THIS ISSUE CONTAINS { Page of Costs
Reinforced Bank Building

Canadian Engineer

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

MONTREAL OFFICE: B 32 Board of Trade Building

WINNIPEG OFFICE, Room 315, Nanton Building

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

BUYER'S REFERENCE—PAGE 48—50.

INDEX TO ADVERTISEMENTS.

* Every Other Week
† Once a Month

THE PIONEER INSPECTION COMPANY OF CANADA
Expert Inspection—Tests and Reports
THE CANADIAN INSPECTION CO., Ltd.
Inspectors to Dominion and Provincial Governments
Representatives at all important CANADIAN, AMERICAN and EUROPEAN WORK
Complete Facilities for all classes of Physical Testing & Chemical Determination
Main Laboratory; 601 Canadian Express Bldg., MONTREAL
Canadian Branches: Amherst, N.S. Toronto, Hamilton, Winnipeg
T. S. GRIFFITHS, Pres. and Gen. Mgr. L. J. STREET, Vice-Pres.

A. L. Reading, Manager. T. C. Irving, Jr., A.M., Can. Soc. C.E., Sec'y
STANDARD INSPECTION BUREAU, Ltd.
Inspecting and Consulting Engineers
Expert Examination and Tests of Material and Workmanship. Inspection of Steel Rails and Fittings, Cars, Locomotives, Bridges, Structural Material, Cast Iron Pipe, etc Resident Inspectors located at all important Manufacturing Centres.
Head Offices: 1314 Traders Bank Bldg., Toronto

DOMINION BUREAU
ROBERT W. HUNT & COMPANY, ENGINEERS
Bureau of Inspection, Tests, and Consultation,
Chemical and Cement Laboratories
OFFICE AND LABORATORIES
CANADIAN EXPRESS, BUILDING, McGILL STREET, MONTREAL
CHARLES WARNOCK, Manager

THE HILL ELECTRIC MANUFACTURING COMPANY
approved types of Distributing
Boards and Cabinets
1560 St. Lawrence Street, MONTREAL

"SAMSON" Canada's Best

THE OWEN SOUND PORTLAND CEMENT CO.,
LIMITED

WRITE FOR PAMPHLET
"CEMENT, HOW TO USE IT, HOW TO BUY IT."

General Sales & Head Office, Owen Sound, Ont.

EXPANDED METAL AND FIREPROOFING CO., LIMITED
New Office and Factories:
Foot of Fraser Ave., Toronto
SPECIALISTS IN
REINFORCED CONCRETE CONSTRUCTION FOR 12 YEARS
SPECIFY SECTION
AND PHYSICAL QUALITIES
Steelcrete
TRADE MARK
ENSURES RELIABILITY
Estimates, Catalogues, Etc.

Our Engineering staff, from now on, more than ever will make a point of replying fully to enquiries from engineers concerning every phase of Re-inforced Concrete construction and design accompanied by plans where called for

BEAMS, COLUMNS, FLOORS, TANKS, CULVERTS, Etc.

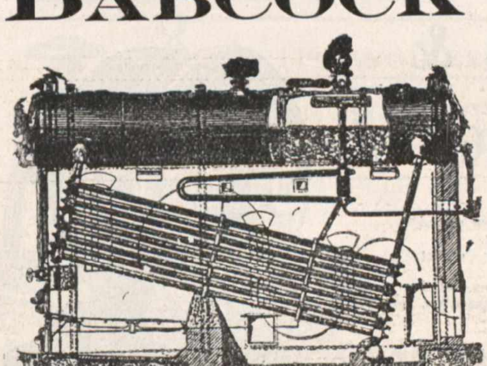
The Standard Adjunct **STEELCRETE** To Concrete Plates is

EXPANDED METAL

WE NOW MANUFACTURE
Fenestra Steel Window Sash for Power and Transformer Houses, Factories, Etc., Etc.
Obtain our estimates and compare wooden sash cost with

FENESTRA STEEL SASH

BABCOCK & WILCOX, LTD.


'B.&W.' Boiler Fitted with Superheater.

PATENT
WATER-TUBE BOILERS
SAFETY - ECONOMY - DURABILITY
Over 7,000,000 H. P. now in use
HEAD OFFICE FOR CANADA—11 PLACE D'ARMES, MONTREAL
Branch Office—Traders Bank Bldg., Toronto

Our text-book STEAM sent gratis on request

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

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

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.

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

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

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

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

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

CAMERON SEPTIC TANK Co.
CONSULTING ENGINEERS
Sewage Disposal
MONADNOCK BLOCK, CHICAGO, Ill.
NEW YORK 143 Liberty Street. SAN FRANCISCO 528 Monadnock Bldg.

HANBURY A. BUDDEN,
PATENT OFFICE
MONTREAL
F.M.Chart.I.P.A, Barrister, Solicitor and Patent Agent
Offices New York Life Building Cable Address, "BREVET"

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.

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.

RIDOUT & MAYBEE
Solicitors of Patents
Counsel, Solicitors and Experts in
PATENT SUITS
Agencies in the leading countries of the world
John G. Ridout, Barrister, etc. 103 Bay St Toronto J. E. Maybe Mech. Eng.

WALTER J. FRANCIS, C.E.
Consulting Engineer
SOVEREIGN BANK BUILDING
MONTREAL
Member Canadian Society Civil Engineers
Member American Society Civil Engineers

HENRY N. NOLD
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.

