THIS ISSUE CONTAINS { Concrete Roadways
Sanitary Review

Canadian Engineer

A WEEKLY JOURNAL

For CIVIL, MECHANICAL, ELECTRICAL and STRUCTURAL ENGINEERS and CONTRACTORS

MONTREAL OFFICE:
B 33 Board of Trade Building

WINNIPEG OFFICE:
315 Nanton Building

Vol. 16. Toronto, Canada, June 4, 1909. No. 23.

BUYERS' REFERENCE—PAGE 54.

INDEX TO ADVERTISEMENTS.

* Every Other Week † Once a Month

CONSULTING ENGINEERS

J. S. Armstrong
CONSULTING ENGINEER, M. CAN. SOC. C. E.
HARBOURS AND TERMINALS
RE. CONCRETE & TECHNICAL LAW CASES
15 WALKER BUILDING, ST. JOHN, N. B.

WALTER J. FRANCIS, C.E.
Consulting Engineer
SOVEREIGN BANK BUILDING
MONTREAL
MEMBER CANADIAN SOCIETY CIVIL ENGINEERS
MEMBER AMERICAN SOCIETY CIVIL ENGINEERS

EDWARD B. MERRILL
B.A., B.A. Sc., Mem. Can. Soc. C.E. Mem. A.I.E.E.
ENGINEER
Power Developments and Transmission. Electric Lighting, Electric Railways, Municipal Engineering, Industrial Plants, Reports, Valuations, Etc.
LAWLOR BUILDING, TORONTO, AND 305 FORT ST., WINNIPEG.

FRANK BARBER
YORK COUNTY ENGINEER
Steel and Reinforced Concrete Bridges
Plans and estimates furnished. Contracts, Specifications and Agreements drawn.
Municipal Bld'g, 57 Adelaide St. E.
Phone M. 1664 **TORONTO**

EDW. O. FUCE
Hon. Grad., Univ. Tor. (S.P.S.)
A. M. Can. Soc. C. E. Ont. Land Surveyor
CIVIL ENGINEER
GALT ONTARIO
REINFORCED CONCRETE STRUCTURES
SEWERAGE, SEWAGE DISPOSAL, WATER WORKS

Charles H. Mitchell
Percival H. Mitchell
Consulting and Supervising Engineers
Hydraulic, Steam and Electric Power Plants
Industrial, Electrical & Municipal Engineering
Traders Bank Building, Toronto

A.M.C.S.C.E. *Ass.A.I.E.E.*
DeGASPE BEAUBIEN
B. Sc.
CONSULTING ELECTRICAL ENGINEER
Liverpool & London & Globe Bldg., MONTREAL

Gagné & Jennings
Consulting and Constructing
ENGINEERS
Lawlor Building, - TORONTO
PHONE MAIN 717

H. J. BOWMAN, M. Can. Soc. C. E.
A. W. CONNOR, B.A., C.E., A.M. Can. Soc. C.E
BOWMAN & CONNOR
Consulting Municipal and Structural Engineer
Waterworks, Sewerage and Electric Plants
Concrete and Steel Bridges and Buildings
CEMENT TESTING
36 Toronto St. Toronto, Tel. Main 5724.
Branch Office, Berlin, Tel. 112B.

GALT & SMITH,
Consulting Engineers
Waterwork, sewerage and sewage disposal. Electric Lighting, steam and water powers, consultations, examinations and reports.
JOHN GALT, C. E. OWEN W. SMITH,
Mem. Can. Soc. C.E. Assoc. Mem, Can, Soc. C.E.
Office : **23 Jordan St. Toronto.** Phone M. 3488.

TELEPHONE MAIN 4652
T. AIRD MURRAY, C.E.
CONSULTING ENGINEER
SEWERAGE—SEWAGE DISPOSAL
WATER SUPPLY AND PURIFICATION
ASSOCIATED WITH
ANDREW F. MACALLUM, B.A.Sc., C.E.
612 CONTINENTAL LIFE BLDG., TORONTO, CAN.

CAMERON SEPTIC TANK Co.
CONSULTING ENGINEERS
Sewage Disposal
MONADNOCK BLOCK, CHICAGO, Ill.
SAN FRANCISCO : 528 Monadnock Bldg.

Superintends Construction and Repairs
20 Years' Experience
JOHN W. GERELL
Canadian Representative
ROBERT STEPHENSON & CO., Ltd.
Shipbuilders, Hebburn-on-Tyne
Consulting Engineer **Naval Architect**
Designs, Specifications and Estimates for all classes of Marine Vessels and Machinery
Phone M. 6555 TORONTO 43 Victoria Street

HENRY N. NOLD
A. M. AMER. INST. E. E.
Consulting Electrical and Mechanical Engineer
Provident & Loan Chambers, Hamilton, Canada
Examinations, Estimates, Reports, Plans, Specifications and Supervision of Hydro-Electric Power Developments, Lighting, Railway Industrial and Power Installations, Power Transmission, Etc.

E. A. CLEVELAND, D. L. S., B. C. L. S. M. AM. INST. M.E.
H. K. DUTCHER, M. SC. A. M. CAN SOC C E.
CLEVELAND & DUTCHER
Civil, Hydraulic and Electrical Engineers Surveyors
Suite 40-41 Flack Block **VANCOUVER, B.C.**

H. J. HAFFNER, B.Sc.
Assoc. Member Can. Soc. C.E.
Irrigation and Hydraulic Engineer.
British Columbia and Alberta.
Box 1667, **Calgary, Alta.**

Telegraphic Address "Rebbeck" Telephone 1068
JAMES K. REBBECK
CONSULTING & MECHANICAL ENGINEER AND NAVAL ARCHITECT
Designs of steamers. Designs of engines, boilers and machinery. Reports and surveys.
32-33 Board of Trade Bldg. Victoria, B.C.

WILLIS CHIPMAN
Civil Engineer
Speciality: Municipal Engineering Works.
TORONTO WINNIPEG SASKATOON

R. S. LEA & H. S. FERGUSON
ENGINEERS
Water Supply, Sewerage, Water Power Development and Transmission, Steam Power Plants, Pulp and Paper Mills, Examinations and Reports.
405 Dorchester St., West, MONTREAL
Telephone Long Distance Uptown 751

J. STANLEY RICHMOND
CONSULTING ENGINEER
Power Plants and Expert Electrical Questions; City and Suburban Railways; Iron, Steel, Fuel and Gas Chemistry; Mechanical and Mining Engineering; Factory Systemization; Building Materials.
34 VICTORIA STREET, TORONTO
TEL. MAIN 5240. CABLE ADDRESS "TROLLEY"

C. J. FENSOM
B.A. Sc.
CONSULTING ENGINEER
Aberdeen Chambers, Toronto. PHONES { Res., N. 2967 Office, M. 1923
Machinery designed, supervised, inspected and contracted for. Tests, Reports, Electric Light Plants, Power Plants, Pumping Plants.

ANDREW F. MACALLUM, C. E.
Consulting and Constructing Engineer.
Steam and Electric Railways.
Hydraulic, Industrial and Mining Plants,
Rooms 612-14 CONTINENTAL LIFE
Tel. Main 4652. BLDG. TORONTO

J. M. SHANLY
M. CAN. SOC. C. E. M. AM. SOC. C. E.
CIVIL ENGINEER
Room 310, Board of Trade
MONTREAL
RAILWAYS, BRIDGES, FOUNDATIONS, HYDRAULIC WORKS

J. EDGAR PARSONS, B.A.
BARRISTER
Rooms 53 and 54 Canada Permanent Bldg.
18 Toronto St. - TORONTO
Tel. Main 2306

A. & E. LOIGNON, C. E.
17 Place d'Armes Hill, Montreal
Reinforced Concrete Constructions, Fireproof Warehouses, Factories, Etc., Steel Structures, Water Power.
Designs and Superintendence of Work.

SMITH, KERRY & CHACE
ENGINEERS
Hydraulic, Steam, Electric, Railway, Municipal, Industrial.
W.U. Code used. Cable Address "Smithco."
TORONTO WINNIPEG CALGARY
Cecil B. Smith J. G. G. Kerry W. G. Chace.

The Canadian Engineer

WEEKLY

ESTABLISHED 1893

VOL. 16. TORONTO, CANADA, JUNE 4th, 1909. No. 23

The Canadian Engineer

ESTABLISHED 1893.

Issued Weekly in the interests of the

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

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

Present Terms of Subscription, payable in advance:

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

ADVERTISEMENT RATES ON APPLICATION.

HEAD OFFICE: 62 Church Street, and Court Street, Toronto
TELEPHONE, Main 7404.

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

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

Address all communications to the Company and not to individuals.
Everything affecting the editorial department should be directed to the Editor.

NOTICE TO ADVERTISERS

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

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

TORONTO, CANADA, JUNE 4, 1909.

CONTENTS OF THIS ISSUE.

NICKEL STEEL FOR THE QUEBEC BRIDGE.

Once more the plans of the Quebec Bridge are being discussed, and this time it is suggested that nickel steel be largely used in its construction.

Canada has the nickel, possessing the most important nickeliferous ore deposits in the world, and if nickel is a suitable material for this work—long-span bridges—it is to be hoped it will be used, for nothing else that we can think of will emphasize so well the value of our nickel deposits.

In Proceedings No. 7, Vol. XXXIV., of the American Society of Civil Engineers, J. A. L. Waddell discusses the use of nickel steel for bridges, and the results of his study, experiments and observations led him to have faith in this new building material for bridges, and to prepare a set of specifications to be used in connection with design and construction where such a material is used.

His experiments showed that nickel steel developed an ultimate tensile strength of almost 40,000 pounds per square inch over that of carbon steel. The tests for elastic limit and compression were if anything more favorable to this material.

It was also shown that nickel steel would stand the abuse to which bridge steel is subjected in the shop and on erection.

Mr. Waddell's experiments in connection with corrosion are of especial interest. Bars of nickel and carbon steels were placed side by side in weak solutions of sulphuric acid, in damp salt, in locomotive fumes, and in wet cinders, and the loss of weight during a given time was ascertained. It was found the carbon steel was about 75 per cent. better than nickel steel in the acid test, while in the other three tests the nickel steel showed up much superior. This was especially true of the salt test, and this is a matter of considerable interest in dealing with this particular problem.

Following Mr. Waddell's paper, Mr. Wm. Webster publishes in Vol. XXXV., No. 3, of the Proceedings of the same society an article on "Nickel Steel Eye-bars for Blackwell's Island Bridge." The eye-bars used in this structure were the largest ever manufactured. Tests and experiments are described, and it is concluded that nickel steel of from 95,000 to 110,000 pounds per square inch in tensile in the unannealed specimen, and of 90,000 pounds per square inch minimum tensile in the annealed specimen would give eye-bars with a minimum elastic limit of 50,000 pounds per square inch in full-sized test and guard against brittle steel.

The strength of nickel steel is nearly twice that of carbon steel. This will give a much lighter bridge and a corresponding decrease in stresses due to dead load, which should make a large saving in cost and ease in erection.

CORROSION OF IRON AND STEEL.

At the spring meeting of the Iron and Steel Institute of Great Britain the question of the preservation of iron and steel was dealt with in three papers.

Mr. W. H. Walker, in a paper entitled "The Electrolytic Theory of the Corrosion of Iron," said that his particular object was to discuss the fundamental conceptions involved in the modern electrolytic theory of the corrosion of iron, to show that the older carbonic acid

theory was included therein, and to point out the applications of the theory to the problem of corrosion as encountered in engineering practice. It was formerly believed that the action of oxygen as a factor necessary in corrosion was simply to oxide the iron ions, and thus to form rust. Its real accelerating effect was due, however, to the fact that it depolarized the hydrogen set free by the reaction, and separated out on the metallic iron.

Mr. Allerton Cushman in his remarks on the "Preservation of Iron and Steel" said that it was probable that the corrosion of all metals was more or less due to electro-chemical action, but that of iron differed from other metals in not being spread evenly over the surface, what was termed pitting being produced by local electrolysis. Carbonic acid was not, as had been imagined, the sole cause of the rusting of iron, but was only one of the factors in the hydrolysis which produced hydrogen ions. The rusting of iron was primarily due, not to attack by oyxgen, but by hydrogen in its ionized condition. Owing to these separate but co-ordinated functions of hydrogen and oxygen, the formation of rust could be inhibited by the addition to the water of certain oxidizing agents as well as by certain reducing agents, such as chromic acid and its soluble salts, and pyrogallol, which interfered with the function of the oxygen. Great dependence was placed upon the application of paint coatings, and it was along this line that the electro-chemical theories of corrosion appeared to find their most important application. The use of varnishes and bitumens recommended itself on account of the well-known insulating properties of such materials.

A SANITARY DEVICE FOR RAILWAY COACHES.

The Delaware, Lackawanna and Western Railroad have introduced the slot machine in their through trains. In every car a machine is installed which supplies drinking cups made of paraffine. The cups cost the passenger one cent, and is thrown away after using. The traveller will appreciate this thoughtfulness for his health. The principle of the scheme is good, and its many advantages will soon commend it to railway officials as well as the travelling public.

EDITORIAL NOTES.

Lethbridge, Alta., has inserted a fair-wage clause in city contracts, the minimum wage to be 27½ cents per hour.

* * * *

In referring to the reorganization of the Colonial Portland Cement Co., of Wiarton, by some perversity we used the word "Canadian" instead of "Colonial." We are sorry for the mistake, and hope it will not cause either company any inconvenience.

* * * *

Vancouver is to have another transcontinental line into their city—this time an American road. The Chicago and North-Western, a Vanderbilt road, with a trackage of 9,665 miles, is making preparations to reach the Pacific coast at two points, Seattle and Vancouver.

* * * *

It is a wonder someone would not commence cutting the red tape that is strung around so many Canadian City Halls. A contractor protested recently that two months after a contract had been awarded to another firm he could not get back his deposit cheque. This is a hardship, and such delays are unnecessary.

* * * *

The annual Summary Report for the calendar year 1908 of the Geological Survey, Ottawa, has recently been issued, and is now in the process of distribution. The volume contains a summarized account of the operations during the past season of this branch of the Department of Mines, and the results are of direct interest to the mining public in general.

* * * *

Now that the geodetic survey branch for Canada has been organized as a separate department it is to be expected the Government will be more generous, and thus provide for more parties and more rapid progress with the work. During the last four years triangulation has been in progress in the better settled parts of the Provinces of Ontario and Quebec, under the Astronomical Branch, the object of which is to determine with the highest attainable accuracy the position of points throughout the country and the lengths and directions of the lines, which may form the basis of survey for all purposes. The topographical and engineering surveys will assist in the survey work carried on by the Department of the Dominion Government, by the Provincial Government, and by the municipalities. The operations have also included a considerable length of lines of precise levelling.

DOMINION LAND SURVEYORS.

Below is a list of successful final candidates at the special examination, held by the Board of Examiners, for Dominion Land Surveyors, in May:—W. A. Begg, Hamilton, Ont.; A. P. C. Belyea, Edmonton, Alta.; G. H. Broughton, Paris, Ont.; T. W. Brown, Edmonton, Alta.; G. H. Ferguson, Toronto, Ont.; P. W. Greene, Toronto, Ont.; J. F. Hamilton, Lethbridge, Alta.; R. M. Hannon, London, Ont.; E. Harrison, New Liskeard, Ont.; J. A. Heaman, Winnipeg, Man.; G. Herriot, Souris, Man.; A. Lighthall, Vankleek Hill, Ont.; J. W. Pierce, Kingston, Ont.; D. F. Robertson, Ottawa, Canada; L. D. N. Stewart, Collingwood, Ont.

In the preliminary examination forty-six candidates were successful.

The examination was held at Ottawa, Montreal, Toronto, Winnipeg, Calgary, and Edmonton.

PERSONAL.

MR. DAVID F. CASHMAN has been appointed secretary to the Provincial Board of Stationary Engineers for Ontario.

MR. CARR-HARRIS, a Canadian engineer, who has charge of construction work on the northern division of the Canton Hankao Railway, is visiting Montreal.

MR. F. JOHN BELL has resigned as director and secretary-treasurer of the Canadian Crocker-Wheeler Company, Limited, Montreal. Mr. Bell has been connected with various engineering and commercial branches of the electrical business throughout Canada for many years.

OBITUARY.

MR. HENRY EARLE CURRY, resident engineer on the National Transcontinental Railway north of Port Arthur, was drowned during the week of May 22nd. Mr. Curry was formerly of Kingston, Ont.

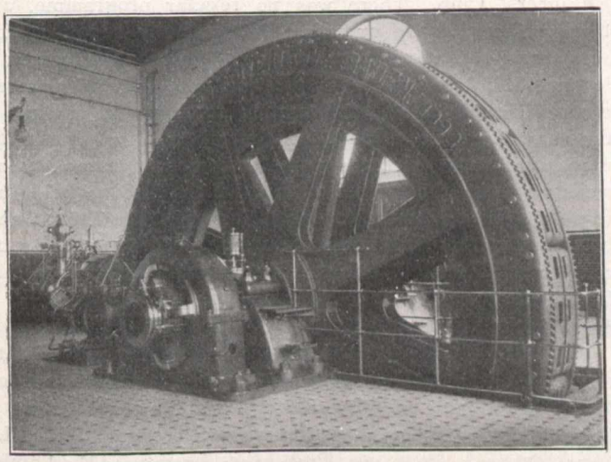
MR. CHAS. E. KILMER, of the firm of Kilmer, Pullen & Burnham, electrical engineers, Toronto, Ont., was accidently killed at Walkerton, Ont., May 19th. Some seven years ago Kilmer and Pullen entered into a partnership in Toronto and represented the General Electric Light Company of Sweden in Canada.

LT.-COL. JOHN BROWN RANKIN, K.C., of Chatham, Ont., Provincial Drainage Referee, died May 20th at the Lakeside Hospital, Cleveland. Col. Rankin was a native of Kent County for many years, and one of the foremost barristers in Ontario. He was appointed Provincial Drainage Referee when that office was instituted about 1892. He was over 60 years of age.

A TWENTY THOUSAND HORSE-POWER GERMAN MUNICIPAL STEAM TURBINE PLANT.

By Frank C. Perkins.

At the Stadt. Elektricitats-Werke at Frankfort-on-the-Main, Germany, there have been installed two 5,000 horse-power turbines and two other units of the same capacity have been ordered making an aggregate of 20,000 horse-power developed by this type of prime movers in this German Central Station. The accompanying illustration and drawings show the curve and tests of this plant and the steam turbine and the electrical equipment of the generator room and sub-station. The steam turbines each drive a Drehstroma generator of the Brown-Boveri type, having a capacity of 22,000 kilowatts, the speed being 1,360 revolutions per minute. The



1,032 Single Phase Alternator.

turbines are of the Brown-Boveri Parsons system, working with superheated steam at 135 pounds pressure and 300 degrees C. The governors are said to act very successfully, the speed variation being very small even with large changes in load, as shown in the accompanying curves, while the steam consumption varies from 6.5 kilograms (14.3) pounds per kilowatt hour to 7.54 kilograms (16.8 pounds) according to the load, temperature and pressure, about 10 kilograms (22 pounds) being the steam consumption at ¼ load.

The Frankfort station is provided with an engine room 86 meters (282 feet) long and 23 meters (75 feet) wide, the height being 10.5 meters (35 feet) from the floor level to the eaves. It is equipped with four 750 horse-power horizontal reciprocating engines and four 1,500 horse-power units of similar construction directly coupled with single-phase alternators constructed at Baden, Switzerland, by Brown, Boveri & Company. This will give a total output for the station of about 30,000 horse-power.

The boiler house is 128 meters (420 feet) long and 18 meters (59 feet) wide, an ash conduit being provided under the boiler house floor with a track communicating with an electric hoist for slag trucks, while a chimney is provided 50 meters (164 feet) high with an inside diameter at the top of 2.8 meters (9 feet) connected with the boiler by a main flue of 3.8 square meters (42 square feet) cross section. The piping cables, oil purifying apparatus and other auxiliary machinery is located in the basement, together with the step-down transformers for the electric light and power service in the station.

