibly, if not probably, harmless.

(3) Next to questions of quality the strongest plea that could be advanced in favor of storage would, if valid, be that of economy.

This question of cost has already been referred to, but here the matter may be considered in a somewhat different light. To deal with it at all it is necessary to start with an assumption. The assumption is that, for purposes of safety as regards **quantity** of water, storage accommodation will have to be provided which will incidentally suffice for purposes of reasonable safety as regards **quality** of water; and, further, that the principle of "active storage" is recognized as sound. If such assumption be granted, then, apart from the increased cost of pumping, etc., consequent on adoption of this principle of "active" as opposed to "passive" storage, and which would not apply to a gravitation scheme, I believe there will be a considerable saving in the cost of filtration under normal conditions. Under normal conditions (e.g., an excessive development of algæ) the reverse might be true; but, in that case, assuming that an **adequately** stored water can be accepted as epidemiologically "safe," I should be satisfied, I think, if such water were passed through mechanical filters at an exceptionally rapid rate with a view to sending the water thus dealt with directly into supply. These mechanical filters, unlike sand filters, can be rapidly cleaned and put into operation again, which would be a great advantage in such circumstances. It is not to be supposed that I have lost faith in the

*Vitality of the typhoid bacillus in artificially-infected samples of raw Thames, Lea and New River water, with special reference to the question of storage (May, 1908).

†The negative results of the examination of samples of raw Thames, Lea and New River water for the presence of the typhoid bacillus, October, 1908.

old system of sand filtration. The contrary is the case; Nevertheless, I think that in certain circumstances mechanical filters may prove of special value. There are authorities which go so far as to assert that not only as regards capital and working cost, but also as regards the quality of filtered water, mechanical filters compare favorably with the old sand filters. On this matter I am not prepared to express a decided opinion, but it is obvious that if it is justifiable to assume that an adequately stored river water is a reasonably "safe" water antecedent to filtration, mechanical filters may, as suggested in a previous report, have a special field of usefulness in dealing with this class of water.

The following are a few of the places which have adopted these filters for public works:—

Hastings, West Gloucestershire, Bolton, Pontypridd, Aberdare, Hertford, Kirkcaldy, Morley (Yorks), West Cheshire, Newport (Mon.), Rothesay, Burnley, Dumbarton, Dumfries, Hamilton, Ruabon, Cowes, Lanark, Largs, Rhymney, Inverleithen, Foleshill, Harrogate, St. Ives, Hythe, Tunbridge Wells and Edinburgh.

(4) Another strong plea in favor of storage is the establishment of a continuous sense of security.

I dealt incidentally with the matter in a previous report, and it is involved in this "triple plea in favor of the safety of stored water," set forth in the present report. But it is desirable to consider the point here in a somewhat different aspect. The Water Board has a great number (over 160) of filter-beds, and, despite the large number of samples examined at the board's laboratories, water is constantly passing into the public supply the quality of which there has not been opportunity of determining. A filter-bed might be acting quite satisfactorily at the time a sample was collected, and yet before the time came for the next sample to be collected a breakdown in the filtering arrangements might have occurred and water have been unsuspectedly delivered from it to consumers in an imperfectly purified condition. At present about 1,000 samples (over 700 bacteriological) are examined each month, and it is a practical impossibility under existing conditions to exceed this large number. There is only one way of feeling continuously the pulse of London's "safety" as regards water supply, and that is by the examination of a sufficiency of samples of stored water, antecedent to filtration, by a very large number of filters.

As previously noted, storage has such a marked "levelling" effect on the fluctuating quality of raw river water, that the water leaving storage reservoirs of adequate capacity and proper circulation is liable to vary only very gradually in quality, so that the examination of occasional samples of such water may suffice to afford information of the utmost epidemiological importance.

If the results of the examination of such samples showed, time after time, that the water had undergone the "changes" which, in my opinion, point to "epidemiological safety," a lasting sense of security would as a consequence be established, and this irrespective of subsequent or final filtration.

I am not suggesting that constant surveillance should not still have to be maintained as regards the efficiency of the filters, but I maintain that the method of pre-judgment that has been indicated would create a constant check on the **general** quality of water supplied to London, unattainable by any other means.

(5) Another argument in favor of storage is that it tends to wipe out the gravity of the charge that London's water supply is derived chiefly from sewage-polluted rivers.

For, if what has been said is true, adequate storage alters a river water so much that it may almost be said to cancel the undesirable features of London's water supply and to bring the quality of the water finally used for filtration purposes to as safe a condition as if the source of supply had been unexceptionable in character. Although not defending the choice of an impure river water for water supply it is none the less true that adequate storage can apparently go far to destroy its dangerous properties.

The choice of London's water supply did not rest with the Water Board. It would be no small achievement for the Board to show that the dangerous elements in the **raw** sources of supply, over which it has no direct control, could be practically eliminated by the use of stored water. In effect it would almost amount, in an epidemiological sense, to the substitution of a nearly unimpeachable source of supply for the present one, which is regarded by some as a constant menace to the health of the metropolis.

I have not dealt specifically with the advantage of storage in enabling engineers to tide over a crisis, either due to drought or heavy floods, because this is a matter which is obvious to everyone and concerning which there has never been any conflict of opinion.

Conclusions.

In the following few sentences endeavor has been made to condense the chief points in favor of the storage of **raw** river water:—

(1) Storage reduces the number of bacteria of all sorts.

(2) Storage reduces the number of bacteria capable of growing on agar at blood heat.

(3) Storage reduces the number of bacteria capable of growing in a bile-salt medium at blood heat, chiefly excremental bacteria.

(4) Storage reduces the number of coli-like microbes.

(5) Storage reduces the number of typical B. coli.

(6) Storage alters certain bacteriological river water ratios; for example, it reduces the number of typical B. coli to a proportionately greater extent than it reduces the number of bacteria of all sorts.

(7) Storage, if sufficiently prolonged, devitalises the microbes of water-borne disease (e.g., the typhoid bacillus and the cholera vibrio).

(8) Storage reduces the amount of suspended matter.

(9) Storage reduces the amount of color.

(10) Storage reduces the amount of ammonical nitrogen.

(11) Storage reduces the amount of oxygen absorbed from permanganate.

(12) Storage usually reduces the hardness and may reduce (or alter the quality of) the albuminoid nitrogen (see text).

(13) Storage alters certain chemical river water ratios; for example, the color results improve more than the results yielded by the permanganate test.

(14) Storage has a marked "levelling" effect on the totality of water delivered to the filter-beds.

(15) Storage tends generally to lengthen the life of the filters. (Only under exceptional conditions is the converse true).

(16) An adequately stored water is to be regarded as a "safe" water, and the "safety change" which has occurred in a stored water can be recognized by appropriate tests.

(17) The use of stored water enables a **constant** check to be maintained on the safety of London's water **antecedent** to, and irrespective of, filtration.

(18) The use of stored water goes far to wipe out the gravity of the charge that the chief sources of London's water supply are from sewage-polluted rivers.

(19) The use of adequately stored waters renders any accidental breakdown in the filtering arrangement much less serious than might otherwise be the case.

(20) The habitual use of stored water would lighten the grave responsibilities of the Water Board, as regards the safety of the London water supply, and would tend to create a sense of security among those who watch over the health of the metropolis.

It will be remembered that in the introductory part of this report it was stated that the primary question to be solved was whether the stored water results were so greatly superior to the raw river results as to justify the policy of storing all river water before filtration.

I venture to anticipate that it will be considered that this question has been answered satisfactorily in the affirmative.

The difficulty of answering the subordinate question as to the exact number of days that a water should be stored before filtration may be rendered easier if certain assumptions are entertained. These are:—

(1) That the principle of "active storage," as opposed to "passive storage," is accepted as sound.

(2) That it is possible to "pool" the existing stored water interests so as to remove the anomaly of using over-stored water for some districts and under-stored water for others.

(3) That the river water can be effectively and continuously circulated throughout the several storage reservoirs.

These assumptions being granted, and bearing in mind that the board's existing storage reservoirs are now capable (in the aggregate) of holding about forty times the average daily supply, it is considered that subject to one qualification, the present storage capacity (say, thirty days) is reasonably sufficient (on the present consumption of water) for purposes of safety. The qualification is that sometimes no river water can be used to replenish the storage reservoirs for the reason that the rivers are in high flood, and in too unsatisfactory a condition to permit these waters to be impounded, or because owing to drought there is too little water in the rivers to allow of its being abstracted for waterworks purposes. In these untoward circumstances the water in the storage reservoirs must needs sink lower and lower each day, with the result that when the conditions again admit of refilling them (possibly with water of inferior quality) a period inevitably follows during which the duration of storage of necessity falls short, it may be far short, of thirty days.

There are two ways of coping with this difficulty:—

(1) To consider thirty days as a minimum period of storage. This would entail the construction of huge reservoirs at an unremunerative cost, capable of holding far more than thirty days' supply of water, in order to cope with the emergency conditions just mentioned.

(2) To consider thirty days a maximum period of storage, but to adopt during times of stress and storm some such additional methods of purification, **antecedent** to storage, or **subsequent** to storage but **antecedent** to final sand filtration, as have been briefly outlined in the concluding paragraphs of sec. 4 of this report.

My final conclusion is that **raw** river water should be stored antecedent to filtration, preferably for thirty days. The question of whether the thirty days' storage should be fixed on a maximum or on a minimum basis must be left unanswered, but if the former alternative be chosen, the desirability of employing supplementary processes of water purification to tide over emergencies is worthy of consideration.

SANITATION ANCIENT, YET NEW.

Dr. Halbherv, the Director of the Italian Archaeological Mission to Crete, writes of the recent discoveries in the Nurrean palaces as quite "al inglese" in the matter of hygienic appliances. Not the least interesting portion of the buildings is the elaborate system of drainage with lavatories and traps. The main drain of the palace at Knosos is 3 feet in height and is coated with cement, white terra-cotta pipes have been found running beneath the floor with small and large ends corresponding to the socket joints of the latest sanitary catalogues.

It is, indeed, difficult to realise that the engineers who produced these arangements and appliances lived at a period so remote that the civilization to which they contributed only survived as a faint tradition at the time of Homer, and that these traps and lavatories were being specified and fixed before Moses had begun to promulgate the sanitary laws which we find written in the Book of Deuteronomy.

Compared with such antiquity, the great sewers, aqueducts and public baths of the Romans appear recent in the vista of these innumerable ages. Ages of advancing civilization must have preceded the work of these early engineers, and yet the very name of the race to which they belonged has apparently been lost forever. Such obliteration and oblivion never came to Rome, but the downfall of the Empire seemed to have brought an end to all sanitary progress, and the great lessons to be gathered from her achievements were first neglected and then utterly forgotten.*

*Chadwick Lecturer (Scott-Moncrieff).

MISCELLANEOUS.

(Continued from Page 581.)

ments and granolithic walks, at an estimated cost of $97,000.

Alberta.

EDMONTON.—The Publc School Board has decided to erect a new high school to cost over $100,000. Tenders for construction will be advertised for shortly.

Saskatchewan.

PRINCE ALBERT.—The city council have decided to macadamize the business streets and to purchase the necessary road-making machinery. A number of streets will also be paved.

British Columbia.

FERNIE.—Tenders will be received up to 5th May for the purchase of 98,000 mining props, 17,000 mining ties, 5,000 cedar fence posts, 432 telegraph poles, two carloads piling, 500,000 ft. saw logs, besides tie loading flume, driving dams, tie chutes, logging camps, river and creek improvements, mill building, seven horses and harness, wagons, sleigh, tools and camp equipments, valued approximately at $24,583. Percy Chapman, P.O. Drawer 4.

VANCOUVER.—The road overseer, at the last meeting of the Richmond council, recommended the construction of several bridges.

VANCOUVER.—Many improvements will be undertaken by the Board of Works this year, including the construction of forty miles of concrete sidewalks, pavements and sewer extensions at a probable cost of $60,000 or $70,000.

PERSONAL.

MR. H. C. GROUT has been appointed assistant superintendent for C.P.R. at West Toronto.

MR. V. A. HARSHAW has been appointed superintendent of No. 1 Division, C.P.R., Toronto.

MR. G. L. LAW, Ottawa, Ont., has been appointed Government Inspecting Engineer on G.T.P.R., Winnipeg, Man.

MR. CHARLES BRANDEIS, consulting engineer, Montreal, has changed his address from 63 Guardian Building to 4 Phillips Place.

MR. GEO. WRIGHT has been appointed assistant city engineer of London, Ont. Mr. Wright will take up his duties almost immediately.

MR. A. L. FORD, B.A.Sc., Government Inspecting Engineer G.T.P.R., Winnipeg, Man., has been transferred to Prince Rupert, B.C.

MR. GEO. E. HARRIS, formerly superintendent for the Nova Scotia Steel and Coal Co., has been appointed vice-president and general manager of the Harris Forge Co., Limited, New Glasgow, N.S.

MR. E. L. MILES, A.M. Can. Soc. C.E., Bala, Ont., has been appointed to take charge under Galt & Smith of the construction work in connection with water supply and sewage disposal for Wetaskiwin, Alta.

MR. RICHARD E. SPEAKMAN, M. Can. Soc. C.E., succeeds Mr. W. H. Shillinglaw, M. Can. Soc. C.E., as city engineer of Brandon, Man., at a salary of $2,250. Originally, Mr. J. K. Heddle, assistant engineer at Hamilton, was appointed and accepted the position, but he finally decided to stay in Hamilton. Until recently Mr. Speakman was city engineer of Calgary.

MR. N. H. BRYDSON, of Pembroke, Ont., has been appointed City Engineer of Nanaimo, B.C., at a salary of $125 per month, his duties to start forthwith. The engaging of an engineer permanently is a new departure brought about by the large amount of work in connection with the new waterworks, sewerage and other public improvements that will take place at Nanaimo for the next few years.

RECORD EQUIPMENT OF THE JOHANNESBURG POWER STATION.

On December 14th, 1905, another addition to the steam plant at the above station was officially started up. On that day a large attendance of town councillors, electricians, and engineers assembled at the Johannesburg municipal power station for the purpose of witnessing the first run of the new 1,000-kw. Belliss Morcom engine, which had been erected by Messrs. Reunert and Lenz for the municipality. The new set was started up by Major L. F. Allan, the chairman of the Tramways Committee, assisted by the vice-chairman, Mr. L. V. Partridge. There were no speeches, but the toast of success to the new plant was duly honored.

The new engine is similar to the two other larger units in the power station, and is built by the well-known firm of reciprocating engine makers, Belliss & Morcom. The complete contract, all of which has been carried out by Messrs. Reunert and Lenz, includes an A. E. G. generator, with switchgear, connecting cables, etc., a 500-kw. Babcock & Wilcox boiler, a superheater and chain-grate mechanical stokers. All the steam-piping was supplied by Messrs. Stewarts & Lloyds. This latest engine and generator have taken nineteen weeks to erect, this being three days inside the contract period. The contractors, therefore, earn a three days' bonus, and maintain their reputation for rapid delivery and erection.

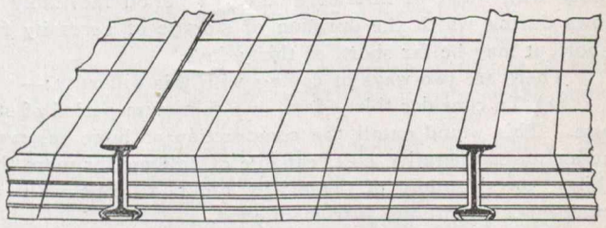
It is worth while reviewing the rapid way in which this steam station has been equipped since the failure of the gas station in the early part of 1907. This meant the stoppage of the tram service and a reduction in the lighting supply. When a steam plant had been decided on, the first order was placed with Messrs. Reunert and Lenz, the local agents of Messrs. Belliss and Morcom, for a complete installation, consisting of two 500-kw. generating sets, with the necessary boilers, steam and exhaust pipes and accessories, which they guaranteed to have completed and supplying power for the tram system within eight weeks under heavy penalties. One of the "Belliss" engines was already in the colony, the other had to be sent out from England. Cabled instructions were received by Messrs. Belliss on April 25, 1907, and the engine and dynamo were despatched on May 1st, leaving England by the mail steamer sailing from Southampton on the 4th. The steamer arrived at Cape Town on the 21st, and the engine and dynamo were promptly unloaded and sent on by special train to Johannesburg, 1,000 miles distant, arriving there on the 23rd. Meanwhile work had been actively proceeding on the site. Foundations had been excavated to a depth of ten feet for the two engines and completed in four days. The engine already on the Rand had been erected. The three Babcock boilers, chimney, and piping were dealt with with equal celerity, with the supply commenced on June 6th. The station was not, as is sometimes the case, merely formally started up and shut down to complete, but the plant was put to full and continuous work, the engines running for eighteen or more hours per day at loads considerably in excess of their rating, and this within six weeks of the placing of the order. When the quantity of the plant which had to be got together is considered, and the fact that a large proportion of it had to be transported upwards of 7,000 miles by sea and land, it will be agreed that the performance constitutes a record in power station equipment. Since then repeat orders have been frequently placed, until to-day there are six sets at work. To supply and erect three 1,000-kw. sets and three 500-kw. sets within twenty months forms another record that is not often touched, even within the United Kingdom.

All the six engines in the tramway and lighting station at Johannesburg are of Messrs. Belliss and Morcom's standard three-crank triple-expansion type, with high, intermediate, and low-pressure cylinders working cranks at equal angles. There are three 500-kw. sets and three 1,000-kw. sets. Two of the 500-kw. engines drive direct current generators by Messrs. Dick, Kerr & Co. and the Lancashire Dynamo and Motor Co., and the third engine drives a single-phase alternator by the Electric Construction Co. Each engine is capable of 720 b.h.p. and 25 per cent. overload, and runs at a speed of 300 r.p.m.

END CONSTRUCTION FLAT ARCH.

An interesting floor and roof construction, known as "End construction flat arch," has been employed in a building for the Royal College of Dental Surgeons, Toronto. This building, which is being erected by the National Fireproofing Company, Traders Bank Building, Toronto, is of pressed brick and terra cotta hollow tile construction. It is the first of this particular type to be erected in Toronto, and presents several unique features.

The building has a frontage on College Street of 102 ft. and 140 ft. on Huron Street, being L shaped, with a depth on the College Street wing of 54 ft. and on Huron Street of 42 ft., with a one-storey boiler house adjoining, extending east a further 42 ft. along the northerly boundary, which abuts on a lane. The main building is four stories in general height, with a Mezzanine on Huron Street extending into the southwest portion of the College Street front westerly, making the building practically five stories in height. It is faced with dark red brick, trimmed with a light stone.



End Construction Flat Arch.

In construction there are no interior bearing walls, each storey being one large flat, spanned by steel beams, supported on steel columns. By this means the various rooms may be changed without in any way affecting the structure, and each flat can be sub-divided without reference to the others, all partitions being supported upon the fireproof floors and girders.

The floors are of hollow tile, end construction, and all the beams, girders and columns are protected by the same material, with a minimum thickness of three inches on the columns and two inches on the beams. The partitions throughout are also of hollow tile, three to four inches thick, according to height of storey.

This type of end construction flat arch in comparison with the side construction flat arch design has been growing in favor. In comparison, it is claimed that if properly set it will develop fully 50 per cent. more strength for the same weight than side construction. A detail of the end construction flat arch is illustrated.

The architects are Messrs. Burke, Horwood & White, of Toronto.

An able American writer, reviewing the commercial and financial prospect in the United States, thus mentions the favorable features: The wisdom and forbearance both capital and labor are showing in the gradual and satisfactory adjustment of the wage problem; the signs of increasing consumption as the result of low prices for commodities; the revival in building operations; the improvement in railroad earnings; the decrease in mercantile failures, and the increase in volume of the Exchanges. But he notes with regret, amid these favorable items, that Wall Street speculators have set too rapid a pace, basing it upon presumed rapid and enormous recovery in business and transportation. "The immediate future has been more than discounted . . . that speculative fervor has got the better of sound judgment, and that serious reaction there is inevitable."

VANCOUVER.—About May 15th a party of seventeen, in charge of Mr. Frederick Lambart, will leave here for Skagway. They will devote all summer to locating a portion of the 141st meridian.

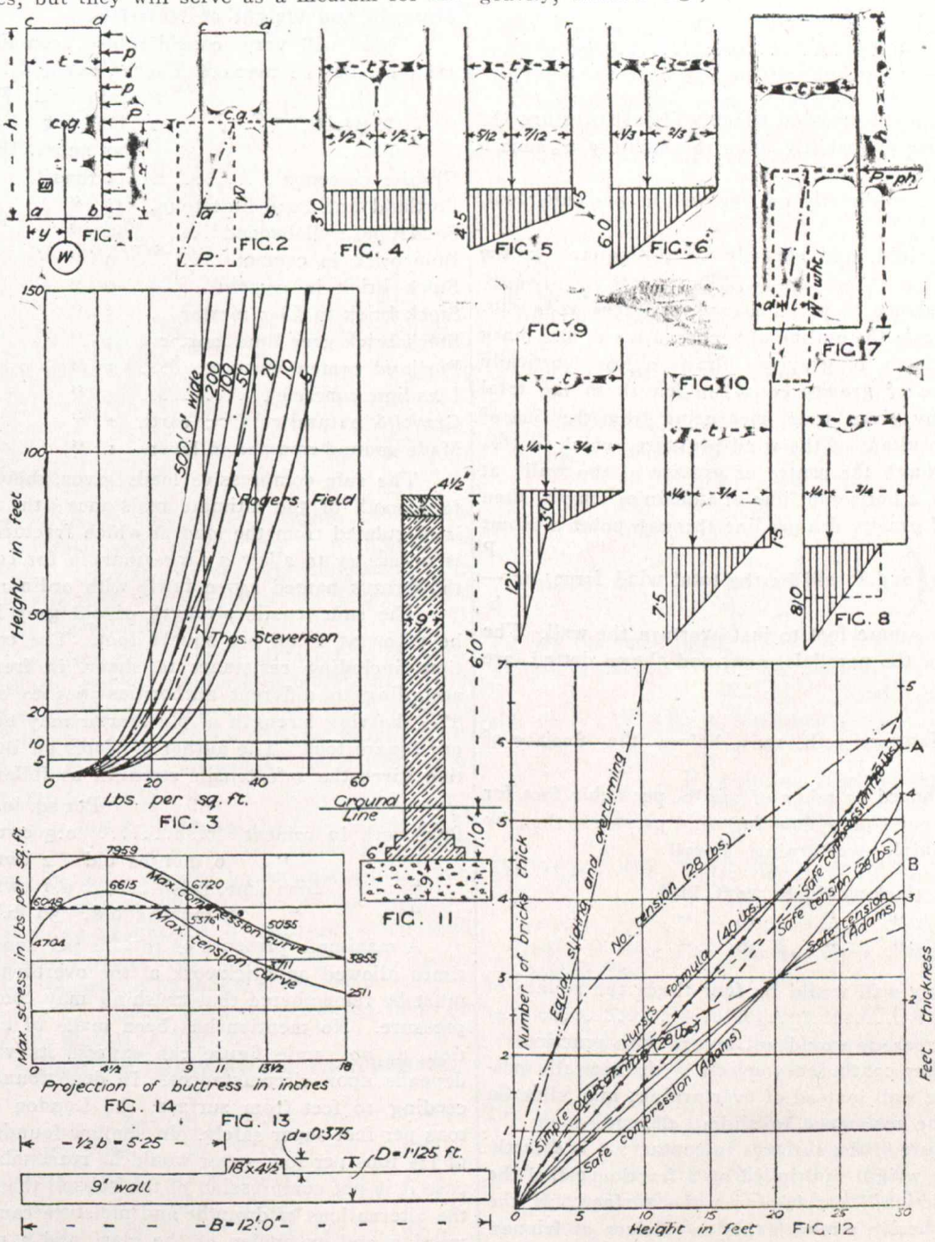
THE STABILITY OF WALLS.