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

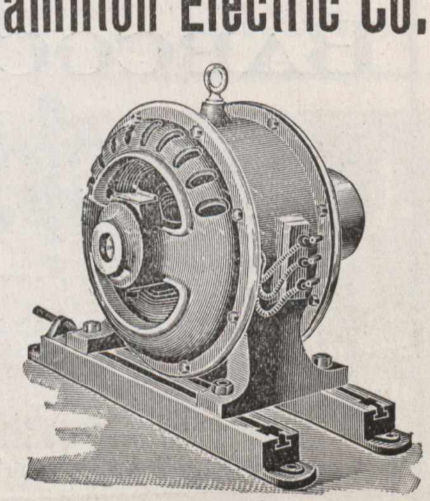
EDW. O. FUCE
Hon. Grad., Univ. Tor. (S.P.S.)
A. M. Can. Soc. C. E. Ont. Land Surveyor
CIVIL ENGINEER
GALT ONTARIO
REINFORCED CONCRETE STRUCTURES
SEWERAGE, SEWAGE DISPOSAL, WATER WORKS

YOUR NAME SHOULD BE HERE
(Send for Rates)

Are You Still Forging Lathe and Planer Tools
Get wise and write for our catalog of
Armstrong Tool Holders
Save all forging—90% tool steel, 70% grinding
We also make a full line of Ratchet Drills
ARMSTRONG BROS. TOOL CO.
107 N. Francisco Ave., Chicago, U.S.A.

Toronto & Hamilton Electric Co.

Motors & Dynamos



Moderate and slow speed of high efficiency.
Either belted or direct connected.
Repairs promptly executed on all electrical apparatus.

Toronto & Hamilton Electric Company,
99-103 McNab St., North
HAMILTON, Ont

NEW INCORPORATIONS.

Montreal, Que.—J. Watson & Son, of Montreal, contractors, $49,000; R. T. Heneker, A. H. Duff, W. S. Johnson.

Edmonton, Alta.—Wilson Limited; Hardisty Cartage Company; McDougall & Secord; Pembina Hotel Company.

Portage la Prairie, Man.—Manitoba Power and Electric Company, $100,000; W. H. Carter, A. H. Aldinger, A. J. Williams, Winnipeg.

Winnipeg, Man.—Excelsior Coal Mining Company, $300,000; J. S. Douglas, A. R. Wooldridge, F. Ashford. Birrell Motor Plow Company, $150,000; J. Birrell, T. A. Crerar, A. M. Blackburn.

Brandon, Man.—Municipal Light, Heat and Power Company, $50,000; G. E. Knechtel, Brandon; M. B. Jackson, W. A. Thompson, Hamiota.

(Continued on Page 48.)

The Canadian Engineer

WEEKLY

ESTABLISHED 1893

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

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

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

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

NOTICE TO ADVERTISERS

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

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

TORONTO, CANADA, APRIL 16, 1909.

CONTENTS OF THIS ISSUE.

During the first three months of 1909 the revenue from subscription to The Canadian Engineer was more than a hundred per cent. greater than for the first three months of 1908.

A CEMENT COMBINE?

A cement combine or a cement trust—we hope not. For many months it has been the talk on the street that efforts are being made and plans perfected for the consolidation of management of many of the cement plants of Canada under one organization. We do not suppose that anyone is unwise enough to suggest that they can form a trust that will for any length of time control the manufacture or output of Portland cement in Canada. The raw products are so widely and generously distributed, the demand for the finished product so large, and the opportunity for safe investment in cement plants is considered so good, that it would require skilful management to prevent the opening of new plants.

The manufacturer of cement in Canada has had his difficulties and discouragements. New processes of manufacture, improvements in equipments and the development of new fields has in ten years cut the price of cement in half. It is true that with the reduction in the price of cement the amount consumed has largely increased; but last year's prices left little margin for profit. Just now prices are firmer, the demand brisker, and altogether the outlook for the cement industry in Canada brighter. Looking at it from the cement manufacturer's standpoint, we cannot see the necessity for a consolidation of interests.

For the consumers, such a union would be most unfortunate. It is true a union would make it possible for the manufacturers to sell cement cheaper. But will they? A consolidation of interests would mean the stifling of those energies which will be devoted to the perfection of the present processes and adoption of new ideas and experimenting which gives us a better product.

Cement, as a material of construction, has become so important and necessary that everything that can be done must be done to maintain its place; and it will be unfortunate in the end if anything should occur to remove the incentive which up to the present has done so much to perfect the finished product.

NIAGARA POWER.

It was the unexpected that the Ontario Power Company had to face during the past week when the Niagara River jammed and the ice-pack almost buried their power house at the foot of the falls.

This is the first severe test that the Niagara power companies have been put to. The district served by the Ontario Power Company is of such an extent that local conditions in Niagara very quickly caused consternation in towns and cities almost a hundred miles away. In this crisis the wisdom of making the power plants at Niagara rather a battery of plants than a series of separate plants was shown.

The generators in all the plants were designed for the same frequency and similar voltage, and when the Ontario Power Company found their plant crippled it was a fortunate thing for their many customers that they were able to secure from the other power companies a sufficient power to supply pressing needs. With the Electrical Development Company prepared to generate fifty thousand horse-power, the Canadian Niagara Power Company fifty thousand, and the Ontario Power Company eighty thousand, and with power plants designed along similar lines, with their intakes placed at different stages along the river, so long as the friendly relations which at present exist continue, this strong battery of the power companies will be able to successfully handle the unexpected when it arises.

PROTECTION.

It is not so much foresight, planning or vision, but courage that counts for success. No matter how carefully one may estimate, no matter how correct his plans, if he has not the courage to take chances, to execute, he is not likely to have success in any marked degree.

Because one must take chances, it is not necessary that he should neglect all precautions. Too many of our contractors carry responsibilities and take chances that with a small outlay they could unload upon others. Now that almost every Province in Canada has placed upon its statute books a Workmen's Compensation Act, those employing labor should protect themselves so that in case of accident or accidents they will not find themselves in deep water. All the Workmen's Compensation Acts become inoperative when the employees' annual income reaches the thousand dollar mark. In other words, it is largely an Act for the protection of the unskilled laborer, the mechanic and the mill hand.