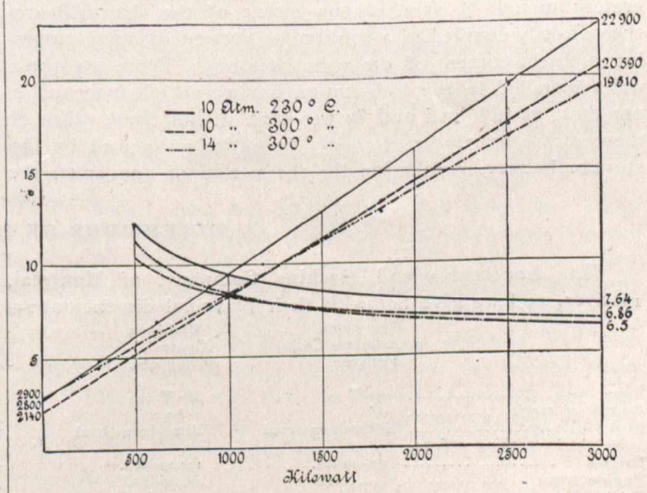
A long coal bunker has been provided the entire length of the boiler house 6 meters (20 feet) high and 11.5 meters (38 feet) wide, the total length being 120 meters (400 feet). The coal is supplied from this bunker to twelve internal flue boilers of the Kuhn type with Galloway tube, transverse drums and Tenbrink grates, together with six automatically fired water tube boilers of the Simonis-Alanz-Munkner construction. These boilers supplying steam to the reciprocating engine having heating surface of 86 square meters and a grate area of 1.98 square meters (22 square feet), the boilers being a trifle less than 9 meters (30 feet) in length. They supply a maximum of 27.5 kilograms (60 pounds) of dry steam per square meter of heating surface at 135 pounds pressure.

The water tube boilers have a heating surface of 310 square meters (1,500 square feet) and a grate area of 4.56 square meters (50 square feet). There are installed in the boiler house on the west side, six water tube boilers of the Steinmuller type having a heating surface of 311.5 square meters (3,461 square feet) equipped with a superheater of 72 square meters (800 square feet). There are four furnaces with each boiler equipped with electrically-driven automatic fuel feeding mechanism of the Leach type. The steam is superheated to 300 degrees C., and these boilers are said to give 9 kilograms (20 pounds) of steam at 150 pounds pressure per square inch for each square meter of heating surface per hour.

The four smaller reciprocating engines develop a maximum capacity of 750 brake horse-power at 85 revolutions per minute and are of the tandem compound type constructed at Stuttgart, Germany, by G. Kuhn, while the larger units develop 1,500 brake horse-power each as a maximum at 120 pounds initial pressure and 85 revolutions per minute. These horizontal engines were constructed by Sulzer Bros., of Winterthur, and are 13 meters (43 feet) in length with Sulzer valve gear and fly-wheels weighing 50 tons each and 6 meters (19.5 feet) in diameter. These engines have a stroke of 1.5 meters (5 fee), the high pressure cylinder being 975 mm. (3.2 feet) in diameter and the low pressure cylinders 1,250 mm. (3.2 feet) in diameter. The steam consumption per indicated horse-power is said to be 6.15 kilograms (13.5 pounds)at about half load or 705 brake horse-power and 6.54 kilograms (14.4 pounds) with a load of 1,408 horse-power.

The electrical generators of the single-phase type are of the revolving fly-wheel supplying a single-phase current of 3,000 volts pressure and a frequency of 25 periods per second. The large engines are directly coupled to Brown-Boveri alternators of 1,032 kilowatts each, while the smaller alternators generate a current of 522 kilowatts.

These alternators each have 64 pole with a copper strip conductor wound on edge, intermediate layers of paper being



Steam Consumption.

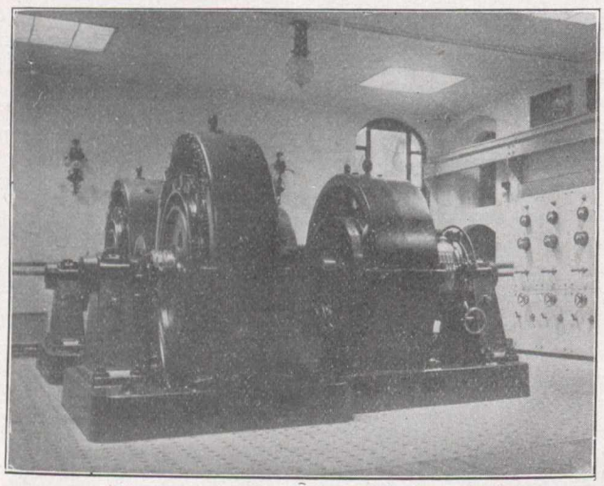
used for insulation. On the extended shaft of each alternator an exciter is mounted outside of the main bearing; these series dynamos utilized on the smaller unit supplying 180 amperes at 80 volts while the larger exciters connected with the large alternators are shunt wound machines and supply 280 amperes at 90 volts.

The electric lighting and power bus bars are arranged in two separate systems with main ammeters measuring the current for each system, concentric lead covered cables are used with iron armour, the primary as well as the secondary circuits being embedded in sand and covered with brick to a depth of 60 to 70 centimeters (24 ins. to 27.5 ins.). The step-down transformers are arranged in underground pits

and lower the pressure from 2,850 volts to 125 volts for distribution in the consumer's building.

For street railway service there is a motor generator sub-station at Schillerplatz connected with the power station by underground fedders together with other sub-stations of a similar character for supplying current for railway service in conjunction with a storage battery as a regulator.

The accompanying illustrations show the motor generator in the sub-station which is divided into two rooms, one for the storage battery and the other for the switchboard and motor generator, each being 20 meters (155 feet) long, .955 meters (31 feet) wide, and 5.6 meters (18 feet) high. The



Motor Generator Sets.

roof, walls and floor are of iron and concrete construction and the electrically-driven fans are utilized for ventilating purposes. The storage battery includes 276 Pollak cells, each having a capacity of 92 oampere hours at one hour discharge rate.

The motor generator equipment, as shown in the illustration, includes two units of 500 kilowatts each, operating at a speed of 340 revolutions per minute. These motor generators include a synchronous motor of the Brown-Boveri type directly coupled to a continuous current dynamo supplying a direct current of 550 volts pressure. There are three units installed in this sub-station having an efficiency of 91 per cent. at full load and 89 per cent. at half load. One of these motor generator sets may be entirely replaced by the storage batterv installation for the period of one hour, the accumulated plant being ordinarily used as a buffer to equalize the railway road and also for starting the motor generator set supplying a continuous current to the direct current dynamos which operate as motors until the units are up to speed and the motor is in synchronism.

It will be noted from the accompanying illustrations that a great saving is effected by using steam turbine units in floor area required, as four units of 5,000 horse-power each with a total output of 20,000 horse-power can easily be placed in the same space required for the reciprocating engines developing only 10,000 horse-power.

SOCIETY NOTES.

Engineers' Club, Toronto.

An informal smoker and business meeting, held May 20, closed the regular season's weekly gatherings of the Toronto Engineers' Club. There was no regular programme, and the members of the organization cheerfully supplied what songs and recitations there were. The season's course of lectures had been a most interesting one, and the members secured much valuable information through the reading of the various papers. About forty members were present last night, and most of these were local men. Arrangements were made for the annual outing, which is to be held July 16 next. Last year the engineers inspected the Trent Canal between Peterborough and Bobcaygeon. This year the same canal will be visited, but the district to be covered will be from Bobcaygeon to Lake Simcoe.

Royal Society of Canada.

The Royal Society of Canada at its concluding meeting May 27th, elected officers as follows: President, Rev. Dr. Geo. Bryce, Winnipeg; Vice-President, Prof. Ramsay Wright of the University of Toronto; Honorary Secretary, W. D. Lesueur, Ottawa; Honorary Treasurer, Lawrence M. Lambe, Ottawa.

Some interesting facts have been made public concerning the Honor Oak storage reservoir constructed for the Metropolitan Water Board, London, England, which has just been opened by the Lord Mayor. To start with the reservoir extends over an area of 28½ acres, and is the largest of its kind ever constructed at one time and under one contract. The actual water area is a little over ten acres. The number of bricks used in the construction is over sixteen millions, all made from material taken out of the excavations, and 20,200 tons of cement were needed. The total cost of the land and other expenses will amount approximately to $1,180,000. The work gave employment to an average of about 400 men.

DIMENSIONS OF NEW LOCOMOTIVES.

The Locomitive and Machine Company, of Montreal, Que., have recently received orders from five firms for locomotives, and we give herewith their principal dimensions:—

	Robertson Asbestos Co., 1 engine.	Michigan Central, 6 engines.	Michigan Central, 2 engines.	Michigan Central, 1 engine.	Intercolonial Coal Company, 1 engine.
Type	040 T 30	462 T 244	060-163	0100-274	244-T-04
Gauge of track	42"	4' 8-1.2	4' 8-1.2	4'-8-1.2	4' 8-1.2"
Fuel	Bituminous coal	Bituminous coal	Bituminous coal	Bituminous coal	Bituminous coal or screenings.
Weight in working order:—					
Drivers	25,000 lbs.	153,000 lbs.	163,000 lbs.	274,000 lbs.	73,500 lbs.
Engine truck	.....	44,000 lbs.	.....	.....	6,500 lbs.
Trailer	.....	47,000 lbs.	.....	.....	14,000 lbs.
Total	25,000 lbs.	244,000 lbs.	163,000 lbs.	274,000 lbs.	94,000 lbs.
Wheel base:—					
Driving	4' 6"	13' 0"	11' 6"	19' 0"	7' 0"
Total engine	4' 6"	33' 7½"	11' 6"	19' 0"	28' 2"
Total engine and tender	....	65' 8½"	42' 5-3.4"	54' 5-1.2"	.....
Valve gear	Stephenson	Walschaert	Stephenson	Walschaert	Stephenson
Cylinders	9 x 14	22 x 26	21 x 28	24 x 28	15 x 24
Driving wheels, diameter	29"	75"	57"	51"	44"
Boiler:—					
Type	Straight top	Straight top	Straight top	Straight top	Straight top
Diameter	29-7.8	72-1.16	67-3/8	80"	46"
Pressure	150 lbs.	200 lbs.	180 lbs.	210 lbs.	160 lbs.
Fire box	34 x 23¾	108-1.8 x 75-1.2	72-1/8 x 65-1/4	108-1/8 x 73-1/4	75 x 55-1/4
Tubes	56 1¾ diameter 7' 4¾" long	394 2" diameter 21' 0" long	308 2" diameter 16' 0" long	447 2" diameter 10' 0" long	146 1-3/4" diameter 1' 6" long
Dia. & length dr. jrnls.	4-¾" x 6	10 x 12"	9' x 12"	Main 10½ x 12" Others 9½ x 12	7½ x 9"
Brakes	Steam	Westinghouse American	do.	do.	Steam
Capacity of tank	325 U.S. gallons	7,000 U.S. gallons	5,100 U.S. gallons	8,000 U.S. gallons	1,200 U.S. gallons
Coal capacity	300 lbs.	12 tons	7-1.2 tons	12 tons	2-1/2 tons
Style of tender truck	.....	4 wheel arch bar	4 wheel	4 wheel	.....
Diameter of tender truck	.....	36"	33"	33"	.....
Tender journals	.....	5-½ x 10	5' x 9"	5-1/2 x 10"	.....

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

THE SANITARY ENGINEER.

At the present day we may distinguish the following divisions of engineering, viz. :—

Military Engineering,	Electrical Engineering,
Railroad Engineering,	Gas Engineering,
Hydraulic Engineering,	Fire-protection Engineering,
Marine or Naval Engineering,	Municipal Engineering,
	Sanitary Engineering,
Bridge Engineering,	Landscape Engineering,
Mechanical or Steam Engineering,	Architectural Engineering,
	* Irrigation Engineering.
Mining Engineering,	

Perhaps the only individual who is supposed to have a knowledge of all of the above subjects is the town engineer.

The average alderman may at any time plump a question bearing on any of the above subjects, and if the unsuspecting and unprepared town engineer does not answer straight he is generally judged incompetent.

It is impossible for any one man to acquire a useful and practical knowledge of all these branches; hence we find that when good and thorough work is demanded the services of the specialist are called for.

The man in the street is getting suspicious of the engineer whose advertised list of proficiencies is almost as long as his years of service.

The sanitary engineer is among the most modern of the various branches. He has been called into being by a wider knowledge of the importance of public health problems. The term, however, carries with it various degrees of qualifications. The real estate man and the plumber all at times aspire to the title of sanitary engineer. The laying down of a drain, or the testing of a drain with a smoke test; the conception of a well and a hand-pump to raise the water to a cistern may in themselves be sufficient basis for an attractive advertisement offering services as a "consulting sanitary engineer."

A recent publication, to be reviewed next week, entitled "Sanitation and Sanitary Engineering," should have the effect of installing even in the minds of many so-called sanitary engineers that there is more in the subject than ever dreamt of in their philosophy.

Sanitary engineering problems are to such an extent affected by branches of sciences, such as organic chemistry and bacteriology, that it is a question whether it is not advisable that a special training is necessary of a particular character not necessary to the bridge, railway or electric man.

Up to the present we find that some of the most successful sanitary engineers have had almost exclusive early training as analytical chemists, while, on the other hand, it is recognized that the engineer cannot bring these various problems to a successful issue without the research work and collaboration of the chemist and bacteriologist. Many of the mistakes which have been made in the past are certainly due to this want of collaboration. What may be possible in the laboratory may not always be possible in practice. The laboratory calls for extreme exactitude, both in appliances and manipulation, producing results correspondingly efficient. Practice deals with all the elements of chance, and the continuously proven platitude, "It is human to err," producing results correspondingly inefficient. On the other hand, if the knowledge of the engineer guiding him as to design of construction and methods of application, is not on correct and scientific bases, he cannot hope for the maximum measure of success.

* From "Sanitation and Sanitary Engineering," by Gerhard.

THE PRACTICAL STERILIZATION OF WATER AND SEWAGE EFFLUENTS.*

By H. C. H. Shenton, M.S.E.

(Continued.)

There are several electrolysers for the production of hypochlorites. Roughly, the method of preparation is as follows: A solution of common salt—i.e., sodium chloride—is prepared and through this an electrical current is sent, with the result that the sodium chloride is split up into its component parts of sodium and chlorine. The chlorine is liberated at the electrode connected to the positive pole of the source of the electricity supply, and the sodium is also liberated at the electrode connected to the negative terminal. Chemists are not wholly agreed as to the exact detail of what takes place, but, for practical purposes, it may be said that the sodium and chlorine recombine with 1 part of oxygen to form hypochlorite, in which the chlorine is in a particularly active condition, and that this liquid contains a quantity of free chlorine and oxygen, and that it is valuable as a sterilizing agent in contact with organic matters, the oxygen present in the hypochlorite is liberated. Very minute quantities of the hypochlorite have to be used, and after the work of sterilization is effected, and the oxygen released, the available chlorine reverts to its inert form of sodium chloride.

Dr. Rideal, who has applied solutions from the Digby electrolyser to the treatment of tap and lake water for the elimination of algæ and confervoid growth, said, in a paper read at the Bristol meeting of the Royal Sanitary Institute: "This solution, besides having the advantage of cheapness, contains but little undecomposed sodium chloride, and consequently the final addition of chloride to the treated water is very small." In the case of tap water treated for conferva, "practically the only alteration in the chemical analysis is a reduction of the oxygen consumed figure, and an increase of the chloride from 2.1 to 2.4 parts per 100,000."

Hermite.

In a paper read before the Faraday Society in 1906, Mr. Charles V. Biggs described the Hermite plant installed by Dr. Alexander and in use at Poplar, and as this gives prices, it is of particular interest. The total space occupied by the electrolizing plant, including the tank, is 7 ft. by 7 ft. The capacity of the tank is about 215 gallons; the total head-room is 10 ft. During a run of eight hours, 108 gallons of hypochlorite solution, at a strength of over 4 grammes per litre (i.e., a 4 per cent. solution) are made. The tank is charged by placing in it 100 litres of a saturated solution of sodium chloride, and 20 litres of a saturated solution of magnesium chloride. To this is added as much water as is needed to

*Read before the Institute of Municipal Engineers.

bring the whole quantity up to 840 litres (185 gallons). The liquid flows from a pipe in the bottom of a tank, at the end of which is a ball valve, into a small flushing cistern at the side, in order to obtain an even flow; otherwise, as the tank emptied, the flow would be slower. Thence it flows through another pipe into a funnel leading to the first row of cells. The second pipe mentioned has a cock for regulating the flow. The flow adopted is 3½ pints (1.9 litres) per minute. This works out at 25 gallons (103.5 litres) per hour, or about 185 gallons (840 litres) in eight hours. The plant is designed to work at 15 amperes and a flow of 1.9 litres per minute. The manufacture of the hypochlorite solutions is carried on by a process which is practically automatic. For an output of 200 gallons per eight hours at 4 grammes per litre (a 4 per cent. solution) the capital cost, including buildings and fittings, would be about $2,000. With regard to running costs, the sodium chloride at $10 per ton, magnesium chloride at $25 per ton, 185 gallons of hypochlorite can be produced for $2.25—that is to say, 30c. for salt, 25c. for magnesium chloride, 60c. for electric current, and $1 for attendance and labor. Seeing that 185 gallons of a .4 per cent. solution of hypochlorite would contain 3.37 kilogrammes of available chlorine this plant produces sufficient hypochlorite to sterilize 180,000 gallons per diem, allowing 4 parts per 1,000,000 of available chlorine. The liquid thus produced is used at Poplar for disinfecting purposes, such as road watering. It should be observed that the objection formerly urged against this process, that the product was unstable, does not now hold. Such a plant as this would apparently serve a town with a population of 6,000.

Oxychlorides.

Dr. Rideal, in a paper read recently before the Faraday Society, described the oxychlorides process in use at Guildford. In this paper the results of very important experiments were given. It is to be noted that prices were not given in this paper, but there is enough evidence as to the approximate cost of the production of electrolytic hypochlorite for any one interested in the subject to come to some conclusion as to the cost of carrying out works similar to those recommended by Dr. Rideal. The first series of experiments made by Dr. Rideal in 1904 showed the efficiency of electrolytic hypochlorite as an oxidizer, deodorizer or germicide of sewages and effluents. Early experiments proved that if 1 part per 100,000 of available chlorine were added at the inlet of a branch pipe through which septic effluent were passing, at the rate of 1,000 gallons per hour, the pipe being 40 ft. long and 2½-in. bore, the liquid would be deodorized in passing through the pipe. "At the commencement a strong foul odour existed at the receiving chamber. The liquid was deodorized in passing through the pipe, and in less than an hour the whole tank had lost its odour." A large number of other experiments showed, first, that it was possible to deodorize septic tank effluent without in any way interfering with subsequent filtration. It might have been expected that a sterilizing agent would have affected the bacteria in the filter-beds so as to lessen their action, but this was not found to be the case, even though very strong mixtures of hypochlorite and sewage were discharged on to the filter. The possibility of thus deodorizing sewage or killing the harmful germs in it by means of a sterilizing agent without interfering with subsequent filtration is a very important fact, for it is well known that the nuisance from septic tank effluents discharged on to filters is very great at many places, and in some cases, especially where brewery refuse is present in the sewage, it would be very beneficial if something could be done to do away with this nuisance. But a much more important fact was ascertained in these experiments—viz., that by the addition of hypochlorite to the tank effluent, clogging growths can be dissolved and washed speedily from filters. It was also found than an addition of strong hypochlorite would prevent the sprinkler from becoming clogged with growths, and it was also established that filters that have been thus treated quickly recover under normal conditions. It was proved that a filter can be successfully matured when hypochlorite is used in such quantities as are required for preventing aerial nuisance, and it even appeared that a bed could be thus matured at a quicker rate than with untreated tank liquor.

Ohio Experiments—Chlorine and Copper Sulphate.

The investigations of Kellerman, Pratt and Kimberley, for the Ohio State Board (United States Department of Agriculture, Bulletin No. 115, October, 1907), give economical results obtained with a solution of chloride of lime, and these investigators, together with Messrs. Phelps and Carpenter, already quoted, appear to have no doubt that more economical results are to be obtained by the use of hypochlorite produced by electrolytic methods, and it is to be hoped that the Ohio State Board will supplement these experiments with others, carried out with electrolytic hypochlorite. The experiments mentioned in the Ohio State report are of such interest that a brief summary with extracts in the present paper will not be misplaced. Copper sulphate experiments were made before the chlorine experiments, and it was clearly established that chlorine, even in the chemical form, was very much more economical than copper sulphate.

Copper Sulphate Experiments.