By Henry Adams, M.Inst.C.E., M.I.Mech.E., F.S.I., F.R.San.I.

In order to bring the subject of stability of walls within the limits of time permissible in a single evening it is proposed to deal only with one class of walls—viz., those known as boundary, enclosure, or fence walls, which have no load but their own weight to support, and no thrust but that produced by the wind to resist. They are not of great importance in themselves, but they will serve as a medium for the introduction of the general principles of determining stability and save our time when we consider more important cases on a future occasion.

By making one or two assumptions the main principle can be shown very easily, but in the application of this principle to practice there are various points open to discussion, and the actual stability is by no means so certain as might generally be supposed. To make the subject perfectly clear, we will commence with a simple wall of uniform rectangular section, assuming that the wind is blowing horizontally and uniformly over one face, that there is no tensile strength in the mortar and that the wall would ultimately fail by overturning on the outer edge at the ground line without crushing the edge.

Let a b c d Fig. 1 be the section of wall, and as the reasoning that applies to one foot of its length applies to every foot, it will be convenient to consider a length of 1 ft. run. Then the total force of the wind will be the pressure per square foot × number of square feet (i.e., the height, because we are only considering 1 ft. of the length), and the centre of action will clearly be at half the height, the leverage to overturn the wall on point a will thus be x. It is not the distance measured from the point of P diagonally down to point a, because the leverage of any force must be measured from the fulcrum perpendicularly to the direction of the force. The wall being of uniform substance and rectangular in section, the centre of figure will be the position of the centre of gravity, marked c.g., where the whole weight may be considered as acting. This weight W is the weight per cubic foot × number of cubic feet (i.e., the height by the thickness, the length being 1 ft.), and its leverage, resisting the overturning on a, will be y. It is assumed that there is no tensile strength at point b to hold the inner edge down, as when the wall is new the cohesion of the mortar cannot be relied upon.



Figs. 1 to 14.—Stability of Walls.

Let p = wind pressure per square foot in pounds.
w = weight per cubic foot of wall in pounds.
h = height of wall in feet.
t = thickness of wall in feet.
P = total wind pressure in pounds.
W = total weight or resistance in pounds.
x = leverage of wind in feet.
y = leverage of resistance in feet.

Then

P = p h, x = ½h, Px = moment of wind pressure,

W = w h t, y = ½t, Wy = moment of resistance,

and by the laws of equilibrium P x = W y,

therefore p h × ½h = w h t × ½t, or p h = w t^2, whence

$$p = \frac{wt^2}{h} \quad \ldots\ldots (1)$$

$$h = \frac{wt^2}{p} \quad \ldots\ldots (2)$$

$$t = \frac{ph}{w} \quad \ldots\ldots (3)$$

If we consider the wind pressure which will just overturn the wall as the measure of stability, then the stability of such a wall varies as $\frac{wt^2}{h}$, or directly as the weight per cube foot, inversely as the height, and directly as the square of the thickness.

This may be shown by parallelogram of forces as in Fig. 2. Draw to any scale the outline of section a b c d, and mark the position of centre of gravity; draw a line vertically through the centre of gravity equal in length to the total weight W upon any given scale, measuring from the line of direction of the resultant of the wind pressure, which in this case will pass through the centre of gravity of the wall; at its extremity draw a horizontal line of indefinite length, then from the centre of gravity draw a line through point a to cut the horizontal line, and P will be the total wind force, or $\frac{P}{h}$ the wind force per square foot to just overturn the wall. The other lines forming the parallelogram, and shown dotted, are frequently omitted.

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*Paper read January 14th, 1909, before the Society of Architects.

Suppose a standard be taken of 112 lb. per cubic foot for weight and 28 lb. per square foot for wind pressure, then by formula (2) for simple overturning, a wall

1	ft. thick	would be	4	ft. high
2	" "	"	16	"
3	" "	"	36	"

or the height of any wall would be four times the square of the thickness . . .. (4)

which for various reasons would not accord with practice.

There is another contingency which is theoretically possible—viz., that the wall instead of overturning, may slide on the bed joint. The resistance to sliding depends upon the weight and the nature of the surfaces in contact; it is directly proportional to the weight multiplied by a fraction called the "co-efficient of friction," varying with the surface. If the mortar has any cohesive strength this co-efficient of friction would merge into the resistance of the mortar to shear stress.

Let u = the co-efficient of friction, then for equilibrium P = Wu, or p h = w h tu, whence p = w tu . ..... (5)

It is evident that there must be a certain proportion of thickness to height where the tendency to overturn or slide would be equal; this will be when $\frac{wt^2}{h}$ (1) = w tu . .....(4),

or, by cancelling, when $\frac{t}{h} = u$ . . .. (6),

that is, when the ratio of thickness to height is equal to the co-efficient of friction, and this being 0.5 for fresh mortar it would require the wall to be only twice the thickness high.

Now, unfortunately, when we come to apply these elementary principles to practice, we are beset by difficulties on every hand, and although an architect's innate sense of fitness may enable him to provide a suitable section for a wall of any height, there are times when he should be able to give a reason "for the faith that is in him," and to do so it will be necessary to make various digressions to ascertain the basis upon which practical calculations must rest.

Walls have been designed so that the overturning moment shall not exceed one-half to two-thirds that which calculation would show to be necessary to produce overturning, but this is a very crude and improper mode of designing, and the author will now endeavor to indicate the true basis upon which it should proceed.

Strength and Weight of Materials.

These will vary considerably according to individual samples, but an average may be taken as follows:

Material.	Safe dead load per foot super.	Factor of safety.	Weight in pounds per cubic foot.
Granite masonry	15 tons	20	160
Portland and hard limestone..	15 "	15	140
Sandstone well bedded	12 "	10	130
Blue brick in cement	9 "	8	120
Stock brick in cement	6 "	5	115
Stock brick in Lias mortar....	5 "	4	112
Stock brick grey lime mortar..	3 "	4	112
Portland cement concrete	5 "	8	130
Lias lime concrete	3 "	8	120
Gravel & natural compact earth	2 "	..	112
Made ground rammed in layers	1 "	..	110

The safe compressive loads given above vary from ¼th to 1/100th of the ultimate resistance: the factor of safety is calculated from the load at which fracture commences. It is necessary to allow a large margin for contingencies, and the figures named agree fairly with ordinary practice.

The safe tensile strength of old grey lime mortar may be taken at 1 ton per square foot. The co-efficient of friction, including resistance to shear, in fresh mortar joints according to different authorities = 0.5 to 0.75 of the load. The shearing strength of old mortar may be taken at ⅔ ton per square foot. The author of Notes on Building Construction gives the safe tensile strength as follows:

	Per sq. inch.		Per sq. ft.
Brickwork in cement, fresh.....	0.5 cwt.	=	3.6 tons
" " 6 months old	2 cwt.	=	14.4 "
" Lias lime, fresh	0.1 cwt.	=	0.72 "
" " 6 months old.	36 lb.	=	2.314 "

A maximum pressure of 10 tons per square foot is sometimes allowed on brickwork at the overturning edge, but it must be remembered that crushing may commence with this pressure. No mention has been made of clay as a foundation, as no single figure can express its value; very much depends upon circumstances. In deep foundations, say, exceeding 10 feet from surface, the London clay will bear 5 tons per foot super safely. In shallow foundations a pressure of 1½ tons per foot super would be reasonable, but in such a case it is not compression of the subsoil that is to be feared; the alternations of drought and moisture cause alternate contraction and expansion of the clay, and a movement of the superstructure is certain to follow, unless special precautions have been taken, more particularly where the surface is sloping, as on a hillside.

Wind Pressure.

The pressure of wind against a plane surface perpendicular to its direction is not yet fully understood, it is, of course, a product of the velocity, but it varies according to laws which have not yet been reduced to correct formulæ, even if it be possible ever to arrive at more than a vague generalization. From the experiments which have been made it appears that surfaces of a few feet area give a greater resistance per unit of area than smaller surfaces, and that very large surfaces are never subject to a uniform pressure over their whole area, so that the mean pressure is again reduced. It has been generally assumed that the force varies as the square of the velocity, and that the effect depends solely upon the area of the resisting plane. Pressures equivalent to 60

lb. and even 80 lb. per square foot have been recorded in England, but 56 lb. is probably ample to allow for under any circumstances, and it is doubtful whether this has ever been actually reached. Half this amount, or 28 lb. per square foot, is enough to allow in rough calculations for boundary walls and similar structures near the ground level, unless in an unusually exposed situation.

The following table shows the average classification of wind force collated from various sources.

Average Classification of Wind Force.

By Smeaton's formula $p = \frac{v^2}{200}$ (v = miles per hour.)

Description.	Velocity in miles per hour.	Approximate corresponding pressure pounds per square foot.
Barely perceptible wind..	2½	1/32
Light breeze	5	⅛
Pleasant breeze	7½	¼
Good breeze	10	½
Strong breeze	15	1½
High wind	20	2
Half gale	30	4½
Strong gale	40	8
Whole gale	50	12½
Great storm	60	18
Hurricane	80	32
Violent hurricane 100		50

The pressures given in this table, although usually accepted, are only approximately correct, as at, and near the critical point of, say, 1,100 ft. per second, the resistance is in a much higher ratio than v^2 while below 100 ft. per second it is more nearly as the velocity simply.

The author has given considerable attention to the subject of wind pressure, and its modification according to the width and height of the surface exposed to its force. He has constructed the following empirical formula for practical use where it is desirable to obtain the closest approximation to actual conditions, viz.:

$$\log p = 1.125 + 0.32 \log g - 0.12 \log l \quad \ldots\ldots\ldots\ldots \quad (7)$$

where p = ultimate wind pressure in pounds per square foot necessary to be allowed for against a plane surface perpendicular to the direction of the wind.

g = height of centre of gravity of surface considered, above ground level in feet.

l = width in feet of part to be taken as one surface.

This would give allowances as in the following table for which the curves are plotted in Fig. 3.

Wind Pressure Pounds Per Square Foot on Plain Surface.

Height in Feet.	Length in Feet.						
	5	10	20	50	100	200	500
150	54.6	50.3	46.3	41.4	38.1	35.1	31.4
100	48.0	44.2	40.7	36.4	33.5	30.8	27.6
50	38.4	35.4	32.5	29.1	26.8	24.7	22.1
20	28.7	26.4	24.3	21.7	20.0	18.4	16.5
0	23.0	21.1	19.5	17.4	16.0	14.8	13.2
5	18.4	17.0	15.6	13.9	12.8	11.8	10.6

(For very exposed positions 25 per cent. may be added.)

For additional notes on wind pressure by the present writer reference may be made to his papers "Wind Pressure on Roofs," read before the Society of Architects in 1893, and "The Force of the Wind," read before the City of London College Science Society in 1895. Reference may also be usefully made to a report by the Director of the Meteorological Office, Official No. 180, entitled "The Beaufort Scale of Wind Force," 1906.

Combination of Weight and Wind Pressure.

The weight of a plain wall of rectangular section produces a uniformly-distributed load over the base, and a horiontal wind blowing against it adds nothing to the weight, but throws the resultant of the forces over to the leeward side and alters the distribution of the loading, reducing it on the side next the wind and increasing it to a similar extent on the opposite side, so that the sum total of the reactions remains the same. Fig. 4 shows the reaction when the resultant is in the centre, Fig. 5 when it has been forced out of the centre, but not so far as the middle third, and Fig. 6 when it just reaches the limit of the middle third. At this point it will be seen that the pressure is reduced to nothing on the inside and increased to double the mean on the outside. It is generally stated that this position of the resultant is the limit for safety, but it is an incorrect expression to use. The limit of the middle third only signifies that there will be no tension on the inner edge, the compression on the outer edge will vary according to the load, and may exceed the limit of safety. On the other hand, the middle third may often be passed without exceeding the limit of safety. Adopting the notation already given the weight of the wall will be $W = w\,h\,t$, and the area of base for 1-ft. run $A = t \times 1$, the mean pressure on the base will then be

$$\frac{W}{A} = \frac{w\,h\,t}{t} = w\,h \quad \ldots\ldots\ldots\ldots \quad (8)$$

and the maximum pressure when the resultant is at the edge of middle third

$$\frac{2W}{A} = 2\,w\,h \quad \ldots\ldots\ldots\ldots \quad (9)$$

The position of the resultant will be found by reference to Fig. 7 where $w\,h\,t : p\,h :: \frac{1}{2}h : l$,

$$\text{whence } l = \frac{ph \times \frac{1}{2}h}{wht} = \frac{1}{2}\frac{ph}{wt} \quad \ldots\ldots\ldots\ldots \quad (10)$$

$$\text{and } d = \frac{1}{2}\frac{ph}{wt} - \frac{1}{2}t = \frac{1}{2}\left(\frac{ph}{wt} - t\right) \quad \ldots\ldots\ldots\ldots \quad (11)$$

By the same figure it will be observed that when the resultant is pushed over to the edge of the middle third

$$p\,h : w\,h\,t :: \tfrac{1}{6}\,t : \tfrac{1}{2}\,h \text{ whence } p = \frac{wt^2}{3h} \quad \ldots\ldots\ldots\ldots \quad (12)$$

(Continued next week.)

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

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

6625—April 1—Authorizing the G.T.R. to construct, maintain and operate branch line of railway to and into the premises of the George McLagan Furniture Company, Stratford, Ont.

6726—March 31—Authorizing the C.P.R. to construct, maintain, and operate branch line to and into the premises of the City Power Plant, Moose Jaw, Sask.

6727—March 31—Granting leave to the Seaman Kent Company, Limited, of Meaford, to lay and maintain a 3-inch iron pipe, and 16-inch box drain across lands and underneath the roadbed and tracks of the G.T.R. between Boucher Street and Bridge Street, Meaford, Ont.

6728—April 1—Approving revision in portion of location of the Kootenay Central Railway Company at Golden, B.C.

6729—April 1—Approving location of the C.P.R. Company's Kininvie branch from mile 0 to mile 162.05, Alberta.

6730—April 1—Authorizing the C.P.R. to change the location of a portion of the spur to the Sherwin-William Company, Montreal, Que.

5731—April 1—Granting leave to the W.E. and L.S.R.R. to erect, place and maintain a telephone line across the track of the C.P.R. at its crossing with the W.E. and Lk.S.R.R. on the Townline Road, Townships of Sandwich East and West, County Essex, Ont.

6732—April 1—Approving location of the C.N.O.R. (Ottawa-French River Line) through the townships of Lauder,

(Continued on Page 593.)

A PAGE OF COSTS

ACTUAL, ESTIMATED and CONTRACTED

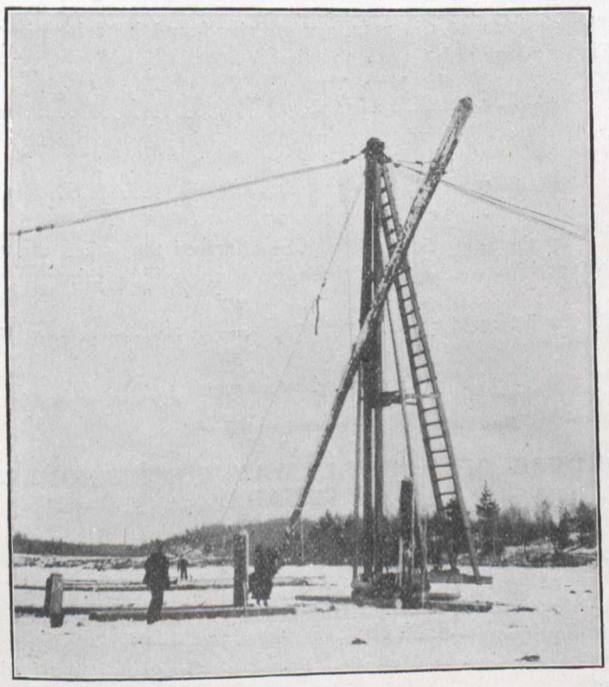
COST OF DRIVING PILES.*

The work consisted in driving piles by horse-drive. The hammer weighed 2,000 pounds, and was raised by block and tackle by horses, two teams being used alternately. As soon as the hammer was tripped, two men hauled back the hammer rope and hooped it on to the second team while the first was returning.

The contract price was 25 cents per foot, delivered and driven, and a gang averaged about 360 lineal feet of pile driven per ten-hour day, using a gang of a foreman, five laborers and two teams. The cost was:—

Five laborers at $1.75	$ 8 75
One foreman	3 50
Two teams (and driver) at $5	10 00
Rent of driver	3 00
	$25 25

Three hundred and sixty lineal feet cost $25.25, or 7.01 cents per lineal foot.



Horse-power Pile-driver.

In driving piles for the T. and N.O. roundhouse at Englehart two drivers were employed. For the first, a team of horses was used to lift the hammer, which was tripped by hand. A gang of four men, one team and a foreman averaged twelve 25-foot piles per day. The piles were in groups of six, each group being twenty feet apart, so that some time was consumed in moving the driver. The distribution was as follows:—

One team	$5 00
One man tripping	2 00
Two men guiding pile	3 50
One man pointing pile	1 75
Two laborers at $1.75	3 50
One foreman	3 50
	$19 25

* Compiled from information furnished by M. C. Hendry, A.M. Can., B.A., C.E.

That is, 300 feet cost $19.25, or 6.4 cents per lineal foot for driving.

On another piece of the same work one horse with a capstan was used for raising the hammer, which weighed 1,800 pounds. Here, the driving was for the walls, the piles being two-foot centres, so that little time was wasted in moving the driver. In this case the cost was as follows:—

One single team	$3 50
Four laborers at $1.75	7 00
One foreman	3 50
	$14 00

They averaged seven 25-foot piles per day. That is 175 feet at $14, or 8 cents per lineal foot for driving.

COST OF PUMPING WATER.

From July, 1907, to July, 1908, the Water Commissioners of Detroit, Mich., pumped 26,857,139,195 gallons of water for a population of 438,157. The total expenses for pumping were distributed as follows. This does not include interest on capital:—

Fuel coal consumed	$40,982 13
Unloading coal	2,073 71
Salaries engineers, firemen, etc.	39,033 37
Salaries men on intake crib	1,440 00
Repairs boiler and engine	1,396 95
Engine oil and grease	812 09
Waste and rags	213 94
Boiler and engine supplies	474 94
Packing and hose	450 20
General supplies	305 69
Electric light fixtures and supplies	11 62
Ice	50 90
Paint, lead and glass	118 50
Printing and stationery	31.55
Horse expense	31 55
Kerosene and gasoline	10 25
Boiler inspection and insurance	30 00
Telephone	40 00
Feed and bedding horse	118 19
Towel supply	65 76
Freight and express	12 10
Advertising	26 78
Hoisting apparatus repairs	33 35
	$87,741 92
Credit memo. for scrap brass, barrels, etc.	225 98
Grand total	$87,515 94
Cost of pumping per 1,000,000 gallons	$3 06
Cost of fuel per 1,000,000 gallons	1 52
Cost of labor per 1,000,000 gallons	1 50
Cost of pumping 100 feet high per 1,000,000 gallons	1 16
Station duty of coal consumed per 1,000,000 gallons —foot pounds	3,325

COST OF CONCRETE BRIDGES.*

By Henry H. Quimby, Engineer of Bridges, Bureau of Surveys, Philadelphia, Pa.

Concrete, either plain or reinforced, as a material of bridge construction possesses the merit of being adaptable as a substitute, within limits, for both stone masonry and steel framework, and of combining the qualities of both.

* A paper before the National Association of Cement Users.

It is equal to and may be more economical than stone masonry for abutments, piers, retaining walls, coping and parapets, and in many cases makes an arch available with its manifold advantages where a stone or brick arch would be impracticable.

It is found also to be an advantageous substitute in the shape of jack arches or reinforced slabs for steel floor troughs and buckled floor plates on steel bridges, whereby we have a composite structure, not strictly reinforced concrete, but a combination of steel members and concrete members. The resulting product, when the design and workmanship are good, is a rigid, enduring and economical bridge.

The limitation of the proper and economical employment of concrete in bridge structures can hardly be stated, certainly not with any degree of definiteness. Conservative designers are not in entire accord with respect to either methods of use or allowable working stresses, and comparisons of values and cost between all steel and part or all concrete or reinforced concrete can only be made on finished designs and for the same site. Even then estimators may not agree as to which will cost the more, and, if we may judge by the wide range of prices quoted in contractors' proposals, the contractors themselves cannot more accurately determine relative values in cost. To the purchaser the cost of a bridge is the contract price; the cost to the builder should, of course, be less.

The actual cost of a job to the builder is usually not published, and is rarely divulged to even the engineer, and an engineer's basis of estimate must be the bids and contract prices previously obtained.

Any list of costs will exhibit great variation in the figures for structures of the same class and similar dimensions and conditions, and when the almost infinite variety of conditions and combinations of varieties are considered, the difficulty of conveying useful intelligence on the subject is apparent.

The length of span, width, height, depth and character of foundations, length and shape of wings, loads to be carried, amount of filling or grading, railing or parapet, character and amount of paving, plain or decorative architecture, character of the concrete, plain or reinforced or rubble, market price of materials, and accessibility of the work to railroad service, all affect the question of cost.

It is, therefore, impracticable to select any unit of measure of a bridge and use it as a reliable basis for estimating cost. In a table covering eighteen concrete arch bridges recently built in Philadelphia the concrete price spread upon the span area, the clear span by the width, varies from $3.11 to $9.74 per square foot, and it varies from $1.73 to $7.39 per square foot of area occupied by the ground plan to end of wings, the latter extremes being not on the same bridges as the other two. The average of the lot was $6.25 per square foot of span area and $3.50 per square foot over all, most of them being single-span bridges with long wings, and all being highway bridges designed to carry loads of 40 tons on two axles 20 feet apart. All have ornamental concrete balustrades and washed granolithic surfaces and paved decks, with electrical conduits and manholes, and water pipe and sewer well-holes, and some have pretty deep foundations.

If the whole contract price be set against the yardage of the concrete in the structure, the unit costs vary from $8.50 to $11.25 per cubic yard, averaging $9.75.

It is found that, in the circumstances under which the bridges referred to were built, steel plate girder bridges will cost more than concrete arches, the difference being considerable. Several opportunities for fair comparison have made this clear, as great a difference as 25 per cent. of the higher being indicated. This saving is in the first cost, and if we add the capitalized cost of proper maintenance of the steel structure, which seems to be a fair element in the comparison, the advantage of the concrete arch appears far greater. A real money value also attaches to the superior beauty and attractiveness of a decorative arch structure in almost any locality, a question that almost always is the subject of consideration and decision in designing public work, for it must be determined what amount is proper to be expended for mere appearance.