The compensation usually allowed is in the neighborhood of fifteen hundred dollars in case of death, and in case of temporary incapacity a daily allowance equal to one-half of the wages received at the time of the accident. A study of the industrial accidents for 1908 makes it very plain that the fatalities are largest among that class of workmen in which the contractor is interested. Of all employers of labor, the contractor has the greatest risk to carry; and we wonder that more do not make use of the accident insurance companies which, for a small premium, will carry their risk.

Competition is so keen and prices have been cut down so fine that the margin of profit is not large, and on small works the simplest kind of accident may result in wiping out profits.

The insurance companies are quite capable of doing their own educational work along these lines, but for the contractor's safety we would suggest that he give the matter more attention than has been his custom in the past.

HIGHWAY IMPROVEMENT.

The impassable condition of country roads in springtime brings to one's attention the seriousness of the problem of highway improvement. At certain seasons of the year the business of the rural community in some sections is disorganized for the want of good country roads. For years the question of good roads has been talked about. In certain sections much has been done, but much still remains. Poorly located, badly constructed rural highways are a great drawback to any country.

One of the most interesting and valuable reports dealing with rural highway improvement is that issued by the Deputy Minister of Public Works for the Province of Ontario. The report for 1909 reviews the situation in the Province of Ontario, and points out very clearly that which is often neglected—the responsibility that urban municipalities should accept in reference to country roads. People in large centres of population seem to think that when they have finished their city pavements they have completed their road system, overlooking the fact that they pay a large proportion of the extra cost of hauling produce over the poor roads of the surrounding district.

Two sections of this report are of special interest to the engineer. The first, entitled "Highway Improvement," deals briefly but thoroughly with such questions as the height of roads, drainage, width of roads, road metals and road machinery. A second section is entitled "Manual of Roadmaking." It contains 304 paragraphs, dealing with every phase of highway construction, and is one of the most concise, complete and useful manuals that we have had the opportunity of examining. It is to be hoped that this portion of the report will be republished as a handbook for road superintendents.

Altogether, the Annual Report on Highway Improvements in Ontario for 1909 is one of the most useful Government reports published.

EDITORIAL NOTES.

The list of members and by-laws of the Canadian Society of Civil Engineers for 1909 has just been distributed. A new feature, and one that will commend itself to the membership, is the arrangement alphabetically of the members' names. An addition, we would like to see in future issues, would be the location of the offices of the branch societies, together with a list of members attached to each branch. With four branches and four branch offices, a member of the Canadian Society of Civil Engineers can now make his headquarters at the society's rooms in five of the leading Canadian cities. There is easily room for four or five more branches, and nothing would do more to give a local interest to this national organization than well-appointed rooms in nine or ten of the leading centres throughout Canada.

* * * *

An interesting, instructive and timely report is that of Albert H. Leake, Inspector of Technical Education for the Province of Ontario. This report, presented as an appendix to the report of the Minister of Education for the year 1908 shows clearly the work that is being done in the manual training schools of the Province that are a necessary step to the development and inception of trade schools, which seem to be the objective point of certain educational leaders in the Province. This phase of the question does not need to be here discussed, but those interested in technical education and trade schools will be much interested in Mr. Leake's report and the seven suggestions he makes as to the needs of development of technical education in this Province, namely, the modification of the public school course in the last two years; the establishment of vocational schools; manual training in wood and metal and household science department; the development of courses in mechanical, machine and architectural drawing and industrial design; the establishment of a technical course in the high schools; evening classes for technical study and the establishment of industrial museums in industrial centres.

RAILWAY EARNINGS AND STOCK QUOTATIONS

NAME OF COMPANY	Mileage Operated	Capital in Thousands	Par Value	EARNINGS Week of Apr. 7	
				1909	1908
Canadian Pacific Railway	8,920.6	$150,000	$100	1,555.000	1 316,000
Canadian Northern Railway	2,986.9	....	......	180,500	167 600
*Grand Trunk Railway	3,568.7	226,000	100	727,667	673,827
T. & N. O.	305	(Gov. Road)	......	27,404	15.841
Montreal Street Railway	138 3	18,000	100	65,391	63,770
Toronto Street Railway	114	8,000	100	69.789	62,123
Winnipeg Electric	70	6,000	100	....	....

NAME OF COMPANY	STOCK QUOTATIONS — TORONTO: Price Apr 9 '08	Price Apr. 1 '09	Price Apr. 8 '09	Sales Week End d Apr. 8	MONTREAL: Price Apr '08	Price Apr. 1 09	Price Apr. 8 '09	Sales Wek End d Apr. 8
Canadian Pacific Railway	156¼ 155½	177	177	455	156½ 156⅛	176½ 176¼	176¼ 176	4063
Canadian Northern Railway	....	....	....	......	....	....	....	......
*Grand Trunk Railway	....	*1st. pref. 105½, 3rd pref. 47⅝, ordinary 19⅞					....	......
T. & N. O.	....	....	....	......	....	....	....	......
Montreal Street Railway	....	....	....	......	188 187⅞	209 208	212 211¾	1470
Toronto Street Railway	98½ 98	123	....	288	98½ 98	123¾ 123½	124 123	324
Winnipeg Electric	143½	167½	170 168	155	....	....	168 167	30

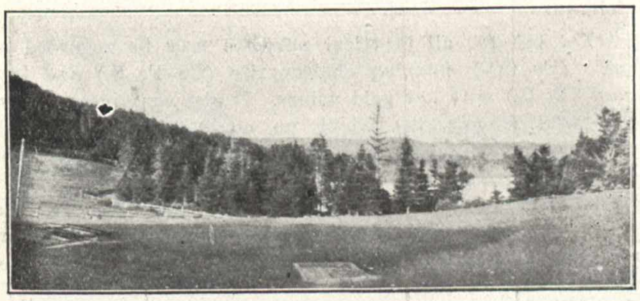
* G.T.R. stock is not listed on Canadian Exchanges These prices are quoted on the London Stock Exchange.