At St. Mary's of the Springs sewage from a school was treated, the population being about 175 persons. The sewage is discharged into two tanks operated in series. The tanks are 10 ft. in diameter and 6 ft. deep, the capacity of each being 3,050 gallons. The flow of sewage is about 12,000 gallons per diem; the sewage discharges from the second tank into a small brook. Dating from September, 1905, it has been the daily practice of the health department of the city of Columbus, Ohio, to apply copper sulphate to the sewage at the inlet of the second tank, the quantity of copper sulphate added daily being 6 lb., 3 lb. of which are introduced at 9 a.m. and the remainder at 3 p.m., roughly approximating to a concentration of 63 parts per 1,000,000. The copper sulphate in a dry state is placed in a perforated enamelled pail, which is lowered into the liquid at a point opposite the discharge pipe from the first reservoir. The copper sulphate remains here and is dissolved by incoming sewage. The treatment removed from 98.98 to 98.99 per cent. of the bacteria. With copper sulphate 6 cents a pound, and a daily sewage flow of 12,000 gallons, the expenditure for chemicals is 3 cents per 1,000 gallons; the labor cost is 25 cents per day; the annual cost of treatment equals $222.65, representing an investment of $4,500. This is distinctly a high price to pay for sterilizing the sewage, but, on the other hand, it must be remembered that the treatment is reduced to a minimum, and that poison from pathogenic germs is entirely prevented. Such treatment might be very useful in the case of a private house or institution polluting a river used for drinking-water purposes, and would, according to scientific data, be very much more efficient in preventing the possibility of disease than a much more elaborate system of filters. However, the idea of permitting even sterilized sewage to go into a stream is very objectionable, and there can be no doubt that it would be better to incur the cost of filtration works, and to pay less for the sterilization, seeing that a filter effluent could be sterilized at a much lower rate.

At Westerville, Ohio, the sewage plant comprises two small septic tanks, which discharge through an aërating device on to six primary contact filters, which in turn discharge on to two secondary filters. The plant, at the time the experiments were carried out, was operated continuously instead of upon the contact principle, which may account for the high rate of cost. The computed discharge is 41,000 gallons in 24 hours. "Copper crystals were dissolved in barrels connected in series. The solution in the barrels was conducted to an orifice box where, by means of a ballcock, a constant head was maintained upon an adjustable orifice. The quantity of copper sulphate used in each test was based upon the computed flow of 41,000 gallons of effluent in 24 hours." After passing through the orifice box the copper solution was discharged into a small storage reservoir at the same

point where the discharge from the sewage effluent orifice box was admitted; the rate of discharge was 0.5 gallon per minute. At the point of entrance of the sewage effluent and the copper solution there was placed a small longitudinal baffle serving to effect a thorough mixture of the chemical and the effluent. The storage period, or time of contact of sewage and copper sulphate, was slightly over one hour. On a basis of treating daily 41,000 gallons of effluent from the primary contact filters, the initial cost of the plant would be about $70. The cost of the chemicals would be about 82 cents, and the cost of labor about 50 cents per diem. The annual cost with copper sulphate at 6 cents a pound, and labor 25 cents an hour, would be $482.5; capitalized at 5 per cent. this would represent an investment of $9,650.

At the Boys' Industrial School, a State institution at Lancaster, Ohio, with a population of 1,100 persons, the sewage is treated on 23 sand filters, which receive screened crude sewage. The sewage flow averages about 160,000 gallons in 24 hours. At the outlet of the effluent drain a weir was constructed, having a length of 1 ft. and a height of 15 in. Over this the sewage effluent was caused to flow. Suitable means were provided for observing the elevation of water on the crest of the weir. The effluent drain discharged into a small brook in which a dam was constructed about 200 ft. from the weir. This improvised reservoir gave a storage period of from three to four hours, depending on the rate of flow from the filters. The quantity of copper sulphate applied was based on the sewage flow of 150,000 gallons. The rate of flow of the copper solution was practically constant at 75 gallons a minute. The daily application of copper sulphate to the Lancaster sand filter effluent, with its flow of 160,000 gallons a day, would require 17.3 pound of copper sulphate, and the cost of this chemical would be about $1.04 a day. The cost of constructing the Lancaster plant used in these experiments, and capable of treating the whole daily flow of 160,000 gallons, was $29. An estimate is given of the cost of a plant under practical conditions for continuous treatment of this flow as $92. The maintenance cost per annum would be $379.5 for copper sulphate at 6 cents a pound, labor (365 days) at $2 a day, equals $730, total $1,109.5; capitalized at 5 per cent. this would represent an investment of $22,000.

The sewage disposal plant at Marion, Ohio, is a combination of septic tanks, contact filters and sand filters, dealing with about 600,000 gallons of sewage daily. To provide a storage reservoir for the copper sulphate treated sewage a dam was built in the effluent sewer, about 900 ft. west of the disposal plant, and a cofferdam, composed of 6-in. sheathing, was constructed at the outlet of the effluent sewer in the creek into which it discharges. The exposed height of the sheathing was such that in all but extreme flood stages the effluent would discharge into the creek in a clear stream. The object of protecting the outlet of the effluent sewer was to prevent the sterilized sewage from becoming contaminated by the water in the creek, which, as it probably contained considerable quantities of domestic sewage, would have spoilt the tests. The storage or contact period of sewage effluent and copper sulphate was about one hour. The copper sulphate solution prepared in a solution tank of about 1,780 gallons capacity was discharged at the rate of 2 gallons a minute. The application of copper sulphate to the Marion sand filter effluent with a daily flow of 600,000 gallons, on a basis of applying 20 parts of copper sulphate to each 1,000,000 gallons of the effluent, would cost $6 a day for chemicals, and the cost of constructing a plant for applying the copper sulphate would be about $151. The cost of treatment annually, using copper sulphate, would be about $2,920; of this labor would be $730, and chemicals $2,190. Capitalized at 5 per cent. this would represent an investment of $58,000.

(To be Continued.)

To Keep Out Mosquitoes.—If a bottle of the oil of pennyroyal is kept uncorked in a room at night, not a mosquito, nor any other blood-sucker will be found there in the morning.

SEWAGE DISPOSAL.

REMOVAL OF SUSPENDED SOLIDS.

Chapter III.—Continued.

SLUDGE DISPOSAL.

Disposal of sludge by air drying or lagooning is a very popular method employed when there is not sufficient area of suitable land available for trenching the wet sludge.

By this method the sludge is either pumped from the sedimentation tank or allowed to gravitate to dug-out beds in the land adjoining the tanks. The beds are generally square excavations, each bed being equal to the sludge capacity of one of the tanks. The sides of the beds are sloped with the natural soil, and the bottoms filled in to a depth of about 9 inches with broken stone or clinker. Below the stone ordinary tile pipes are laid to drain the liquid to a well, from which it can be raised by a hand pump back to the sedimentation tank for treatment.

The moisture in the sludge can be reduced to about 60 per cent., or even more depending on the length of time allowed in the beds. When the moisture is reduced to 60 per cent. sludge becomes what is called "spadeable," that is, it can be dug out of the beds, loaded into carts and carried away to neighboring farms, without any nuisance to the roads from dripping.

The reduction of moisture takes place by two processes: (a) Evaporation and (b) drainage. With reference to (a) evaporation: The amount of evaporation depends entirely upon the area exposed to the atmosphere, so that the shallower the beds are the quicker the drying process will be. With reference to (b) drainage: This depends upon the size of clinker used at the base of the beds and the efficiency of the method of sub-drainage. The area which can be utilized for sludge beds, depends entirely upon the amount of land available, but wherever possible the depth of sludge layer should not exceed one foot.

Where beds can be provided at one foot in depth with 9 inches of broken stone as a base, and the beds well underdrained, the sludge will be spadeable in dry weather in 6 to 7 days. At a depth of 2 feet, it takes just about three times this period to provide a reduction of moisture equal to 30 per cent.

Assuming a case of a daily discharge of 1,000,000 gallons of sewage, depositing 10 tons of sludge at a moisture percentage of 90; we will consider the best form of bed arrangement to dispose of this sludge allowing duplicate sedimentation tanks, each emptied once every two weeks.

Such a sewage will deposit 70 tons per week or 70 tons to each tank per two weeks. Each tank having a sludge capacity below the depth at shallow end of 2,310 cubic feet.

The tanks would be emptied alternately, and at each process the beds must be ready to receive 2,310 cubic feet of wet sludge. It will generally be found that it is more convenient to provide two or more beds for each process rather than one large one. For the above case two beds each, 35 x 35 x 1-0 deep, would take just over the quantity. Two setts provided in duplicate would give just 14 days for drying, but as time is taken up in digging out the sludge and delay is caused by wet weather it is usual to provide twice the above number.

During severe weather and winter period it is necessary to run the tanks as septic tanks, unless the sludge beds are provided with a covering. The latter is always preferable, as tanks built on the continuous system are not of sufficient capacity for septic accumulation.

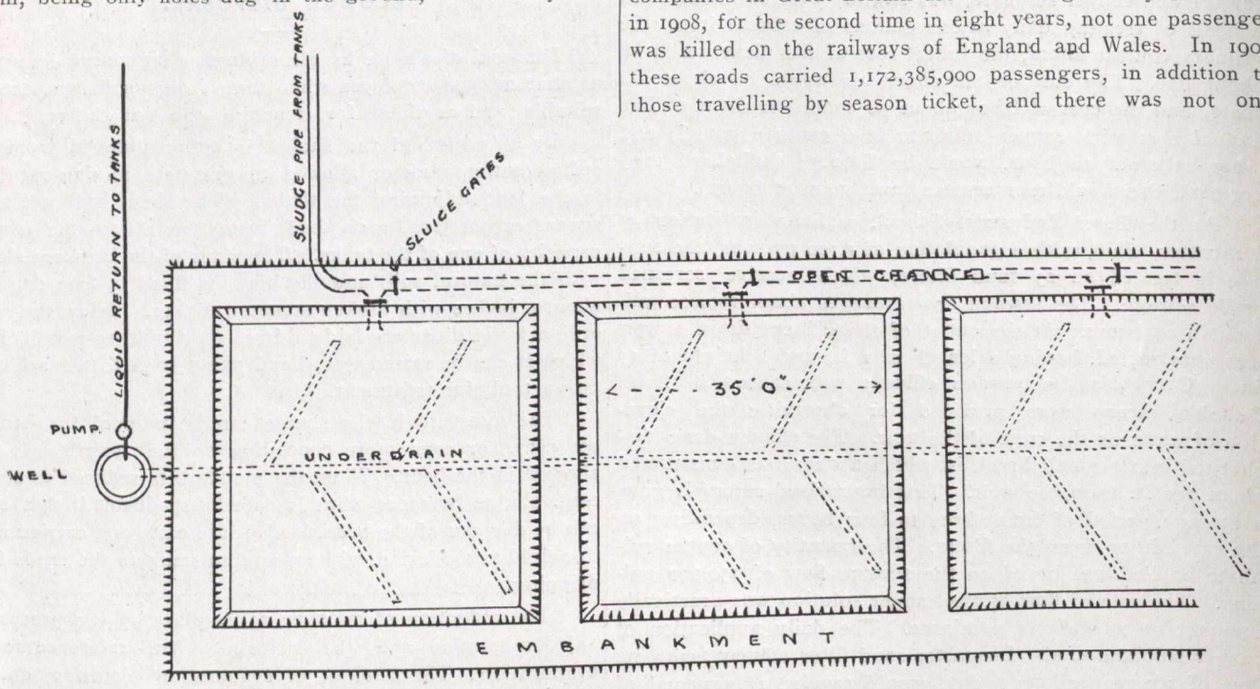
Referring to accompanying plan and section, the general lay out of well constructed sludge beds is shown. Here we have beds arranged that any two will take the accumulated discharge of sludge from 1,000,000 gallons daily discharge, representing a deposit of two weeks.

It is, of course, only necessary to pump back the liquid to the sedimentation tanks when further filtration of the

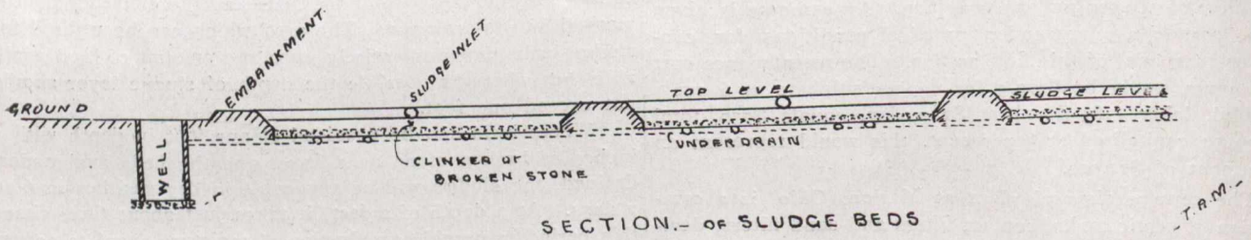
liquid is required. In cases where only removal of solids is required, the liquid from the sludge beds may be allowed to discharge into the same source as the tank effluent, without further treatment. A hand pump will be found quite sufficient to deal with the liquid in the well.

In many cases sludge beds are made in a very rough form, being only holes dug in the ground, without any consideration given either to drainage or surface exposed for evaporation. It is in such cases that it is generally found impossible to dry the sludge, and much nuisance is caused in the attempted operation. If care and thought be given to this part of sewage disposal, the trouble attending sludge disposal will be to a great extent avoided.

(To be Continued.)



PLAN OF SLUDGE BEDS.



SECTION OF SLUDGE BEDS

T.A.M.

THE SEPTIC TANK PATENTS.

The Cameron Septic Tank Company have made a claim against London (Ontario) for royalty payments in connection with tanks recently installed. London is not the only town which has heard recently from the company. The city of Hamilton, town of Berlin, and several others have also received similar communications.

A large number of municipalities throughout Canada have installed septic tanks in blissful unconsciousness that they were covered by a patent of any kind.

The same thing has also happened in the United States, with the result that the Cameron patents have been held valid on appeal. Whether the Canadian laws, with reference to patents, are different from those of the States to the extent of affecting the issue here, we are not in a position to say.

The direct result of the company's action is that a great amount of correspondence has recently taken place between the towns affected, and a meeting is being arranged for in Toronto on June 15th at which representatives will discuss the whole matter and endeavor to devise some concerted action. This is certainly a much better plan of facing the difficulty than by isolated action; and it is to be hoped that some arrangement can be made by which the various towns affected will join in supporting a test case, and arriving at a final settlement upon the vexed question.

Some recent statistics given out by accident insurance companies in Great Britain are interesting. They show that in 1908, for the second time in eight years, not one passenger was killed on the railways of England and Wales. In 1901 these roads carried 1,172,385,900 passengers, in addition to those travelling by season ticket, and there was not one fatality, while only 476 persons were injured. The record for last year was even better. The number of passengers carried was 1,259,000,000, the number injured was only 283, and there was not a single death. Railway travel in England is safer than in any other country in the world. In marked contrast is the showing as to street accidents. During the seven months ended December 31st last, there were 17,973 street accidents in England and Wales, 746 of which were fatal. These accidents were distributed as follows:

	Accidents.	Fatal.
Motor cars and cycles	4,499	198
Motor omnibuses	1,156	50
Horse-drawn omnibuses	294	11
Other horse vehicles	9,045	418
Horse-drawn tramcars	111	...
Mechanically-propelled tram-car.	2,878	69

A large proportion of these accidents, of course, occurred in London streets, where the number of casualties causing death or injury rose from 9,200 in 1879 to 17,055 in 1907.

CONCRETE ROADWAYS.*

By Charles W. Ross, C.E., Street Commissioner, Newton, Mass.

Without any doubt the time has come for a decided change in the method of constructing streets.

Up to the present time, we thought a macadam road for a rural town or city was the best that could be built, but to our great surprise we find that our roads in many cases are being rapidly destroyed by the automobiles. It is not my purpose to find fault with the automobiles, as I thoroughly believe in them and think they have come to stay. It is only for us to prepare the way for them. In my opinion, this can easily be done by a change, not a radical one, but a slight one in our surfacing coat for streets.

In the first place, crushed stone or carefully prepared gravel screened into different sizes is the proper basis on which to build. This stone must be cemented together in some way to make it waterproof, as solid as a rock, and free from dust. These three things must be combined in the proper construction of a macadam street.

In the past few years we have tried many experiments. Some of them have turned out very satisfactorily, while others have been decided failures. We are not discouraged with the failures, but believe that the only way to obtain the highest standard is to meet the different conditions which are constantly arising.

We have been striving to overcome the annoyance that the automobiles cause from dirt and dust and this is a condition that we had not considered as being serious until within the past two or three years.

The cement was mixed in large boxes, which were moved along as the work progressed and the material spread on the surface of the road.

The surface of the roadway had been thrown off by the automobiles and worn down to the No. 2 stone. It was two or three inches lower in the centre than on the sides, while it should have been higher. The material was screened out and put back on to the surface of the road. Then we mixed up a grout of three parts sand with one part cement and made a very thin mortar. We spread it on with large coal shovels and swept it with brooms. That mixture very readily penetrated into the surface of the road, grouted together, flushed up on to the surface and made it perfectly smooth. The cost of the cement work on roadway was as follows:—

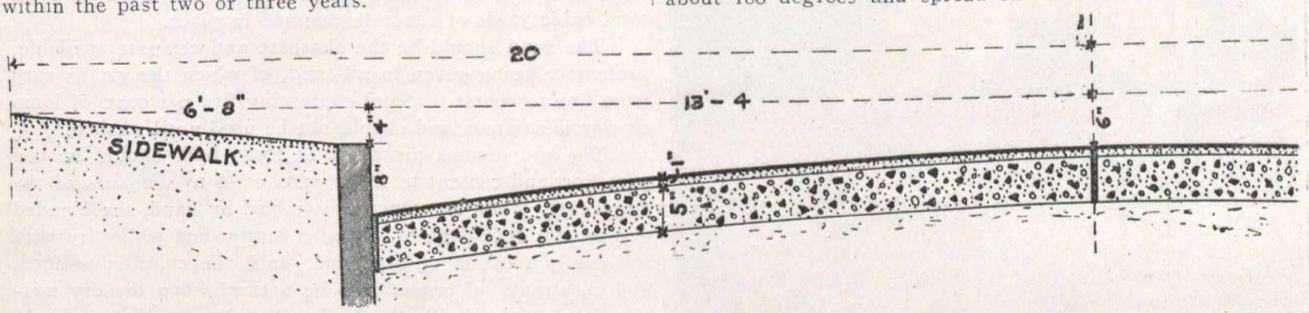
Cement and sand	$371.63
Labor and teams (applying and mixing)	356.50
	$728.13

Surface covered, 9,939 square yards.

Cost per square yard material	3¾ cents.
Cost per square yard, labor and teams	3½ "
Total cost per square yard	7¼ "

After about one year, the surface began to show signs of scaling off under the action of the wheels, and the opinion has always been that it is impossible to make a new coat of cement stick to an old surface after it has once set.

The experiment was tried by putting on a coating of tarvia A, also a preparation of coal tar just as it was taken from the gas works. This was heated to a temperature of about 180 degrees and spread on to the surface of the cement, swept down evenly with a broom and then a light coating of stone screenings or fine screened gravel applied, which I think I much prefer to the stone screenings.



The general public has not come to the realization of the fact that every particle of dust taken off the surface of the street means just so much of the road material being wasted, and to my knowledge, by actual count, we have from two to three thousand automobiles passing over one road in twenty-four hours. This road is in a place where the automobiles are allowed to go at a rate of twenty miles an hour, but there are many cases where no attention is paid to the speed limit. It can readily be seen that a heavy machine driven at a high rate of speed means that roads are coming to grief in a very short time.

We have tried experiments with the different kinds of oils, tarvia, asphaltoilene, liquid asphalt, coal tar and terracolio. Up to the present time, our experiments have been mostly surface or penetration treatments. They penetrate into the road enough to keep the fine material from being torn off, thus preserving the surface of the road, but we must go still further than that. If we build a street, it is not to be built for this year or next but for years to come, and is it not better to build the road of a proper material to make it last year than to constantly be obliged to surface it with some of the different preparations which are only beneficial for a short time, but which help the foundation of the road but very little, merely as surface treatments.

We have tried different preparations of Portland cement and some of the other preparations already referred to.

The surface has been kept intact for over a year and the tar preparation on the surface is in good condition at the present time.

The cement foundation is as good as it was two years ago and for a light surface treatment on a macadam road, I see no reason why it is not perfectly satisfactory. I would suggest, however, when we consider building a new road that we take into consideration the difference between hard and soft stone. The trap-rock costs about one-third more than the softer stone and in many cases it is almost impossible to obtain it, but with a softer stone, which can easily be obtained in almost any community, when made into a mixture of concrete, it will prove just as satisfactory for a road as trap-rock at a very much less expense. If you build a six-inch macadam road of trap-rock, it would cost about 60 cents per square yard; if built of concrete and a softer coat of stone used, it would cost from $1 to $1.20 per square yard. The cement adheres so much more readily to soft stone than it does to a hard trap-rock that I think the time has come for us to build concrete roads and cover them with a treatment of coal tar or tarvia or some of the liquid asphalts which will adhere to the surface of the road very readily, thus giving a solid foundation with a waterproof coating, a road that will stand all kinds of weather and wear much longer than the treatment of tar on the surface of a macadam road and also one that will be entirely free from dust.