The composite bridges, steel structural frame with concrete envelope, share with the arches, or at least promise to, the quality of permanence, and, therefore, exemption from expensive maintenance charges. As between the ordinary steel plate-girder bridge with buckled plate floor for permanent paving, and the composite type, the lower first cost is with the composite if the spans be short, for the greater dead weight of the concrete floor tells on the long main girders, whose section is usually determined by the general load, dead plus distributed live, while the individual floor members are determined by the heavy concentrated live load. The embedment of the floor stringers or joists in the concrete jack-arch construction effects a saving of steel, first by dispensing with floor plates, and second by permitting light stringers to be used, for the jack arches distribute a concentrated load over, say, three beams, where, with a buckled plate floor, each beam must carry the whole concentration, and besides, the embedment of a beam in concrete increases its carrying capacity about one-third.

Where it is the practice to protect steel bridges over railroad locomotive service by means of a wooden ceiling under the whole underside of the bridge, the economy of the concrete floor is more marked, because such a ceiling costs about 25 cents per square foot and lasts only a few years. This first cost alone will pay for about one cubic foot of concrete in the floor, and only about 15 to 18 inches average thickness of floor concrete is required. As steel floor plates with their riveting cost from 50 to 70 cents per square foot, the concrete floor appears to cost only about half as much as an all-steel floor, besides saving materially in the stringers. Floor beams may or may not be required to be heavier to carry the concrete floor. If they are not very long, the value of the concrete embedment may make up for the increased dead load stress. The main girders will need to be heavier than for the steel floor because little or no value can safely be assumed to be derived from the concrete casing.

The cost of concrete bridge work of almost all classes can be materially reduced and the service value of the concrete at the same time increased by the embedment in the concrete of a suitable hard stone in size from that of spalls to the largest that can be conveniently handled or that will be comfortably accommodated in the compass of the forms. The economy of this construction depends upon the cost and shape of the embedded stone and the amount embedded without too much labor expended and without restricting the output of the concrete plant. It has been found that the percentage of the volume of the finished work that such stone amounts to varies from 25 to 40 or from 33 to 66 per cent. of the volume of the mixed concrete according to the shape of the stone and the care taken in placing it.

The cost of handling and placing this approximate third is probably about equal to that of mixing and placing an equal volume of concrete. The saving therefore, should be the difference between the delivered cost of the concrete materials and that of the stone. If the stone delivered costs one-half as much as the cement and sand and gravel that, when mixed, equals it in volume, and if the embedded stone amounts to only one-third of the finished work, then the cost per cubic yard of the finished work is 80 per cent. of that of plain concrete.

A century ago the world's requirements were satisfied by the production of 1,000,000 tons of iron; the output of the principal contributing countries last year was no less than 59,000,000 tons of iron

From statistics furnished by the Labor Department it appears that the total output of the lumber mills of the Ottawa valley during 1908 was only 503,000,000 feet, while in 1907 it was 532,000,000 feet, thus showing a decrease of 9,000,000 feet last year under the previous year.

KALADAR DRAINAGE SCHEME.

Kaladar is a siding on the Toronto-Montreal Division of the C.P.R., and for several years the C.P.R. tried to adopt a comprehensive drainage scheme. One of the land owners for some time blocked the scheme, and the judgment of the Railway Board in this matter is of general interest because of the points decided.

The facts are fully set forth in the judgment of the Chief Commissioner.

The Canadian Pacific Railway Company applied to the Board for an order authorizing the company to construct a ditch upon and across certain specified lands according to a plan submitted with the application.

The lands in question consisted of certain lots in concessions three and four of the township of Kaladar, and in concession two of the township of Sheffield, owned by different private individuals, only one of whom, James Murphy, has made objection to the construction of the drain through his land or the granting of the order.

The railway actually intersects all the lots except Murphy's, the nearest portion of which is distant several hundred feet from the line of the railway, and is separated from the railway company's property by the lands of other private owners which actually adjoin the railway.

The applicant company relies upon the powers given by subsections (m), (p), and (q) of section 118 of the Railway Act, 1903:—

"(m) makes drains or conduits into, through, or under any lands adjoining the railway, for the purpose of conveying water from or to the railway;

"(p) from time to time to alter, repair or discontinue the before-mentioned works of any of them, and substitute others in their stead;

"(q) do all other acts necessary for the construction, maintenance and operation of the railway."

On behalf of Murphy it has been argued that section 196 makes it the duty of the company to make and maintain sufficient ditches and drains along each side of the railway for the purposes of any necessary drainage; that this method is the only one that can be used after the railway has been completed; that this railway has been completed and in operation for many years, and any powers of expropriation of land, or of the use of adjoining lands for purposes of drainage, have been exhausted and cannot now be resorted to; that drainage by means of ditches along the railway has been found to be sufficient for the maintenance of the railway, as evidenced by its use for so many years; and that Murphy lands were not "lands adjoining the railway" within the meaning of subsection (m) of section 118.

Section 196 provides that "the company shall in constructing the railway make and maintain suitable ditches and drains along each side of, and across and under the railway, to connect with ditches, drains, drainage works and water courses upon the lands through which the railway runs, so as to afford sufficient outlet to drain and carry off the water, and so that the then natural, artificial or existing drainage of the said lands shall not be obstructed or impeded by the railway."

This clause is evidently inserted for the purpose of imposing upon the company the duty of instituting such a system of drainage along its tracks as will prevent the interference of its works with the drainage of the lands of others. It is not intended to indicate the powers which the company may exercise for the proper construction and maintenance of its railway. These powers are found in section 118, and among them are powers from time to time to alter, repair or discontinue the works previously referred to and to substitute others in their stead, and to do all other acts necessary for the construction, maintenance and operation of the railway.

Under these powers it appears to me that, when a system of drainage established upon the construction of the railway is subsequently found to be insufficient, improvements may be made therein and such further drainage works executed as will assist in keeping the railway in an efficient condition and relieve it from the danger of injury by water. And I think that, for this purpose, the company may avail itself of the power contained in subsection (m) to make drains into or through lands adjoining the railway.

We have been referred to the case of Kingston and Pembroke Railway Co. v. Murphy, 17 S.C.R. 582. In that case it was considered that a railway completed according to its charter could not be farther extended and lands compulsorily taken for the purpose. It should be noted, however, that that case was decided under the Railawy Act of 1879, 42 Vic., c. 9, which did not contain the provisions of subsection (p) and (q) before-mentioned, and that what the company there sought to do was to construct an extension of its railway, not to alter or repair the works of its existing railway.

The natural meaning of the word "adjoining" is lying next to or in contact with; contiguous. Such is the sense usually ascribed to it by the courts. See I Bouv. L.

The general principle is best stated in the language in Maxwell on Statutes, 4th ed., p. 78. "The words of a statute are to be understood in the sense in which they best harmonize with the subject of the enactment and the object which the legislature has in view. Their meaning is found not so much in a strictly grammatical or etymological propriety of language, nor even in its popular use, as in the subject or in the occasion on which they are used and the object to be attained." See also Beal on Cardinal Rules of Interpretation, p. 34; The Dunelm, 5 P.D. 171 and Wakefield Local Board v. Lee, 1 Ex. D., at p. 343.

The statute authorizes the construction of drains into adjoining lands. It is obvious that it must be necessary in many instances to find outlets for the drains or ditches along the sides of the railway tracks, and for this purpose to carry drainage works out of and beyond the land used for the railway right of way according to the natural configuration of the ground. In authorizing the carrying of drains through or under adjoinng lands the legislature must have contemplated that the drains should leave the boundary line between the company's lands and those of other owners; and it must have contemplated that the distances to which they would be carried would differ according to circumstances. And it appears to me that the legislature could not have had in view the ownership of the particular parcels or strips of land through which it would be necessary to carry such works. Having once adopted the view—which, as it appears to me, is the necessary view—that under subsection (m) the railway company was authorized to carry drains away from the point of contact and into lands of others, I think that it necessarily follows that the power to carry the drains as far as might be reasonably necessary to effect the purpose for which they were to be constructed was included. Naturally such drainage works must be adapted to the formation of the land. It would be unreasonable to suppose that they were to stop at the boundary of the owner of the land next adjoining the railway, leaving the water to run as it would thereafter. In my opinion, ownership should not be treated as an element in determining whether or not the lands are "lands adjoining the railway" for the purposes of a case such as that with which we are now dealing.

After consideration of the report of one of the assistant engineers of the Board and the evidence taken upon the hearing, the chief engineer of the Board has reported that he is "of opinion that the sooner the water is taken away from the railway at this point the safer it will be for the railway embankment, and that this is necessary for the proper maintenance and operation of the railway."

Under the amending Act passed at the last session of Parliament, the Board is empowered to make an order giving its sanction or approval to any matter, act or thing sanctioned by the general Railway Act. It does not appear to me that the company needs any sanction or approval from the Board to enable it to exercise the power contained in subsection (m) of section 118; but it is convenient that it should submit to the Board proposals for the construction of any such works in order that the Board may exercise some control as to the nature of the works and for the protection of other parties.

The evidence shows that the portion of Mr. Murphy's lot which would be cut off by the proposed drain is of little, if any, value, and that no serious injury would be done to the remainder of his land by the proposed work.

I think, therefore, that the order should go sanctioning and approving the construction of the drain as indicated by the railway company, with a condition that the railway company is to construct and maintain a suitable crossing over the drain for Mr. Murphy at such place and in such manner as shall be approved by an engineer of the Board.

RAILWAY ORDERS.

(Contiuned from Page 589.)

Boulter and Chisholm, District of Nipissing, Ont., mileage 191.4 to 212.3, Ottawa West.

6733—April 1—Authorizing the M.C.R.R. to reconstruct drawbridge over Chippewa Creek, near Montrose, Ont.

6734—March 26—Amending Order of March 17, 1909, and adding following clause: "Authorizing the G.T.R. to collect such additional sum for switching and handling traffic to and from branch line of railway or spur, directed by the said Order to be constructed, as shall be agreed upon between the parties, and in the event of the parties failing to agree, then such additional sum shall be fixed by the Board."

6734 A—April 2—Authorizing the C.P.R. to construct, maintain and operate branch line of railway to and into the premises of the Victoria Park, Calgary, Alta.

6735—April 2—Authorizing the C.P.R. to use and operate bridges on its Toronto-Sudbury line.

6736—April 1—Granting leave to the Enterprise Telephone Co. to erect, place, and maintain its wires across the tracks of the Algoma Central Railway, in the Township of Korah, District of Algoma, Ont.

6737 and 6738—April 1—Granting leave to the Corinne Rural Telephone Co. to erect, place, and maintain its wires across the track of the C.P.R. at Sec. 30, Township 12, Range 19, and Sec. 29, Township 12, Range 19, west second meridian, Sask.

6739 to 6741—April 1—Granting leave to the Theodore, Springside and Veaverdale Rural Telephone Co., Limited, to erect, place, and maintain its wires across the tracks of the C.P.R. at Springdale, Sask., at Sec. 15, Township 28, Range 7, west second meridian, Saskatchewan, and in the south-west quarter Sec. 6. Township 28, Range 6, west second meridian, Saskatchewan.

6742 and 6743—April 1—Granting leave to the Welland County Telephone Co. to erect, place, and maintain its wires across the tracks of the M.C.R.R. and G.T.R. at the village of Bridgeburg, Ont.

6744—April 1—Granting leave to the Erie Telephone Co. to erect, place and maintain its wires across the tracks of the G.T.R., between 10th and 11th Concessions Township of Walpole, near Garnet Station, Province of Ontario.

6745—April 2—Granting leave to the Georgian Bay and Seaboard Railway Co. to construct its railway across the highway in the Township of Medonte, County of Simcoe, Ont., at mileage 12.97.

6746—April 2—Granting leave to the B. T. Co. to erect, place and maintain its wires across the tracks of the G.T.R. Co. at public crossing three miles north-east of Springford, Ont.

6747—April 2—Granting leave to the municipality of the village of Streetsville, Ont., to erect, place, and maintain two electric light wires under the track of the Orangeville branch of the C.P.R. at Streetsville Junction Station, Ont.

6748—April 2—Authorizing William Long, of the parish of Clair, County Madawaska, N.B., to lay and maintain a two-inch water pipe under the tracks of the Temiscouta Railway, in the Parish of Clair.

6749—Feb. 11—Directing the C.P.R. to substitute for its present rates on coal, in carloads, from Bienfait, Sask., to points in Manitoba and Saskatchewan rates ranging from fifty cents to one dollar and five cents.

6750—March 30—Ordering the Columbia and Western Railway Co. to protect its crossing at Riverside Avenue, Grand Forks, B.C., by electric bells, the same to be installed within sixty days.

6751—Feb. 19—Granting leave to the city of Edmonton to cross at rail-level with its electric street railway tracks the tracks of the C.N.R. and the G.T.P.R. at Syndicate Avenue, at or near Griesbach Street, Edmonton, Alta.

6752—April 5—Granting leave to the Central Ontario Railway to cross with its track the tracks of the G.T.R. from Belleville to Peterborough at Anson Junction, Township of Rawdon, County of Hastings, Ont.

6753—April 3—Amending Order of the Board No. 6424, dated February 25th, 1909, directing that the crossing of highways in the village of Dutton, Ont., be protected by folding fence gates; by providing for the installation of an additional gate south of the tracks of the M.C.R.R.

6754—April 3—Authorizing the C.N.O.R. to construct a bridge over the French River at mileage 67.72, Parry Sound North, Ont.

6755—March 10—Ordering the C.N.R. to continue to permit the public to use the crossing at Bermillion Street, Dauphin, Man.

6756—April 3—Granting leave to the Montreal Street Railway Co. to cross with its track the tracks of the Montreal Terminal Railway at rail-level at Davidson Street, Montreal, Que.

6757—April 5—Ordering that interlocking plant be installed by the G.T.P.R. at its bridge over the Kaministiquia River, Fort William, Ont., and that trains be permitted to pass over the bridge without being brought to a stop.

6758—April 3—Amending Order of the Board No. 6423, dated February 25th, 1909, directing that the crossing be protected by folding fence gates; by providing for an extra gate immediately south of the tracks of the M.C.R.R. at the village of West Lorne, Ont.

6759—March 10—Dismissing complaint of the Board of Trade of Prince Albert, Sask., against the C.N.R., that the joint tariffs of that company and the C.P.R. from Prince Albert to British Columbia points of fifty cents per 100 pounds on grain and grain products is unreasonable.

6760—Feb. 11—Directing the C.P.R. to maintain and keep in proper shape with regard to planking, grading, etc., crossings in the village of Heward, Sask.

6761—Feb. 11—Granting leave to the C.N.R. to connect the tracks of its Brandon-Regina branch with tracks of the C.P.R. Arcola branch) at north-west quarter Sec. 20, Township 17, Range 19, west second meridian, Saskatchewan.

6762—March 10—Directing the C.P.R. to provide and maintain at Redvers, Sask., a station in accordance with what is known as its No. 5 Standard Plan.

6763—Feb. 19—Ordering that where shippers have ordered stock cars for the shipment of live stock and are supplied with box cars, and are obliged to furnish lumber for temporary doors thereof, the shipper may deduct and retain one dollar and twenty-five cents ($1.25) from the freight charges.

6764—April 1—Ordering that tariffs of joint tolls with the C.P. and the C.N. Telegraph Companies filed by the G.T.P.R. applying on messages transmitted between the offices of the said companies in the Provinces of Manitoba, Saskatchewan and Alberta be, and the same are temporarily approved, until the Board shall dispose of the question of telegraph tolls generally.

6768—Refusal of application of the Essex Terminal Railway to set aside Orders of the Board, March 22nd, 1907; June 5th, 1906; March 13th, 1907, which approved the location of the Windsor, Essex and Lake Shore Railway between Windsor and Leamington, and authorized certain crossings over the tracks of other railways. Authorizing the operation and maintenance of the Windsor, Essex and Lake Shore Rapid Railway along the gravel road. Granting leave to the Essex Terminal Railway to cross the railways of the W.E. and L.S.R.R. and C.P.R. at or near the existing crossing of the C.P.R. and W.E. and L.S.R.R.

6765—April 6—Ordering the G.T.R. to prepare plans, in accordance with the plan on file, within ten days from date

of Order, for diversion of the Montreal Road, Kingston, Ont.; that the G.T.R. commence work ten days after the plans have been approved, and that all work connected with the subway be completed on or before the 1st of August, 1909, unless further extended.

6766—April 6—Granting leave to Robert Gordon, Government agent of the Province of British Columbia, to construct a highway level crossing over the track of the Revelstoke and Arrow Lake branch of the C.P.R.

6767—April 6—Approving and sanctioning location of the C.N.O.R. through unsurveyed territory in the Sudbury mining division, District of Algoma, Ont., mileage 60 to 80, from Sudbury Junction, Ont.

6768—Essex Terminal (particulars to follow).

6769—April 6—Authorizing the C.P.R. to use for the carriage of traffic that portion of its line of railway known as the Lauder Extension, from Broomhill, mileage 16.0 to mileage 28.5, a distance of 12.5 miles, Province of Manitoba.

6770—April 7—Extending for six months from date of Order time within which construction of overhead farm crossing on A. M. Dickie's land, Lot 27, Concession 3, Township of London, County Middlesex, Ont., be completed by G.T.R.

6772—March 26—Directing the Grand Valley Railway Co. to equip all its cars, freight motors, passenger motors and trailers with air brakes by the 1st of July, 1909.

6772—April 6—Ordering that bridge of the C.V.R. over Richelieu River, St. Johns, Que., be protected with inner steel guard-rails within sixty days from date of Order.

6773—April 6—Authorizing the C.P.R. to construct Bridge No. 160.35 over Bow River, Soo branch of its line.

6774—April 6—Authorizing the C.P.R. to construct Bridge No. 55.8 on its Smith's Falls section of its line of railway.

6775—April 6—Authorizing the C.P.R. to construct Bridge No. 33.6 over Little Gravel River, on the Nipigon section of its line.

6776—April 6—Authorizing the C.P.R. to construct a bridge at mileage 26.2 of the Shuswap section of its line of railway over Eagle River.

6777—April 6—Authorizing the C.P.R. to construct a bridge, No. 28.9, over Gorge Creek, on the Shuswap section of its line.

6778—April 6—Authorizing the C.P.R. to construct Bridge No. 25.0 over Eagle River, Shuswap section of its line of railway.

6779—April 6—Authorizing the C.P.R. to construct, maintain, and operate branch line to and into the premises of the Hutchins Car Roofing Co., Montreal, Que.

6780—April 7—Granting leave to the Commissioner of Railways and Telephones for the Province of Saskatchewan to erect, place, and maintain wires across the tracks of the C.N.R., Secs. 17 and 18, Township 17, Range 18, west second meridian, Saskatchewan.

6781 and 6782—April 7—Granting leave to the Dundurn Rural Telephone Co. to erect, place, and maintain its wires across the track of the C.N.R. at two points in the Provin e of Saskatchewan.

6783—April 7—Granting leave to the Dunnville Consolidated Telephone Co. to erect, place, and maintain its wires across the tracks of the M.C.R.R. at Canfield Junction, in the Province of Ontario.

6784—April 8—Authorizing the British Columbia Southern Railway (C.P.R.) to construct coal tipple over the main line and other tracks of its railway near Michel Station, B.C.

6785—April 8—Extending until the 31st of May, 1909, Order of the Board No. 6102, dated the 25th of January, 1909, authorizing the C.P.R. to install interlocking and derailing appliances on its Pembina branch at Oak Point Junction, near Winnipeg, Man.

6786—April 8—Approving plan or diagram of proposed reconstruction of the St. George Viaduct on the 17th Dictrict of the G.T.R., between Lots 6 and 7, Second Concession of the Township of South Dumfries, Ont.

6787—April 8—Rescinding Order of the Board No. 6542, dated 25th February, 1909, dismissing complaint of the municipalities of Burnaby and Coquitlam, B.C., regarding defective cattle guards on the line of the V.W. and Y.R. or the V.V. and E. Railway and Navigation Co.

6788 and 6789—April 6—Granting leave to the New Brunswick Telephone Co. to erect, place, and maintain its wires across the tracks of the C.P.R. Co. at two points in the Province of New Brunswick.

6790—April 3—Directing the C.P.R. to open highway crossing on its line between Arden and Kaladar, Ont.

6791—April 6—Ordering that the city of Kingston bear and pay the cost of night watchman at subway at Kingston Junction, being constructed by the G.T.R.) until the same is constructed.

6792—April 6—Dismissing application of the C.N.Q.R. re crossing the C.P.R. south of St. Jerome, Que.

6793—April 6—Dismissing application of the C.P.R. to take additional lands adjoining its railway and station grounds at Sidney, Man.

6794—April 6—Dismissing application of the C.W. and Lake E.R. for Order altering or varying Order of the Board, dated the 4th October, 1906, which granted leave to the C.W. and Lake E.R. to cross at grade the tracks of the G.T.R. at William Street, Chatham, Ont.

6795—April 6—Limiting the speed of trains on the G.T.R. and K. and P.R. at Place d'Armes, opposite Tete du Pont Bararcks, city of Kingston, Ont., to six miles per hour.

6796—April 8—Authorizing the C.P.R. to construct bridges at fourteen different points on its railway, on Ontario, Western, Lake Superior and Eastern Divisions.

6797—April 8—Authorizing the C.N.O. Railway to construct bridge over the west branch of the Vermilion River, at mileage 23.51 from Sudbury Junction on the Sudbury-Port Arthur line of its railway.

6798—April 8—Authorizing the C.N.O. Railway to construct bridge over the Vermilion River, at mileage 30.5 from Sudbury Junction on the Sudbury-Port Arthur line of its railway.

6799—April 8—Granting leave to the Manitoba Government Telephones, to erect, place, and maintain its wires across the tracks of the C.P.R. at P.C., ¼ of a mile east of Moore Park, Manitoba.

6800—April 8—Granting leave to R. S. Brewster, M.B., of the Village of Beeton, Simcoe County, Ontario, to erect, place, and maintain wires across the track of the G.T.R. at three points in the Township of Tecumseth, County of Simcoe, Ont.

6801—February 23—Dismissing complaint of the Municipality of Burnaby, B.C., in respect of the fares charged on certain portions of the B.C. Electric Railway Company's Interurban line between Vancouver and New Westminster, B.C.

6802—April 7—Directing the City of Montreal to carry out the terms of an agreement entered into between the City of Montreal and the C.P.R., dated February 3rd, 1892, and repair bridge No. 1.65, being a steel viaduct carrying St. Catharines Street across the track of the C.P.R., Montreal, P.Q.

6803—April 6—Directing the C.P.R. to install and maintain a complete interlocking plant, with derails, on the line of the G.T.R. and its own line, where the G.T.R. crosses the C.P.R. on the level crossing at Brampton, Ontario.

6804—April 6—Directing the C.P.R. to install and maintain a complete interlocking plant, with derails, on the line of the G.T.R. and its own line, where the G.T.R. crosses the C.P.R. on the level crossing at Drumbo, Ontario.

6805—April 6—Ordering that the Montreal Street Railway Company be made a party to the complaint of the corporation of the City of Montreal, complaining against the rates charged by the Montreal, Park & Island Railway Co. and the service and operation of the said railway in the City of Montreal.

6806 to 6809, inclusive—April 13—Granting leave to the City of Edmonton, Alta., to erect, place, and maintain its telephone and electric light wires across the track of the C.N.R. at Edmonton, Alberta, at four points.

(Continued on Page 599).

CORRESPONDENCE

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

SEWAGE DISPOSAL, ETC.