PROPERTY OF THE LAKE COPPER MINING CO., LIMITED, AT COPPER LAKE, ANTIGONISH, N.S.

John W. McLeod.

Historical.

This property of the Lake Copper Mining Co., Limited, is historic ground, and it is a difficult matter to distinguish between legend and facts. The occurrence of copper in this region was long known, and the finding of rich boulders led to intermittent prospecting. So far as the writer could learn from the old residents of the locality, a Cornish miner, attracted by the similarity of the country to his native Cornwall, was the first to begin operations over sixty years ago. He drove a tunnel



Copper Lake.

into the side of the hill marked "old tunnel" on map No. 1. It is said that he made a very rich find and in the dead of night, after having taken a sufficient quantity of samples, caused the tunnel to cave in. He immediately took ship for England to report his valuable discovery and to organize a company to develop the property, but the frail craft upon which he had embarked was swallowed up by the angry waves of an Atlantic storm.

Authentic history dates from 1864 when Dr. Honeyman made a survey of the district and prepared a report for the Government of Nova Scotia. A company was incorporated in 1867 for the purpose of developing the mineralized territory. They, however, failed to discover the vein, the origin of the boulders, and in course of time their means became exhausted and they ceased operations.

In 1872 Dr. G. M. Dawson, of the Geological Survey Department, Canada, and Sir William Dawson, of McGill University, visited the Copper Lake district. The former in a letter dated October 2, 1872, addressed to Mr. A. P. Ross, of Pictou, Nova Scotia, and countersigned by Sir William Dawson, states: "I am of the opinion that the main deposit, which had given off such a quantity of surface fragments, has never yet been discovered, and from the appearance and size of the boulders, some of which are said to have yielded from 10 to 13 per cent. in analysis, there seems every indication of a large and valuable deposit of cupriferous pyrites in the immediate neighborhood."

Mining areas were now taken up by two rival companies, the promoters being Mr. A. P. Ross, mentioned above, and Mr. Alex. McBain, of Thorburn, the discoverer of the famous McBain coal seam. McBain began developments on what is now the surface rights of the Lake Copper Mining Co., Limited, and in 1875 discovered the "Lake Copper Vein." In 1876 the vein was opened by a shaft twenty-five feet deep and at a distance of 150 feet along the lode where the superficial deposit is reduced from twenty-five to five feet in thickness another opening was made; the vein was also located across Copper Lake in Sear's farm. Unfortunately, the limits of the mining areas of the two rival companies were not properly defined, consequently, McBain's important discovery precipitated a struggle for the possession of the valuable property. The rival companies were desperately in earnest. Finally Ross organized a band of select men who drove McBain's men out and took possession of the mine. For three months Ross' men slept under arms in the shaft house awaiting the expected return of the McBain force, who never came. However, on one occasion the sentinel slept and the men within were terrified when they awoke to find that the shaft house was enveloped in flames. The case was carried into court and appeals were made from court to court, until cost of litigation exhausted the financial resources of both companies. At the expiration of their time limit the Lake Copper Mining Co., Limited, obtained a clear title to the areas of the two rival companies.

Situation.

The property is situated in the southwest corner of the County of Antigonish, Nova Scotia. The mineral rights under the control of the company comprise an area of ten square miles surrounding Copper Lake, and the surface rights extend over an area slightly exceeding twenty-three acres, situated on the east side of Copper Lake. Map No. 1 shows position and boundaries of surface rights of company.

The property is easily accessible either from Antigonish station on the Intercolonial Railway, about eighteen miles distant in a northerly direction, or from County Harbor on the Atlantic coast, in the County of Guysboro, about fifteen miles by road in a southerly direction. Map No. 2 shows the relative position of the property with respect to the railway systems in Eastern Nova Scotia.

Topography.

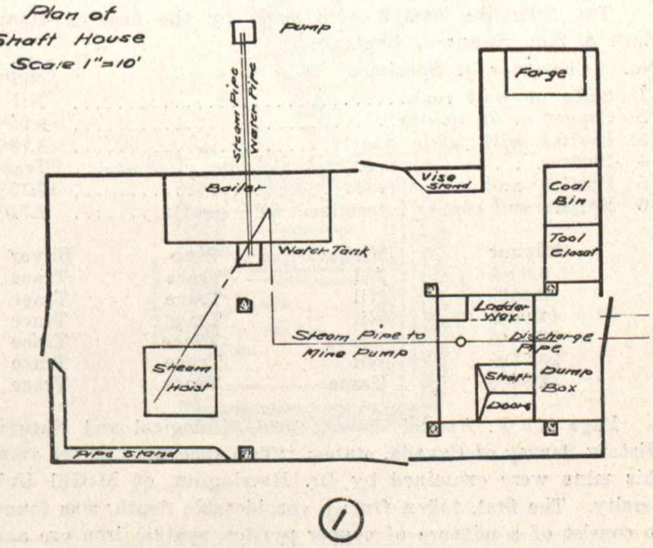
The copper deposit lies almost at the apex on the northern slope of the watershed, which extends east and west throughout the county. Lochaber Lake lies three miles to the southwest, and South River Lake one and one-half miles to the northeast; the former flowing into the Atlantic Ocean by the St. Mary's River, the latter by the South River into Antigonish Harbor. The country is traversed by a range of low rounded hills, having a general north and south trend, with off-setting ridges at right angles. The deposit outcrops on one of the eastern ridges and overlooks Hattie's mill stream, which is a short distance to the north of it. This stream has its origin in Copper Lake and flows eastward into South River Lake. The country immediately surrounding the mine is given to agriculture, but in the near vicinity are extensive tracts of forest land.

Geology.