* This article was awarded the second prize for the best paper on Concrete Roadways in the contest arranged by the Association of American Portland Cement Manufacturers.

In building a cement road, I think there is but very little need for expansion joints. If the road is properly crowned with a good foundation, the surface of the road acts very much like a bridge and in my opinion will never heave or change its position enough to warrant any expansion joints. If they are necessary, as for instance, against a street railway track, thin strips of board about six inches wide set on edge make very good expansion joints. They need not be taken out, as they will wear down and fit themselves to the surface of the road in such a way that they will not be noticed. If it is thought best to remove them, they can be easily drawn out and the joint poured with any of the preparations that I have spoken of for the surfacing of the road, thus making a joint that will be elastic enough to take care of all the expansion or contraction that will take place.

In preparing the gravel concrete for a road, the gravel should be of various sizes, not over two and one-half inches nor less than one-quarter inch in greatest diameter and mixed in the proportion of five parts gravel to two parts sand and one part cement.

The concrete can be mixed in a concrete mixer, or if mixed by hand, the sand and cement should be mixed either in boxes or on a platform with sufficient water to make a soft mortar, then the stone and gravel should be united and thoroughly turned over and mixed. The work must proceed rapidly until the concrete is in place, and so thoroughly rammed that water flushes to its surface and all interstices are thoroughly filled with mortar.

Concrete Roadway.

Before forming the subgrade to receive the concrete base, all present and prospective sewer, water, gas and subway connections should be made and extended under the curbs, and all old and new trenches should be tested with a ten-ton roller, and depressions should be filled and wetted and rolled until solid. Provisions should also be made for all surface drainage, which should be cared for through a system of pipes connected with proper catch basins with grates to receive the water at the sides of the road. All this should be carefully attended to before the road is considered ready for the concrete surface.

The concrete mixture should be prepared in the following manner:

The cement should never be used directly from any original barrel or bag, because there may be more or less damaged or defective packages, each of which would form a bad spot in the work. This chance is wholly avoided by requiring that the contents of from five to seven packages shall be mixed dry in the cement-shed before any is sent out on the work.

If it is decided to use gravel for a concrete mixture, it should be a natural water-shed gravel and can be taken from almost any good gravel bank that is free from fine silt or clay which will adhere to the small stone. This must be carefully guarded in order to be sure to get a mixture of gravel that is perfectly clean and sharp, as in my opinion, there is more concrete being spoiled at the present time by using a poor grade of sand and gravel than by using a low grade of cement. You should use the best cement that is possible, but by taking a poor mixture of gravel or sand, the whole substance would be a failure. Do not understand that I recommend a low grade of cement, for I thoroughly believe the best material obtainable is the cheapest in the end.

In buying cement, specifications should be carefully drawn up and tests should be thoroughly made. The quality of the gravel and the kind of sand that is used should be just as carefully watched as the specifications are for the cement.

The above mixture is wholly a preparation of different kinds of gravel, which if properly used, will make a very good quality of concrete.

If it is decided to use crushed stone, the quantities may be crushed from some of the softer grades of stone or granite, though the hardest and toughest is preferable.

Special care is necessary to see that the stone, before crushing, is clean and free from mud and clay. Stone unfit for macadam may serve the purpose when it shall be embedded in the matrice of mortar in the concrete.

The best results can be obtained by taking a two and one-half inch stone, the next size from half inch to inch and one-half, and the third size would be the screenings after the fine dust has been eliminated. If fine screened stone is used in place of sand, nothing finer than a kernel of wheat should be used. If the stone before crushing is not entirely clean, the crusher-dust should be excluded by screening. Clean gravel and sand may be used in place of stone with the same provision as to the included sand. Where neither stone nor gravel are available, as in the Middle West, fragments of brick or of furnace-slag are often used as aggregates. In any case, the number of cubic yards of loose material for the aggregate will be twelve to twenty per cent. more than the total cubic yards of concrete rammed in place.

The sand should be the sharpest and cleanest available, preference being given to pit-sand, of which the grains vary from fine to coarse. Sand containing five per cent. of loam or clay is common and should not be used until washed.

The proportions measured in loose bulk should be one part Portland cement to three parts sand to six parts of the aggregate. When the concrete is mixed by hand, the blended dry cement should be mixed on a mortar-bed while dry with the due proportion of dry sand, until the color is uniform and no streaks of cement can be noticed when the dry mixture is smoothed with the back of a shovel. Water should then be added gradually while mixing until plastic mortar is formed. The aggregate should be spread in a four-inch layer upon the platform, for which a sheet of iron ten feet square is the best, and on top of the layer is spread the mortar; the whole is turned with shovels. This mixing is continued until the face of every particle and fragment is perfectly coated with mortar, requiring hard work which must be done quickly.

The required amount of water varies, as the aggregates are more or less moist, so as to give a uniform result, for to be either too wet or too dry is a serious defect in concrete. The surplus mortar must be brought to the surface by ramming after filling all voids. The effectiveness of ramming will vary on different works; the ease with which the mortar is brought to the surface varies with the amount of water, up to the condition where the concrete is so wet that no ramming is needed, which is bad practice, but not uncommon. The best practice is to use the least water with which the available rammers can be made to bring the mortar to the surface. It is useless to try to secure this necessary result by the persistent ramming of concrete which has been mixed too dry, and which it were better to remix with more and wetter mortar. There should never be enough water to produce free grout, which can drain away into the subgrade and be lost.

The most practical way to mix concrete for road work is by a portable concrete rotary mixer, as it is made better and more cheaply than it can ever be made by hand.

There are other mixers that are equally as good, but this happens to be the one that we have found to be very satis-

factory. It is operated by a gasoline engine, the whole being mounted on a truck, which can readily be hauled along the road as the work progresses. It is a light, durable and very satisfactory way of handling work of this nature.

The bags or barrels of cement can be carted to the sides of the road and the proper amount of stone and sand, as nearly as can be calculated, can be deposited near the gutters. The material can be shovelled into what is known as a coal bag, commonly used by coal dealers for delivering coal. The bag will hold but one bushel, and is much more practical than a basket, as the bags are lighter and can be transported from place to place very quickly. The stone and sand can be measured in the proper proportions and thrown upon the platform of the truck, then emptied into the mixer and the whole thing can be handled in a very cheap and easy manner.

The spreading and the ramming must be done so that each successive batch shall be rammed before the preceding and the adjoining batches have begun their first set. The stiffness of the concrete after ramming in place must be such that the fresh mass will retain its form and will not crumble when the boards are removed preparatory to filling the adjoining space. If properly managed, there will be no lines between the batches, which will all be merged into one mass.

Each day's work can also readily be bonded with the base previously formed, so that the whole will be a monolith, and should be left at night with a slope of about four to one. The whole slope will allow the next day's work to join on and should be coated with a Portland cement mixture of one part sand to one part cement, which should be spread upon the slope before the next lay's work is commenced. This will cause the whole thing to bond together so that the joint will not be perceptible.

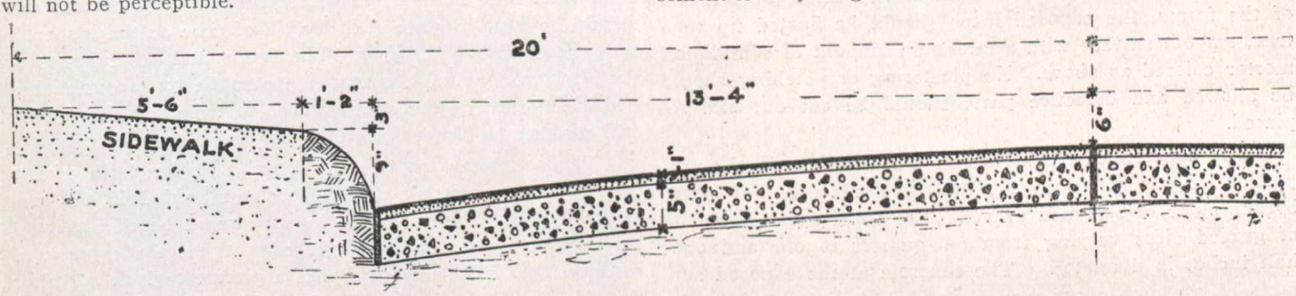
When concrete has been rammed in place, it must be entirely undisturbed until it sets firmly, which should take from four to seven days ordinarily and longer in cold weather. It is of vital importance that the concrete should be kept wet during all this time, and that it be sprinkled freely at night and morning, and be covered from the sun by sand or canvas which will retain the water. It is a common thing to find experienced foremen who fully believe that concrete should dry out, and many pieces of otherwise good concrete have been rendered worthless by acting upon this idea. Traffic of all kinds, both by foot or by vehicles, should be kept from the concrete-base for at least a week if possible, using planks to cover street-crossings where the passageways must be permitted. Another good way is to spread a light coating of fine hay over the surface of new laid concrete and keep it thoroughly saturated with water for two or three days, as this will protect it from the sun and also retain the moisture. It is very necessary to have this work done before the freezing weather commences, as frost is very injurious to new laid concrete and should not be tolerated wherever it can possibly be avoided.

The objection to closing a street can be readily overcome by taking one-half of the street at a time, leaving the other half open for traffic. The surface of a concrete road should be coated about one-half inch thick with a mixture of good, sharp, clean sand and mixed in the proportion of two parts sand and one part cement. This hould be spread upon the surface of the foundation coat, as soon as the foundation coat is laid, not allowing it to set before the surface coat is put on. Great care should be taken that these directions are carefully followed; if they are not, the top coats will not adhere to the foundation coat. This should not be rammed but should be swept with a broom, commonly called a push broom, which is a mixture of bass and rattan. It can be swept to a perfectly true and smooth surface while the cement is soft. After it has been allowed to dry out and before the road is open for traffic, a coat of hot tar or tarvia or liquid asphalt, which has been heretofore described, can be placed upon the surface of the concrete. It should not be less than one-quarter of an inch in thickness when finished. The stone screenings should be carefully scattered into the tar, putting on as much as the tar will take up. This forms a surface that cannot be improved upon for a cement road, and in my opinion, it is absolutely necessary that this should be done, as a cement road is apt to be dusty, wears uneven, and gives more or less trouble if it is not coated with some waterproof preparation, which can be done at an expense of not more than ten cents per square yard.

I will now take up the subject of curbing and sidewalks, which, in my opinion are a part of the road, and as much care should be given to their construction as to the road itself.

One of the best curbings that it is possible to make can be made from a mixture of concrete, using the same proportions of stone, sand and cement as are referred to in the specification for walls, bridges, etc.

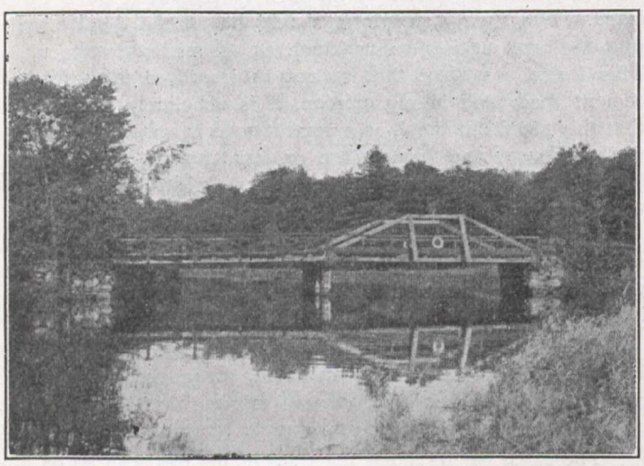
The catch basins along the sides of the road can be built of a concrete mixture, the same as the foundation course for the surface of the road. These can be made in portable wood forms in the proper shape to suit the purpose for which they are required. As soon as the concrete is set, the forms can be removed, leaving the catch basins. In my opinion, the cement is fully as good as brick and can be built at a much less expense. I would recommend that all large sewers and surface drains be built of concrete in place of brick or pipe, as they can be built fully as cheap, that is, all sizes above twenty-four inches in diameter.



The following specification is a very good one for heavy walls, curbing, bridge work, sidewalks, etc. Concrete masonry should be composed of Portland cement, sand and broken stone or gravel screenings mixed in the proportions hereinafter specified. The cement should be a first quality Portland cement, made by manufacturers of established reputation and of a brand approved by the engineer. The cement should conform in quality to the requirements of the specifications of the engineer or whoever may be in charge. It should be packed in well made barrels lined with paper or in canvas or paper sacks. One barrel of Portland cement contains about 376 pounds of cement, four sacks of 94 pounds net being equivalent to one barrel. The cubic contents of one barrel is equal to about 3½ cubic feet. The cement should be delivered and stored as directed by the proper authorities at least two weeks before it is to be used, and the party in charge should immediately take samples and make such tests as are required in specifications. Any cement found of improper quality, or which is unsatisfactory, should be immediately removed from the work. After the delivery of the cement, it should be kept raised above the ground several inches by blocking or otherwise and properly covered from exposure to the weather and dampness.

The sand should be sharp, clean and free from vegetable matter or other foreign substances, and satisfactory to the

inspector. The gravel or crushed stone should be of graded sizes varying from one-quarter inch to not over two and one-half inches in diameter except for the arches and parapet walls of the bridge, where no stone greater than one and one-half inches in diameter should be used. The concrete for the parapet wall should include all concrete above the sidewalk grade and consist of concrete mixed in the proportion of one part cement, two of sand and five of broken stone or gravel, except that all exposed faces of the parapet wall should be finished with at least one inch of sand mortar,



mixed in the proportion of one cement to two of sand, the mortar to be colored with lamp black in the proportion of one-half pound lamp black to one hundred pounds cement. The top surface of the parapet wall should be trowel finished to a smooth, hard surface. Immediately after the removal of the forms, the exposed faces should be floated up to a true, smooth surface with a minimum amount of semi-liquid mortar colored as above. No plastering or patching should be allowed and defective parts should be cut out and replaced.

The concrete in the arches should be mixed in the proportion of one part cement, two of sand and four parts broken stone or screened gravel. The stone used should be of graded sizes varying from one-quarter to one and one-half inches in diameter. The concrete at the exposed surfaces of the arch rings may be placed directly against the molds, the stones being pushed back from the exposed surfaces with spades or trowels. After the moulds have been removed, the exposed surfaces should be floated to a smooth finish with a semi-liquid mortar composed of one part cement and two parts of fine sharp sand, care being taken that no body of mortar is left on the face, sufficient only being used to fill the pores and give a smooth face.

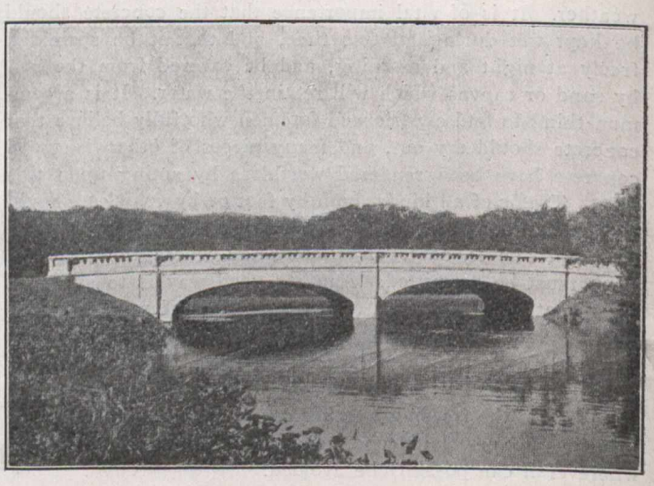
The concrete used in the spandrel, wing walls and buttresses should consist of one part Portland cement, two parts sand and five parts screened gravel of graded sizes varying from one-quarter to two inches in diameter. These proportions may be varied slightly for the purpose of obtaining a dense concrete with all voids filled. The exposed surfaces of this class of concrtee should, after the removal of the centres, be picked or bush-hammered to an even surface. The entire surface, except the corner borders, should be covered with hammer marks, and sufficient hammering done to remove all marks of boards or forms.

The concrete placed in the abutment and pier should be mixed in the proportion of one part cement, three parts sand, and six parts broken stone. Boulders and other stones of solid texture may be embedded in the concrete of abutments and pier below the line shown on the plan as the limit of boulder concrete. No boulder or stone of more than four cubic feet in volume should be used. All boulders should be placed not less than six inches from each other nor more than ten inches apart.

The thorough mixing and incorporation of all materials should be insisted upon. Boxes or forms, satisfactory to the inspector, should be used to measure the material for batches of concrete. The whole operation of mixing and laying each batch in place should be performed as expeditiously as possible, by the aid of machinery or a sufficient number of skilled men. No mortar or concrete should be used after it has begun to show signs of setting. If mixed by machinery, approved mixing machines should be used. The ingredients should be placed in the machine in a dry state, and in volumes specified, and be thoroughly mixed, after which water should be added and the mixing continued until it is thoroughly accomplished and the mass uniform. If mixed by hand, a mortar shall be first prepared in proper boxes for that purpose; the cement and sand, in the proportions specified, shall be thoroughly mixed dry, a moderate dose of water to be afterwards added to produce a paste of proper consistency, the whole to be thoroughly worked. The prepared paste should then be spread evenly over the pile of gravel, after the gravel has been sprinkled with water, and the whole mass should be thoroughly turned over, with shovels, not less than four times, and mixed until every particle of stone is completely enveloped with mortar. If concrete is mixed in batches requiring one barrel of cement, the platform, which must be water tight, shall not be smaller than ten by twelve feet. A larger amount than can be made with one barrel of cement should not be allowed to be mixed in one batch by hand.

Proper forms and mouldings, satisfactory to the inspector, should be provided and used by the contractor to fit the shapes of the work; and when they lose their proper dimensions or shape, they should be replaced by others. They should be smooth, tight and made of timber of such thickness and stiffness, and so braced that they will not quake under the ramming of the concrete placed therein; should be satisfactorily braced, secured and supported, and should be kept in place such length of time as the inspector may direct before striking. The forms and other limits of the various concrete structures are to be truly established and maintained by the contractor so that the completed work will conform in dimensions and position to the plans.

The accompanying picture shows a bridge built with a construction consisting of steel rods embedded in the concrete; it shows the difference in appearance between a good bridge and a poor one, without considering the expense of maintenance. The new bridge is a picture to look at, while the old one speaks for itself. One of its class should not be tolerated in any municipality where it is possible to obtain steel and concrete, especially at the low price possible at the present time.



It is not wholly my purpose to illustrate the construction of the roadbed alone, but I have also included the sidewalks, bridges, curbing and all abutments and retaining walls along the lines of railroad tracks that pass through the different cities.

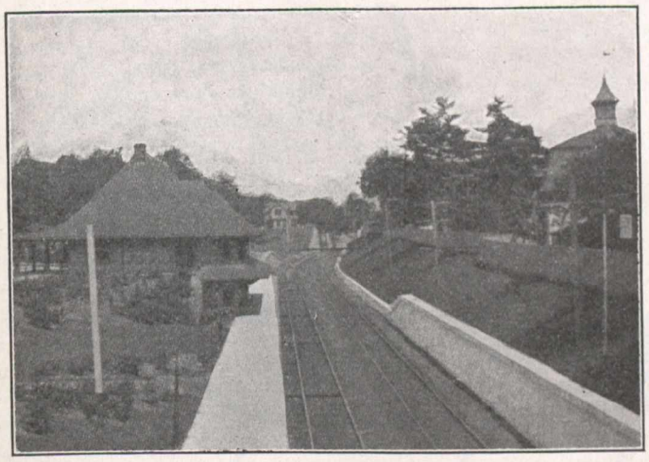
Why should we not try to make something that is ornamental and at the same time useful rather than to cling to

the old methods of construction which were adopted many years ago when it was impossible to obtain money to build permanent works.

In proportion to the amount of money that is in circulation at present, it seems to me that we are far behind the times and are not as up-to-date as our forefathers were. We can readily see that they spent more in proportion to their income than is being expended at the present time by the different municipalities.

It is very gratifying to me to see this work progress and I think that the time is coming and in fact has already arrived, where it is up to the engineer and street commissioner to do the work in as thorough a manner as it is capable of being done. Good, thorough construction is always the cheapest in the end. It may cost a little more than you think it ought to in the first place, but after it is once completed, you and the public will be more satisfied than you would be with some unsightly, inexpensive, temporary arrangement.