Sir,—Having read the very discursive and learned dissertation on the above, published in the "News-Advertiser," of Vancouver, as well as Mr. Donald Cameron's reply thereto, of the same date, I beg leave to say that I thoroughly endorse every word Mr. Cameron has uttered on the subject, what he has said being perfectly correct.

An ounce of practical knowledge gained by actual experience in matters of purely engineering import, such as this, is worth a whole hundredweight of mere academic, dilettante utterance, the ipse dixit of pedagogues and pedants, presuming to speak with authority upon matters which lie entirely beyond their ken and comprehension—the case here—and so, in going so far as to call in question, at length, and with some detail, the extraordinary and totally misleading statements set forth by this schoolman, or schoolmaster, and "expert" in fiction, I mean to oppose these by solid facts alone, and facts

"Are chiels that winna ding, an' daurna be disputit."

It is a fact that, now full half a century ago, the Burgh of Portobello, Midlothian, Scotland, watering-place for Edinburgh, the capital, and situated along a broad, sandy beach, one mile in length, installed, for the first time in its history, a complete and thorough "combined-system" of sewerage, having its main intercepting brick culverts carried along the upper side of said beach, east and west, for fully half a mile each way, to deliver their "crude" sewage, mixed, of course, at times, with rain flood water, directly into the Firth of Forth (no intervention whatever) by cast-iron pipes, debouching at level of low water spring tides, the extreme tidal range there being 19 feet. All this was accomplished without the slightest inconvenience to bathers (a big crowd in summer time), harm to the beach itself, or serious injury to the North Sea

Before starting the work of the above scheme the Burgh Municipal Council thought it advisable to submit the whole proposal, for revision, to a gentleman then considered to be the very highest living authority on this special subject, the late Mr. James Newlands, M.I.C.E., Municipal Engineer of Liverpool, the burgh's engineer being the late Mr. John Paterson, C.E., Edinburgh.

Mr. Newlands reported favorably, and the work—under my own supervision—was proceeded with and carried out satisfactorily, results being as stated above, and the burgh's one and only great natural asset—its precious bathing-beach—was preserved inviolate and intact.

To the west from Portobello, along the same littoral, stretches for six miles, the seaward boundary of the city of Edinburgh, and of the Burgh of Leith (its seaport) with an aggregate population of about 450,000, occasional and regular users of the Portobello bathing-beach, before mentioned.

About one-half of the sewage resulting from this large community is—or was, for I speak of forty-six years ago—after being utilized for irrigation purposes, and partially purified by that means, on the—in this connection well-known—Craigentinny Meadows, or "Sewage Farm," of 500 acres, or thereby—allowed to run upon the mile long beach in front, and to spread all over it, finding its own way to meet the tide, and so, ultimately and finally, to disappear within it, once and forever.

The great bulk of the other half, however, that from Leith and the northern and western portions of Edinburgh, including almost the whole "New Town," is collected by a capacious main intercepting sewer, about six miles long, carrying the "crude" sewage, combined in rains with flood-water, and finally debouching at the Black Rocks, at level of low water, springs direct into the estuary in precisely the same manner as has already been described for Portobello, and with exactly the same results.

This scheme, popularly known as "the Water-of-Leith Sewerage," both corporations (1863) united in promoting as a joint undertaking, which it was figured would serve its purpose for a period of twenty-five years, to be renewed, or duplicated, at the expiry of that term, as has now actually been done, on identically the same lines and principle which was followed in the first instance.

The fact which I now wish to direct particular attention to is that—while engaged as assistant to Messrs. David and Thomas Stevenson, M.I.C.E., Edinburgh—upon the work of the preliminary surveys for the required Act of Parliament, I was called upon to travel through, inspect, and report upon, perhaps, ten miles of tubatory sewer-culverts, all of which were found to be constructed of sound, solid masonry—some of them over seven feet high in the clear, and including those of almost the whole "New Town" of Edinburgh, said sewers having been built at the time of the laying-out of the new townsite, or during the latter half of the eighteenh century.

Strange though it may appear to some people, I caught no "zymotic disease," encountered no "foul and pestilent congregation of vapours," "deadly organisms," dead cats and dogs, or other "putrifying matter"—things which exist only in the heated and fertile imagination of the ingenious and accomplished writer, and ventilated now in order to humbug the public, while it suits a purpose to do so, on the late Abraham Lincoln's well-known first principle and dictum, that "you can fool some people all the time," just as has been done during a long series of years past, right here in Vancouver, B.C., and, as we know to our cost, a legacy and burden that will continue to be felt and regretted for all time to come.

It is a fact that the city of Aberdeen, Scotland (180,000 population), sewers directly into the North Sea, which, nevertheless, has not been materially damaged thereby.

In 1880, however, when I was requested by the late Mr. William Boulton, M.I.C.E., city surveyor, to examine and fully report upon the entire, then existing, sewerage system of the city, with a view to contemplated improvements and extensions, the outfall at that time emptied right into the River Dee and harbor near to its mouth, without any serious inconvenience or nuisance being felt or complained of in consequence.

My examination of many miles of these sewers, granite and brick, of ancient and recent construction, was almost an exact repetition of my previous (1863) experience of the same kind in Edinburgh—lots of good, wholesome, fresh air, and little or no sediment—the latter in reality being confined to one spot only, where the Footdee main trunk outfall culvert had been cut down half way and flattened out, in order to allow of the railway tracks of the Great North of Scotland Railway freight station being laid to grade over the lowered top of the said main outfall sewer.

At another point, and for some quite considerable distance, the effluent from Ogston's extensive soap and candle factory exhaled a peculiar, not altogether disagreeable pungent odor, while a greasy coating covered the surface of the brick walls and invert of the sewer, making the latter somewhat slippery to go upon, but, with these two exceptions, both readily accounted for, and the last named in no way

detrimental, everything else was found to be in perfect good order and condition.

Aberdeen, Edinburgh, Leith and Portobello, all similarly situated on the sea coast, like Vancouver, and sewered as (avoiding all minute details) has now been described are shown, by the most reliable statistics, to rank amongst the very healthiest and most salubrious centres of population in the civilized world; but perhaps the most notable fact of all, which still remains to be mentioned, is that politics, in their case, are never allowed to enter into this question at all.

The corporations are composed of public-spirited business citizens of average or superior intelligence, who willingly devote their time and talents gratis to the work of the public, and with a single eye to the prosperity and good of the whole civic community.

They select, as the proper agents to carry out public work, involving large money expenditure, only the best, most capable and most reliable men that can possibly be had for that purpose, really competent men, trained to their work and possessed of practical experience in the execution of it —men, as well, of known probity, and unquestioned integrity, and the natural consequences follow in economy with efficiency, and the end—general satisfaction.

What, therefore, Vancouver needs is to take note of this indisputable fact, and proceed to act upon that knowledge, for "it is not given to any to neglect facts with impunity," else terrible punishment becomes the inevitable, and citizens the victims of the rotten "machine," "combine," system, we know and hear and read so much about.

This writer tells us in the same connection, about Toronto and of his canoeing experiences upon Lake Ontario, along the shores of which he says "at all seasons are to be encountered acres of floating fæcal refuse." I do not dare to dispute what this veracious gentleman professes to have seen, but I would just like to ask him, What all that has to do with us and our 15 feet tide, and the open ocean right in front of us? Is not that quite a different proposition?

Why talk nonsense like that here, where the case does not apply at all? Who ever saw "acres of floating fæcal refuse" anywhere in tidal waters, and why should we have to fly to that dernier resort and forlorn hope—the septic tank —which may be, and doubtless is, the correct thing for places so unfortunately circumstanced as Toronto, Exeter, Manchester, Sheffield, and other inland communities, now being named, as having no option but recourse to this acknowledged imperfect, unsatisfactory and wholly tentative method of trying to rid themselves of their "crude sewage" evil—a perpetual source of trouble and annoyance to them? But why should we bother about what does not concern us?

Some seventeen years ago our neighbors, citizens of the Royal City, were worked up into a state of frenzied panic and for a short time suffered throes of agony, occasioned by the sudden advent in their midst of another false prophet and son of Ananias, who actually led them to beileve that, were their sewage to be emptied into the river, their salmon-fishing and canning industry, on which they so much depend, would be forever ruined.

One writer, however, "Aquila," in the "Columbian," of that day, undertook to undeceive them, and this is what he said:—

"Westminster has a population of 8,000, and proportionately (to London, England), should give 360,000 gallons of sewage per day. The Fraser has a discharge of 16,938,-036 millions of gallons, or, one gallon of sewage to 47,050,102 gallons of actual discharge of the river. . . . All the sewage that Westminster will produce for a hundred years to come would not, therefore, disturb the stomach of the daintiest fish that swims; in fact, it would be entirely unrecognizable."

I do not know where he ("Aquila") got his figures, but they look to be correct, and I perfectly agree with him in his conclusions; and yet after all, what is the great Fraser River itself, ultimately swallowed up and lost within the bosom of the still greater Gulf of Georgia, and what that also, compared with the volume and immensity of the inconceivably vast, whole-globe-circling ocean beyond? What, again, the utter insignificance of the sewage production of the city of Vancouver now, or a thousand years from now, put in comparison or contrast with either?

Why, that can be thought of, or spoken of only in such terms as microscopic or infinitesimal, even as those thousand years are viewed in like comparison with the aeons of eternity, Q. E. D.

J. W. Balmain,
Assoc. Inst. C.E. (1872).

North Vancouver, B.C., March, 1909.

RECENT DEVELOPMENTS IN ENGINEERING PRACTICE IN ENGLAND.*

J. F. B. Vandeleur, M.E.

In presenting this paper I beg to place before you a few notes which I made respecting the latest development in engineering practice that came to my notice during a recent trip to Europe. It is not, of course, to be expected that this covers the wide field broken into by the best of European savants in their research work but rather is a practical and general exposition of more recent development as effecting the civil, mechanical and electrical engineering profession.

Electrical Ore Finding.—Foundation of the Invention.

The system is based on the discovery made by Sir William Preece, some twenty years ago, who when experimenting with wireless telegraphy, energised the earth with an interrupted current of low potential, and found, by means of a telephone circuit connected to earth with portable electrodes, that the geological conditions of the earth's crust, through which his currents were flowing, altered the shape and changed the intensity of his field.

Description of the Instruments Used.

The instruments used are of special design, and a great deal of money has been expended in perfecting them, some forty different types of instruments having been designed and tested continually at various mines. The whole apparatus is portable, and can be carried by two men. It consists of,—(1) A portable battery, which will supply sufficient current for about fourteen hours' working and is then recharged. (2) A transmitting apparatus made in two sizes, of which the following is a description of the smaller size used at Coniston. It consists of an induction coil adapted to deliver, when required, a very heavy secondary charge into a condensor, 40,000 to 50,000 volts, from which wires connect to portable electrodes, and having two spark-gaps-in-series and parallel-inserted in circuit, which is completed by the earth. (3) The receiving circuit consisting of two telephone receivers, each of 500 to 900 ohms, resistance, connected to the exploring electrodes (steel rods about 24 inches long), through a series parallel switch. These telephone receivers are constructed to respond to tuned waves and can be varied at will.

Field of Operations.

The extent of the field to be explored, in which operations can be conducted, without shifting the transmitting apparatus, is almost illiminitable, depending entirely on the size of the apparatus used. The earth can be energised for a radius of many miles, but, owing to the portability of the apparatus, it is obviously in most cases preferable to move it about than to employ larger and more expensive instruments, which would be required to energise a larger field.

Explanation of System.

On earthing the transmitting electrodes, usually about 100 yards apart, a field of force is created in the earth's crust something similar to an exaggerated field force from a large horse-shoe magnet. With a suitable amount of condensor in action and proper adjustment of the spark gaps, the telephones, connected to the receiving electrodes immersed in in the earth from 20 to 70 feet apart, give an audible note at least a mile away. Variations in lines of flow will be caused by underground deposits of metalliferous bodies. Lodes are electrically divided into two classes, those which are better

* Read before Engineers' Club, Toronto, Ont.

conductors than the enclosing rock, and those which are, comparatively speaking, insulators. A good conducting lode changes the shape and intensity of the normal field, elongating it in the direction of the strike. Waves are brought to the surface by the lode, and there is a concentration of energy over the apex of the lode, and a corresponding increase in sound. When, however, the receiving electrodes are equidistant from the apex of the lode, a point of equipotential is reached, and a marked diminution in sound occurs, if not absolute silence, which, to the untrained operator, it appears to be.

Practical Application of the System.

(1) To locate an outcrop covered by a few feet of subsoil:—The transmitting electrodes are placed in the ground in a line at right angles to the direction of the strike of the lodes. Two operators, each holding a receiving electrode and a telephone, proceed, at a few paces apart, cross the field to be tested in a line parallel to the transmitting electrodes. The receiving electrodes are thrust a few inches into the subsoil, taking care to make a good contact, and the sounds heard are noted. On approaching a metalliferous lode the sounds are intensified, and the operators then come closer together, and proceed more cautiously, only moving electrodes a foot or so at a time, until silence is obtained. A post is then planted in the ground midway between the electrodes, and this post represents the apex of the lode, or the spot under which the metalliferous body will be found.

In the case of an insulated lode, such as a quartz reef, the sound will be most intense over the apex of the lode. The method adopted in this case is to earth the transmitting electrodes in a line parallel to the strike of the lode, when the waves in the centre of the field travel in a parallel direction, and if the apex of the lode is not too deep down, a "shadow" takes place in the earth at the back of the lode. This method is called "shadowing."

(2) To locate a lode at depth:—The test as to depth is obtained by restricting the electric field so that audible sounds are only obtained over a given diameter, and with waves of the highest potential possible. Once ascertaining this radius, and contracting it by cutting down the prime energy used and shortening the base line, i.e., narrowing the distance between the transmitting electrodes, the approximate depth to which the waves penetrate is calculated and obviously a lode situated below that depth can show no variation in the field above.

The Application of Electricity to Location of Ore Bodies.

When we consider the many physical properties possessed by ore bodies lying in the near surface of the earth's crust, it seems apparent that there must be some method of detecting their presence by means other than that of visual observation and geological inference. A vein is a comparatively thin sheet more or less mineralized, possessing both length and depth. The movement of the earth gives it a rotary speed of approximately one thousand five hundred feet per second and the orbital speed through space of about nineteen miles per second. Numerous lines of force and vibration of many orders from inter-stellar space are cut and corresponding phenomena must be produced in the ore body. In many cases oxidisation and other chemical changes are taking place and various portions of a vein are subjected to thermal differences,—all of which must set in motion forms of energy.

There are at least six theoretically possible methods of determining the presence of position of a mineralized vein:—

1st.—Resistance.
2nd.—Electro-chemical affinity.
3rd.—Magnetism.
4th.—Electro-magnetic induction.
5th.—Radiations or Emanations.
6th.—Conduction.

Radiations and Emanations.

Whenever oxygen combines with any metal or mineral an "emanation" is thrown off. The nature of this emanation is unknown. It apparently proceeds in straight lines and passes through water, soil and any rock capable of absorbing water, but it is arrested by oil, mica, etc. It affects the salts of silver like light waves and photographic plates exposed to its influence are darkened. Practically the whole surface of the land on the earth is bathed in this emanation, as wherever tests were made in Europe and America it has been present. It is especially strong in some mining areas. In fact, veins undergoing considerable chemical changes can often be located by its presence. In carrying out tests of this kind, phenomena has been observed that could not possibly arise from this emanation, and the character of which proves to me at least that a class of radiation of the order of light or possibly longer electro-magnetic waves is being emitted from strongly defined veins.

In the case of some classes of quartz veins which may be highly payable in gold values and at the same time, too sparsely mineralized to conduct as well as the enclosing rocks, these can often be located by negative methods. Usually waves of low potential would be used for such work. On encountering an insulating vein and finding free passage barred, the waves would be deflected and travel up the wall to the apex of the vein and escape in the material between the apex and the surface of the soil. In this case assuming the distance from the apex to the surface to be twenty-five feet, most of the train of waves travelling half a mile or more underground would be deflected upwards and crowd over in the twenty-five feet of material available to their passage. Obviously, the electricity in the telephone would be increased suddenly on encountering such a flux of energy. By patiently exploring an area and mapping up the increase and the decrease of the flux of energy, and more particularly, the direction of the flow, the positions of many veins can be determined.

Waves carried to great depth and distance by a persistent vein frequently arrive at the return electrode a fraction of a second late, and they cause interference which is manifested in the receiver by a lack of synchronism. When a section of the wave flow has been carried at an acute angle from the normal flow through the subsoil, a cross field is formed giving effects of retardation in the telephone. Where these effects are noticed, a conducting vein must be present in the area energised and by tracing the source of the cross field, the vein can be located.

Pneumatic Brush Gear.

You will have noticed that the question of a steel shaft of a turbo-generator rotating at a very high speed has a tendency to develop two centres. The first centre is the normal mechanical centre which could be the one and only centre if it were possible that the steel shaft could have the same homogenity. This result, of course, is scientifically impossible to obtain. Therefore, around the centre we have two unequal bodies and the greater speed that these bodies obtain the greater variation, therefore, we have another centre revolving around the ordinary mechanical centre. Consequently the strain on any bearings on which this shaft travels is increased practically developing an eccentric motion. To overcome this difficulty pneumatic brush gear for direct current generators has been introduced on account of air being extremely resilient and able to take up the slightest vibration in pressure, which would otherwise cause disintegration of the carbon blocks. It is also a well-known fact that springs under compression tend to crystallize and become fatigued and lifeless. This will give a brief idea of the pneumatic brush gear. The air compression is maintained by means of a small foot pump, the pressure being about three to four pounds per square inch.

Another modern invention which I had my attention drawn to is what is termed an inkless combined feeder log which has been adopted by electrical departments of Glasgow and several other corporations. One can obtain simultaneous readings of watts and frequency, volts and amperes, power factor and frequency, etc. Absolute synchronism and accuracy of time contacts is thereby obtained. An inkless recording meter, as the name designates, is a meter which records without the use of ink or pen, the chart being formed by series of contacts made over a type-writer ribbon, the contact impulse being actuated from a control clock which can give an impression every second, and as close as one

seven hundred and sixtieth part of an inch apart, thus forming a continuous line. The most modern switch boards are now designed with these recorders, and it is a matter of interest to note that frequently as many as six or seven instruments are governed by one master control clock.

The stringent rules which have been enforced by the British Board of Trade has resulted in the demand for "Fool-proof" apparatus being met by rather elaborate product now placed on the market by several prominent manufacturers. This is exemplified by the life and fire saving devices which are now used for enclosing the live contact parts of switches, fuses and terminals. A modern switch for low-tension work in its outward appearance would merely indicate a metal box with a plunger knob attached in the centre of the face thereof. However, it will be noticed that it is impossible to open the box to make an inspection of the switch and fuses unless the plunger has been withdrawn, thereby interrupting the circuit and it is also impossible to close the switch box lid when the plunger is on the "in" position, thus making sure that short circuits are impossible from the carelessness of the operator. Every switch used in the Franco-British Exposition in London last year was of this character.

For the purpose of interesting the members of the profession who are not electrical engineers, and who are possibly not as keenly interested as those gentlemen in the remarks already made, I will endeavor to interest you for a few moments in the plans which I have located. This position which I now take originates from the fact that one of the Canadian railways asked me to secure information bearing on land surveys at the time of the early colonization of this vast Dominion, which, you will remember, at that time was under military control. I located a number of very interesting maps in the War Office in London, and have placed Dr. Doughty, the Dominion Archivist, in possession of this information, and these plans will be forwarded in due course through the Secretary of State to Ottawa. This plan that I will now show you illustrates the Battle of the Plains of Abraham, celebrated by the recent Quebec Tercentenary and the strategical position to the troops changing during a period of a few days, General Wolfe commanding the British troops won by superior strategy as I will show you by a cross section of the ground. Another item of interest is the Duke of Wellington's report on the Rideau Canal. This is of engineering interest as well. Wellington had never been to Canada, but was considered to have such ability that having full plans and data before him, he could form an opinion suitable for either aggressive or defensive operations. Wellington could not have been able to have compiled this report unless he had been in receipt of valuable data and maps secured under great difficulties by the military engineers of that date.

I will now close this subject and give a brief resume of naval engineering as applied to the latest developments in war ships.

Stoking Indicator.—Regular stoking is essential to regular steaming, and is of special importance with Belleville and other water tube boilers. One must remember the fact that there are in the neighborhood of 50 boilers on board a first-class battle ship, the stoking of which are all individually indicated in the Chief Engineer's cabin. In each stoke hole an instrument of this type is erected, and is so operated that when the steam pressure of any one boiler decreases to a certain point the shutter on the instrument indicates the number of that boiler and at the same time a loud gong is struck sharply thus indicating to the stokers that attention is required at that point.

You will notice a sketch on the board which shows two guns which are situated close to each other with a limited field of fire. This sketch shows a small trumpet with a buzzer of an intolerable tone in loudness. The angle of a blast from the muzzle of a gun is about 140 degrees, thus one gun will bear on another without necessarily touching it or even being in line with the end of the other gun, and could blow the muzzle off simply by the blast. These are worked by the contacts situated from the turret trunks.

Another interesting naval instrument is the fire control apparatus which transmits from the conning tower of other controlling position orders to the guns in each gun position. The signals include "combined fire," "independent fire," the "range of objects in yards," and "deflection left or right in knots."

Certain difficulties are inherent in the operation of submarines.

The driving mechanism entails the use of a patrol engine, dynamo, motor and storage batteries, and quite a complicated switch-board. It is obvious that the most economical method in which a submarine can be driven through the water when running in a half submerged state is to drive the propellor shaft by an oil combustion engine. This engine at the same time has capacity to operate a dynamo which in turns charges the storage batteries. In order to obtain the maximum output of the generator with the minimum amount of material it has been found advisable to construct the machine of steel of high magnetic permeability, thus a greater capacity is obtained from the same dimensions of a generator that is ordinarily used for land service. When the Commanding Officer of the submarine desires to direct his boat below the surface the petrol engine is thrown out by a clutch and a change over switch throws the motor which is directly attached to the propellor shaft into operation. This motor, of course, is operated from the storage batteries before mentioned. The complete elimination of sparking is absolutely necessary, since the electrical apparatus is most rigidly tested before acceptance by the authorities.

Reverting to the electrical illuminating advancement. The latest development in arc lamps is the use of a single enclosing opalescent globe having a diameter not greater than 7-inches, which is a maximum amount of air in which an arc can be struck satisfactorily. Most of the towns in England are being lighted by flame arcs, which appears to be the only satisfactory method of lighting streets. Frequencies of 25-cycles are used now to operate flame arc lamps, the lamps being suspended in the neighborhood of 25 feet from the ground. A slight amount of flickering is noticeable. A lamp has not yet been designed which will operate on a circuit of this frequency for enclosed spaces, such as public halls, stores, etc., but in as much as the illuminating engineers of the various arc lamp companies are concentrating their attention to this feature, doubtless we may look forward to a solution of the problem at a very early date.

The Tatarinoff Pistonless Press or Jack. This press introduces mechanical principles hitherto but little understood, and even now are scarcely credited. It requires no foundations and is easily portable, for instance a press weighing about 430 pounds is able to exert a pressure from about 24 to 30 tons. Diagram on the board illustrates the principle involved. The aim of the engineers to increase the power of a press by increasing the area of the piston upon which the working fluid acts has been foiled by the technical difficulties of constructing a cylinder of large diameter in which it was possible to keep a tight gland.