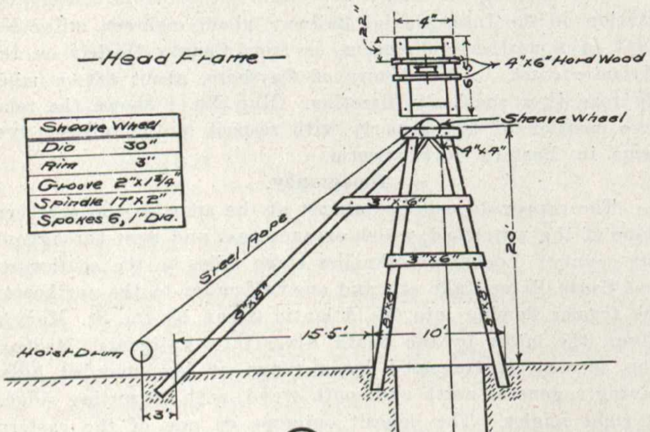
Nova Scotia Sheet No. 35, 1893, of the Geological Survey Department, Canada, which is appended to this report, represents the distribution of the rock formation on the surface of the country surrounding the Copper Lake deposit.

The principal openings in the deposit have been made at an elevation of 66 feet above the level of Copper Lake, and 415 feet and 475 feet to the east of it. At these points the ore body is overlaid by about 15 feet of drift.

Mr. M. V. Gradin, President of the company, who is very sanguine as to the great value of the property, has described it as follows: "The deposit is a fissure vein traversing a cupriferous belt of Devonian rock which extends westward from the east side of Copper Lake to beyond Lochaber Lake. The



vein when exposed by the shafts and drifts lies a little to the north of a diorite dike, and occupies a line of faulting which cuts at an oblique angle, a band of shales having a general east and west strike. On the opposite side of the lake the vein has been exposed in close proximity to a felsite dike towards which it is apparently heading. At the main shaft the vein dips at an angle of about 65 degrees and strikes N. 70 degrees W. This direction, however, it probably does not maintain for any great distance, as it must swing a little to the south before reaching the point at which it has been located on the west side of the lake. The vein filling is crystalline siderite through which is disseminated copper and iron pyrites. The south or foot-wall is a hard bluish black shale (or slate), while the north or hanging wall is a soft friable gray shale. In faulting, the shale on the north side of the vein has either slipped down or, what is practically the same thing, the rock on the south side has been pushed up. The vein varies considerably in thickness, ranging from 11 feet (at the thickest thus far found) to less than an inch at the face of the east level. It is 7¼ feet thick at the air shaft, but its average thickness is apparently about 5½ feet. The thinning out at



②

the end of the east level is apparently no cause for alarm. Pinches and swells are of frequent occurrence in most fissure veins. The existence of other large and rich veins running parallel and at no great distance from the deposit is indicated by the presence of large boulders of copper ore in positions which it is impossible they could have reached if derived from the deposit. Dynamic and eruptive forces have been remarkably energetic in this region, causing great disturbance of the rocks, accompanied by faults, fissures and eruptions. The district is, therefore, most probably split up with a great number of fissure veins, and it is not unlikely that here, as in many other mineral districts, two sets of veins may have developed, those of each set being parallel to each other, and crossing one another at a constant angle. The evidence afforded by the rocks themselves and the exploratory work undoubtedly point to great horizontal and vertical continuity of the deposit.''

Quality of the Ore.

The following assays were made by the firm of Henry Bath & Son, Swansea, England:

No.	Character of Specimen	Copper
1	Slate or wall rock	Nil
2	Copper or in quartz	9.95%
3	Pyrites with little quartz	8.78%
4	Pyrites	Trace
5	Pyrites and copper	17.15%
6	Pyrites and copper intermixed with quartz	9.71%

Sulphur	Nickel	Zinc	Silver
3.60%	Nil	Trace	Trace
12.05%	Nil	Trace	Trace
44.00%	Nil	Trace	Trace
33.51%	Trace	Trace	Trace
23.77%	Nil	Trace	Trace
32.84%	Trace	Trace	Trace

Page 119 P. Annual Report, 1886, Geological and Natural History Survey of Canada, states: ''Two specimens of ore from this mine were examined by Dr. Harrington, of McGill University. The first, taken from a considerable depth, was found to consist of a mixture of copper pyrites, spathic iron ore and a little iron pyrites, containing 11.70 per cent. of copper, but no silver. The spathic iron ore is a pale brownish gray in color, coarsely crystalline, and has a specific gravity of 3.61. It was found to contain 73.68 per cent. of carbonate of iron, or 35.573 per cent. of metallic iron. The second specimen was from the surface and consisted of copper pyrites, pale iron pyrites, hydrated peroxide of iron and some rock matter. It was found to contain 5.67 per cent. of copper.''

The following analyses of samples taken from different parts of the vein give an average of the distribution of the values.

Samples taken from	Copper	Gold
East Level	4.66%	0.025 oz.
North Side Shaft	8.66%	0.120 oz.
East of Shaft	7.50%	.....
West of Shaft	3.30%	.....
West Level	2.00%	.....
West Level	0.20%	.....

Average, 4.36 per cent. of copper.

Shipments obtained in course of development were made as follows:

40 Tons	12—13%	Cu. = 10,000 lbs.	to Swansea, England.
40 Tons	11—12%	Cu. = 9,600 lbs.	to Liverpool, England.
37 Tons	10½%	Cu. = 5,670 lbs.	to New Jersey.
150 Tons	3½%	Cu. = 6,000 lbs.	to Pictou, N. S.
100 Tons	2%	Cu. = 4,000 lbs.	on dump.

Total, 357 tons, averaging better than 4 per cent. copper.