A very good plan for a cobblestone paving for gutters is to lay the cobblestone on a bed of sand and have it thoroughly rammed; then mix up a grout of three parts of sand and one part cement and make a thin mortar, pour it over the surface of the stone and sweep it with a broom until it comes to an even, smooth finish on the surface. In most cases, it proves very satisfactory, as it will take care of the water very readily, be free from weeds and grass, and makes an ornamental finish for the side of the road.



I think that every municipality should be governed largely according to its own judgment in regard to how much money to spend but should never think of being penurious in regard to street work. In many cities having a fine fire department, good schools, good water, pood police protection, everything that goes to make a city attractive, you will still find the streets are kept in a wretched condition. This is both extravagant and unsatisfactory. If you can afford to build but one mile of street, build it well. The public at large will be much better pleased with even one mile of good street for an object lesson and will be more ready to make an additional appropriation for other permanent improvements in the same line.

It is a wise economy to have plenty of steam road rollers, stone crushers and in fact, all kinds of modern machinery, so that the work may be done as cheaply as possible.

In the past twenty years, I have seen many places where permanent improvements have been made of a durable nature and the work has been so satisfactory that other larger and more costly improvements have been entered into.

I do not feel that all our roads should be built in accordance with the specifications previously mentioned, but as I have already stated, where permanent improvements are to be made and the sewer, water and gas pipes are already laid in the streets and in many cases the street railway tracks are already in place, there is no reason why this class of work should not be entered upon immediately. The public is always trying to obtain the best and the most that is possible for the dollar.

These facts are well worth considering and I am glad to see that the United States Government and all the different States in the Union are being aroused to the fact that more money must be spent on our highways, and it is only a question of a short time as to just what that construction will be. There was a time when the log house was the best that could be afforded; in many cities and towns at present the people are living in the old-fashioned log houses and are not looking for anything better in the line of improvement over their fathers or grandfathers. It is a well-established fact that every home is made better by good roads, every farm is enhanced in value, in fact, every municipality is made richer by the amount of money that is spent on improving the highways.

I have never yet heard a complaint made that a city is extravagant in regard to its highways. In many cases, the amount of money appropriated for that purpose is what is left after the other appropriations have been made and if they come short, it is very often taken from the street department.

There are many places where the money spent has been squandered through lack of judgment. In many cities and towns, it is a common practice to shift the heads of the departments at each annual election. In my opinion, this is a grave mistake. If a man has done good work this year, he will be able to do better work next year and so on. If an official can feel that his term of office is depending wholly on his methods and quality of work, he will certainly take more interest in it and will not feel that he is obliged to build his fences in place of building his streets as soon as he is elected.

QUEBEC BRIDGE.

The plans for the new Quebec Bridge have been so far advanced that the completed plans may be laid before the Government within a short time.

The new bridge will have a span almost as great as the 1,800-foot span of the first bridge. This means that the present piers, which cost a million and a half dollars, will be made use of. However, the new bridge will avoid the old weakness of the single tower, so the present plans will probably have to be duplicated on the river side. This will mean some shortening of the centre span and the length may be reduced to 1,600 feet. The cantilever design will be retained and the structure will be built of nickel steel, which has vastly greater strength than the carbon steel of which the first bridge was built.

The carrying capacity will be considerably greater than was designed for the first, which would not have been able to have accommodated the heaviest locomotives and loaded cars. The new bridge will not only carry itself safely, but will carry any load that can be transported over 80-pound rails. The height of the bridge has been definitely fixed at 150 feet above water at high tide.

STATEMENT OF ACCIDENTS DURING APRIL 1909.

Trade or Industry.	Killed.	Injured.	Total.
Lumbering	4	12	16
Mining	7	6	13
Building trades	..	13	13
Railway service	13	20	33
Navigation	8	5	13
General transport	..	17	17
Civic employees	..	1	1
Miscellaneous	2	8	10
Unskilled labor	5	7	12

The copper ore shipped during 1908 from Quebec amounted to 26,598 tons of 2,000 pounds, worth $159,588. The number of men employed was 122, who worked during the whole year and received $50,030 in wages.

CORRESPONDENCE

PLANS FOR A NEW WELLAND CANAL.*

Sir,—A second new Welland Canal or a Georgian Bay Canal—which will it be, or will it be both? Already a good deal of writing and talking, both officially and unofficially, has been given to this all-important canal question, and that something definite must be decided on very soon is evident from what our neighbors of the United States are doing regarding the improvement of their canals. As is already well known, the State of New York has provided millions of dollars for extensive work on its Erie Canal, and only a short time ago Governor Deneen of the State of Illinois, in his message to the State of Assembly, urged the completion of a Lakes-to-Gulf deep waterway.

If memory is right, Sir Wilfrid Laurier has stated that his Government would build the Georgian Bay Canal when it was in a position to do so, and the Hon. George P. Graham, Minister of Railways and Canals, stated on more than one occasion during the late election campaign that the Government would build a new or enlarge the present Welland Canal, and that it would be done very soon. The Georgian Bay Canal is estimated to cost $130,000,000, and the enlarged or new Welland Canal to cost $30,000,000. The proposed Georgian Bay Canal has been talked of to be built to accommodate boats 600 feet long and 60 feet wide, and drawing 21 feet of water. The strong argument in its favor is the very short distance it would make from the upper lakes to the seaboard. The strong argument against it is the fact of having to climb a hill of 100 feet, with locks, and then descend that hill on the other side; also the fact that natural lakes would require to be found or artificial lakes provided on top of that hill of sufficient volume of water to feed the canal both ways. Again the great expense of construction and the long time it would take to build it, namely, about fifteen years, are mentioned as reasons against the building of the Georgian Bay Canal.

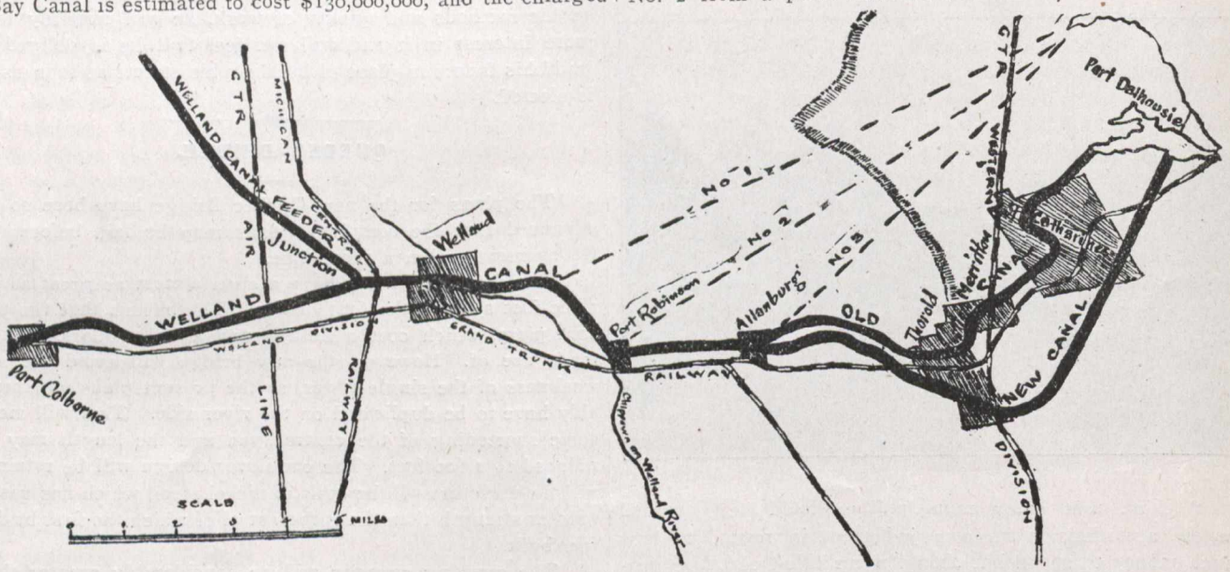
Natural and Available.

The proposed new Welland Canal has been talked of to have locks in size 700 feet long by 75 feet wide, with a depth of water of 24 feet. The argument in its favor is that it is the natural and best available route. It is certain that the present new canal has outlived its usefulness, and as a matter of fact, strange as it may seem, it has outlived its usefulness before its completion, for the reason that during the fifteen years' time it was building the boats on the great lakes had increased in size to such an extent that the building of another new canal could have been started on the completion of the present one. While it took about fourteen or fifteen years to build the present new Welland Canal, it is considered the second new Welland Canal could be built in about five years.

The passage of boats through the new canal takes from twelve to sixteen hours, and it is considered that this time could be cut down to at least seven hours through the proposed new Welland Canal. The present new canal could be utilized as its predecessor is now being used, namely, to furnish power for mills and factories, there being available at least 500 horse-power at the great majority of the waste weirs adjacent to the locks, and this would be a source of great revenue to the country.

The Proposed Routes.

As the Welland Canal work is likely to be taken in hand by the Government first, I herewith submit a map of the route of the present Welland Canal, and also showing the several routes surveyed and under survey for the proposed new work. Route No. 1 is from a point near Welland, route No. 2 from a point near Port Robinson, and route No. 3 from a point near Allanburg, all terminating at or near the Fifteen-mile Creek on Lake Ontario, three miles west of Port Dalhousie. So far route No. 1 seems to be the favored one, as it gives a canal pretty nearly in a straight line from lake to lake.



Regarding the engineering difficulties in the way, the principal one seemed to be the obtaining of a sufficient depth of Water at Welland, 24 feet, in conveying the waters of the canal over the waters of the Welland or Chippawa River, which must pass beneath or under the canal. The removal of millions of cubic yards of earth and rock excavation to build the canal does not seem to give the engineering department any serious thought.

Only Seven Locks.

On the new canal only seven locks will be required. This seems to the uninitiated a surprising statement, when it is considered that the present new Welland Canal has no less than twenty-five locks, in length of 270 feet, and width 45 feet, with a depth of water of 14 feet. A comparison of the contemplated size of the locks of the proposed new Welland Canal, with the large lock built by the Dominion Government at the Soo Canal in the year 1900 may be interesting. The dimensions of the Soo lock, which many readers may have seen, are as follows:—

Length between gates 900 feet; width of lock, 60 feet; depth of water, 20 feet 3 inches; height of walls (lock), 44 feet 6 inches; thickness of walls, 20 feet.

In connection with this magnificent Soo lock, it may be said that all the plant upon the work and every part of the construction was supplied within Canada. The fact is, however, that already the Soo lock is too narrow and has not enough water on the sills.

Big Time-saving.

The principal advantages to be derived from this new or enlarged Welland Canal would consist in permitting the very largest boats now on the great lakes to pass from Lake Erie to Lake Ontario with much larger cargoes than go through the present canal, and with only seven locks to go through, the passage through the canal would be made in one-half the time it now takes. Such advantages, it is claimed, would divert all the large lake freight boats from Buffalo as their terminal point on Lake Erie to Kingston, Prescott, and Ogdensburg as their terminal points on Lake Ontario. From the increased depth of water in the proposed new Welland Canal of 24 feet it would be absolutely necessary that our lake ports receiving these very large boats should have their harbours and docks deepened to at least 24 feet of water. This would naturally mean a large amount of dredge and submarine work for a number of years, which would no doubt gladden the hearts of the dredging contractors.

Day of Low Rates.

The day of small boats with cargoes at a high freight rate is apparently a thing of the past, and large boats with cargoes at a low freight rate are now and will be the rule. In connection with this the following illustration will show the great change that has taken place. In the year 1870 the three-masted schooner "Mary Battle" of St Catharines, Ont., brought a cargo of 21,000 bushels of grain from Chicago to Prescott at a rate of 29 cents a bushel, the highest rate of freight ever paid between these two points, while last year boats carried as large cargoes as 75,000 and 85,000 bushels about the same distance for as low as 3 cents a bushel.

We must now allow our American neighbors to get ahead of us on this canal question. Canada is big enough and able enough to build both the second new Welland Canal and the Georgian Bay Canal if it is found they are both absolutely necessary, and the cost of doing so should not prevent the work being done.

Our immense western country must have ample outlets for the many millions of bushels of grain that it is now producing, and which will be continually on the increase. It is no reflection on our magnificent railways to say that they are, and will be, unable to do this of themselves, and so our present canal system should be much improved and the work should be done at once without any delay whatever.

Yours truly,

David Battle.

Thorold, Ont.

A new catalogue prepared by T. Cooke & Sons, 14 Great Chapel Street, London, Eng., descriptive of the transits and levels they are making for the Canadian market, is now being distributed. Their instruments are generally similar to the American patterns with which Canadian engineers are most familiar, but they embody several improvements. Moreover they are able to supply them with inverting eyepieces when required. The inverting eyepiece certainly has the disadvantage of making objects seen appear upside-down, but on the other hand it is far more efficient as regards light, and is also smaller and cheaper. The list prices are given in sterling and in dollars, and include customs duty and freight to Canada. It also includes a cable code, so that an instrument of any description may be ordered by wire at a minimum of expense.

ORDER OF THE RAILWAY COMMISSIONERS OF CANADA.

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

Referring to last list of Orders, the summary for Order No. 7022 should have been as follows:—

7022—Authorizing the Canadian Pacific Railway to construct a bridge at mileage 31.8, cross country ditch, Smith's Falls Section of its line of railway.

7048—May 21—Rescinding Order No. 6885, dated April 23rd, 1909, (authorizing the C.N.R. to construct the standard trestle of the N. St. C. and T. Railway) by authorizing the N. St. C. and T. Railway to construct standard trestle as shown on plan filed.

7049—May 21—Authorizing the G.T.P. Railway to construct its railway, at grade, across the highways in the N.E. ¼ of Sec. 6, Tp. 47, Range 11, West 4th Meridian, District of North Alberta.

7050—May 21—Granting leave to the G.T.P. Railway to construct its railway, at grade, across the highways between Sections 7 and 18, and 7 and 8, Tp. 46, Range 10, west of the 4th Meridian, District of North Alberta.

7051—May 21—Granting leave to the G.T.P. Railway to construct its railway, at grade, across highways between Sections 11 and 12, and 11 and 14, Tp. 47, Range 12, west 4th Meridian, District of North Alberta.

7052—May 21—Granting leave to the G.T.P. Railway to construct its railway, at grade, across five highways in Tps. 45 and 46, Range 10, west of the 4th Meridian, Alberta.

7053—May 21—Granting leave to the G.T.P. Railway to construct its railway, at grade, across the highways between Sections 28 and 29, Tp. 45, R. 9, west of the 4th Meridian, Alberta.

7054—May 22—Granting leave to the G.T.P. Railway to take possession of, use, or occupy a portion of the right of way of the railway line of the C.N.R. at St. Boniface, Manitoba.

7055—May 20—Ordering that the Elgin & Havelock Railway be restrained from charging or collecting any toll or tolls, or fare or fares, or from levying or collecting any money for any service of any kind performed by the said railway until a by-law authorizing the preparation and issue of tariffs of such tolls has been approved by the Board.

7056—May 20—Ordering that the Salisbury & Harvey Railway be restrained from charging or collecting any toll or tolls, or fare or fares, or from levying or collecting any money for any service of any kind performed by the said railway until a by-law authorizing the preparation and issue of tariffs of such tolls has been approved by the Board.

7057—May 20—Granting leave to Harry P. Leonard, of Roblin, Man., to institute proceedings against the C.N.R. for the violation of the provisions of the Act; on account of failure of the C.N.R. to run its trains for the carriage of passengers and mails on the 1st of February last, between Dauphin, Man., and Humboldt, Sask.

7058—May 22—Extending for one month from date of Order time during which the C.N.R. may cross the tracks of the G.T.R. Company's spur line to Edward's Mills, at Rockland, for construction purposes.

7059—May 22—Temporarily approving form of agreement of the Bell Telephone Company with the following Telephone Companies:—The Belmont Telephone Co-operative Association, the Colchester No. Municipal Rural Telephone System, the Lobo Telephone Company, and the Zorra Telephone Association, Limited.

7060—May 25—Granting leave to the Superior and Western Ontario Railway Company to join with its tracks the track of the G.T.P. Railway at Velora Junction, Ont.

7061 to 7065 inclusive—May 21—Granting leave to the Bell Telephone Company to erect, place, and maintain its wires across the tracks of the G.T.R. at five points in the Provinces of Ontario and Quebec; namely, Hamilton, (2); Peterboro, Ont, (1); and St. Martins Junction, P.Q. (2).

7066—May 22—Authorizing the C.P.R. to construct, maintain and operate a branch line or spur for W. A. McGowan, in the town of Durham, Ont.

7067—May 22—Authorizing the N. St. C. & T. Railway to construct bridge over the Government Raceway at St. Catharines, Ont.

7068—May 25—Granting leave to the British Columbia Telephone Company to erect, place and maintain its wires across the E. & N. Railway at Nanaimo, B.C.

7069—May 19—Dismissing application of the Kettle River Valley Railway for an Order sanctioning the construction of an undercrossing under the Granby spur of the V. V. & E. Railway and Navigation Company on the right of way of the Columbia & Western Railway Company.

7070—May 19—Dismissing application of the Kettle River Valley Railway Company for an Order sanctioning the construction of an undercrossing under the Granby spur of the Columbia & Western Railway.

7071—May 19—Dismissing application of the Kettle River Valley Railway Company for an Order sanctioning a connection with the Columbia & Western Railway at a point on "Y."

7072—May 19—Dismissing application of the Kettle River Valley Railway Company for an Order sanctioning a crossing at the level of the Columbia & Western Railway at a point marked 1 on the plan and profile.

7073—May 25—Extending until October 1st, 1909, time within which interlocking plant between G.T.R. and C.P.R. and Ontario & Quebec Railway at a point east of Weston Road, Toronto Junction, Ont., is to be installed.

7074—May 26—Approving the Spokane and British Columbia Railway Company Standard Freight Tariff C.R.C. No. 6.

7075—May 25—Granting leave to the G.T.P. Railway to construct its railway across the highway (undergrade) between Sections 27 and 28, Tp. 37, Range 18, west 3rd Meridian, District of West Saskatchewan, Province of Saskatchewan.

7076—May 26—Granting leave to the G.T.P. Railway to construct its railway, at grade, across the highway between Section 7, Tp. 48, R. 13, and Sec. 12, Tp. 48, Range 14, west 4th Meridian, District of North Alberta, Alberta.

7077—May 26—Granting leave to the G.T.P. Railway to construct its railway across highway at grade, in the west half of Section 33, Tp. 46, Range 11, west 4th Meridian, District of North Alberta.

7078—May 25—Granting leave to the G.T.P. Railway to construct its railway across seven highways between Sec. 2, Tp. 51, R. 19, and Sec. 2, Tp. 53, Range 22, West 4th Meridian, District of North Alberta, Alberta.

7079—May 25—Granting leave to the G.T.P. Railway to construct its railway across the highway between Sec. 3, Tp. 48, Range 13, and Section 34, Tp. 47, Range 13, west 4th Meridian, Province of Alberta.

7080—May 25—Granting leave to the G.T.P. Railway to construct its railway across the highway, at grade, in the north-east quarter of Sec. 12, Tp. 50, Range 18, west of the 4th Meridian, District of North Alberta.

7081—May 5—Granting leave to the G.T.P. Railway to construct its railway across the highway, at grade, between Sec. 23 and 26, Tp. 46, Range 11, and Sections 26 and 27, Tp. 46, Range 11, west of the 4th Meridian, District of North Alberta.

7082—May 25—Granting leave to the town of Barrie, Ont., to lay sewer pipe, under the track of the G.T.R. at Bayfield Street, Barrie, Ont.

7083—May 19—Dismissing complaint of Stark Brothers Company, Limited, Toronto, Ont., complaining that the rate of seven cents per 100 lbs. by the Central Ontario Railway on a car of corn from Buxton, Ont., to Bannockburn, Ont., is excessive.

7084—May 19—Dismissing complaint of Downings American Despatch General Merchandise Forwarders, of Montreal, against the overcharge made by the C.P.R. of the local rate from Fort William, Ont., to Winnipeg, Man., on a carload of liquor shipped from England.

7085—May 25—Dismissing application of the Times Publishing Company for Order directing the C.P.R. Company's Telegraph, the G.N.W. Telephone Company, and the Western Union Telephone Company, to transmit press messages to the Marconi Wireless Station at Glace Bay at the same rate as charged to other points along the Atlantic Coast of Canada.

7086—May 19—Dismissing complaint of C. E. Plain & Company, of Ottawa, alleging excessive rates charged by the C.P.R. on shipments of apples from Picton to Smith's Falls, as compared with the rate charged from Picton to Ottawa.

7087—May 18—Rescinding Orders No. 6167 and 6366, dated the 4th and 22nd of February, 1909, respectively, for Order directing express companies operating in Canada and subject to the jurisdiction of the Board to classify for the transportation of acetylene gas when shipped under the so-called "Safety Storage System;" as it appeared to the Board that it has no jurisdiction to make the said orders.