The press invented by Tatarinoff has no piston whatsoever, and so the problem of increasing the power of a press by increasing the area upon which the working fluid acts is easily solved. Tatarinoff's press speaking in general terms, consists of the following parts,—(a) a receiver, the sides of which fold like the bellows of a concertina; (b) a moving plate, either top or bottom one, which bears round one of the pressing plates of the press, the second one being fastened to the stationary bottom plate of the receiver by steel columns which guide the moving top plate of the receiver. Water or air enters the receiver, and by its pressure raises the top plate, with the result that an object may be pressed between the plate of the receiver and the upper pressure plate of the press.

Having a large area the pistonless press transforms a small initial pressure into a great working pressure for all purposes for which presses are used.

The presses manufactured by the company in their latest forms have receivers, the folding sides of which consist of a

rubbered canvas, as stated before, folding like the bellows of a concertina, and which can stand a pressure up to ten atmospheres to the square centimeter. The bottom plate of the receiver is connected with the pressing plate by means of steel columns. The top plate of the receiver has guiding rings. Thus the receiver is perfectly watertight and airtight. The water or air is let through an ordinary tap or valve and let out likewise. There are no packing boxes in the press, and consequently there is no danger of leaking.

Being of very simple construction and devoid of any complex parts Tatarinoff's press requires no skilled mechanic to work it or to look after it. This quality is of great importance in rural industries, and in a number of small industries which cannot afford to employ a skilled engineer, also in those places which are situated at a great distance from any industrial centre where a skilled engineer could be obtained.

Requiring very small initial pressure, Tatarinoff's press can be worked by the pressure from an ordinary domestic water service. At outlying works and factories where there is no water installation, ordinary gravity hydraulic pressure which can be used in cases of fire, and is stored for that purpose, is quite sufficient to work the press. Ordinary iron pipings are sufficient to connect it with the water tap, but where iron piping cannot be obtained, rubber tubing enables one to place the press wherever desired which cannot be said of those presses that are driven by shafts.

With regard to the operation of winches on board ships, dock yards, ship yards, hoists and mines, the day of the donkey engine is passed. The greatly increased use of electric motors has replaced the old steam driven winch which under the most favorable conditions was a source of annoyance to the operator, and in cold weather when the long lines of steam pipe were filled with the water of condensed steam it can readily be imagined that the difficulties of operation were sometimes almost insurmountable. The use of the electric motor, however, was not complete without a specially designed brake which would allow for a rapid starting, stopping and reversing. Various types have been produced, but it remained for a member of the British Institute of Electrical Engineers, by the name of Scott, to produce a brake which in its simplicity and absolute reliability is probably many years in advance in the design of other brakes. The magnetism developed in the motor itself is utilized for actuating the brake gear without interfering in any way with the mechanical simplicity and strength of the motor itself. A gap or a partial gap in the magnetic circuit at the root of the two pole pieces is made so that lines of force pass across the gap and through the brake flappers which are thus attracted.

The brake is made of cast or wrought steel and the brakes used are easily adjustable for wear. These shoes are controlled by two strings which are in parallel. Apparently the springs are designed with a large factor of safety, and appear to work well within their elastic limits, as they are large for the work they have to do. However, it will be seen that a dashpot is entirely unnecessary and wound coils are not used in any way as they are also unnecessary.

The use of this brake affects the magnetic reluctance of the magnetic circuit to a very small degree, and I have seen a motor thus affected operate at the same speed and give the same rated output at the same temperature with the brake as without.

The starting current is not increased because the brake flappers are attracted with much less than the full load current, and the slight extra reluctance of the circuit when the brakes are partly "on" at a light load only involves a little greater speed which is rather an advantage than otherwise. These brakes are designed to operate on series direct current motors just as well as shunt wound machines.

The boat on which I crossed, i.e., the R.M.S. "Lusitania," was equipped with motors fitted with this style of brake on the davits of the life boats, and it was surprising to witness the degree of dexterity with which the operators could raise or lower a boat. It seemed as though they could adjust the motor to operate at any speed they desired.

RAILWAY ORDERS.

(Continued from Page 594).

6810—April 13—Granting leave to the Bell Telephone Co. to erect, place, and maintain its aerial wires across the tracks of the G.T.R. at private property 3½ miles west of Paris station, Ontario.

6811 and 6812—April 13—Granting leave to the City of Edmonton, Alta., to erect, place, and maintain its telephone and electric light wires across the C.N.R. at lane between Xinistine Avenue and Syndicate Avenue and lane between Fraser Avenue and Namayo Avenue, Edmonton, Alta.

6813—April 6—Directing the G.T.R. to permit its siding, as at present constructed across Preston St., Ottawa, Ont., to be joined with the proposed siding of the Export Lumber Co., Ottawa, Ont.

6814—April 6—Directing the G.T.R. to build a new bridge across Preston Street, Ottawa, Ont., within six months from date of Order.

6815—February 1—Dismissing application of the Winnipeg Jobbers' & Shippers' Association, Winnipeg, Man., for Order directing railway companies to provide carload rating on blankets from points in Eastern Canada to Winnipeg, Man.

6816—March 5—Dismissing application of the Canada Zinc Company, Limited, of Nelson, B.C., for leave to carry an electric power transmission line over the track of the C.P.R. (Proctor branch) about one mile distant from Nelson, B.C., between stations 1.6 and 1.7 on its line of railway.

6817—March 3—Directing that the V.V. & E. Railway & Navigation Co. may divert Ladner Highway, in the municipality of Delta, B.C., and acquire the necessary lands for the relocation of same along the route and through the lots as shown on plan.

6818 and 6819—April 14—Granting leave to the Bell Telephone Co. to erect, place and maintain its wires across the tracks of the G.T.R. at Carp, and Galetta, Ontario.

6820 to 6826, inclusive—April 14—Granting leave to the rural municipality of Miniota, to erect, place and maintain its wires across the tracks of the G.T.P. Railway at various points in the Province of Manitoba.

6827 and 6828—April 14—Granting leave to the B.T. Co. to erect, place and maintain its wires across the track of the C.P.R. at Monklands, Ont.; and the G.T.R. at P.O. Mulcaster Street, Barrie, Ont.

6829—April 14—Granting leave to the Burgesville Telephone Co. to erect, place and maintain its aerial wires across the tracks of the G.T.R. at Concessions 5 and 6, Township of Norwich, and at Stover Street, between Lots 7 and 8, Concession 5, Township of Norwich, Ontario.

6830—February 19—Releasing twenty-five (25) land owners of what is known as the Beechmount subdivision, in the northern part of the City of Edmonton, Alta., from plans numbered 7851 R and 3624 U, filed by the G.T.P. Railway.

6831—April 14—Granting leave to the Toronto & Hamilton Railway Company to cross with its track the tracks of the C.P.R. (Ontario and Quebec division) near Lambton Mills, Township of York, Ontario.

6832—April 14—Approving plan of overhead bridge, crossing what is known as the Haystead Road, at mileage 119.67, on Lots 14 and 15, Concession 4, Township of Foley, district of Parry Sound, Ontario, filed by the C.P.R.

6833—February 11—Directing the C.N.R. to properly plank certain highway crossings on its Humboldt division of its line between sections 3-36-16; 34-35-16, and 20 and 29-35-15 West 2nd Mer., Sask.

6834—February 3—Dismissing complaint of the Manitoba Grain Growers' Association alleging that the C.P.R. and the C.N.R. charge excessive freight rates on bulk headed cars of grain going to Fort William and Port Arthur, Ontario, and applying for Order directing the said railways to reduce their charges on the said shipments.

6835—April 6—Directing the C.P.R. and the C.N.R. to publish and file joint class and commodity tariffs of rates on freight traffic in classes 6 to 10 inclusive, of the Canadian Classification, between Edmonton and all points on the Cana-

dian Pacific Railway except Strathcona, via Strathcona Junction on the basis of one cent per 100 pounds over and above the class and commodity rates of the Canadian Pacific Railway to or from Strathcona.

6836—April 15—Granting leave to the Farmers' Long Distance Telephone Company to erect, place and maintain its wires across the track of the M.C.R.R. at highway 2½ miles west of Mull station, Ontario.

6837—April 14—Authorizing the Chatham Gas Co. to lay a gas main under C.P.R. at the Lacroix Street crossing, Chatham, Ontario.

6838—April 15—Authorizing the Atlantic, Quebec & Western Railway to construct four bridges on its line of railway in the Province of Quebec.

6839—April 15—Authorizing the C.N.Q. Railway to construct bridge over the Lac Ouareau River, at mileage 9 from St. Jacques, on the Jacques-Rawdon extension of its line of railway.

6840—April 13—Granting leave to the C.N.O. Railway to cross with its track the track of the C.P.R. (Toronto-Sudbury branch) by means of an undercrossing, near Pakeskeg station, at Big Key River, mileage 283 west from Ottawa.

6841—April 15—Granting leave to the municipality corporation of the Township of McKim, district of Sudbury, Ontario, at its own expense, to construct a crossing over the right-of-way of the C.P.R. in the Township of McKim, Ontario.

6842—April 15—Authorizing temporary crossing of the C.N.R. by the G.T.P. Railway near Swift's Packing House, at Edmonton, Alta.

6843—April 15—Authorizing the C.N.O. Railway to construct bridge over the Seguin River, at Parry Sound, on the Parry Sound Spur, Ont.

6844—April 6—Granting application of the Canadian Freight Association for permission to substitute for the existing commodity rates on wire fencing and netting, in carloads, from Hamilton, Windsor and Walkerville, to points east of Toronto, the class tariff rates thereon, subject to the existing commodity rates to Montreal and Ottawa as maxima.

6845—April 15—Authorizing the C.P.R. to construct, maintain and operate branch line of railway to and into the premises of A. E. Fenton, Fort William, Ontario.

6846—April 16—Granting leave to the Mount McKay & Kakabeka Falls railway to cross with its track the track of the C.N.R. Co. at Gowanlock Spur, on Lot 12, Concession 1, in the Township of Neebing, district of Thunder Bay, Ontario.

6847—April 16—Granting leave to the London Township Telephone Co., Limited, to erect, place and maintain its telephone wires under the tracks of the Canadian Pacific Railway Co. at Hyde Park flag station on its main line west from London, Ontario.

6848—April 16—Granting leave to the corporation of the Town of Orillia, to, at its own expense, erect, place and maintain certain electric power wires over and across several tracks of the G.T.R. where the same crosses the public road between Concessions 5 and 6, Township of Orillia, County of Simcoe, Ontario.

6849—December 22—Refusing application of Messrs. McDiarmid & Gall, of Montreal, P.Q., for Order directing the railway companies to allow seventy-two hours for the unloading of charcoal, instead of forty-eight hours allowed by the Rules of the Canadian Car Service Bureau.

6850—April 16—Granting leave to the Toronto Electric Light Company to erect, place and maintain, at its own expense, certain electric light wires over and across the right-of-way of the G.T.R. at Greenwood Avenue, Toronto, Ont.

6851—April 19—Approving the general location of the proposed extension of the Nicola, Kamloops & Similkameen Railway from Merritt to Similkameen, B.C.

6852—April 17—Granting leave to the B.T. Co. to erect, place, and maintain its wires across, under, the tracks of the G.T.R. at Eastern Avenue in the City of Toronto, Ont.

6853 and 6854—April 17—Granting leave to the B.T. Co. to erect, place, and maintain its wires across, under, the tracks of the G.T.R. at Eastern Avenue, near Broadview, and at Queen Street, Sunnyside Avenue, Toronto, Ont.

6855—April 17—Granting leave to the Seymour Power & Electric Co., Limited, to erect, place and maintain its electric transmission line across the track of the Central Ontario Railway in Lot 8, Concession 7, Township of Marmora, Hastings County, Ontario.

6856—April 17—Granting leave to the Seymour Power & Electric Co., Limited, to erect, place, and maintain its electric transmission line across the track of the Canadian Pacific Railway in Lot 1, Concession 1, Township of Marmora, Hastings County, Ontario.

6857—April 19—Authorizing the C.N.O. Railway to place the lines and tracks of its Ottawa-French River division over the lines and tracks of its Toronto-Sudbury division, near Cranberry Lake station, about mileage 284 west from Ottawa, Ontario.

6858—April 19—Granting leave to the Atlantic, Quebec & Western Railway to operate its trains over its line of railway from mileage 19.75 to mileage 20.5 at the new station at Port Daniel, P.Q.

6859—February 6—Directing that the stopping in transitu charge on grain via C.N.R. and C.P.R. at Winnipeg should not exceed one cent per hundred pounds, and the switching charge from point of interchange at Winnipeg or St. Boniface to the proper unloading tracks, and for reswitching the said grain back to the said point of interchange, shall not exceed $5 per carload, regardless of weight, in each direction; the said tolls to become effective May 17th, 1909.

6860—April 19—Granting leave to the C.P.R. to construct its railway across the road allowance on its Pheasant Hills branch between mileages 530 and 556, west of Saskatoon, Sask.

6861—April 20—Granting leave to the Bell Telephone Company to erect, place and maintain its aerial wires across the tracks of the C.P.R. at P.C., one mile east of Conception Station, P.Q.

6862—April 20—Granting leave to the Manitoba Government Tel. to erect, place and maintain its wires across the tracks of the C.N.R. at P.C. at Swan Lake, Man.

6863—April 20—Authorizing W. C. Albert, of Edmunston, N.B., to lay water pipe under the tracks of the C.P.R. in the town of Edmunston, N.B.

6864—April 20—Authorizing the C.P.R. to reconstruct bride No. 151.1 over the Walker River, on the Soo Branch, Lake Superior Division of its railway.

6865—April 19—Granting leave to the Corporation of the City of Revelstoke, B.C., to erect, place and maintain its transmission wires across the tracks of the C.P.R. at McKenzie Avenue, Revelstoke, B.C.

6866—April 19—Granting leave to the C.P.R. to construct its tracks across Galt Street, Lethbridge, Alta.

6867 and 6868—April 19—Granting leave to the Corporation of the City of Revelstoke, B.C., to erect, place and maintains its transmission wires across the track of the C.P.R. at Fourth Street, and at a point near the easterly end of the railway yard, City of Revelstoke, B.C.

6869—April 20—Approving revised location of the G.T.P. Railway Company's line, Prince Rupert Easterly, mileage 50 to mileage 100, Copper River, Coast Dist., B.C.

6870—April 20—Approving location of the C.P.R. Company's branch line of railway, from a point on the revision of the Crow's Nest Pass line, Section 30, Township 9, Range 22, West 4th Meridian to a point on the west boundary of Section 8, Township 17, Range 24, west of the 4th, Alberta.

6871—April 21—Authorizing the Canadian Pacific Railway to open for the carriage of traffic that portion of its line of railway from Eburne to New Westminster, B.C., mileage 0 to mileage 9.64.

6872—April 20—Granting leave to the Port Hope Telephone Company, Ltd., to erect, place and maintain its telephone line across the tracks of the G.T.R. Company at crossing between Lots 8 and 9, Concession B F, Clarke Township, County of Durham, Ont.

6873—March 8—Amending Order of the Board No. 4353, dated the 3rd of February, 1908, authorizing the C.P.R. and theAlberta Railway and Irrigation Company to construct spur to and into the premises of the North-West Jobbing Company's premises, Lethbridge, Alta.; by striking out clause 1 of the operative part of the said Order and substituting therefore the following clause:—" That the Pacific Company be, and it is hereby directed to construct, maintain and operate a branch line of railway, or spur, from a point marked " E " on the present freight spur; thence curving across Baroness Road to the east side of Smith Street; thence along Smith Street to the north side of Dufferin Street in the City of Lethbridge, Province of Alberta, a distance of fourteen hundred and forty-five feet, as shown in yellow, to the north side of Redpath Street, to the north side of Dufferin Street on the plan on file with the Board under case No. 3583, File No. 3955, which is hereby approved."

6874—April 21—Granting leave to the B.T. Company to erect, place and maintain its wires across the G.T.R. at private property, G.T.R. to Varnish Works, Owen Sound, Ont.

6875—April 21—Amending Order of the Board, dated August 15, 1907, by rescinding the authority therein granted in so far as it affects Lot 16, in Block 14, according plan of Parish Lot 31 to 35 both inclusive, of the Parish of St. Boniface, Man.

6876—April 21—Ordering the Guelph and Goderich Railway (C.P.R.) to install, at its own expense, and thereafter maintain an electric bell at a point where its railway crosses Queen Street in the village of Blyth, Ont.

6877—April 15—Authorizing the C.P.R. to construct, maintain and operate two branch lines of railways at Hudson Station for Nap. Masson, on Lot 157, village of Como, Co. of Vaudreuil, P.Q.

6878—April 22—Granting leave to the Walkerton & Lucknow Railway (C.P.R.) to construct its railway across three highways in the Township of Glenelg, County of Grey, Ont.

6879—April 6—Refusing application of the Export Lumber Company for Order directing the G.T.R. and the C.P.R. to provide a connection by a branch line between the sidings of the said companies at present constructed across Preston Street and York Street, Ottawa.

6880—April 13—Amending Order No. 6440, February 25th, by striking out the figures " 6 " and " 10 " in the 9th line of the operative part of Order and substituting the figures " 7 " and " 7."

6881—April 13—Amending Order No. 6424, February 25th, by striking out the figures " 6 " and " 10 " in the 9th line of the operative part of Order and substituting the figures " 7 " and " 7."

6882—April 13—Amending Order No. 6423, February 25th, by striking out the figures " 6 " and " 10 " in the 9th line of the operative part of Order and substituting the figures " 7 " and " 7."

6883—April 22—Authorizing the C.P.R. to construct four bridges on its line of railway in the province of Ontario.

6884—April 22—Granting leave to the Ingersoll Telephone Company to erect, place and maintain its wires across the Tillsonburg, Lake Erie & Pacific Railway, between Concessions 5 and 6, Township of Dereham, County Oxford. Ont.

SOCIETY NOTES.

British Columbia Surveyors.

Exactly fifty per cent. of the candidates who tried the recent British Columbia Land Surveyors' examination were successful. The following passed: A. P. Augustine, W. B. Bucknill, Cecil M. Roberts, H. H. Roberts and P. A. Landry. Those who were in charge of the trials are appended: W. S. Gore, W. S. Drury, S. A. Roberts, E. A. Cleveland, E. B. Herman and J. H. McGregor. Twenty-two students took their preliminary examinations. The names of those who gave satisfaction are not published at this juncture. The examiners state that the number of those applying for certificates in British Columbia is increasing every year. On the last occasion comparatively few wrote, but now, not only was the class larger and the percentage of those successful exceptional, but there was a large number en route to being full fledged surveyors.

Ontario Land Surveyors.

The results of the supplementary examinations for Ontario Land Surveyors have been announced. The following were successful: Messrs. F. M. Eagleson, Winchester; F. E. Patterson, Sudbury; K. G. Ross and T. D. LeMay, Toronto; G. S. Jones, Smith's Falls; A. V. Chase, Orillia; S. E. Farley, Ottawa, and A. H. Greenlees, London.

Queen's University B.Sc. List.

The results of the final year at Queen's were given out this week. They are in the engineering departments, as follows:

Bachelors of Science (B.Sc.)

In Mining—W. G. S. Agassiz, Kingston; S. Blenkhorn, Canning, N.S.; F. A. Brewster, Banff, Alta.; P. J. Browne, Kingston; W. M. Campbell, Eganville; G. H. Kilburn, Stratford; W. E. Lawson, London; J. K. Osborne, Marquette, Mich.; F. Ransom, Deloro; J. N. Scott, Wallaceburg; M. Y. Williams, Bloomfield; T. B. Williams, Bloomfield.

Chemistry and Mineralogy—E. L. Bruce, Smith's Falls; C. W. Drury, Kingston.

Mineralogy and Geology—N. L. Bowen, Kingston; J. A. S. King, Souris, Man.; B. Rose, Iroquois; H. T. White, B.A., Stratford.

Chemical—J. A. Kelso, Wallacetown.

Civil Engineering (C.E.)

T. D. Campbell, Perth; E. Chartrand, Chartrand; R. H. Cooper, Springfield, N.S.; C. L. Hays, Port Colborne; G. J. Jackson, Simcoe; G. A. Jenkins, Orwell, P.E.I.; H. C. Saunders, Kingston; G. S. McIntosh, Dundas; J. B. Saint, Vancouver.

Mechanical—H. K. Fleming, Craigleith; A. G. Neilson, Stella; A. N. Squire, Kingston.

Electrical—J. G. Daley, Ottawa; W. O. Dwyer, Kingston; D. S. Nicol, Cataraqui; W. J. Orr, Kingston; O. M. Perry, Perth; F. H. Ryan, Newburgh; T. B. Speers, Appleton; S. A. Woods, Tamworth.

Sanitary—J. E. Carmichael, Strathcona, Alta.

Power Development—A. W. Haddow, Simcoe; C. U. Peeling, Campbellford.

Mining Engineers (M.E.)

C. Orford, De Lamar, Idaho.

K. S. Twitchell, De Lamar, Idaho.

The returns are not complete, and it was announced that there would be a supplementary list.

STATISTICS OF CONSUMPTION OF WATER, DETROIT, MICH.

Estimated total population of Detroit		426,592
Estimated population on lines of pipe.....		440,744
Estimated population supplied		438,157
Total consumption for the year.....	26,857,139,195	gallons
Passed through meters	8,368,105,508	gallons
Percentage of consumption metered		31.2
Average daily consumption	73,380,162	gallons
Gallons per day to each inhabitant, City of Detroit		169.9
Gallons per day to each consumer		167.5
Gallons per day to each tap		880.5
Cost of supplying water, per million gallons, figured on total maintenance (item CC)....	$	7.78
Total cost of supplying water, per million gallons, figured on total maintenance + interest on bonds	$	9.06

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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 FORESTRY ASSOCIATION.—President, Thomas Southworth, Toronto; Secretary, R. H. Campbell, Ottawa.

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

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

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

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

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

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

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

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

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

COMING MEETINGS.

American Gas Power Society.—April 27. Quarterly meeting, Minneapolis, Minn. Secretary, R. P. Gillette.

American Society of Civil Engineers.—Annual convention, Mount, Washington Hotel, Bretton Woods, N.H., July 6 to 9. Secretary, Chas. W. Hunt, 220 West 57th Street, New York.

Air Brake Association.—May 11 to 14. Annual meeting at Richmond, Va. Secretary, F. M. Nellis, 53 State Street, Boston, Mass.

American Society of Mechanical Engineers.—May 4-7. Spring meeting at Washington, D.C. Secretary, Calvin W. Rice, 29 West 39th Street, New York City.

American Electrochemical Society. — May 6-8. Annual meeting at Niagara Falls, Canada. Secretary, Jos. W. Richards, Lehigh University, South Bethlehem, Pa.

American Foundrymen's Association.—May 18-20. Annual meeting at Cincinnati, Ohio. Secretary, Richard Moldenke, Watchung, N.J.

American Railway Association.—May 19. Annual meeting at New York City. Secretary, W. F. Allen, 24 Park Place, New York City.

American Waterworks Association.—June 8-12. Annual convention at Milwaukee, Wis. Secretary, John M. Diven, 14 George Street, Charleston, S. C.

American Railway Master Mechanics' Association.—June 16-18. Annual convention at Atlantic City, N.J. Secretary, Jos. W. Taylor, 390 Old Colony Building, Chicago, Ill.