Mr. M. V. Grandin has reported on the quality of the ore as follows:

''The ore for all practical purposes may be regarded as siderite ($Fe\ CO_3$) carrying chalcopyrite ($Cu\ Fe\ S_2$) and iron pyrites ($Fe\ S_2$) with low gold values. It also contains occasionally pyrrhotite ($Fe_7\ S_8$) which no doubt carries the small quantity of nickel reported by assayers. It may be mentioned here that in the case of nickeliferrous pyrrhotite the ore bodies are especially rich along contacts of diorite intrusions. Should the diorite to the south, therefore, at any place along the corner of the vein form a wall, it is possible that nickel may become an important product of the mine.

''The ore minerals (chalcopyrite and iron pyrites with which it is intimately associated) are mainly concentrated along and near the foot-wall and become more sparingly disseminated through the gangue mineral (siderite) as the hanging wall is approached, in fact they are sometimes entirely absent near the wall. The concentration on the side of the vein nearer the diorite would seem to indicate that rock as the source of the copper contents of the vein, although it is quite probable this position may have at least in part been determined by a selecting and precipitating action exerted by the black shale.''

Dr. Gilpin in his report, of June 20, 1908, to the Commissioner of Public Works and Mines of Nova Scotia, wrote regarding the quality of this ore:

''At Lochaber there are a large number of mines carrying copper pyrites, and associated with diorite dikes. These veins have been prospected a little and are apparently valuable as the copper contents in the case of the largest vein, about six feet thick, were returned for large average samples at 19 per cent. From this point the cupriferous belt has been traced about four miles to Copper Lake. Here the presence of large rich boulders instigated a desultory prospecting for a number

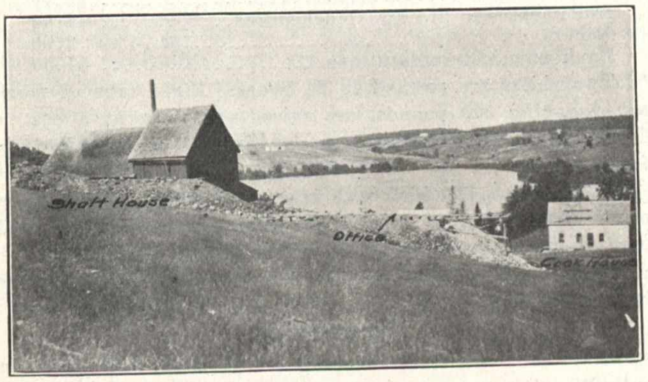
Ore Car and Dump.

of years. Finally a vein of spathic ore holding copper pyrites was found in 1875 and traced several hundred feet. Its width, as proved by several shallow pits, varied from six to eleven feet. Large average samples yielded from 5.6 to 11.7 per cent. of copper. The distance of this district from a railway and shipping point has apparently postponed development, although it is probably well worth the cost of a railway.''

Development.—The policy of the company at present is purely that of development in order to ascertain the quantity of ore in the property. Their method of procedure will be to continue the sinking of the main shaft and at each 110 feet measured on dip to drive levels to divide the ground into approximate rectangles and thus determine the form, size and value of the ore body. The following table will show the extent of development up to the beginning of the month of August, 1908.

	Main	Air	Aband.	Total Length
Shaft.	103 ft.	38 ft.	25 ft.	166 ft.
	East	West		
Levels.	122 ft.	200 ft.		322 ft.
	North	South	South	
Drifts.	30 ft	20 ft.	21 ft.	71 ft.
Total.				559 ft.

Quantity of Ore.—On the assumption that the vein has an average thickness of 5½ feet, then the triangular body of



Lake Copper Mining Company's Buildings.

ore marked "A" (on Map No. 3), blocked out by shaft and east level, contains approximately 2,000 tons, and triangle B, bounded by the west level and shaft, 3,000 tons, or a total of 5,000 tons of ore now in sight. There is also sufficient data available to estimate the possibilities of the deposit. From the workings to the point where the deposit has been exposed at head of the lake is about 5,000 feet. Now if we assume that the ore body holds its strength to a depth of 100 feet, there is here a body of ore measuring $5{,}000 \times 100 = 2{,}750{,}000$ cubic feet, or about 200,000 tons, almost all of which may be considered available ore.

This apparently over-sanguine expectation is supported by Dr. Selwyn, of the Geological and Natural History Survey of Canada, who wrote as follows regarding the quality and quantity of the Lake Copper vein:

"The indications of a very valuable copper lode could not well be more promising than they are in the two pits already sunk in the vein, in addition to which the distribution of the rich specimens, which have been found on the surface and underneath the water of the lake on the course of the vein, is such as to fully warrant the conclusion that it will be found to hold its character and productiveness for a very considerable distance."

Buildings, Etc.

Shaft House—46 by 25 by 16 feet. Roof shingled and walls battened; see drawing No. 1. Head frame 20 feet high, posts 8 by 8-inch hemlock, braced by 6 by 3-inch hemlock. See drawing No. 2. Cost, $500.00.

Cook House—36 by 20 by 11 feet frame building. Roof and walls shingled, with sheating paper underneath. Rough sealed walls and ceiling covered with sheathing paper. Double floors with sheathing paper between. Doors and windows well finished. Heated with steam from shaft house. See drawing No. 3. Cost of cook house, $450.00; cost of equipment, $150.00.

Office—12 by 20 by 9 feet. Roof and walls shingled, with sheathing paper underneath. Sheathed with tongued and grooved material. Doors and windows well finished. Heated by steam from shaft house. Cost, $150.00.

Barn—15 by 20 by 10 feet. Roof shingled, walls battened. Cost, $100.00.

Magazine—6 by 6 by 7 feet. Roof shingled. Cost, $24.00.

Blacksmith Shop—10 by 10 by 8 feet. Roof shingled, attached to shaft house. Cost, $20.00.

Well—8 feet in depth and walled by stone. Cost, $7.00.

Mechanical Equipment.