7088—May 25—Amending Order No. 6033, January 13th, 1909, calling for light to be placed at the crossing of the M.C.R.R. on Erie Avenue, Leamington, Ont., by providing that same be kept burning all night.

7089—May 27—Rescinding Order No. 5223, dated August 26th, 1909, authorizing the by-law No. 28 of the G.T.R. by approving the same.

7090—May 26—Granting leave to the Manitoba Government Telephones to erect, place, and maintain its wires across the track of the C.P.R. at P.C., at Ash Avenue, Winnipeg Beach, Man.

7091—May 27—Granting leave to the British Columbia Electric Railway Company to erect, place, and maintain certain electric light wires across the right of way of the C.P.R. at Bute Street, Vancouver, B.C.

7092—May 26—Granting leave to the British Columbia Electric Railway to erect, place, and maintain certain power wires across the track of the C.P.R. at Bute Street, Vancouver, B.C.

7093—May 19—Authorizing the G.T.R. to refund to the British-American Oil Company, of Toronto, Ont., the difference between the rate of 20c. per 100 lbs., and rate of 32c. per 100 lbs., charged and collected on shipments.

7094 and 7095—May 27—Granting leave to the Government of the Province of Alberta to erect, place, and maintain its wires across the track of the C.P.R. at Hardisty Station, and 750 feet north-east of the railway company's station at Bawlf, Alta.

7096—May 27—Granting leave to the People's Telephone Company to erect, place, and maintain its wires across the track of the G.T.R. at John Street, the third crossing east of Forest Station, Ont.

7097—May 27—Granting leave to the Government of the Province of Alberta to erect, place, and maintain its wires across the track of the C.P.R. near section house at Chin, Alta.

7098—Granting leave to the Government of the Province of Alberta to erect, place, and maintain its wires across the track of the C.P.R. at Claresholm, Alta.

7099—May 27—Granting leave to the People's Telephone Company to erect, place, and maintain its wires across the track of the G.T.R., 4th Concession east of Forest, Ont.

7100—May 27—Granting leave to the Western Counties Electric Company to erect, place, and maintain its electric wires across the track of the G.T.R. at Elgin Street Subway, Brantford, Ont.

7101—May 27—Granting leave to the Bell Telephone Company to erect, place, and maintain its wires across the track of the G.T.R. at P.C., one-quarter mile south of Unionville Station.

7102—May 28—Approving location of the C.N.Q. Railway Company's freight shed at St. Tite, Quebec.

7103—May 28—Approving location of the C.N.Q. Railway Company's proposed freight shed with waiting room at Herouville, Quebec.

(Continued on Next Page.)

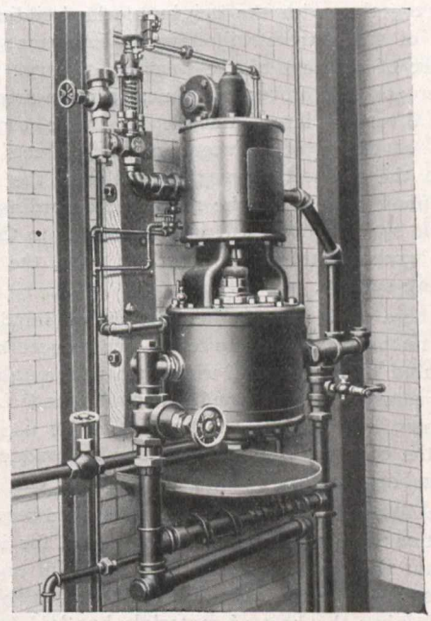
HIGH PRESSURE GAS TRANSMISSION.

During the past few years the apparatus for manufacturing and purifying gas has been greatly improved, and the many by-products obtained have found wide demand. To economically prepare these by-products in marketable shape requires a plant of comparatively large production, so that the tendency now is to centralize the point of manufacture for several neighboring communities, thus obtaining the benefits resulting from the disposal of the by-products.

This idea of a central plant supplying a considerable area, naturally implies the necessity of many miles of piping, which, applied to the ordinary low-pressure system with its large, heavy pipes, means a large outlay of capital. But with the high-pressure system of gas transmission, these disadvantages are avoided and many additional advantages obtained.

The installation of a compressor to accomplish this stepping up of the pressure from that at which the gas is produced to that at which it is transmitted, involves no complication of apparatus and no considerable outlay of capital. A large compressor is seldom necessary; and, with a suitable governing device, no special attention is required to insure perfectly reliable operation.

The standard types of air compressors used in steam and



Steam Driven Compressor For High Pressure Gas Transmission.

electric railroad service, and manufactured by the Westinghouse Air Brake Company, are particularly well adapted for compressing gas for transmission at high pressure. Their distinguishing characteristics are simplicity, ease of installation, reliability, durability and low cost of maintenance.

They may be driven either by steam or an electric motor. The two types of compressors are illustrated in the accompanying cuts. Both occupy small space and are simple in their general arrangement.

They are connected so as to draw the low-pressure gas directly from the gasometer, compress it and deliver it through a suitable storage reservoir into the high pressure mains. For cases where the high-pressure is required to be constant during the twenty-four hours, an automatic governor may be applied to the compressor, which regulates its speed so as to maintain the desired pressure practically constant. For cases where the high-pressure is raised to a certain maximum and allowed to decrease to a fixed minimum, a governor may be furnished which will stop and start the compressor for any desired range of pressures.

The following application illustrates the simplicity of this system. An Eastern municipal gas and electric light plant supplies three neighboring towns. It is situated in the central part of one town and is from three to four miles from the others. The whole town where the plant is situated is supplied with low-pressure gas, flowing directly from the gasometer through large mains at a pressure of 2½ inches of water. The other towns are supplied through high-pressure mains, the gas being drawn from the gasometer by the compressor and delivered directly into the high-pressure mains. A governing valve is placed in each house supplied by these high-pressure mains, which automatically reduces the pressure to the low house service pressure. About fifteen miles of two-inch pipe are already laid in the territory of about four miles' radius, covered by the high-pressure system.

The gas compressing outfit in this plant consists of two Westinghouse 9½" x 13" x 10" water-jacketed compressors mounted on the wall of the engine room. The steam pressure varies from 60 to 100 pounds at different periods of the day. Only one compressor is used at a time, the other being a square unit. The low gas pressure is very constant. The high pressure varies from 10 to 14 pounds, being lowest in the day time when the steam pressure is low. The average number of cubic feet of gas delivered during the day time appears to be from 10 to 12 cubic feet per minute, running up to about 25 cubic feet in the late afternoon, at the time when gas is required for both lighting and cooking.

The management of the gas work expresses itself as perfectly satisfied with the compressor operation. The operating unit is shut down only occasionally, about once or twice a month, during the hours of the day when the gas consumption is lightest, to clean and oil the valves, and the storage in the mains is then enough to supply the demand until the plant can be started again. At all other times no attention whatever is paid to the compressor, outside of oiling.

RAILWAY ORDERS.

(Continued from Preceding Page.)

7104—May 28—Rescinding Order No. 7055, May 20th, 1909, restraining and prohibiting the Elgin & Havelock Railway Company from charging or collecting tolls until filling of by-law; by approving said by-law.

7105—May 28—Approving location of the C.N.Q. Railway proposed station and freight shed at Garneau Junction, P.Q.

7106—May 28—Approving location of the Q.M.S. Railway Company's station in the town of Nicolet, P.Q.

7107—May 26—Authorizing the Brantford Gas Company to lay and maintain gas pipe under the B. & H. Electric Railway on Alfred Street, Brantford, Ont.

7108—May 27—Authorizing the Consumers' Gas Company, of Toronto, Ont., to lay and thereafter maintain a six inch gas main under the C.P.R. on Osler Street, Toronto, Ont.

7109—May 26—Granting leave to the North Carievale Rural Telephone Company to erect, place, and maintain its wires across the track of the C.P.R. at Sec. 5, Tp. 3, R. 31, and Sec. 31, Tp. 2, Range 31, west 1st Meridian, Sask.

7110—May 26—Granting leave to the Thunder Creek Rural Telephone Company to erect, place, and maintain its wires across the track of the C.P.R. between Sec. 35 and 36, Tp. 2, R. 32, west 1st Meridian, Sask.

7111—May 28—Authorizing the C.P.R. to construct a highway bridge at Le Jeune Street, Three Rivers, P.Q.

7112—May 18—Granting leave to the M.C.R.R. to cross with two additional tracks Sandwich Street, Windsor, Ont., and temporarily approving structure pending completion of permanent structure.

The magnetic sands of the North Shore, Quebec, are still the subject of experiment. Some experimenters are striving to secure direct smelting and reduction by the electric furnace to make steel, while others confine themselves to agglomerating the sands previously concentrated so as to get a very pure ore carrying 68 to 70 per cent. of metallic iron and capable of being treated by blast furnace.

CAUSES AND PREVENTION OF DEFECTS IN ASPHALT PAVEMENTS.*

By Isaac Van Trump, Asphalt Chemist, Chicago, Ill.

There are numerous causes of the defects that appear in asphalt surfaces, such as: Improper specifications, lack of rigid base and lateral support, lack of cleanliness, action of water, gas or both, flushing with water under high pressure, neglect of maintenance, insufficient crown, inferior sand, lack of filler, inferior asphalt or lack of intelligence in its use, careless workmanship, climatic changes, natural wear, neglect, etc. Of these causes, the first seven are almost entirely under the control of the municipal engineer, and unless he sees that the necessary and proper precautions are taken, it would not be surprising if the lives of some asphalt surfaces, even when constructed with the best materials under laboratory control and with the highest of skilled labor, are materially lessened.

It is entirely unfair to the municipality, the tax payer and the contractor, for the municipal engineers through ignorance or neglect, to permit conditions to exist, either during the course of construction or after the street has been completed, that will permanently impair the usefulness or appearance of the thoroughfare. When the city officials are fully and properly educated to realize the importance of what may appear to be minor details, the cost to the contractor of maintaining the work for a period of years will be greatly reduced, and, the city and tax payers, being the beneficiaries, will receive better and longer service from the street for less money.

Improper specification is the cause of the failure of many asphalt surfaces; lack of rigid base and lateral support is the cause of many more. Lateral supports, such as headers, car tracks, manholes, etc., should be perfectly rigid. Car tracks should be imbedded in concrete with a triple row of bricks or blocks on either side of each rail, thoroughly grouted with Portland cement or asphaltic block filler, the latter being desirable for many reasons.

Asphalt surfaces should have proper drainage both above and below. Sufficient crowning will assist materially. Insufficient crown appears to be the general fault, although the opposite extreme is occasionally found. One of the main thoroughfares in the City of Mexico has an 8-inch crown with but a 22-foot roadway and I frequently noticed, while there, the large number of horses that fell on the wet street owing to the extreme arch of the pavement caused by the high crown.

Roughly estimated, the average crown for a level asphalt street is 1 inch to every 5 feet in width. However, as the grade of the street increases the height of the crown is reduced. The formula adopted by the City Engineer's Office, Omaha, Neb., in 1902, is as follows:—

$$C \text{ equals } \frac{W\ (100\text{-}4f)}{5{,}000};$$

C—Crown of pavement in feet;
W—Distance between curbs in feet;
f—Number of feet fall per 100 feet of street.

Persons disapproving of asphalt pavements make the claim that sheet asphalt cannot be laid satisfactorily on streets having a high percentage of grade. In reply to this allegation, it can be said that there are numerous instances, in all parts of the country, where this form of pavement is giving excellent results on streets of 10 per cent. grade and in several cities this figure has been greatly exceeded, such as: Scranton and Kansas City, 12.5 per cent.; San Francisco, 16 per cent.; and in Pittsburg, 17 per cent. grade has been reached and is giving satisfactory service.

In cities where illuminating gas is used, it is a common occurrence for asphalt surfaces to disintegrate in spots, caused by leaks in the gas mains. It is useless to merely repair these spots, as the patches will soon disintegrate also. The only way to stop this disintegration is to stop the leak.

The action of continued standing or running water will in time destroy the best asphalt surface. This form of pavement will, however, withstand a reasonable amount of water for years.

Water, acting on the asphalt surface from beneath will in time, cause the pavement to seriously disintegrate, especially in winter when the moisture absorbed by the mixture freezes, breaking the bond between the grains of sand. Therefore, it is extremely essential that such form of construction be employed that will entirely prevent water from attacking the pavement in this way.

The actions of climatic changes cannot be entirely overcome, but they can be guarded against if the contractor employs the proper skilled labor, that is, an asphalt expert, under whose supervision the pavement should be mixed and laid. Such an expert should inspect the scene of the improvement before the work of mixing the binder and topping is commenced. He should note the width of the thoroughfare, the character of the buildings facing the street and the various businesses conducted therein, as this will assist in determining the volume and character of traffic the pavement is to carry. The direction the street trends north, south, east or west, together with the height of the buildings and the presence of shade trees will have an important bearing on the degree of softness of the wearing surface. Whether or not the proposed improvement is near a main artery of travel and will divert a large amount of traffic owing to the wretched condition of adjacent parallel streets should be noted, so the mineral aggregate and also the consistency of the asphalt cement can be regulated accordingly. A perusal of the specifications will inform him as to the thickness (also the proportions) of the concrete base, the binder and the wearing surface.

All these and many other details of importance will manifest themselves instantly to the experienced eye and the trained mind of the expert, who, being thoroughly familiar with the many different sands, asphalts and fluxes (with their numerous individual characteristics) in use in various parts of the country, is in the position to produce the most durable and satisfactory surface mixture that can be made.

The skill employed by a contractor should receive serious consideration from the municipal engineers, for it is as important that the pavement be laid in a skilful and scientific manner as for the materials to be the best quality. A pavement containing the best of materials but laid by unskilled workmen is usually inferior to one made with poor ingredients but which were scientifically and intelligently combined and laid. Thus the tax payer and the city, as well as the contractor, are materially benefited by the employment of skilled and specially trained workmen.

The flushing of streets, if properly done, will do an asphalt pavement no harm, but in some cities such high pressures are used that it would not be surprising if some asphalt surfaces were injured.

Neglect of maintenance is another serious error on the part of many city officials. This economic problem is usually attended to in a reasonably conscientious manner. There are but one or two cities in the United States where no attempt is made to maintain asphalt streets after the guarantee period has expired, and they are, consequently, after a few years, in a wretched condition, causing adverse criticism of this form of pavement on the part of the citizens. As a matter of fact, an asphalt pavement, if well constructed and properly maintained, is the equal of any form of pavement now in use.

In conclusion I would again caution the municipal engineer as to the importance of proper specifications, rigid base and lateral support, proper drainage, sufficient crown, proper street cleaning facilities and soft wearing surfaces, for usually, the softer the pavement, to a reasonable limit, the longer its life.

* From an address at Notre Dame University, Ind.

CONSTRUCTION NEWS SECTION

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

TENDERS.

New Brunswick.

LOGGIEVILLE.—Tenders will be received up to Thursday, June 10th, for the construction of a three-stall engine house, turntable, ring-wall with centre foundation, freight shed, loading platform, and for the alterations and additions to and moving of the station building. Plans and specification may be seen at the station-master's office, Chatham, N.B., and at the chief engineer's office, Moncton, N.B. M. J. Butler, Chairman, Government Railways Managing Board, Ottawa, Ont.

Quebec.

QUEBEC.—The City Council invites tenders for paving various streets at an estimated cost of $50,734. W. D. Baillairge, city engineer.

QUEBEC.—The Quebec Harbor Commissioners will receive tenders up to Thursday, 10th June, for the paving of a part of the cross wall and embankment roadways. James Woods, secretary-treasurer.

MONTREAL.—Tenders will be received up till Tuesday, 8th June, for stores, cast iron pipes, stop valves, lumber, cement, oils, special castings, lead pipe, pig lead and tin, brass castings; also for the purchase of iron and lead scrap. Geo. Janin, superintendent waterworks, City Hall. L. O. David, City Clerk.

MONTREAL.—Tenders will be received until June 11th for roof, skylights and Montreal Examining Warehouse. Plans can be seen at the office of Mr. C. Desjardins, clerk of works, Montreal. Napoleon Tessier, secretary, Department of Public Works, Ottawa.

Ontario.

BURLINGTON.—Tenders will be received until Monday, June 21st for a pump house, pumping machinery, steel pump well. O. T. Springer, secretary. Willis Chipman, C.E., 103 Bay Street, Toronto. (Advertised in The Canadian Engineer).

COLUMBUS.—Tenders will be received until Tuesday, 15th June, for a 40-foot reinforced concrete arch bridge near Oshawa. Bowman & Connor, engineers, 36 Toronto Street, Toronto. (Advertised in The Canadian Engineer.)

KINGSTON.—Tenders, addressed to R. F. Elliott, for coal will be received until Saturday, June 12th, for the year's supply of fuel for the Light, Heat and Power Department. C. C. Folger, general manager.

OTTAWA.—Tenders will be received until Thursday, June 17th, for the construction of a building for Mines Branch Fuel Testing plant. Napoleon Tessier, Secretary, Department of Public Works.

SAULT STE. MARIE.—Tenders will be received up to June 15th for the clearing, grading and bridgework on the first eight-mile section of The Manitoulin & North Shore Railway, from mile 14 west. For plans, specifications and details apply to C. N. Coburn, chief engineer, M. & N.S. Railway, Sault Ste. Marie, Ont.

TORONTO.—Tenders will be received by the city of Toronto up till noon of June 30th, 1909, for laying between 350,000 and 450,000 duct feet of underground conduit. For specifications, form of tender, etc., apply Electrical Department, City Hall. (Advertised in The Canadian Engineer.)

Manitoba.

WINNIPEG.—The City Council have decided to invite tenders for the hydraulic and electrical machinery required for the generating station. Estimated cost, $450,000.

WINNIPEG.—Tenders for coal and fuel wood required to heat the Military Buildings at Winnipeg and Brandon for ten months ending March 31st, 1910, will be received up to Monday, June 7th. Full particulars may be obtained from the secretary of the Militia Council, Ottawa, or at the office of the District Officer Commanding, Winnipeg.

WINNIPEG.—Tenders will be received up till 5th June for the purchase of steam stern wheel paddle ships; two tow barges; clam shell, engine, equipment, fittings, and one sand hopper; two sand pumps; one Waterous engine; one locomotive boiler. Graham & Young, 469 Main Street.

WINNIPEG.—Tenders will be received until June 10th for the supply of steam coal screenings required by the Winnipeg General Hospital for the eleven months beginning July 1st next. J. M. Cosgrave, business manager.

Saskatchewan.

GOVAN.—Tenders will be received up till June 15th for the construction of about sixty pole miles of system of the Govan Rural Telephone Company, Limited. Thomas Fargey, secretary.

SASKATOON.—Tenders will be received until Tuesday, June 22nd, for a generator, exciter and switchboard installed complete and for a 750 horse-power Corliss engine. J. H. Trusdale, city clerk. (Advertised in The Canadian Engineer.)

Alberta.

LETHBRIDGE.—Tenders will be received up to June 5th for the supply of all plant material, labor and performing of all work necessary to complete the erection of a Court House. John Stocks, Deputy Minister of Public Works.

CONTRACTS AWARDED.

Quebec.

MONTREAL.—At the meeting of Roman Catholic School Commissioners, the contracts for the coal supply were granted to the same dealers as last year, and the contract for the new Salaberry school supply was awarded to the Lackawana Coal Company. It was decided to ask Perrault, Marchand and Sawyer to prepare plans for the Meilleur, Marchand and Point St. Charles schools.

MONTREAL.—At the last meeting of the Outremont Council tenders were opened for 30,000 square feet of concrete sidewalks, and the contract was awarded to R. T. Smith & Company, the lowest tenderers, at twenty-four cents per square foot.

MONTREAL.—Here are some prices quoted the City Council for paving material:—Composition cement for sidewalks, $2.22 and $1.86 per sq. yard; Danforth stone, $2.15; Fort Jackson stone, $1.78; New York bluestone, $1.65; Laurentian granite, $1.79, $1.43; asphalt, $29.75, $25.75 a ton; metric asphalt for sidewalks, $2.45, $1.90 a yard.

Ontario.

NIAGARA FALLS.—For concrete walks, 11½ cents a square foot, and curbs 8 cents, a contract was given to Peter Lorenzo.

NORTH TORONTO.—Tenders were received for the construction of a concrete bridge on Davisville Avenue, and that of Mr. Hyles, of Atwood, was accepted at $1,294.