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

American Institute Electrical Engineers, Toronto Section.—Friday, April 23, at 8 p.m. Address by Mr. Alexander Dow, Mem. A.I.E.E., of Detroit, on "Underground Conduits and Cables."

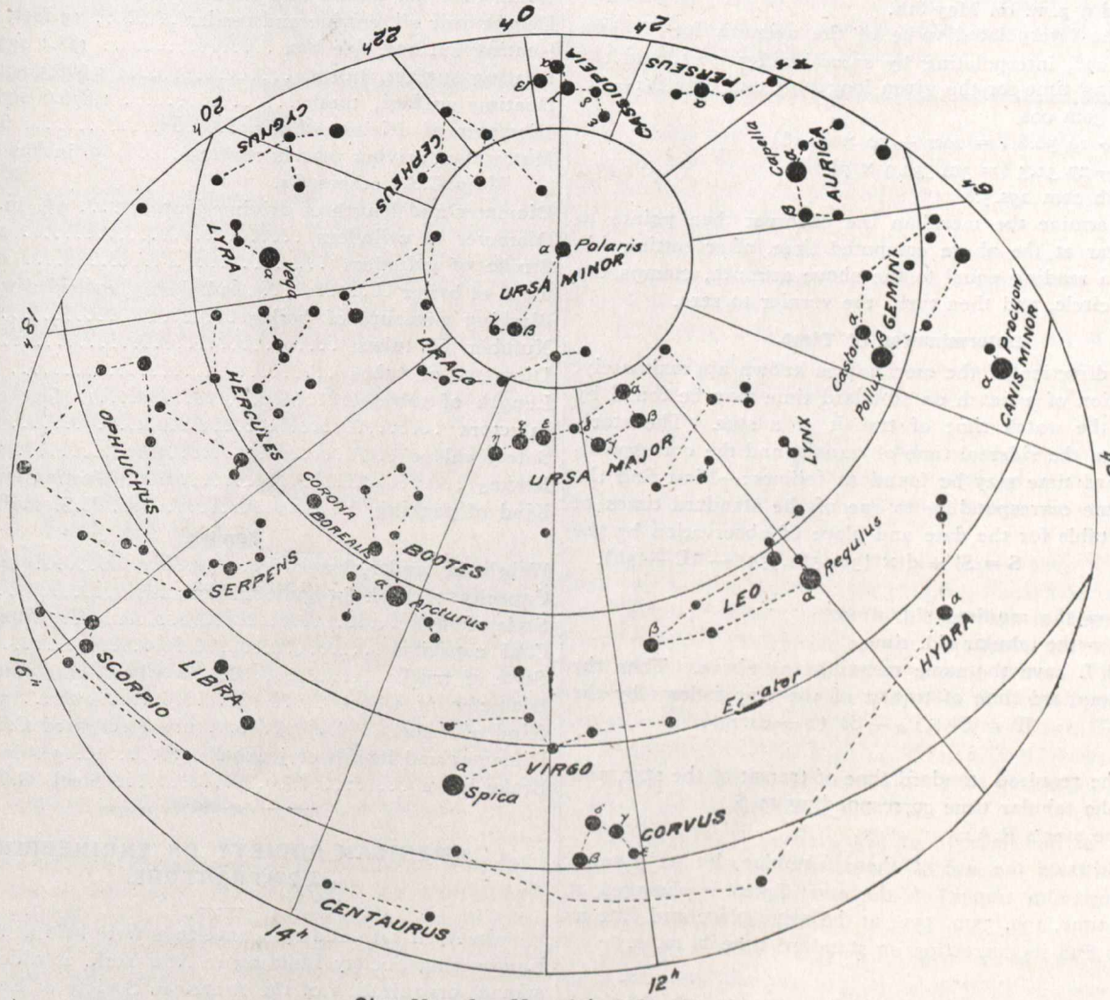
International Railway General Foremen's Association.—June 1 to 5, 1909, at Chicago. E. C. Cook, Royal Insurance, Chicago, Ill.

Master Car Builders' Association.—June 21 to 23, 1909, at Atlantic City, N.J. J. W. Taylor, Old Colony Building, Chicago, Ill.

National Electric Light Association.—June 1 to 4. Thirty-second convention, Atlantic City, N.J. Secretary, John F. Gilchrist, 29 West 39th Street, New York.

National Fire Protection Association.—May 25 to 27. Annual meeting at New York City. Secretary, W. H. Merrill, 382 Ohio Street, Chicago, Ill.

ASTRONOMICAL PAGE



Star Map for May 1st, 1909, 10 p.m.

CUT OUT FOR REFERENCE.

STAR MAP, SHOWING THE PRINCIPAL STARS, VISIBLE AT 10 P.M. MAY 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 May 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 17.4	+ 58 38 36
α Cassiop	2.5	0 35 18.5	+ 56 02 04
γ Cassiop	2.3	0 51 10.4	+ 60 13 13
α Ursæ Min. (Polaris)	2.1	1 25 31.1	+ 88 49 04
α Aurigæ (Capella)	0.2	5 09 56.1	+ 45 54 26
α Geminorum (Castor)	2.0	7 28 46.9	+ 32 05 27
α Canis Min. (Procyon)	0.5	7 34 31.6	+ 5 27 28
β Geminorum (Pollux)	1.2	7 39 44.2	+ 28 14 53
α Leonis (Regulus)	1.3	10 03 31.8	+ 12 24 44
β Ursæ Maj.	2.4	10 56 22.4	+ 56 52 27
α Ursæ Maj.	2.0	10 58 08.4	+ 62 14 48
β Leonis	2.2	11 44 25.9	+ 15 04 51
γ Ursæ Maj.	2.5	11 49 04.3	+ 54 12 13
δ Ursæ Maj.	3.4	12 10 57.4	+ 57 32 28
ε Ursæ Maj.	1.8	12 50 03.7	+ 56 27 21
ζ Ursæ Maj.	2.1	13 20 17.9	+ 55 24 08
α Virginis (Spica)	1.2	13 20 24.9	— 10 41 19
η Ursæ Maj.	1.9	13 43 59.3	+ 49 46 05
α Bootis (Arcturus)	0.3	14 11 31.9	+ 19 39 17
α Lyræ (Vega)	0.1	18 33 52.7	+ 38 41 41

Determination of Azimuth by the Pole Star.

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

T P.M.	Sid. time h. m. s.	L = 44° A ° ′ ″	a ″	L = 48° A ° ′ ″	a ″	L = 52° A ° ′ ″	a ″
8 00	10 37 13.5	358 54 53	+19	358 50 09	+21	358 44 17	+22
8 30	11 07 18.5	359 04 58	+21	359 00 59	+23	358 56 03	+25
9 00	11 37 23.4	15 58	+23	12 47	+25	359 08 50	+27
9 30	12 07 28.3	27 40	+24	25 20	+26	22 27	+28
10 00	12 37 33.2	39 54	+25	38 27	+27	36 40	+29
10 30	13 07 38.2	359 52 28	+26	359 51 55	+28	359 51 15	+30
11 00	13 37 43.1	0 05 09	+26	0 05 31	+28	0 05 58	+30
11 30	14 07 48.0	17 45	+25	19 01	+27	20 36	+30
12 00	14 37 53.0	30 03	+25	32 13	+26	34 54	+29

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 May 1st.
L = the longitude.
d = number of days elapsed since May 1st.

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 May 8th.

Here the interpolated value of the azimuth for 8h 30m is 358° 59′ 27″, 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.

Determination of Time.

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 Spica is observed at the watch time, 10h. 35m. 45s., at the same place and date as above; to find its correction on standard time h. m. s.

		h.	m.	s.
Sidereal time, 10h. 30m. (table)....	=	13	07	38.2
7 × (3m 56s. 555)	=		27	35.9
		13	35	14.1
Difference of longitude	=		20	00
S	=	13	15	14.1
R.A. of star	=	13	20	24.9
α—S	=		— 5	10.8
5.2 × os.16	=			0.8
Equivalent mean time interval.....	=		5	10.0
T′	=	10	30	00
T	=	10	35	10.0
Watch	=	10	35	45.0
Watch fast	=			35.0

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.

NEW GRAND TRUNK PACIFIC RAILWAY ENGINES.

Some time ago it was announced that the Grand Trunk Pacific Railway had placed an order with the Canadian Locomotive Works, Kingston, Ont., for twenty-five Mogul engines. We give herewith the principal dimensions and equipment of the engines:—

Engine.

Gauge	4 feet 8½ inches
Type of engine	Simple Mogul
Fuel used	Bituminous coal
Weight in working order, drivers	138,176 lbs.
Weight in working order, total	161,976 lbs.
Wheel base of engine, rigid	15 feet 8 inches
Wheel base of engine, total	24 feet 3 inches
Wheel base of engine and tender	53 feet 10 inches
Length over all, engine and tender	64 feet 11½ inches.
Width over all, engine and tender	10 feet.
Height over all, engine and tender	15 feet, 2 inches.
Heating surface, fire box	188.1 square feet.
Heating surface, tubes,	1,688.5 square feet.
Heating surface, total	1,876.6 square feet.
Diameter of driving wheels	63 inches.
Material of driving wheels centres	56 inches diameter, Main C.S., others C1.
Diameter and length of driving journals	9½ in. × 12 in.
Diameter of cylinders	20 inches.
Stroke of cylinders	26 inches.
Type of boiler	Radial stay, extended wagon top.
Working pressure of boiler	200 lbs.
Number of tubes	271
Diameter of tubes	2 inches.
Length of tubes	11 feet 11 inches.
Injectors	Hancock.
Safety valves	"World."
Brakes	Westinghouse E. S.
Kind of packing	U.S. multiangular.

Tender.

Weight of tender, loaded	143,300 lbs.
Capacity of tank in gallons U.S.	7,000
Style of tank	Water bottom.
Coal capacity	10 tons.
Style of truck	4 wheel, cast steel bolster
Diameter of wheel	34 inches.
Kind of wheel	Steel tired C.I. centres.
Diameter and length of journal	5½ in. × 10 in.
Brake beam	Steel, G.T.R. type.

AMERICAN SOCIETY OF ENGINEERING CONTRACTORS.

On April 14th and 15th, meetings were held at the United Engineering Society Building in New York, at which the permanent organization of the American Society of Engineering Contractors was effected. This new national society begins its career with a membership of nearly 1,500.

A constitution was adopted at the meeting on April 15th, and officers and directors were elected. "The object of the Society is the advancement of engineering knowledge and contracting practice, the maintenance of a high professional standard among its members and the elimination of those practices and abuses that now exist in the engineering and contracting business, add to strengthen the bond that should exist between engineers and contractors."

Corporate members must be engineers, contractors, or manufacturers of engineering material or equipment that have been engaged in these lines for at least 7 years, a degree from a college or university of standing counting as 2 years' experience. The constitution also provides for Associate Members.

Officers for the first year were elected as follows: George W. Jackson, of Chicago, President; Halbert P. Gillette, of New York, First Vice-President; D. E. Baxter, of New York, Second Vice-President; and Daniel J. Hauer, of New York, Temporary Secretary. These officers with the following gentlemen will make up the board of directors: De Witt V. Moore, of Indianapolis; Edward Wegmann, of New York, and W. D. Lockwood, of New York, to serve one year. F. S. Hanson, of Chicago; George Warren, of Boston, and J. R. Wemlinger, of New York, to serve two years; and Major Cassius E. Gillette, of Philadelphia, F. C. Hitchcock, of New York, and Howard J. Cole, of Morristown, N.J., to serve three years.

The Society will begin to hold monthly meetings in the fall. It is already assured of a large membership of eminent engineers and contractors, and sufficient funds to carry on its work. Application for membership can be made to the Temporary Secretary, 721 Park Row Building, New York.

CONSTRUCTION NEWS SECTION

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

TENDERS.

Nova Scotia.

NORTH SYDNEY.—Tenders will be received up till Saturday, May 1st, for excavations, brickwork, stonework, concrete work and all the necessary iron beams, iron pillars and anchors; also the necessary flashing according to plans and specifications to be seen at the store of The Kirk & Whitman Tailoring & Clothing Company, Limited, North Sydney.

Quebec.

LACHUTE.—Tenders for fittings, Lachute, Que., Post Office, will be received until Friday, May 7th, 1909. Napoleon Tessier, Secretary, Department of Public Works, Ottawa.

MONTREAL.—Tenders will be received until May 5th for tile floors or mosaic floor for City Hall building. Address: L. O. David, City Clerk.

NEW CARLISLE.—Tenders are invited by the New Canadian Company, Limited, for the steel superstructures of bridges and trestles, 14 in number, of a total length of 4,900 feet, which are to be erected on the Atlantic, Quebec & Western Railway, in the district of Gaspe, in the Province of Quebec. Further particulars are given in our advertising pages.

QUEBEC.—Tenders will be received until the 10th May for the construction of an Annex to the Jacques-Cartier Normal School, on Parc Lafontaine, Montreal, P.Q. Alphonse Gagnon, Secretary, Department of Public Works.

Ontario.

BRANTFORD.—Tenders will be received up to Tuesday, the fourth day of May, next, for the supply of material and the construction of two concrete abutments for an iron bridge. The site of the bridge is about two miles north of G.T.R. station at Onondago Village. The abutments will measure 90 cubic yards. Tenders to be at a rate per cubic yard describing the quality and the proportion of the several ingredients to be used in the composition of the concrete. S. J. M'Kelvey, Clerk, Township of Onondaga, Tuscarora P.O.

BROCKVILLE.—Tenders will be received up to May 6th for the supply of lumber for sidewalks and street purposes, salt glazed vitrified sewer pipes, cut and steel wire spike for walks, Portland cement and sand for granolithic walks. Geo. P. Gamble, Chairman Board of Works.

DUNNVILLE.—Tenders for the erection of a House of Refuge at Dunnville for the County of Haldimand will be received up to Wednesday, May 12th. Lowest or any tender not necessarily accepted. Munro & Mead, architects, Chancery Chambers, Main Street, Hamilton.

ESTEVAN.—Tenders will be received until May 19th, for constructing a waterworks system and a main sewer. Further particulars appear elsewhere in this issue. Willis Chipman, C.E., Chief Engineer, 103 Bay Street, Toronto.

PORT ARTHUR.—Tenders will be received up till Tuesday, May 4th, for the erection and completion of a private residence. J. E. Cauchon, Jr., architect.

PORT ARTHUR.—At a recent meeting of the Electric Light & Telephone Commissioners the clerk was authorized to call for tenders for material required in connection with the new spur line to be built on Arthur Street. Estimated cost: Line, $1,370.10; track, $7,857.20. Tenders for material for the power service will also be called for.

OTTAWA.—Tenders will be received up to 31st May, 1909, for work required in connection with the abutments and approaches of the new bridge below the waste weir at Kingston Mills Lock Station on Rideau Canal. L. K. Jones, Secretary, Department of Railways and Canals.

OTTAWA.—Tenders will be received up to 5th May for a vessel to be used as a lightship at southeast shoal, off Point Pelee, Lake Erie. The vessel required must be about 100 feet long, 25 feet beam, and 9 feet draft. Further particulars can be obtained from G. J. Desbarats, Acting Deputy Minister of Marine and Fisheries.

OTTAWA.—Tenders will be received until April 29th, 1909, for a 25 horse-power locomotive type boiler. Newton J. Ker, City Engineer.

OTTAWA.—Tenders will be received until Monday, 3rd May, for the erection of a grand stand, etc., at Lansdowne Park. W. E. Noffke, architect, room 26, Central Chambers. John Henderson, City Clerk.

ST. THOMAS.—Tenders will be received until Friday, the 30th April, for the necessary artificial stone sidewalks, curbing and gutter to be constructed during the current year. Jas. A. Bell, City Engineer.

SANDWICH.—Tenders will be received up to Monday, May 4th, for the construction of 4,600 lineal feet of vitrified pipe or brick sewers, from 18 to 24 inches in diameter; 510 lineal feet of 48-inch brick sewer, 1,550 lineal feet of concrete box sewer, or reinforced concrete pipe sewers. Plans and specifications may be seen at the office of Owen McKay, Civil Engineer, Walkerville, Ont. E. R. North, Town Clerk.

TORONTO.—The City of Toronto will receive tenders for laying underground conduit. For specifications, apply to Electrical Department, City Hall.

TORONTO.—Tenders will be received up to Tuesday, May 4th, for the construction of a concrete bridge at Chippewa Avenue, Toronto Island. Joseph Oliver (Mayor), Chairman Board of Control.

TORONTO.—Tenders will be received until Friday, April 30th, for the erection of a new school building on Avenue Road. W. C. Wilkinson, Secretary-Treasurer, City Hall.

TORONTO.—Tenders will be received until May 18th, 1909, for the supply of material and the construction of a water filtration plant. Further particulars appear in our advertising pages. Joseph Oliver (Mayor), Chairman, Board of Control.

TOWNSHIP OF McNAB.—Tenders will be received up to Tuesday, May 18th, for the construction of a concrete arch bridge and abutments with filling and fencing, addressed to Mr. John McGregor, clerk of the Township of McNab. Plans and specifications have been prepared by Messrs. Macallum & McAllister, engineers, 612 Continental Life Building, where the same may be examined.

WINGHAM.—Tenders for remodelling the steam heating system in the public school will be received until 11th May. John F. Groves, Secretary Public School Board.

Manitoba.

WINNIPEG.—Tenders for grading, curbing and construction of 49,672 square yards of asphalt pavements will be received until May 20th. H. N. Ruttan, City Engineer. M. Peterson, Secretary Board of Control. (Advertised in The Canadian Engineer.)

WINNIPEG.—Tenders will be received up till May 4th for all of the work, except the structural steel, plumbing, heating and electrical work, required in the erection and completion of a twelve storey and basement fireproof office building on Portage Avenue. J. H. G. Russell, architect, Silvester-Willson Building.

WINNIPEG.—Tenders will be received by the Winnipeg Public School Board up to May 6th, for the erection of an iron fence at the following schools: Collegiate, Dufferin and Norquay. Address: J. B. Mitchell, School Board Office.

Saskatchewan.

LUMSDEN.—Tenders will be received up to May 8, for the construction of Wascana Rural Telephone system. Arthur Anslow, Secretary-Treasurer.

MOOSE JAW.—Tenders for boring for water in Tuxford village will be received until May 1st. For further information apply to John B. Calver, Secretary-Treasurer.

MAPLE CREEK.—Tenders for fittings, public building, will be received until Friday, May 7th, 1909. Mr. Jas. Reid, Clerk of Works, Maple Creek, Sask. Napoleon Tessier, Secretary, Department of Public Works, Ottawa.

PRINCE ALBERT.—Tenders will be received until April 30th for taking up 8-inch wooden stave pipe and re-laying with 8-inch cast iron pipe. Specifications may be seen and forms of tender obtained at the office of the City Engineer. C. O. Davidson, Secretary-Treasurer.

PRINCE ALBERT.—Tenders will be asked shortly for the construction of the Dominion penitentiary here.

Alberta.

LETHBRIDGE.—Tenders for a waterworks pump, to be installed by the City of Lethbridge, Alberta, will be received until May 17th, by Smith, Kerry & Chace, Consulting Engineers, Confederation Life Building, Toronto, from whom specifications, etc., may be obtained. (Advertised in The Canadian Engineer.)

British Columbia.

VICTORIA.—The City Council have decided to call for tenders for the erection of a high pressure pumping station.

VANCOUVER.—Tenders will be received up to Wednesday, June 2nd, 1909, at 4 o'clock p.m., for the supply of water pipe for the City of Vancouver. Wm. McQueen, City Clerk.

VICTORIA.—Tenders will be received up to 30th April, 1909, for the construction of eight steel conical buoys for the Fraser River, including delivery on the wharf of the Public Works Department at New Westminster, B.C. Plans and specifications may be seen at the offices of the Agency of Marine and Fisheries, Victoria, B.C., the Public Works Department, New Westminster, B.C., and the offices of the Harbor Master, Vancouver, B.C., where forms of tender may also be obtained. James Gaudin, Agent Marine & Fisheries.

VANCOUVER.—Tenders for the construction of five miles of concrete sidewalks will be called for by the City Council to ascertain if the work can be done cheaper by contract than day labor.

VANCOUVER.—Tenders will be received up to Wednesday, June 2nd, 1909, for the supply of waterpipe for the City of Vancouver. Specification may be obtained from the waterworks office, City Hall. Wm. McQueen, City Clerk.

VANCOUVER.—Tenders will be received up to Wednesday, May 5th, for the purchase of a portable sawmill. Full particulars may be obtained at the office of Messrs. Hermon & Burwell, Engineers and Surveyors, Inns of Court Building, 423 Hamilton Street. Wm. McQueen, City Clerk.

CONTRACTS AWARDED.

New Brunswick.

FREDERICTON.—Hon. John Morrissy, Chief Commissoner of Public Works, has awarded the contract for the Wall bridge, parish of Northfield, Sunbury County, to Frank L. Boone, of St. Mary's. The contract price is in the vicinity of $2,500.

Quebec.

MONTREAL.—The Roads Committee accepted tenders as follows: The Laurentian Granite Company, supply Laurentian blocks, $1.79 a square yard; the Sicily Asphalt Company, Laurentian blocks, $1.43 a yard. If the lowest tenderer is unable to meet all demands supplies will be purchased from the other company rather than have the work delayed. The lowest tender for lumber was that of the J. T. Marchand Company, at $27 a 1,000 feet, for white pine inch boards, and the next that of J. Therrien at $29. The committee recommended both tenders, the lower to get the preference. The Montreal Hassam Paving Company, laying paving blocks, $2.45 a yard, with concrete foundation. At a previous meeting tenders were granted for the laying of granite blocks in the ordinary way at $2.35 to the Sicily Asphalt Company. Portland cement, A. Bremner, 36¾ cents a 100 pounds. The acceptance of the tender of the Compagnie de Pavages Modernes, at 51 cents, the cement to be delivered in barrels was also recommended. Bricks, C. Bourdon, $11 a thousand. The tender of Hyde & Webster was $11.40, but as they were lower on bevelled bricks, it was decided to recommend them with the first named firm.

Ontario.

BROCKVILLE.—The Board of Works has purchased from Mussens Limited, Montreal, a new road roller, cement mixer and small compound engine to run the mixer. The machinery is to be delivered by June 1st.

GUELPH.—The tender of the Hamilton & Toronto Sewer Pipe Company, of Hamilton, for the year's supply of pipe was accepted.

HAMILTON.—The sewers committee opened tenders on several sewers and awarded the contracts as follows: Richmond Street sewer, to Andrew Mercer, at 43 cents per foot; Case Street sewer, to Andrew Mercer, at $1.08 per foot; Jackson Street sewer, to Andrew Mercer, at 58 cents per foot; Hunt Street sewer, to J. Armstrong, at 47 cents per foot.

PORT ARTHUR.—Stewart & Hewitson, of Port Arthur, have been awarded the contract for the construction of all concrete bridges and retaining walls on C.P.R. between here and Whitefish.

LINDSAY.—The Water Commissioners accepted the tender of the McLennan Company for galvanized pipe as follows: 5,000 feet, ¼-inch, $3.45 per 100 feet; 500 feet, ¾-inch, $4.35 per 100 feet; 200 feet, 1¼-inch, $8.30 per 100 feet; 300 feet, 2-inch, $13.20 per 100 feet.