One 16 h.p. Monarch boiler, internally fired, suited for burning wood in six-foot lengths. Two hundred square feet of heating surface, 46 tubes, 2-inch outside diameter and six feet long. This boiler is practically adapted for development work because it is mounted on skids and can be easily moved from place to place. Cost, $500.00.

One double cylinder, single friction-drum hoisting engine, with ratchet, pawl, foot brake and winch head attached. Cylinder 6 by 8 inches. Cost, $600.00.

One Cameron vertical sinking pump. Diameter cylinder, 6 inches; diameter plunger, 3 inches. Stroke piston, 7 inches. Capacity ordinary speed, 28 gallons per minute. Space occupied in shaft, 27 by 21 inches; weight, 725 pounds. Pump is slung and can be lowered as sinking progresses. Cost of pump and fixtures, $500.00.

One Duplex boiler feed pump. Diameter of steam cylinders, 3 inches; diameter of water plungers, 2 inches; length of stroke, 3 inches; steam pipe, ⅜ inch; exhaust pipe, ½ inch; suction pipe, 1¼ inches; discharge pipe, 1 inch; 8 to 20 gallons per minute delivered by both plungers; weight, 100 pounds. Cost, $40.00.

One side-dumping steel ore car. Cost, $75.00.

One 28-inch sheave wheel and spindle. Cost, $15.00.

Flexible steel wire rope, 250 feet, ⅝-inch diameter; six strands of 19 wires each of crucible cast steel. Cost, $35.00.

Forge—Tools and fixtures. Cost, $250.00.

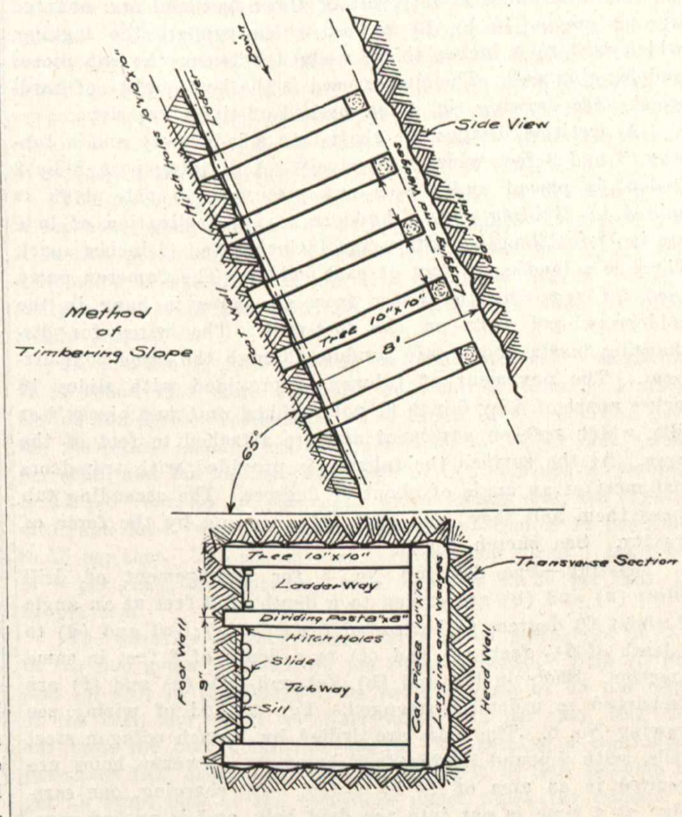
Rails for dump, 12 pounds per yard, manufactured by the N. S. Steel Co. Cost per ton, $34.00.

Smoke stack, 30 feet 18 inches diameter. Cost, $20.00.

Steam fittings. Cost, $100.00.

Tub or bucket for hoisting made by strapping, hooping and baling oil cask.

In addition to above mentioned plant, there will shortly be installed an air plant consisting of a compressor having compound air and simple steam cylinders, and will be 14 by 16 by 10 by 16 inches, having a capacity of 558 cubic feet of free



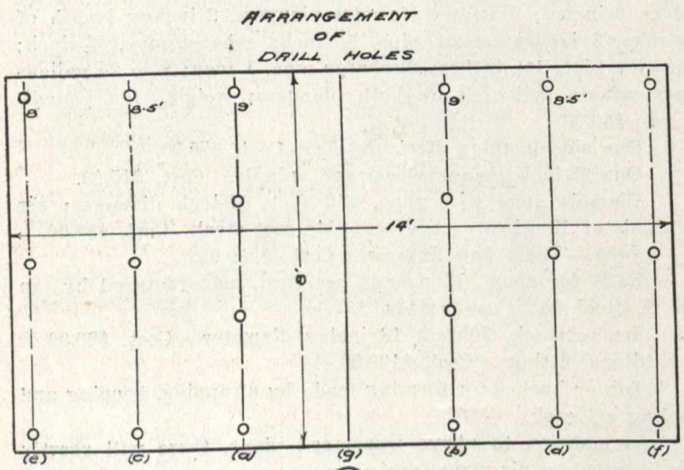
4

air per minute when running at a normal speed of 150 revolutions per minute; it will be ample for six or seven and possibly eight drills, depending upon how they are operated; also one receiver 42 inches in diameter by 10 feet in length, three UC or 2¾-inch drills, one U3 tripod with weights, two 8-inch column bars, three 50-feet lengths of hose, three sets of steels 2 to 8 feet, seven pieces of smith shop tools. This air plant will cost about $3,750.00 delivered at Antigonish Station, with an additional expense of $3.00 per ton to haul to mine.

The machinery of the plant was manufactured and installed by I. Matheson & Co., Limited, New Glasgow, Nova Scotia. The same firm has the contract for the air plant.

Mining.