TORONTO.—The Public Works Department has awarded tenders for coal and wood for the Government buildings in Toronto, and the Normal Schools throughout the Province at figures slightly lower than last year. The tenders for hard coal run from $5.50 to $6.50; for pea coal, $4.20; for soft, $4.15 to $5; hard wood from $7 to $7.50; and soft coal from $6.50 to $6.75. There were six tenders from Toronto.

Manitoba.

WINNIPEG.—For the sanitarium, to cost $50,000, the contract for the building was given to William Bell, of Brandon, while Gates & Sons, of Winnipeg, will do the plumbing and heating.

WINNIPEG.—At a recent meeting of the council, the following tenders were awarded:—Cedar block pavement, College Avenue, to the engineer, $2,447.60; block pavement on lane between Furby, Langside, Buell and Preston, engineer, $1,872.28; repairing floor of Louise Bridge, Edwin Doidge, $595; granolithic walk, on Powers, Thos. Jackson & Son, $527; granolithic walk, on south side of Anderson Avenue, Galbraith Bros., $1,139; granolithic walk, south side McAdam Avenue, engineer, $378; granolithic walk, north side of Inkster Avenue, engineer, $2,436; granolithic walk, north side of Redwood Avenue, Thos. Jackson & Son, $918; granolithic walk, south side of Redwood, engineer, $325.08; granolithic walk, north side of Logan, engineer, $787.20; granolithic walk, south side of Logan, engineer, $806.40; granolithic walk, south side McDermot Avenue, Thos. Jackson & Son, $871.20.

WINNIPEG.—The Manitoba Bridge and Iron Works, of Winnipeg, have been awarded the contract for structural steel for the Great West Life Assurance Company's new building at Winnipeg, amounting to 650 tons. This will be a large building. Steel frame construction designed for five additional storeys. This is the second largest contract for steel building construction in Winnipeg this year.

British Columbia.

NELSON.—One thousand barrels of cement at $3.60 have been ordered from Mr. Gillett by the city council.

VANCOUVER.—On May 18th the board of works awarded to Palmer Bros. a contract for ten miles of cement walks at 11 7-10 cents per foot. The bids were as follows:—Lawrence & Hull, 13 cents; Palmer Brothers, 11.7 cents; Scott & Ledingham, 12 cents; D. G. McKenzie, 13¾ cents. For block paving George Street, M. P. Cotton presented the lowest figure, his price being $61,053 and the contract to him was recommended. Other prices were as follows:—T. R. Nickson & Company, $64,984; Ironside, Rannie & Campbell, $68,707.05; Christian & Hartney, $61,788; Palmer Brothers, $61,357; Lawrence & Hull, $64,297.50.

England.

IPSWICH.—Reavell & Company, Limited, have secured an order from the Mysore Gold Mining Company, for a large two-stage air compressor of their direct-coupled type, to be driven by a three-phase motor of 200 horse-power. This company is extremely busy with a number of important compressor contracts largely for mining work at home and abroad.

RAILWAYS—STEAM AND ELECTRIC.

Ontario.

NORTH TORONTO.—The Ontario Ry. Board recently inspected the Metropolitan Railway from the C.P.R. crossing to Mulock's Corners, 28 miles, as a result of complaints respecting the condition of the roadbed.

OTTAWA.—Work has comenced on the new hotel being built on Major Hill Park for the Terminal Company, some 100 men are employed and before fall the building should be well advanced. Mr. Swartz, C.E., of Toronto and Mr. Mitchell are in charge.

ST. THOMAS.—The Pere Marquette is equipping all locomotives on the M.C.R. division of the road with water-scoops to expedite the running between this city and Buffalo.

SAULT STE. MARIE.—The Manitoulin and North Shore Railway have invited tenders for construction work on the first eight-mile section from mile 14 west. C. N. Coburn, chief engineer.

Manitoba.

EMERSON.—The Great Northern have filed their plans for a right-of-way through the town and adjoining municipalities at the local registry office. It is expected that work will commence at an early date.

Saskatchewan.

PRINCE ALBERT.—The construction of the C.N.R. extension through Shellbrook district started last week. Sixty miles will be built this year.

British Columbia.

VANCOUVER.—An agreement was signed recently whereby the Union Pacific, Northern Pacific and G.N.R. will enter Vancouver by the same route after leaving South Tacoma, 150 miles. This, it is said, will stop competiitive building.

Foreign.

KALISPELL, MONT.—The Chicago, Milwaukee & Puget Sound Railway survey is now within five miles of the Canadian line, according to location maps filed within the last few days, and will be across the International Boundary within another week.

SEWERAGE AND WATERWORKS.

Ontario.

BARRIE.—The amendment plans for the treatment of sewage at Barrie have been accepted by the Board of Health

COBALT.—The Board of Health are holding the plans prepared for sewerage and waterworks system at this place pending a report from a member of their board.

DUNNVILLE.—Plans for the partial treatment of Dunnville sewage before its discharge into the Grand River have been prepared by Willis Chipman, C.E., of Toronto, and approved by the Provincial Board of Health.

GUELPH.—A start has been made by the city engineer's department in building the new sewerage beds.

LINDSAY.—At a recent meeting of the Provincial Board of Health, Mr. J. D. Flavelle, Chairman of the Water Commission of Lindsay, submitted plans of the new system of purification of water by mechanical filter and ozonizing. Drs. Sheard and Hodgetts were appointed to inspect the plant and pronounce upon its possibilities for giving pure water.

MARKDALE.—The plans submitted for a waterworks sytsem at Markdale will be passed by the Provincial Board of Health after a few amendments have been made.

NORTH BAY.—Extensions to the sewer and water system are being considered by the Town Council.

NORTH TORONTO.—The report and plans prepared by T. Aird Murray, C.E., of Toronto, for a sewage disposal system for this municipality, were accepted by the Provincial Board of Health.

Manitoba.

BRANDON.—Work will be commenced on the Pacific Avenue trunk sewer in a few days. A contract for stone at $5 a cord has been given to R. E. Rice, while a quantity, for concrete work, will be purchased from Mr. Pope at $4.50.

Alberta.

CALGARY.—The gravity system is practically complete, and Calgary now has a waterworks system which will meet all requirements for a long time to come.

British Columbia.

VANCOUVER.—In a report presented at a recent meeting of the City Council, Mr. W. A. Clement, city engineer, outlined plans involving an expenditure of $133,250 for sewer extensions.

VICTORIA.—The city's offer of $900,000 for works at Goldstream and Thetis Lake has been turned down by the Esquimalt Waterworks Company.

LIGHT, HEAT, AND POWER.

Quebec.

MONTREAL.—At a recent meeting of the Fire Committee it was decided to recommend to the City Council the acceptance of the Saraquay Electric Light Company's offer for street lighting in three wards, at $70 per light per year, which is $5 less than the price offered by the Montreal Light, Heat & Power Company.

MONTREAL.—McGill University is to install a large power plant, to furnish steam heat and electric power to all of its buildings. The power house is to be situated directly in the rear of the Arts Building, and from it long lines of tunnels and conduits, containing pipes and wiring, will eventually stretch out, connecting each of the ten buildings with the main source of supply. This, however, has become inadequate, and when the new Macdonald engineering building was in process of construction, plans for a new power plant were made. The plant is to cost about $150,000, but provision has been made for an expenditure of twice that sum as the university grows. The dimensions of the building are 80 by 116 feet, the boiler room 80 by 48 feet, and the engine room 42 by 60 feet. The chimney will be 8 feet in diameter by 160 feet in height, and is being constructed by H. R. Henricke, of New York.

Ontario.

HAMILTON.—The by-law authorizing the Corporation to enter into a contract with the Hamilton Cataract Power, Light, and Traction Company, Limited, will be submitted to the ratepayers on June 17th, for ratification .

TORONTO.—Contracts were signed last week for the equipment for the power and transformer stations at Niagara Falls, Dundas and other points along the hydro-electric line. The amount is nearly $1,000,000, two-thirds of which goes to the Canadian General Electric Company, Ltd., and the balance to the Canadian Westinghouse Company.

INGERSOLL.—The Ingersoll Electric Light and Power Company have refused an offer of $35,000 for their plant, made by the Light Committee of the City Council.

OTTAWA.—The latest issue of The Canada Gazette announces the incorporation of The Northern Light, Power & Coal Company, Limited, of Dawson, Yukon, with a capital stock of $3,000,000.

OTTAWA.—The Erindale Power Company, Limited, with a capital stock of $250,000, have been incorporated. The chief place of business will be at Toronto.

British Columbia.

FERNIE.—At the last meeting of the City Council tenders were accepted for the construction of pole line distribution and machinery in connection with the municipal electric light system.

VICTORIA.—The British Columbia Electric Railway Company is seeking to increase its water supply. The company proposes to secure an additional 25 cubic feet per second and construct a dam and power house near the mouth of the Jordan River.

FINANCING OF PUBLIC WORKS.

Nova Scotia.

GLACE BAY.—The City Council will shortly ask the ratepayers to sanction a loan of $30,000 for improvements to the reservoir.

HALIFAX.—The Board of City Works recommended to the Council that $30,000 be borrowed for new sewers, $15,000 per permanent sidewalks and $70,000 for water improvement and extension.

Quebec.

MONTREAL.—A by-law for new sewers and sidewalks was passed recently by the town of St. Paul.

MONTREAL.—For the completion of the aqueduct works, the Water Committee have asked for a further grant of $457,000.

Ontario.

ARTHUR.—A by-law for the issue of $25,000 waterworks debentures was defeated by a majority of 31.

BROCKVILLE.—By-laws to provide for reconstruction of bridges and improvements to light and power plant will shortly be submitted to the ratepayers.

GRAVENHURST.—The by-law to raise $20,000 for waterworks was carried by a majority of 84.

Manitoba.

BRANDON.—Debentures for waterworks, $50,000, and sewers, $47,000 have been sold to H. O'Hara & Company, of Toronto.

CARMAN.—The by-law to raise $25,000 for the completion of waterworks carried. The work will commence early.

MACDONALD.—H. Grills, secretary-treasurer of this municipality, invites tenders for $6,000 telephone debentures. The money is required to complete the local system.

Saskatchewan.

REGINA.—By-laws calling for $33,000 for the extension of the electric light system, the same amount for the extension of the waterworks and also an equal amount for extension of the sewage system, received their first and second reading at a recent meeting of the Council, and will be submitted to the ratepayers on June 11th.

SASKATOON.—Out of ten money by-laws voted on seven carried, aggregating $1,847,800, which includes $125,000 for a collegiate institute. The others carried were $36,000 for power house extension and $5,000 for land; $10,000 for road machinery; $5,000 for temporary city offices; $2,100 for the C.P.R. supplementary sum given for strengthening the bridge for traffic attachment, and $1,000 for Wilson Park.

Alberta.

MEDICINE HAT.—On June 11th the ratepayers here will vote on by-laws to provide $81,000 for sewers, sidewalks, etc.

British Columbia.

NELSON.—A by-law to raise $10,000 to purchase from the Nelson Electric Tramway Company its lines and equipment will shortly be submitted to the ratepayers.

CURRENT NEWS.

Quebec.

MONTREAL.—In connection with Montreal's harbor improvements the following gentlemen constitute the Board of Engineers which is discussing the reports of Mr. R. C. H. Davidson, harbor engineer of London, England, and Mr. F. W. Cowie: Messrs. G. J. Desbarats, Deputy Minister of Marine; St. Laurent Coste and George Marcil, of Ottawa; Henry Holgate, John Kennedy, and F. W. Cowie, harbor engineer, Montreal.

MONTREAL.—Major J. W. Stephens made the announcement on May 27th that work would be commenced immediately on a $2,500,000 drydock for Montreal. One million and a half partly provided by the Canadian Government and partly by English capital will be sunk immediately.

Ontario.

OTTAWA.—Included in the programme of work to be done by the Geological Survey Department this summer are: Mr. F. H. McLaren, topographic map of Texada Island; Mr. R. H. Chapman, topographical survey of Vancouver Island; Mr. L. Reinecke, topographical map of the Tulameen and survey of the west fork of the Kettle River; Mr. W. H. Boyd, topographical map of the Slocan; Mr. S. J. Schofield will be employed in mapping the East Kootenay district; Mr. W. A. Johnston will resume his mapping of the Lake Simcoe region; Mr. M. E. Wilson will be working north of Lake Temiskaming.

PORT ARTHUR.—An agreement was signed last Friday on behalf of the Council with the Western Drydock & Shipbuilding Company, which is composed mainly of Cleveland capitalists. The terms call for the prompt construction and operation of a yard wherein ships of the largest tonnage on the lakes may be built, and also of a drydock capable of handling such vessels.

Alberta.

CALGARY.—A gas flow estimated at one million cubic feet per day and capable of developing four thousand horsepower has been struck in East Calgary at a depth of 2,900 feet.

TELEPHONY.

Ontario.

WOODSTOCK.—Work on the line from Hartland to Woodstock has been commenced by the Farmer's Telephone Company.

OBITUARY.

MR. DAVID BELL, mechanical superintendent of the Grand Trunk Railway at Allandale, Ont., died May 29th, 1909. Mr. Bell was forty-three years of age and had been with the G.T.R. twenty years.

MR. WILLIAM J. LARKWORTHY, B.A. Sc., died at Mitchell, Ont., May 30th, 1909. Mr. Larkworthy graduated from the School of Science, Toronto, 1904, and spent most of his time since graduation at Niagara Falls, Ont., and New York.

MR. HENRY H. ROGERS, vice-president of the Standard Oil Company, died May 19th in New York City. Mr. Rogers was president of the Virginia Railway and of the Amalgamated Copper Company, and was connected as a director or executive with a number of other important corporations. He was born in 1840 at Fairhaven, Mass., and was educated in the schools of that village, graduating at the Fairhaven High School in 1856. After leaving school, he sold papers for a time in Fairhaven and New Bedford, but soon gave up this work to become a clerk in his father's grocery store, in Fairhaven, at three dollars a week and board. He continued in this position for five years and then, after a short interval in which he worked as a brakeman for the Fairhaven Branch R.R., he went to the Pennsylvania oil regions, where he remained about six years and obtained his foundation knowledge of the details of the oil business. He next entered the employ of the oil refinery controlled by Charles Pratt in Brooklyn, N.Y., and soon attained a place of prominence in the Pratt Company, becoming with Mr. Pratt a trustee of the Standard Oil Company at the time of its inception in 1874.

MARKET CONDITIONS.

Toronto, June 3rd, 1909.

Advices from Pittsburg are more rose-colored than for many months as to activity in steel. So pressed with orders were they that the Carnegie Steel Mills and the American Steel and Wire Company would not observe the usual public holiday of Decoration Day, but ran full time. Nearly all other concerns followed this lead, having also a pressure of orders. Stocks of nails, wire, and structural steel are all light, and there is a prospect of a long run at full time for some of the mills, as a result of a steady and general increase of commercial activity. The feeling among iron and steel men is improved and independent producers propose to advance prices. The speculative demand, however, is much more active than the consumptive demand. The same is true of copper.

Building is active in Toronto, and the demand for brick so great that the supply is distinctly short. Lumber is moving fairly well, too. House repairing and house-building in country parts of Ontario, however, is less active than usual, and the sudden falling-off in roofers' materials mentioned in this column of last week's issue may be explained thus:—Farmers have become alarmed at the possible bad effects upon the crops of the prolonged cold weather in May, and have ceased repairing or extending operations. Hardware men find shelf goods moving steadily in small parcels, and sporting goods as well; but heavy metals cannot be called active.

The intelligence from the United Kingdom about metals is not particularly reassuring. Production of pig-iron is at a low point, the home demand being slow during May, with, however, a slightly better prospect just now. In manufactured iron producers are only partially employed. The shipyards do not show any improvement in activity, and steel makers, therefore, are not busy. Tin and copper are subject to more or less speculative manipulation, but appear rather steadier than usual.

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

Antimony.—No very active demand, and market unchanged at $9.25.

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, 1¾-inch, 10c.; 1½-inch, 9c. per foot; 2-inch, $8.50; 2¼-inch, $10; 2½-inch, $10.60; 3-inch, $12.10; 3¼-inch, $15; 4-inch, $18.50 to $19 per 100 feet.

Building Paper.—Plain, 30c. per roll; tarred, 40c. per roll. The spring rush is over and business steady.

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

Cement.—The supply is far beyond the demand, and every maker seems to have his storage capacity occupied to the full. There is no reason, therefore, to look for any immediate change in the present quotation of $1.70 per barrel, including bags, or $1.30 without bags, car lots; for smaller quantities $1.40 to $1.50 per barrel in load lots delivered in town and bags extra. In paper packages, price would be, including paper bags, $1.40 to $1.50. Dealers are more cheerful, expecting a marked improvement in demand within a few weeks.

Coal.—The only kinds of coal dealt in in this market come from Pennsylvania, whether anthracite or bituminous, and it is bought by wholesale dealers at Suspension Bridge. Of hard coal the retail price in Toronto is $6.50, with a strong likelihood of its continuing at this price for a month or two, the operators appearing to have agreed for a while. This price applies to grate, egg, stove, and chestnut; only pea coal is cheaper, namely, $5.50. These are all cash, and the quantity purchased does not affect the price. Soft coal is in good supply, American brokers have been covering the ground very fully. In the United States there is an open market for bituminous coal and a great number of qualities exist. We quote: Youghiogheny lump coal on cars here, $3.70 to $3.80; mine run, $3.60 to $3.75; slack, $2.65 to $2.85; lump coal from other districts, $3.40 to $3.70; mine run 10c. less; slack, $2.50 to $2.70; cannel coal plentiful at $7.50 per ton; coke, Solvey foundry, which is largely used here, quotes at from $5.25 to $5.50; Reynoldsville, $4.50 to $4.75; Connellsville, 72-hour coke, $5.25 to $5.50.

Copper Ingot.—The firmness continues at $13.75 to $14.05. The demand is steady.

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

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

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

Fire Bricks.—English and Scotch, $30 to $35; American, $27.50 to $35 per 1,000. The demand is good, and, as is usual in spring, stocks are low.

Fuses.—Electric Blasting.—Double strength, per 200, 4 feet, $4.50; 6 feet, $5; 8 feet, $5.50; 10 feet, $6. Single strength, 4 feet, $3.50; 6 feet, $4; 8 feet, $4.50; 10 feet, $5. Bennett's double tape fuse, $6 per 1,000 feet.

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

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

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

Iron Pipe.—Black, ¼-inch, $2.03; ⅜-inch, $2.26; ½-inch, $2.63; ¾-inch, $3.16; 1-inch, $4.54; 1¼-inch, $6.19; 1½-inch, $7.43; 2-inch, $9.90; 2½-inch, $15.81; 3-inch, $20.76; 3½-inch, $26.13; 4-inch, $29.70; 4½-inch, $38; 5-inch, $43.50; 6-inch, $56. Galvanized, ¼-inch, $2.86; ⅜-inch, $3.08; ½-inch, $3.48; ¾-inch, $4.31; 1-inch, $6.19; 1¼-inch, $8.44; 1½-inch, $10.13; 2-inch, $13.50. Prices firmly maintained.

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 100 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.—A fairly steady demand for domestic pine. Southern pine and hemlock, as well as for shingles and lath, with prices in the main unchanged. 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 dimension timber from $30 to $45, according to size and grade; finished Southern pine according to thickness and width, $30 to $40. Hemlock in car lots, $16.50 to $17; spruce flooring in car lots, $22; shingles, British Columbia, $3.20; lath, No. 1, $4.25; No. 2, $3.75; for white pine, 48-inch; for 32-inch, $1.50.

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

Pitch and Tar.—The demand is moderate. Price so far unchanged at 70c. per 10 olbs. Coal tar quotes $3.50 per barrel.

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.

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

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

Roofing Slate.—Most of the slate used in Canada comes now from Pennsylvania or Maine, the Canadian supply being slender and mostly from the Rockland quarries of the Eastern Townships in Quebec. There is a great variety of sizes and qualities, so that it is difficult to indicate prices. But No. 1 Pennsylvania slate 10 x 16 may be quoted at $7.25 per square of 100 square feet, f.o.b., cars, Toronto.

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	.....

Not much moving; price, 73 per cent. off list at factory for car-load lots; 65 per cent. off list retail. Small lots subject to advance.

Steel Beams and Channels.—Quiet. We quote:—$2.50 to $2.75, 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-inch, $2.40 per 100 lbs.

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

Tin.—Market firm and demand good. The price continues at 31c. to 31½c. The feeling rather steadier abroad.

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

Zinc Spelter.—A very active movement continues, and the market is higher at $5.50 to $5.75.

(Continued on Page 40.)

(Continued from Page 752.)

Montreal, June 3rd.