TORONTO.—The contract for the electrical equipment at the Ontario Dock Company's new wharf on York Street was awarded to The Standard Electric Company, Confederation Life Building.

WATERLOO.—A special meeting of the Waterloo Public School Board tenders were received for the erection and completion of a brick school building and the contracts awarded as follows: August May, Berlin, mason work, $5,495; Reitzel Bros., carpenter work, $4.840; Liphardt Bros., plumbing, $1,620; Kroetsch & Boppre, painting, $304; The Metal Shingle & Siding Company, metallic ceiling, $225; Liphardt Bros., tinwork, $94; heating, Pease Furnace Co., $1,750.

WATERLOO.—The following tenders for the construction of the cement walks were received: Ed. Dermul,—Walks, 9 cents a square foot; driveways, 10 cents a square foot; street crossings, 12 cents a square foot; 3-inch tile drain, 5 cents a foot; 4-inch tile drain, 8 cents a foot; 6-inch tile drain, 15 cents a foot; 9-inch drain, 25 cents a foot; 12-inch drain, 45 cents a foot; cast iron work, 5 cents a pound; wrought iron work, 10 cents a pound; filling, 50 cents a cubic yard; brickwork, $20 a thousand, laid in cement; raising old walks and supplying all material, 6 cents per square foot; new blocks in old walks, 9 cents per square foot. Paul Bergman,—Walks, 9½ cents a square foot; driveways, 11 cents a square foot; street crossings, 12½ cents a square foot; 3-inch tile drain, 3½ cents a foot; 4-inch tile drain, 10 cents foot; 6-inch tile drain, 13 cents a foot; 9-inch tile drain, 30 cents a foot; 12-inch tile drain, 45 cents a foot; cast iron work, 3 cents a pound; wrought iron work, 5 cents a pound; filling, 55 cents a cubic yard. The tender of Ed. Dermul was accepted on condition that he repair old streets at 6 cents a square foot and replace broken blocks in old walks at 9 cents a square foot, and supply all the material and filling.

BRANTFORD.—Three tenders for the improvements and alterations to the Court House were opened and the contract was awarded to Schultz Bros., their tender being the lowest. The work outside of the floor will cost $5,000. The floor will be $640 extra, the floor to be made of ceramic tile.

Manitoba.

NEEPAWA.—Tenders for fittings, public building, will be received until Friday, May 7th. Mr. Geo. Kellington, Clerk of Works. Napoleon Tessier, Secretary, Department of Public Works, Ottawa, Ont.

PORTAGE LA PRAIRIE.—The Town Council of Fort Francis awarded the contract for the labor on the new water and sewerage system to Holmes and Kinnimond, of Portage la Prairie. The price is $12,857. The total contract is over $25,000.

Saskatchewan.

MOOSE JAW.—The tender for the new fire hall has been awarded to Navin Bros., Moose Jaw, the price being $19,000. The other tenderers were the Brandon Construction Company, Limited, $18,403; S. A. Covert, Moose Jaw, $21,000; Healey & McGregor, Sault Ste. Marie, $24,375; Smith Bros., and Wilson, Regina, $19,800, and E. E. Poole, Moose Jaw, $21,480.

PRINCE ALBERT.—The tender was let to J. F. Hughes for 38 cents a house. The Fleming Method offered to do the work at 40 cents a house.

SASKATOON.—The tenders received on the three different sections of the sewerage and waterworks scheme to be done in the city this year were: Municipal Construction Co., Regina, $14,934; $29,584 and $12,843.85, or bulk, $54,632.35; Craig & McVean, Prince Albert, $13,908, $23,699 and $10,758, or bulk, $47,170. H. Welsh, $13,725, $24,630 and $11,445, or bulk, $49,400; F. F. Fry, Toronto, $39,700 bulk; Parson's Engineering Company, Regina, $17,137, $29,093 and $12,427, or bulk, $58,000; J. Brodt, Regina, $15,137, $18,978 and $10,496, or bulk, $44,350; H. F. Moore, $13,831, $24,048 and $11,281, or bulk, $49,000; Reginald Bolton, Prince Albert, $15,000, $17,900 and $9,500, or bulk, $42,000.

British Columbia.

VANCOUVER.—At a meeting of the Municipal Council of Burnaby the following contracts were awarded: Grading Greenwood drive, E. Scouffi at $18 and H. Sommer at $15 per chain; clearing pole line road, H. Sommer $11 per chain; grading Haszard road, J. J. Mervyn, at $17.90 per chain; redrawing map of the municipality on larger scale, Mr. H. W. Stewardson, $130.

LIGHT, HEAT, AND POWER.

Ontario.

TORONTO.—The electrical department of the City of Toronto have issued the following schedule of rates for power users in Toronto when the Hydro-Electric line is completed to the city. This does not include the additional charge on the peak to users of power who have the meter rate, this additional charge being six cents per horse-power. as stated:—

Maximum demand in h.p.	Minimum monthly bill	Flat rate per h.p. per month	Meter rate per h.p. per hour off peak
300	$ 344	$2.29	.71
400	425	2.12	.65
500	506	2.02	.62
600	588	1.96	.60
800	750	1.87	.58
1,000	912	1.82	.56
1,200	1,075	1.79	.55
1,500	1,320	1.76	.54
2,000	1,725	1.72	.53

The peak hours are as follows:—October 15 to October 31, 5.30 p.m. to 6.30 p.m.; November 1 to November 30. 5 p.m. to 6.30 p.m.; December 1 to January 15, 4.30 p.m. to 6.30 p.m.; January 16 to February 15, 5 p.m. to 6.30 p.m.; February 16 to March 1, 5.30 p.m. to 6.30 p.m.

Manitoba.

BRANDON.—Some details of the power project planned for Manitoba have been given out. The Byllesby Company claim they can develop 150,000 electrical horse-power at Great Falls. Construction work will be started as soon as 20,000 horse-power is contracted for. Supplies of 100 horse-power will be delivered at the rate of $20 per horse-power, while for amounts of from 5,000 to 10,000 horse-power the charge will be $15. The charge for transmission will be 3½ cents per mile. Brandon is 225 miles from the plant, which will bring the rate for 6,000 horse-power up to $22.87½, delivered at the high tension station here.

Alberta.

LETHBRIDGE.—On May 10th votes will be taken on a by-law to raise $153,000 for additional machinery, the erection of buildings, and necessary extensions for the city's electric power station, waterworks plant and water main extensions.

British Columbia.

VICTORIA.—A by-law for an additional loan of $50,000 for sewer purposes will shortly be submitted to the people.

VICTORIA.—On April 14th the big storage battery and "booster" at the British Columbia Electric Railway power house were connected with the system and started in on their service. The new apparatus constitutes a species of reservoir which fills automatically. In the storage batteries are 260 cells with a capacity of 1,200 ampere hours, and these contain some forty tons of materials. The cells consist of lead plates suspended in sulphuric acid. This addition to the plant has cost about $50,000, and the installation was made by English experts, the storage battery by E. T. Humphreys, of the Tudor Export Syndicate, and the "booster" by G. E. Mason, of the Lancashire Dynamo & Motor Company.

SEWERAGE AND WATERWORKS.

Nova Scotia.

NEW GLASGOW.—Sewer and waterworks extensions to cost $12,000 are being considered by the Town Council.

Ontario.

BROCKVILLE.—The town is intending extending its electrical system and waterworks pumping station. C. H. and P. H. Mitchell are engaged in making a report upon the matter and are advising on the economies of a continued generating and pumping plant.

LINDSAY.—Several extensions to water mains are being made here.

LISTOWEL.—The by-law to provide money to establish a municipal lighting plant here carried by a large majority on Monday, April 19th. Work will be proceeded with immediately, and contracts will be made with Messrs. Kilmes, Pullar and Berneham for two 50 kilowatt generators; the Robb Engineering Company for engines; Waterous engine works, boiler; George Thomas, Windsor, line materials and erection. C. W. and P. H. Mitchell are the engineers for the town.

PORT ARTHUR.—Numerous extensions to sewer and waterworks system will be made by the City Council this year.

RAILWAYS—STEAM AND ELECTRIC.

Quebec.

MONTREAL.—The Southern Counties Railway Company gave a contract to Stack & Brogan for paving Common and Mill Streets and the approaches to Black's bridge, the work to be started as soon as weather will permit.

MONTREAL.—The contract for grading in St. Lambert in connection with the Montreal and Southern Counties Railway has been awarded to George Duncan, who also has the contract for the excavation work for the sub-station and car barns, which will be erected of concrete, opposite Elm Avenue on St. Denis Street. Work was begun on the grading near Victoria bridge last week.

Ontario.

STRATFORD.—Mr. N. M. Cantin, St. Joseph, has submitted a proposition to the city council on behalf of New York capitalists to build an electric railway between St. Joseph and Stratford, a distance of sixty-five miles, upon the condition that the city guarantee the bonds of the concern up to $250,000. The road would run via Parkhill, Exeter and Hensall, Stratford would be given an hourly service for fifteen

hours daily. The proposition will be discussed at the next council meeting.

TORONTO.—What promises to be a long legal fight, involving over half a million dollars, opened April 26th, before Mr. Justice Britton. The plaintiffs in the case, Messrs. Michael A. Piggott, Herbert E. Larkin, E. Larkin and George Sangster, trading as M. A. Piggott & Company, railroad contractors are claiming an alleged balance of $523,-574 from the Guelph & Goderich Railroad Company for construction work. Through their counsel, Wallace Nesbitt, they allege that their agreement provides for extra payment for "overhauling" in excavating work, with the chief engineer of the railroad as sole arbitrator. The defendants, through their counsel, Messrs. G. F. Shepley, K.C., and George Mason, have offered to pay $100,000 in full of all claims, but this has been refused. The railroad company also counterclaimed for $250,000 damages, alleging that the work is not yet completed. The railroad was begun in July, 1904, and, according to the plaintiffs, was completed in August, 1907.

WELLAND.—Tenders for rails, poles and other equipment will be opened shortly by the Dunnville, Wellandport and Beamsville Electric Railway. Grading operations will start in three weeks.

Saskatchewan.

REGINA.—The C.P.R. will immediately start the construction of large freight sheds here, five hundred feet long, to be erected this year. The company will also erect a station.

Alberta.

CALGARY.—The Grand Trunk Pacific started work on April 19th on the construction of a line from Wainwright to Calgary. W. E. Mann is the locating engineer for the link between the G.T.P. and Calgary.

British Columbia.

VANCOUVER.—Five engineering parties will be engaged this season in locating a line for the Canadian Northern Railway between the present terminus, thirty miles west of Edmonton, and Vancouver and New Westminster. Two of them will work west from the prairies to the summit of the Rockies, while the other three outfits will be employed in British Columbia. Kamloops will be the base of the engineers at work on this side of the divide. The three parties now being organized at Kamloops will take the field next week. They will comprise about forty members.

VANCOUVER.—The Great Northern Railway have made a start towards the rail connection from its main line on False Creek to what will be its future deep-water terminals on Burrard Inlet. Ironside, Rannie & Campbell, the contractors, made a start clearing the right-of-way from the head of False Creek across by way of Raymur Avenue.

VANCOUVER.—Instructions have been given the G.T.P. Company's engineers to send out an exploratory party to report on a direct feasible route for the railway main line to Vancouver.

TELEPHONY.

Ontario.

PORT ARTHUR.—At a recent meeting of the Board of Railway, Light and Telephone Commissioners, the purchase of telephone supplies was authorized.

TORONTO.—The latest issue of the Government Gazette contains notices of incorporation of the Ernestown Rural Telephone Company, Odessa, Ont., of which J. F. Dawson is an incorporator, and the Foster Rural Telephone Company, at Abernethy, Sask.

PORT ARTHUR.—The Electric Light and Telephone Commissioners have recommended the purchase of business and domestic phones.

Saskatchewan.

REGINA.—Hon. N. A. Calder, Minister of Telephones, announced on April 21 that the Department had purchased the Bell Telephone system throughout Saskatchewan for a cash consideration of $367,500, of which $10,000 is to be returned for unearned rentals.

HANLEY.—A Telephone Company with a paid-up capital of $10,000 has been organized to operate a local system. The long distance telephone line is expected to reach Hanley about the middle of May and several rural lines are projected.

LUMSDEN.—Mr. Arthur Anslow is advertising for tenders for the construction of the Wascana Rural Telephone system.

FINANCING OF PUBLIC WORKS.

Quebec.

MONTREAL.—The Westmount City Council has passed the following by-laws to authorize a loan of $135,000 for the extension of the lighting plant and for the garbage destructor. Permanent pavements for sidewalks, street crossings, etc., $125,000; drains, main sewers, etc., $35,000; macadamizing, opening, widening and making streets and boulevards, $130,0000.

Ontario.

OWEN SOUND.—On May 15 the citizens will vote on four by-laws as follows: Waterworks extension and filtration plant, $125,000; electric light debt and extension, $30,000; town hall improvements, $7,000; isolation hospital, $3,500.

WELLAND.—Tenders will be received up to May 3rd for $44,242 sewer and concrete walks debentures bearing 4½ per cent., payable half yearly.

Saskatchewan.

SASKATOON.—Eight by-laws, aggregating an expenditure of $96,800, which includes $36,000 for extension to the light and power plant, will be voted on by the citizens on the 18th May.

YELLOW GRASS.—The ratepayers of Yellow Grass voted on two more by-laws, one to raise $20,000 for a waterworks system and one to grant a bonus of $1,000 and exemption from taxation for ten years for an electric light and power plant. The waterworks by-law was carried with practically no opposition, while the lighting by-law was decisively defeated, there being a majority of six against it.

EDMONTON.—The Canadian Northern Railway Company will spend $60,000 boring for gas and oil in the Morinville oil fields. The company's big boring outfit, which operated for some time at Langham, Sask., will be shipped to Morinville. W. R. Martin, of Medicine Hat, who is to take charge of the boring operations, will commence operations within a couple of weeks.

MARKET CONDITIONS.

Toronto, April 28th, 1909.

As the opening of lake navigation approaches, accounts are heard of increased orders for merchandise, though spring activity of trade is by no means general. Industrial establishments in the United States are getting some spring orders, which help to swell the thus far limited volume of orders of March and April. The report of the United States Steel Company for March quarter is not very encouraging, although it does confirm a slight revival in business. The orders show 3,542,595 as against 3,765,343 in March, 1909. The Carnegie Steel Company has advanced its prices on bar shapes and plates a dollar per ton.

Brick makers are busy; cement dealers report a stagnancy, except for trifling parcels; building and roofing papers, sewer pipe and fire brick moving steadily; lumber, firm. Hardware and metal dealers do not find any freedom of demand except here and there at lake ports for rope, chain, anchors, and such ship-chandlery. Tin keeps its price, copper also is steady, demand for structural steel moderate.

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

Antimony.—The market fairly active; price continues at 9½c.

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

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

Boiler Tubes.—Orders continue active. Lap-welded, steel, 1¼-inch, 10c.; 1½-inch, 9c. per foot; 2-inch, $8.75; 2¼-inch, $10; 2½-inch, $10.60; 3-inch, $12.10; 3½-inch, $15; 4-inch, $18.50 to $19 per 100 feet.

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

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

Cement.—Price in 1,000-barrel lots $1.70 per barrel, including bags, or $1.30 without bags. Similar quantities, $1.55 to $1.60 per barrel, in load lots delivered in town, and bags extra. Movement confined mainly to small parcels.

(Continued on Page 44.)

AMONG THE MANUFACTURERS

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

COMPRESSOR.

The Reavell compressor is now so well-known in the 'mining world," and so largely used under all circumstances where compressed air is required, that we think it may interest our readers to have a short description of same.

The compressor is made by Messrs. Reavell & Company, Ltd., of Ranelagh Works, Ipswich, England, and owing to its special construction it is admirably adapted for electric driving.

The " Reavell " compressor has four cylinders arranged radially in a circular shaped casing, each of the four cylinders is fitted with a trunk piston, and the four connecting rods are all driven from a common crank pin. The circular casing contains an annular space through which the cylinder is forced, and each cylinder forms as it were a separate single-acting compressor, and as they all deliver into a common delivery passage, a practically continuous delivery of air is secured because the compressor, owing to the pressure being always in one direction, can be run at relatively high speed. The compressor has no suction valve, air being admitted above each piston by means of a port in the latter which coincides with a similar port in the top of each connecting rod during the stroke, and near the end of this stroke the piston over-runs the ports, cuts through the cylinder wall, thus making a direct communication between the cylinder and the inside of the compressor casing, which is arranged for a suction chamber, this resulting in a gain of at least 5 per cent. of the volumetric efficiency, as compared with compressors having spring loaded valves. The machine is simplicity itself, and the whole of the internal running gear can be removed in two or three minutes for the thorough inspection of the machine, and can be replaced equally quickly.

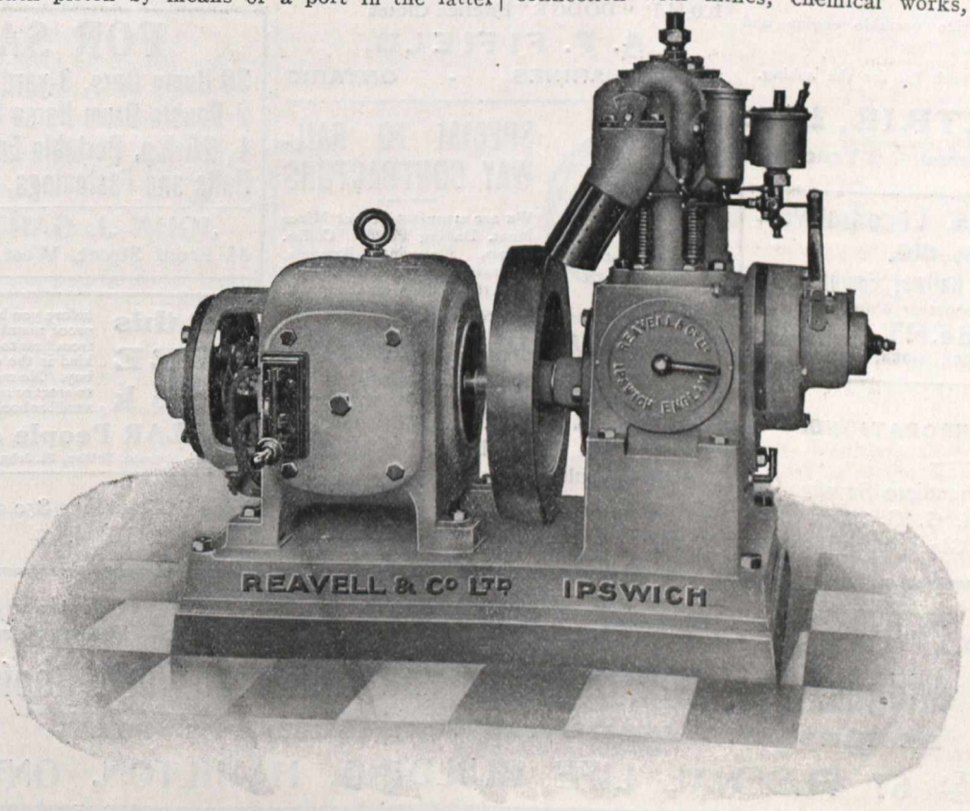
All the rods are of forged steel and the gudgeons which form the suction valve are of hard cast iron.

The delivery valves are of a very special type, and there are no forced fits anywhere. The valve seats can be lifted out by hand for inspection and adjustment, and all the valves can be removed from the machine and replaced in half an hour. The illustration we give shows one of these compressors direct coupled to an electric motor. This method of construction forms a very efficient and quiet running plant. The absence of gears naturally entails a saving of power and noise.

Direct coupling is obtained either by extending the crankshaft of the compressor and threading it through the armature of the motor, the outer end of the crankshaft running in the motor bearing, or by fitting the compressor crankshaft to the half coupling. The motor being supplied with one bearing and armature built on shaft with half coupling. The two half couplings are rigidly bolted together, and the plant under either of the above arrangements runs with only two bearings.

The compactness and reliability of these plants has caused them to be very largely used, especially in mining work, where " in bye " compressors, taking up little room are required.

They are to be found in use in all parts of the world in connection with mines, chemical works, breweries, workshops, water lifting, acid pumping and all the various uses to which compressed air can be put.



OTTAWA.—Material is being rushed to Black Rapids, about ten miles from the city, where a serious break has occurred in the canal embankment and is likely to retard the re-opening of navigation on the Rideau Canal.

FREDERICTON.—The Legislature have been discussing at great length the idea of taking steps to compel, if possible the Grand Trunk Pacific to run all trains through New Brunswick by means of electricity, and thus prevent forest fires. The G.T.P. passes through a densely wooded section of the Province and timber there is very valuable. Premier Hazen and several others spoke strongly on the matter and a resolution was adopted with that end in view.

CONTRACTOR'S SUPPLIES

NEW INCORPORATIONS.

Ottawa, Ont.—Chaudiere Supply Co., $20,000. A. Wilson, G. G. Roe, F. B. Wilson. Horwood Glass Manufacturing Co., $20,000. C. G. H. Horwood, H. Torwood, W. T. Powis.

British Columbia. — Mohawk Creek Mining Co., $300,000.

Fraserville, Que. — La Compagnie Trans-St.-Laurent, $50,000; M. Fraser, J. Viel, J. C. Pouliot.

TENDERS CALLED FOR

WATER FILTRATION PLANT

NOTICE TO CONTRACTORS.

TENDERS will be received by registered post only, addressed to the Chairman of the Board of Control, City Hall, Toronto, up to noon on 18th May, 1909, for the **Supply of Material and the Construction of the Necessary Works in Connection with a Water Filtration Plant** for the City of Toronto.

Envelopes containing tenders must be plainly marked on the outside as to contents.

Specifications and plans may be seen and forms of tender obtained at the office of the City Engineer, City Hall, Toronto.

The usual conditions relating to tendering as prescribed by City By-law must be strictly complied with or the tenders will not be entertained.

The lowest or any tender not necessarily accepted.

JOSEPH OLIVER (Mayor),
Chairman, Board of Control.

City Hall, Toronto, April 16th, 1909.

CONDUIT

The city of Toronto will shortly call for tenders for the laying of underground conduit. For specifications, apply to the Electrical Department, City Hall.

TOWN OF ESTEVAN

PROVINCE OF SASKATCHEWAN.

Tenders Wanted

Sealed Tenders will be received by the Secretary-Treasurer until Wednesday, May 19th, for constructing a Waterworks System and a Main Sewer, comprising 7,300 feet of Water Mains, 2,400 feet of Tile Sewer, also Steel Water Tower, Gasoline Engines, and Power Pump.

Plans and Specifications may be seen at the office of the Secretary-Treasurer, Estevan, or of the Chief Engineer, 103 Bay Street, Toronto, on and after April 22nd.

No Tender necessarily accepted.

L. A. DUNCAN, Esq.,
Secretary-Treasurer,
Estevan, Sask.

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

TENDERS FOR ASPHALT PAVING

Sealed proposals addressed to the Chairman, Board of **Control, Winnipeg**, Man., and endorsed as above, for grading, curbing and construction of asphalt pavements, approximately 49,672 square yards, will be received at the **office of the undersigned up to 11 a.m. on Thursday, May 20th, 1909.** Plans, specifications and forms of tender, together with conditions governing tender as prescribed by by-law, may be obtained at the office of H. N. Ruttan, City Engineer, 233 James Street, Winnipeg. The lowest or any tender not necessarily accepted.