In the United States, there was a particularly active buying demand for pig-iron, during the past week, certain classes of finished material being also in request. Prices of pig are advancing, sales having been made at fully 75c. per ton above the low point reached in March and early April, and the majority of producers are now demanding a further advance of 25c. to 50c. per ton for deliveries extending over the third quarter. The idea seems to prevail that for delivery during the fourth quarter a further increase of 50c., or thereabouts, will be possible, in view of the greatly improved conditions. Scrap iron, particularly heavy melting-scrap for steel making purposes, has advanced $1 per ton during the past week, and fully $2 per ton during three weeks. Recent low prices of pig were not warranted by the situation, and were not in harmony with the cost of production, figured on a reasonable profit. The market can hardly be expected to keep up last week's gait, the buying activity having been greater than consumption would warrant, some part of the purchases having gone to replenish stocks. It would look, however, as if the recent extremely low prices are a thing of the past, and that a gradual improvement might be looked forward to.

So far as the English market is concerned, there has been a rather quiet and unsatisfactory trade, with prices somewhat off from the higher level recently established. This, however, is largely due to speculative reasons. The pendulum has again swung in an upward direction, latest cables showing an advance of a full shilling on English iron and about one shilling and sixpence on good Scotch brands. While the feeling is not very optimistic, on the whole, the tone of the market is steadily in an upward direction, and the volume of business coming out shows an improvement. Competition is extremely keen, and any upward movement is very speedily checked by the very evident desire on the part of producers to secure orders.

The local market is showing a materially better feeling. Not only has the turn-over exceeded that of any week during the past eighteen months, but consumers have evidently decided that it is well to cover the somewhat advanced prices now being asked for pig-iron as against two or three months ago. Owing to heavier booking of steel orders, certain Canadian furnaces are now putting their entire output into the manufacture of steel, and are not offering pig on the open market. The remaining furnaces are booking larger orders than usual, which circumstance, considering the established advances in the United States and the rising price on English and Scotch iron, has established a basis of prices in Canada of at least $1 per ton higher than three or four weeks ago. Canadian dealers are securing larger orders, many works which have until recently been running on short time are again running on large capacity, and in some cases extensions are under contemplation. This condition cannot be said to be general as yet, but without doubt there is a more optimistic feeling throughout the country.

After the numerous changes of a week ago, prices of the following lines have remained steady during the past week:—

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

Bar Iron and Steel.—Prices are steady and trade is better. 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, $1.90 for 1 x ⅜-base; toe calk steel, $2.35; machine steel, iron finish, $1.90; smooth finish, $2.70; imported, $2.20.

Boiler Tubes.—The market is steady, quotations being as follows:—1¼ and 2-inch tubes, 8½c.; 2½-inch, 10c.; 3-inch, 11½c.; 3 1-2-inch, 14¾c.; 4-inch, 19c.

Cement.—Canadian cement is quotable, as follows, in car lots, f.o.b., Montreal:—$1.30 to $1.40 per 350-lb. bbl., in 4 cotton bags, adding 10c. for each bag. Good bags re-purchased at 10c. each. Paper bags cost 2½ cents extra, or 10c. per bbl. weight.

Building Paper.—Tar paper, 7, 10, or 16 ounces, $1.80 per 100 pounds; felt paper, $2.75 per 100 pounds; tar sheathing, 40c. per roll of 400 square feet; dry sheathing, No. 1, 30 to 40c. per roll of 400 square feet; tarred fibre, 55c. per roll; dry fibre, 45c. (See Roofing; also Tar and Pitch).

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, $2; ⅞-inch, $2.95; 1 inch, $2.95.

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

Copper.—Prices are firm at 14 to 14½c.

Explosives and Accessories.—Dynamite, 50-lb. cases, 40 per cent. proof, 15c. in single case lots, Montreal. Blasting powder, 25-lb. kegs, $2.25 per keg. Special quotations on large lots of dynamite and powder. Detonator caps, case lots, containing 10,000, 75c. per 100; broken lots, $1. Electric blasting apparatus:—Batteries, 1 to 10 holes, $15; 1 to 20 holes, $25; 1 to 30 holes, $35; 1 to 40 holes, $50. Wire, leading, 1c. per foot; connecting, 50c. per lb. Fuses, platinum, single strength, per 100 fuses:—4-ft. wires, $3; 6-ft. wires, $3.54; 8-ft. wires, $4.08; 10-ft. wires, $5. Double strength fuses, 4-ft., $3.75; 6-ft., $4.20; 8-ft., $4.83; 10-ft., $5.37. Fuses, time, double-tape, $6 per 1,000 feet; explohmeters, fuse and circuit, $7.50 each.

Galvanized Iron.—The market is steady. Prices, basis, 28-gauge, are:—Queen's Head, $4.40; Comet, $4.25; Gorbal's Best, $4.25; Apollo, 10¾ oz., $4.35. Add 25c. to above figures for less than case lots; 26-gauge is 25c. less than 28-gauge. American 28-gauge and English 26 are equivalents, as are American 10¾ oz., and English 28-gauge.

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

Iron.—The outlook is steady. The following prices are for carload quantities and over, on cars, Montreal, delivery from dock being 35c. less; 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 $3.65.

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

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

Nails.—Demand for nails is better, but prices are steady at $2.20 per keg for cut, and $2.25 for wire, base prices. Wire roofing nails, 5c. lb.

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

Pipe.—Cast Iron.—The market is unsettled and uncertain, as dealers are compelled to meet competition from all sources. Prices are easy and approximately as follows:—$31 for 6 and 8-inch pipe and larger; $32 for 5-inch and 4-inch at the foundry. Pipe, specials, $3 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

Pipe.—Wrought and Galvanized.—The market is steady, moderate-sized lots being: ¼-inch, $5.50 with 63 per cent. off for black, and 48 per cent. off for galvanized; ⅜-inch, $5.50, with 59 per cent. off for black and 44 per cent. off for galvanized; ½-inch, $8.50, with 69 per cent. off for black, and 59 per cent. off for galvanized. The discount on the following is 72½ per cent. off for black, and 62½ per cent. off for galvanized; ¾-inch, $11.50; 1-inch, $16.50; 1¼-inch, $22.50; 1½-nch, $27; 2-inch, $36; 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 $30.50 to $31 is given for 60-lb. and 70-lb.; 80-lb. and heavier, being $30; rails, per gross ton of 2,240 lbs., f.o.b. mill. Re-laying rails are quoted at $27 to $29 per ton, according to condition of rail and location.

Railway Ties.—See lumber, etc.

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

Rope.—Prices are steady, at 9c. per lb. for sisal, and 11c. for Manila. Wire rope, crucible steel, six-strands, nineteen wires; ¼-in., $2.75; 5-16, $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 better demand and prices are steady at $2.30 per 100 pounds, base of 5½ x 9-16. Ship spikes are doing better also, and prices are steady at $2.85 per 100 pounds, base of ⅝ x 10-inch, and ⅝ x 12-inch.

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

Steel Plates.—The market is steady. Quotations are: $2.15 for 3-16; $2.25 for ⅜, 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, $3.50 per barrel of 40 gallons, weighing about 500 pounds; roofing pitch, No. 1, 70c. per 100 pounds; and No. 2, 55c. per 100 pounds; pine tar, $8.50 per barrel of 40 gallons, and $4.75 per half-barrel; refined coal tar, $4.50 per barrel; pine pitch, $4 per barrel of 180 to 200 pound. (See building paper; also roofing).

Tin.—Prices are unchanged, at 32½ to 33c.

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

* * * *

Winnipeg, June 1st, 1909.

Assisted by another week of favorable conditions, construction work in Winnipeg is proceeding rapidly. Work is being rushed, and great progress is being made, particularly on the larger structures. So far as building and construction work in general is concerned, the outlook was never brighter in the history of the West. No sooner is one large lot of work contracted for than we hear of plans and specifications in preparation for further erections on an extensive scale. The permit court is kept busy daily, and the season's total bids fair to put every previous year far in the shade. With such a state of conditions, it is almost needless to say that all branches of trade interested are having a busy and successful season. All the local engineering works are working at full pressure executing orders for Winnipeg and the West.

The Board of Consulting Engineers, composed of Messrs. Louis Herdt, Wm. Kennedy, Jr., and H. N. Ruttan, have made an inspection of the city power development works at Point du Bois, and found satisfactory progress being made. The power tramway is in good shape, and the contractors for the general works, Messrs. John Gunn & Sons, are proceeding rapidly with the work on the coffer dams. The controllers have decided to call for tenders for the hydraulic and electrical machinery for the generating station, at a value of about $450,000.

The Manitoba Bridge & Iron Works Company report that the extensive additions to their Winnipeg plant are on the point of completion. The handsome new union depot is rapidly taking shape, and construction is being rushed at top speed. Many of the blocks used weigh as much as ten tons, and the massive design of the front entrance gives an idea of the imposing structure that will be erected.

In connection with the new Transcontinental Railway bridge over the river at Lombard Street to the new Union Depot, a proposal is on foot to construct a double deck bridge, the upper portion for railway traffic, and the lower for street cars, vehicles, and pedestrians. The civic bridge committee have been in conference with R. F. Uniacke, chief bridge engineer of the N.T.R., and the question is to form the subject of further discussion.

Prices of local material remain at the figures of a week ago. The demand for all kinds of building material is increasing, and, as one large firm puts it, business is "unquestionably very good."

Appended are Winnipeg quotations:—

Anvils.—Per pound, 10 to 12½c.; Buckworth anvils, 80 lbs., and up, 10¾c.; anvil and vice combined, each, $5.50.

Bar Iron.—$2.50 to $2.60.

Beams and Channels.—$3 to $3.10 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., 4¼c.

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

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

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

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

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

Plaster.—Per barrel, $3.

Roofing Paper.—60 to 67½c. per roll.

Lumber.—No. 1 pine, spruce, tamarac, British Columbia fir and cedar—

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.

TENDERS CALLED FOR

CITY OF BRANTFORD

Tenders for Sewers.

SEALED TENDERS, addressed to Ald. John Moffatt, Chairman of the Board of Works, in care of the City Clerk, Brantford, Ont., will be received till 12 o'clock, noon, on **Thursday, June 10th, 1909,** for the furnishing and laying of about 6,000 lineal feet of sanitary sewers on Scarfe, Gilkison, Brant and Oxford Streets, 12-inch and 9-inch in diameter, together with necessary manholes.

Plans and Specifications may be seen and Instructions to Bidders and Forms of Tender obtained at the City Engineer's Office.

Each tender must be accompanied by a marked cheque for 5 per cent. of the amount of the tender.

The lowest or any tender not necessarily accepted.

T. HARRY JONES,
City Engineer.

City Engineer's Office,
City Hall, Brantford, May 22nd, 1909.

CITY OF BRANTFORD

Tenders for Pavement.

SEALED TENDERS, addressed to Ald. John Moffat, Chairman of the Board of Works, in care of the City Clerk, Brantford, Ont., will be received till 12 o'clock, noon, on **Thursday, June 10th, 1909,** for the pavement of Queen and George Streets. (a) About 6,000 square yards of concrete foundation, including grading; (b) about 6,000 square yards of top surfacing (tenders for different kinds will be received); (c) about 3,000 lineal feet of concrete curb and gutter.

Separate tenders are required for a, b, and c. A guarantee bond for the maintenance of the pavement for 10 years will be required.

Plans and Specifications may be seen and Forms of Tender obtained at the City Engineer's Office.

Each tender must be accompanied by a marked cheque for 5 per cent. of the amount of the tender.

The lowest or any tender not necessarily accepted.

T. HARRY JONES,
City Engineer.

City Engineer's Office,
City Hall, Brantford, May 22nd, 1909.

PETERBOROUGH ONTARIO WATERWORKS

SEALED TENDERS, addressed to the undersigned, are invited by the Peterborough Water Commissioners, for the necessary excavation, coffer dams, concrete dam and pump house, foundations, etc., for waterworks purposes, on the Otonabee River, near Peterborough, Ontario, and will be received up to Monday, the Fourteenth Day of June, prox., at noon.

Specifications will be furnished, and plans may be seen at the office of Mr. W. Henderson, Superintendent Waterworks, Peterborough, Ontario, or at the office of the Designing Engineer, Mr. William Kennedy, Jr., Y.M.C.A. Building, Montreal, on or after the Fourth Day of June, prox.

No tender necessarily accepted.

S. R. ARMSTRONG,
Secretary, Water Commissioners,

22nd May, 1909. Peterborough, Ontario.

CONDUIT

"Tenders will be received by the city of Toronto, Canada, up till noon of June 30th, 1909, for laying between 350,000 and 450,000 duct feet of underground conduit. For specifications, form of tender, etc., apply Electrical Department, City Hall."

TENDERS FOR REPAIRS TO CONCRETE GAS HOLDER TANK

SEALED TENDERS, addressed to H. B. R. Craig, City Engineer, and marked "Tenders for Gas Holder," will be received up to 12 o'clock, noon, the 19th day of June next, for the repair of the concrete Gas Holder Tank belonging to the Corporation of the City of Kingston, Canada.

Information and general specifications may be obtained upon application to the undersigned.

The lowest or any tender not necessarily accepted.

(Signed) H. B. R. CRAIG,
City Engineer.

TENDERS FOR BRIDGE.

Sealed tenders addressed to Wm. Purves, Esq., Clerk of East Whitby Township, Columbus, Ont., will be received until noon on Tuesday, June 15th, for the building of a 40-foot Reinforced Concrete Arch Bridge near Oshawa.

Plans and specifications may be seen at the office of the Engineers.

The lowest or any tender not necessarily accepted.

BOWMAN & CONNOR, Engineers,
33 Toronto Street, Toronto.

June 1st, 1909.

BURLINGTON WATER WORKS.

TENDERS WANTED.

Sealed tenders will be received by the Clerk until 8 p.m. on Monday, June 21st, 1909, for the following works:—

Contract "B"—Pump House.

Contract "G"—Electrically Operated Pumping Machinery.

Contract "I"—Steel Pump Well.

Plans and specifications may be seen at Burlington, or at the office of the Chief Engineer, Toronto, on and after June 8th.

M. C. Smith, Esq., Chairman, Burlington, Ont.
O. T. Springer, Esq., Secretary, Burlington, Ont.

Willis Chipman, C.E.,
Chief Engineer,
103 Bay Street,
Toronto, Ont.

CITY OF TASKATOON.

TENDERS WANTED FOR ELECTRICAL MACHINERY.

Sealed tenders addressed to the undersigned City Clerk will be received until 5 o'clock p.m., Tuesday, June 22nd, 1909, for the following:—

"A."—500 K.W. 2,200 volts, 60-cycle, 150 R.P.M., 2-phase, Generator, Exciter, and Switch Board, installed, complete.

"B."—750 H.P. 150 R.P.M. Vertical, Cross, Compound, Corliss Engine, with the necessary condensing apparatus, installed complete.

Plans and specifications may be seen at the office of the Electrical Superintendent, E. L. White, Chubb Block.

The lowest or any tender not necessarily accepted.

W. HOPKINS, Mayor. J. H. TRUSDALE, City Clerk.

Saskatoon, May 27th, 1909.

WINNIPEG POINT DU BOIS HYDRO-ELECTRIC DEVELOPMENT---TENDERS FOR EQUIPMENT OF GENERATING STATION.

Sealed tenders on prescribed forms addressed to the Chairman of the Board of Control, Winnipeg, Canada, and marked on the envelope "Point du Bois Hydro-Electric Development, Tenders for ....." will be received at the office of the undersigned up to 11 a.m., on Monday, August 2nd, 1909, and Monday, August 16th, 1909, as below, for the manufacture, delivery and erection of the hydraulic, electric and auxiliary equipment of the Municipal Generating Station on the Winnipeg River.

The specifications and plans will be on exhibit after June 15th, at the office of the following;—Engineering, London, Eng.; Engineering News, New York City; Smith, Kerry & Chace, Toronto; Wm. Kennedy, Jr., Y.M.C.A. Building, Montreal; and Smith, Kerry and Chace, Winnipeg.

Copies of the Instructions to Bidders, of the plans, specifications and form of tender may be obtained from the Power Engineer's office, Carnegie Library Building, Winnipeg, and at the office of "Engineering," London, Eng., after June 15th, but the application for these must be accompanied by deposit, as listed below, for each section applied for. This deposit will be returned to the applicant only upon the return to the Power Engineer's office of the plans and specifications in good order.

Each tender must be accompanied by a certified cheque payable to the City Treasurer for the sum called for in the corresponding Instructions to Bidders, which cheque will become forfeit to the Corporation in the event of the successful tenderer refusing or neglecting to execute a satisfactory contract when called upon so to do.

Tenders will be received upon the following sections:—

*A.—Specifications Nos. 5 and 6 respectively for 5,200 H.P. Turbines (5); 450 H.P. Turbines (2). Deposit, $250.

*This tender returnable August 2nd, 1909.

B.—Specifications Nos. 7, 8 and 11, respectively for 3,000 K.W. Generators (5); 250 K.W. Generators (2); Switching and Accessory Apparatus. Deposit, $250.

C.—Specification No. 10 for Step-up Transformers (6). Deposit, $100.

D.—Specification No. 12 for Light, Heat & Power Systems. Deposit, $50.

E.—Specification No. 23 for Protective Apparatus. Deposit, $50.

F.—Specification No. 25 for Electric Travelling Cranes (3). Deposit, $50.

G.—Specification No. 27 for Auxiliary Apparatus. Deposit, $100.

As an alternative, tenderers may include or group together one or more of the above sections, providing that they have also tendered for the individual sections of such grouping.

The Board reserves the right to reject any or all tenders or to accept any tender, which shall appear advantageous to the city of Winnipeg.

M. Peterson, Secretary.

Office of the Board of Control,
Winnipeg, Canada, May 31st, 1909.

CONTRACTOR'S SUPPLIES

NEW INCORPORATIONS.

Fort Frances, Ont.—Foley Gold Mines Company, $1,000,000; J. L. Morrison, J. A. Manks, J. J. Durage, Duluth.

Sherbrooke, Que.—MacKinnon Holmes & Company, $75,000; G. D. MacKinnon, J. Nicol, Sherbrooke; A. R. Holmes. P. Biron & Sons, $20,000; P. Biron, M. E. Biron, F. A. Biron.

Before the electrical equipment of the Sinclair tunnel was accepted by the railway company, a thorough test of the electrical apparatus under operating conditions was made, during a period of several months, by the contractors. It was found that the electric locomotives were capable of hauling 1,000 ton trains, as against 700 ton trains hauled by the steam locomotives. The 27.3 car trains, which was the average size of the train hauled by the electric motors, require 10 minutes to pass through the electric zone. The average size of the steam trains was 19.7 cars, and it took the steam locomotives fifteen minutes to haul them over the same distance. The steam locomotives burned per month, $5,000 worth of coal, costing $6 per ton; the electric service, burning soft coal costing $3 per ton, required only $1,150 for fuel for the same period.

NEW INCORPORATIONS.

Toronto.—Belmont Silver Mines of Kerr Lake, $2,000,000; R. W. Eyre, H. C. Macdonald, E. E. Wallace. Willet Silver Mines, $2,000,000; F. O. Campbell, W. Kelly, J. A. Hopeson. Elk Valley Coal & Coke Company, $500,000; G. D. Lewis, D. I. Warren, C. H. Port.

Winnipeg, Man.—Boyds, $20,000; N. Boyd, W. J. Boyd, W. S. Boyd. International Lumber Company, $20,000; J. C. Shields, Savona, B.C.; J. Blanchard, S Chiswell, Winnipeg. United Glass Manufacturing Company, $500,000; J. H. S. Blanchard, H. S. Blanchard, H. Dutton.

Montreal.—Western Canada Power Co., $5,000,000; J. W. Burrill, G. P. Wilson, L. R. Warden. Ogilvie Brothers, $45,000; P. C. Ogilvie, S. Ogilvie, G. Duff. Desnoyers, Varin et Compagnie, $95,000; W. Reed, L'Assomption; T. Desnoyers, Maisonneuve; V. Varin, Montreal. Lafontaine Construction Company, $50,000; R. Forget, D. Masson, P. Desforges. La Compagnie des Rechaudes Injecteurs Guimont, $275,000; W. Guimont, G. Guimont, O. Guimont. Ownly Company, $20,000; J. A. O'Brien, F. D. Anthony, J. T. Clark. A. P. Cimon Shoe Manufacturing Company, $20,000; A. P. Cimon, A. S. Lavallee, P. Chicoine. Chateau Dupere, $28,000; A. B. Dupere, J. B. Fafard, J. B. Lavigne.

BUYERS' REFERENCE

Numbers indicate pages on which may be found advertisements of desired materials.