M. PETERSON,
Secretary.

Board of Control Office, Winnipeg, April 20th, 1909.

TOWNSHIP OF McNAB

TENDERS FOR CONCRETE ARCH BRIDGE

Sealed tenders addressed to the undersigned will be received till noon of **Tuesday, May 18th,** for the construction of a Concrete Arch Bridge over Dochart Creek at Dochart Village, near Arnprior.

Each tender shall be accompanied by a certified cheque, payable to the Treasurer of the Township of McNab, for 5 per cent. of the amount of tender, which will be returned to the tenderer unless he fail to execute an agreement should contract be awarded to him.

Plans and specifications may be seen at the Clerk's office, near Burnstown, at J. E. Thompson's office, Arnprior, or at the office of A. F. Macallum, C.E., 612 Continental Life Building, Toronto, and at the office of the Canadian Engineer, 62 Church Street.

Tenders will be opened by the Council at the Township Hall, Stewartville, on Wednesday, May 19th, at 12 o'clock noon. The lowest or any tender not necessarily accepted.

JOHN McGREGOR,
Clerk of Township of McNab,
Burnstown P.O., Ont.

April 30th.

BRIDGE TENDERS

Tenders are invited by the New Canadian Company, Limited, for the steel superstructures of bridges and trestles, 14 in number of a total length of 4,900 feet which are to be erected on the Atlantic, Quebec and Western Railway, in the district of Gaspe, in the Province of Quebec.

1. The Bridge Company is to agree to supply, build, erect, paint and complete the metal superstructures, and to frame, place and complete the wooden or rail floor system of the bridges referred to above, all in conformity with the specifications, drawings and strain and material sheets of the superstructures which may be had on application to the New Canadian Company, Limited, at New Carlisle, P.Q., and in conformity with Class 2 of the Standard Bridge Specifications of the Dominion Government, Department of Railways and Canals, Edition 1908, it being understood that both plans and specifications are to form part of the agreement.

2. All tenders are to be sent in duplicate, one copy addressed The New Canadian Company, Limited, New Carlisle, P.Q., and the other to be addressed to the Chairman, The New Canadian Company, Limited, Queen Anne's Chambers, Broadway, Westminster, London, S.W., England.

3. All tenders are to be sealed and to be marked on the outside "Bridge Tenders."

4. The New Canadian Company, Limited, does not bind itself to accept the lowest or any tender.

5. Newspapers inserting this advertisement without authority will not be paid for same.

6. All tenders to be posted so as to reach New Carlisle, P.Q., by 21st of May, 1909.

(TENDERS—Continued on page 44.)

TENDERS CALLED FOR

City of Lethbridge, Alberta, Canada

TENDERS FOR WATERWORKS PUMP

TENDERS will be received up to the 17th day of May, 1909, for a steam pumping equipment to deliver 2,000,000 gallons per 24 hours.

Specification, drawings, and form of Tender, may be obtained from Messrs. Smith, Kerry & Chace, Confederation Life Building, Toronto, on and after May 3rd.

Tenders are to be addressed to Messrs. Smith, Kerry & Chace, Toronto.

Each tender must be accompanied by a certified cheque, payable to the order of the Secretary-Treasurer, City of Lethbridge, for ten per cent. (10%) of the amount of the tender, which cheque will be returned unless the tenderer fails upon request to enter into a contract at the rate stated in the tender.

The lowest or any tender will not necessarily be accepted.

TENDERS FOR CONCRETE BRIDGE CONSTRUCTION.

TENDERS will be received at the office of the undersigned up to twelve o'clock, noon, of **Monday, May 10th, 1909,** for the construction of a **Reinforced Concrete Arch** over the Humber River on a deviation of the townline between the Townships of King and Vaughan; also for **Two Concrete Abutments** for a bridge over Highland Creek, Concession 1, Lot 14, in the Township of Scarboro'.

Plans and specifications may be seen and all necessary information may be obtained at the office of the undersigned, 57 Adelaide Street East, Toronto.

The lowest or any tender not necessarily accepted.

FRANK BARBER, C.E.,
Engineer for the Municipalities.

Toronto, April 27th, 1909.

(Continued from Page 608.)

Lead.—Prices steady outside. This market holds firm at $3.80 to $3.90, with an active movement.

Lime.—Retail price in city 35c. per 180 lbs. f.o.b., car; in large lots at kilns outside city 22c. per 100 lbs. f.o.b., car. More is moving, in medium to small lots.

Lumber.—The greater ease in the money market having permitted or encouraged more building of warehouses or factories, the result is felt by the lumber trade in a marked demand for Southern pine of large dimensions. This wood, which has been scarce in this market, is beginning to come in freely, and some beautiful clear stuff, as large as 10 by 20 inches, is in stock. For hemlock there is a fair demand, with a scarcity of the longer lengths. It is noticeable that 32-inch lath are rising in price, as we foreshadowed a week or two ago, sales of several cars have been made lately at $1.50. Prices are rather stiff, all along the line. Dressing pine quotes $32 to $35 per M; common stock boards, $26 to $30; cull stocks, $20; cull sidings, $17.50; Southern pine Hemlock in car lots, $16.50 to $17; spruce flooring in car lots, $22; shingles, British Columbia, $3.20; lath, No. 1, $4.25; No. 2, $3.75; for white pine, 48-inch; for 32-inch, $1.50.

Nails.—Wire, $2.25 base; cut, $2.70; spikes, $3. Moving freely.

Pitch.—A little demand is perceptible; price continues at 70c. per 100 lbs.

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

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

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

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

Sewer Pipe.—

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

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

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

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

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

Tank Plate.—3-16. $2.40 100 lbs.

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

Tin.—Market more steady, with moderate activity. The price continues at 31c. to 31½c.

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

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

* * * *

Montreal, April 28th, 1909.

The past week has been unproductive of anything exciting in the pig-iron markets of the world. Throughout the United States, the situation has settled down into a condition of dullness. Reports appear now and again to the effect that demand is showing an improvement and that business is picking up again, but the fact has been that these reports have not been followed by the hoped for conditions. Prices for pig continue steady. There has been a further closing down of some of the iron and steel producing plants, and further reductions have been made in the wages of the men, the present being, apparently, an opportune time to inaugurate a lower scale of wages. This fact, of itself, is a reply to the trade-improvement stories.

In Great Britain, the situation shows little change. As compared with some months ago, trade is undoubtedly more encouraging, and in some cases prices have shown a slight advance. At the same time, there is nothing of consequence taking place, which would lead to the belief that any revival of industrial activity is at hand. In Great Britain, as in other markets, the tariff revision in the United States seems to be the scapegoat for the refusal of business to go after the manner desired. Doubtless the tariff revision is a very considerable factor, but it is not sufficient to account for the entire situation.

In Canada, dealers generally report a fairly satisfactory trade, and it looks as though the Dominion were the most fortunate of all the countries, in this respect, this season. Now that navigation is again opening, dealers in hardware of all kinds as well as in iron and steel material, are experiencing a period of activity which is quite encouraging in comparison with what is reported from across the boundary or from the other side of the Atlantic. Prices are steady, this week, after the very considerable changes of a week ago, although a number of changes have taken place in metals, as shown below:—

Antimony.—The market is dull at 8½ to 8¾c.

Bar Iron and Steel.—Prices are easy all round, and trade is dull. Bar iron, $1.85 per 100 pounds; best refined horseshoe, $2.10; forged iron, $2; mild steel, $1.85; sleigh shoe steel, $1.85 for 1 x ⅜-base; tire steel, $1.95 for 1 x ⅜-base; toe calk steel, $2.35; machine steel, iron finish, $1.90; smooth finish, $2.70.

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, $1.80 per 100 pounds; felt paper, $2.50 per 100 pounds; tar sheathing, 40c. per roll of 400 square feet; dry sheathing, 30c. per roll of 400 square feet; tar fibre, 55c.; dry fibre, 45c. (See Roofing; also Tar and Pitch).

Cement.—Canadian cement is now so cheap it is impossible for English, Belgian, German, or American to compete with it, so that these do not sell, save in rare instances. Very little, if any, will be imported this year. Quotations are for car lots, f.o.b., Montreal. Canadian cement is readily available at $1.40 to $1.50 per 350-lb. bbl., in 4 cotton bags, adding 10c. for each bag. Good bags re-purchased at 10c. each. Paper bags cost 2½c. extra, or 10c. per bbl. weight.

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 ⅜-base; tire steel, $1.95 for 1 x ⅜-base; toe calk steel, $2.40; machine steel, iron finish, $2.10; smooth finish, $2.75.

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, 35c. per roll of 400 square feet; No. 2, 35c.; dry sheathing, No. 1, 45c. per roll of 400 square feet, No. 2, 28c. (See Roofing; also Tar and Pitch).

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

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

Copper.—Prices are firm at the recent decline to 13¾ to 14c.

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 strentgh, 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 eHad, $4.40; Comet, $4.25; Gorbal's Best, $4.25; Apollo, 10¾ oz., $4.35. Add 25c. to above figures for less than case lots; 26-gauge is 25c. less than 28-gauge. American 28-gauge and English 26 are equivalents, as are American 10¾ oz., and English 28-gauge.

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

Iron.—The outlook is steady. The following prices are for carload quantities and over, on cars, Montreal, delivery from dock being 35c. less;

GREAT BRIDGE OPENED.

The new Queen's Borough bridge, connecting New York and Long Island City, was opened recently. Thousands of people and a long procession of automobiles gathered at either end of the bridge, all anxious to be first over after Mayor George B. McClellan, accompanied by several of the city officials, had crossed the 7,749 foot roadway in an automobile.

A number of newsboys beat everybody, but the mayor in running from Manhattan to Queen's Borough was as fast as the boys could sprint.

The formal opening will be held on June 12th. A $20,000 fund has been raised for the celebration.

The new bridge in many ways is a remarkable structure, of the cantilever type. It cost about $15,000,000, and has been about ten years in building. There are five spans, the longest of which is 1,182 feet, that being the longest span in America and one of the longest in the world. The height of the floor above the East River is 135 feet, which permits the largest ships to pass under it.

The bridge has a capacity which exceeds that of any other in the world. It is a double-decker, with two sixteen feet promenades and room for the elevated car tracks on the upper floor. The main roadway is 56 feet wide.

Canadian pig, $18.50 per ton, Montreal; No. 1 Summerlee, $18.75 to $19; selected Summerlee, $18.25 to $18.50; soft Summerlee, $17.75 to $18; Clarence, $17 to $17.25 per ton.

Laths.—See Lumber, etc.

Lead.—Prices are about steady, at $3.60 to $3.70.

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 poor, 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: ¼-inch, $5.50 with 63 per cent. off for black, and 48 per cent. off for galvanized; ⅜-inch, $5.50, with 59 per cent. off for black and 48 per cent. off for galvanized. The discount on the following is 69 per cent. off for black and 50 per cent. off for galvanized; ½-inch, $8.50; ¾-inch, $11.50; 1-inch, $16.50; 1¼-inch, $22.50; 1½-nch, $27; 2-inch, $36; 2½-inch, $57.50; 3-inch, $75.50; 3½-inch, $95; 4-inch, $108.

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, 70c. per roll; three-ply, 95c. per roll of 100 square feet. (See Building Paper; also Tar and Pitch).

Rope.—Prices are steady, at 9c. per lb. for sisal, and 11c. for Manila. Wire rope, crucible steel, six-strands, nineteen wires; ¼-in., $2.75; 5-16, $3.75; ⅜, $4.75; ½, $6; ⅝, $7.25; ¾, $8.50; ⅞, $10; 1-in., $12 per 100 feet.

Spikes.—Railway spikes are in dull demand and prices are steady at $2.30 per 100 pounds, base of 5½ x 9-16. Ship spikes are also dull and steady at $2.85 per 100 pounds, base of ⅝ x 10-inch, and ⅝ x 12-inch.

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

Steel Plates.—The market is steady. Quotations are: $2.15 for 3-16; $2.25 for ⅛, and $2.15 for ¼ andthicker; 12-gauge being $2.30; 14-gauge, $2.15; and 16-gauge, $2.10.

Telegraph Poles.—See lumber, etc.

Tar and Pitch.—Coal tar, $3.75 per barrel of 40 gallons, weighing about 500 pounds; roofing pitch, No. 1, 90c. 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 unchanged, at 32 to 32½c.

Zinc.—The tone is steady, at 5½ to 5¾c.

* * * *

Winnipeg, Manitoba, April 27th, 1909.

The Western market conditions are in splendid shape and the demand continues to grow for all lines of builders' supplies. A report comes from British Columbia that the price of shingles is likely to advance 10 cents.

This increase, it is stated, has been expected for some time by the trade, as the demand has been very great during the past two or three weeks, and a conference of the owners of the large producing mills in Vancouver have practically decided to make this advance. Other quotations are stationary, and as we have mentioned before, there is very little variation in price on the Western market.

The building conditions are in splendid shape in Winnipeg although the weather during the past week has been a little backward and cold. Reports come from the country that the activity is just as brisk as in the city.

The contract has been let for the large Transcontinental Railway bridge at Winnipeg, across the Red River, to Hanley, Quinlin and Robertson for the substructure, and to the Dominion Bridge Company, for the superstructure. Contract price for the former is $265,000, and for the latter $240,000.

Local market prices are as follows:—

Anvils.—Per pound, 10 to 12½c.; Buckworth anvils, 80 lbs., and up, 10¼c.; anvil and vice combined, each, $5.50.

Bar Iron.—$2.50 to $2.60.

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

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

Bricks.—$11, $12, $13, per M, three grades.

Cement.—$2.25 to $2.50 per barrel, in cotton bags.

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

Dynamite.—$11 to $13 per case.

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

Hinges.—Heavy T and strap, per 100 lbs., $6 to $7.50; light, do., 65 per cent.; screw hook and hinge, 6 to 10 inches, 5¼c. per lb.; 12 inches up, per lb., 4¾c.

Iron.—Swedish iron, 100 lbs., $4.75 base; sheet, black, 14 to 22 gauge, $3.75; 24-gauge, $3.90; 26-gauge, $4; 28-gauge, $4.10. Galvanized—American, 18 to 20-gauge, $4.40; 22 to 24-gauge, $4.65; 26-gauge, $4.65; 28-gauge, $4.90; 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—

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, $24.50; No. 1 clear cedar, 6-inch, 8 to 16 ft., $60; Nos. 1 and 2 British Columbia spruce, 6-inch, $55; No. 3, $45.

NEW INCORPORATIONS.

(Continued from Page 7)

Rigaud, Que.—La Raquette Waterworks, $45,000; J. H. Redpath, J. J. Riley, A. DeL. McDonald.

Cobalt, Ont.—Northern Canada Supply Co., $100,000; A. C. Bedford-Jones, R. W. Hart, T. S. Webb.

Sherbrooke, Que.—Eastern Canada Mines Company, $500,000; C. E. Kennedy, G. R. E. Kennedy, J. A. Tate.

St. Jean-Baptiste de la Pointe-aux-Trembles, Que.—Aqueduc Pointe-aux-Trembles, Incorporee, $20,000; J. A. Gagnon, C. E. Gagnon, A. Lobel, Montreal.

Quebec, Que.—Frank Carrel Co., $200,000; F. Carrel, G. M. Fairchild, Hon. C. E. Dubord. J. M. Landry, $20,000; J. M. Landry, P. Lefrancois, P. Dubeau.

Outremont, Que.—Beaver Oil Co., $49,000; W. V. Henderson, St. Louis; M. R. McKenzie, Outremont; H. J. Henderson, St. Louis.

Montreal.—Trench Electric Blasting Fuse Company, $20,000; L. A. Robertson, W. W. Rathie, W. T. Woodall. Liddell Lesperance & Co., $190,000; R. M. Liddell, F. G. Bush, G. R. Brennan. Bisco-Gowganda Transport Co., $150,000; L. O. Armstrong, R. L. Prieur, A. Geoffrion. Pulp Screening Reduction Co., $150,000; E. F. Surveyer, A. Chase-Casgrain, J. W. Weldon.

Toronto.—Auto Falcon & Waite Die Press Co., $50,000; J. C. Palmer, H. N. Baird, W. Lawless. Canadian Mineral Rubber & Paving Co., $1,500,000; J. S. Lovell, W. Bain, R. Gowans. Superior Steel Co., $250,000; R. W. Hart, T. S. Webb, A. C. Bedford-Jones. Algoma Lumber & Chemical Co., $300,000; A. G. Ross, M. L. Gordon, W. S. Edwards. Cobalt Commercial Mines, $300,000; I. Bucknall, Toronto; S. B. Bisbee, Beamsville; J. Dunkin, London.

WHERE TO BUY

An Engineering Trades Directory.

FOR INDEX TO ADVERTISERS SEE PAGE 3.

Air Compressors
Mussens Limited, Montreal, Que.
Reavell & Co., Ltd., J. F. B. Vandeleur, agent, Toronto, Ont.

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

Arc Lamps
Northern Electric & Mfg. Co., Limited Montreal, Que.

Automatic Railways
Babcock & Wilcox, Ltd., Montreal.

Bars, Steel
Priddle, Arthur, San Francisco, Cal.

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

Belting
McLaren, D. K., Ltd., Montreal, Que.
McLaren Belting Co., J. C., Montreal.

Boilers, Marine, Stationary and Water Tube
Babcock and Wilcox, Ltd., Montreal.
Petrie, H. W., Ltd., Toronto, Montreal, Vancouver.

Bonding for Concrete
Canada Wire Goods Mfg. Company, Hamilton, Ont.
Priddle, Arthur, San Francisco, Cal.

Books, Technical
John A. Hart & Co.

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

Bridges, Roof Trusses, etc.
Canadian Bridge Company, Ltd., Walkerville, Ont.
Cleveland Bridge & Engineering Co., Ltd., Darlington, Eng.
Dominion Bridge Co., Ltd., Montreal.
Hamilton Bridge Works Co., Ltd., Hamilton.
Manitoba Bridge & Iron Work, Ltd., Winnipeg, Man.
Pennsylvania Steel Co., Steelton, Pa.
Stewart, James A., Hamilton, Ont.
Structural Steel Co., Ltd., Montreal, Que.

Buckets (Clam Shell, Coal and Concrete)
Mussens Limited, Montreal, Que.

Cableways
Mussens Limited, Montreal, Que.

Car Hauls (Wire Cable and Chain)
Jeffrey Mfg. Co., Montreal, Que.

Cement, Machinery
Mussens Limited, Montreal, Que.

Coal Cutters
Jeffrey Mfg. Co., Montreal, Que.

Coal Crushers
Babcock & Wilcox, Ltd., Montreal.

Coal Handling Machinery
Northern Engineering Works, Detroit, Mich.

Coal Tipples and Screens
Jeffrey Mfg. Co., Montreal, Que.

Contractors
Cleveland Bridge and Engineering Co., Ltd., Darlington, Eng.

Concrete Mixers
Mussens Limited, Montreal, Que.
Rogers Supply Company, Toronto.

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

Conveyors
Babcock & Wilcox, Ltd., Montreal.
Jeffrey Mfg. Co., Montreal, Que.

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WHERE TO BUY.

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Cranes
Advance Machine Works, Ltd., Walkerville, Ont.
Dominion Bridge Co., Ltd., Montreal.
Mussens Limitied, 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.
Manitoba Bridge & Iron Work, Ltd., Winnipeg, Man.
Mussens Limited, Montreal, Que.
Northern Engineering Works, Detroit, Mich.
Structural Steel Co., Ltd., Montreal, Que.

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

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

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

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

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

Dynamos
Laurence Scott & Co., Ltd. (J. F. B. Vandeleur, agents, Toronto, Ont.)
Northern Electric & Mfg. Co., Limited, Montreal, Que.
Toronto & Hamilton Electric Co., Hamilton, Ont.

Economizers
Babcock & Wilcox, Ltd., Montreal.

Electric Apparatus
Hill Electric Mfg. Co., Montreal, Que.
Northern Electric & Mfg. Co., Limited, Montreal, Que.
Toronto & Hamilton Electric Co., Hamilton, Ont.

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

Elevators
Jeffrey Mfg. Co., Montreal, Que.
Northern Engineering Works, Detroit, Mich.

Engineers, Consulting
Barber, F.
Beaubien, Gaspe de, Montreal.
Cleveland & Dutcher, ancouver, B.C.
Francis, W. J., Montreal, Que.
Fuce, Ed. O., Galt.
Gagne & Jennings, Toronto, Ont.
Haffner, H. J., Calgary, Alta.
Metcalf Engineering Co., Ltd., Montreal, Que.
Mitchell, C. H., C.E., Toronto, Ont.
Nold, Henry N., Hamilton.
Rebbeck, J. R., Victoria, B.C.
Richmond, J. Stanley, Toronto.
Standard Inspection Bureau, Limited, Toronto, Ont.

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

Engines
Canadian Buffalo Forge Co., Montreal and Toronto.
Mussens Limited, Montreal, Que.
Northern Engineering Works, Detroit, Mich.
Reavell & Co., Ltd. (J. F. B. Vandeleur, agent, Toronto, Ont.)
Petrie, H. W., Ltd., Toronto, Montreal, Vancouver.

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

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

Fence, Fencing, Wire
Owen Sound Wire Fence Co.

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

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

Foundry Supplies
Mussens Limited, Montreal, Que.

Generators, Alternating and Direct Current
Northern Electric & Mfg. Co., Limited, Montreal, Que.
Toronto & Hamilton Electric Company, 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.

Locomotives (Electric)
Jeffrey Mfg. Co., Montreal, Que.

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

Motors
Fleming Aerial Ladder Co., Ltd., Toronto, Ont.
Laurence Scott & Co., Ltd. (J. F. B. Vandeleur, agent, Toronto, Ont.)
Mussens Limited, Montreal, Que.
Northern Electric & Mfg. Co., Limited, Montreal, Que.
Toronto & Hamilton Electric Company, 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
Lindsley Bros. Co., Spokane, Wash.

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

Posts
Lindsley Bros. & Co., Spokane, Wash.

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

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

Prison Work
Canada Wire Goods Mfg. Company, Hamilton, Ont.

Pulleys
Mussens Limited, Montreal, Que.

Pumps—Steam and Power
Canadian Buffalo Forge Co., Montreal and Toronto.
Mussens Limited, Montreal, Que.
Petrie, H. W., Ltd., Toronto, Montreal, Vancouver.
Reavell & Co., Ltd. (J. F. B. Vandeleur, agent, Toronto, Ont.)
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.

Reinforcing Materials
Canada Wire Goods Mfg. Company, Hamilton, Ont.
Priddle, Arthur, San Francisco, Cal.

Rock Crushers
Mussens Limited, Montreal, Que.

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

Screens
Canada Wire Goods Mfg. Company, Hamilton, Ont.

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

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

Sewer Pipe
Hamilton & Toronto Sewer Pipe Co.

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

Shovels, Steam
Mussens Limited, Montreal, Que.

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

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

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

Ties, Railroad
Lindsley Bros. Co., Spokane, Wash.

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

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

Transformers
Toronto & Hamilton Electric Company, Hamilton, Ont.

Transmission Machinery
Mussens Limited, Montreal, Que.
Toronto & Hamilton Electric Company, Hamilton, Ont.

Trucks
Northern Engineering Works, Detroit, Mich.

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

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

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

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

Wirework
Canada Wire Goods Mfg. Company, Hamilton, Ont.