Timbering.—The shaft is vertical to a depth of 25 feet where it takes the dip of the lode, which is about 65 degrees. The method of timbering used through the superficial deposit is locally known as "square set and skin tight." The lowest layer of timber rests on the solid rock, then tier lies upon tier until the surface is reached. The timber used is hewed hemlock, 8 by 10 inches by 12 feet and 8 by 10 inches by 8 feet for wall plates and end plates respectively. Corners are framed to resist lateral pressure. For timbering the sloping portion of the shaft hitch holes 10 by 10 by 10 inches are cut in opposite sides of pavement or foot-wall and at right angles to it by hitch cutters made of ⅞-inch steel 1 to 2 feet long, driven by 6-pound hammer having 28-inch handle. Posts or "trees" 10 by 10 inches are placed in holes at intervals of three feet and are mounted by cap pieces 10 by 10 inches, which support the lagging, which is 2 to 4 inches thick, wedged between the cap pieces and hanging-wall. The timber used is the best quality of hardwood. See drawing No. 4 for method of timbering slope.



⑤

A partition divides the shaft into a ladderway and a tubway, 3 and 9 feet wide, respectively. A dividing post, 8 by 8 inches, is placed under each cap piece, and 3-inch plank is spiked to dividing posts. Ladders having inclination of lode are in 18-foot lengths, with rungs 18 inches and 14 inches apart. There is a landing at foot of each ladder. The Cameron pump used for removing the water from the mine is hung in the ladderway and rests on the foot-wall. The wires for discharging blasts find a safe conduit through the same compartment. The pavement of tubway is provided with slides 16 inches apart of 6 by 6-inch fir poles spiked on "bed pieces" or sills, which rest on pavement and are attached to foot of the trees. At the surface the tubway is provided with trap-doors that meet at an angle of about 90 degrees. The ascending tub opens them and they drop back into position by the force of gravity. See sketch No. 1.

Blasting.—See drawing No. 5 for arrangement of drill holes; (a) and (b) are driven to a depth of 9 feet at an angle of about 60 degrees to horizontal towards (g); (c) and (d) to a depth of 8½ feet, (e) and (f) to a depth of 8 feet in same direction. Shots in (a) and (b), (c) and (d), (e) and (f) are discharged in order as arranged. For method of wiring see drawing No. 6. The holes are drilled by ⅞-inch octagon steel drills, with 5-pound double face hammers. Twenty holes are required in an area of 14 by 8 feet. In charging, one cartridge at a time is put into the drill hole, and is pushed carefully but firmly into place before insertion of next. The cartridge containing the detonator should be gently pushed with the wooden rammer until it rests on the others. The charge, which consists of 1¾ pounds of rippite, is tamped at first by loose clay to a depth of several inches, then more tamping is added and firmly stemmed. The battery used is a magnetic battery, manufactured by the Dominion Electric Co. The explosive used is called "rippite" and has the following composition, which shows that it is not unlike the well-known explosive gelignite.

Nitro-glycerine	59½% to 62½%
Nitro-cotton	3½% to 4½%
Nitrate of potash	18 % to 20 %
Oxalate of ammonia	9 % to 11 %
Castor oil	½% to 1½%
Wood meal	3½% to 5¼%
Moisture	1 %

It is claimed that there are no injurious after-effects from the use of "rippite" due to smoke and gases, neither is it affected by sudden changes in temperature.

Ventilation.—The mine is ventilated by means of "Natural Ventilation." The air enters the main shaft and passes out through the air shaft. The direction of air current is determined by arrangement of doors at mouth of shaft, and by escape of exhaust steam from the Cameron sinking pump in the air shaft, which aids the natural ventilation.

Staff, Scale of Wages, Etc.

The manager is Mr. Geo. J. Ross, the well-known mechanical and mining engineer.

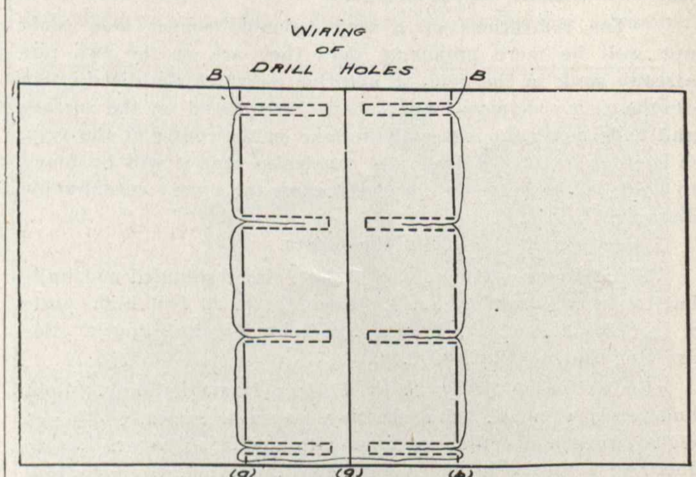
	Per Day.
Foreman	$3.00
Hoistmen, who are also blacksmiths	2.00
Miners	$1.75 to 2.00
Bank men and surface men	1.50

Two shifts are worked in 24 hours. Eight tubs of muck, each weighing 500 pounds, are raised per hour, at a cost of 25 cents per ton, and two men can drill 15 feet by hand in rock per day.

The men are provided with board and lodgings in the company's cook house at a cost of $4.00 per week. The cook house is run at a slight profit, although the primal object is to provide comfortable quarters for the men at cost. For plan see drawing No. 3.

Transportation.

The most convenient shipping points at present are from South River Station on the Intercolonial Railway and Country Harbor, Guysboro county, distant 17 and 15 miles, respectively. The mine occupies an elevated position with respect to shipping points, hence the slope of grades is favorable for transportation. The grades are gentle because the roads meander around the hills and follow the tortuous courses of the streams. The soil is of a gravelly nature, the bridges are short, hence the conditions for "good roads in bad weather" are as nearly ideal as can be obtained in the province. However, it is not expected that traction or animal transportation will be the method in use for any considerable time. A line of railway has been located from New Glasgow, Pictou county, to Country Harbor, Guysboro county, with a branch line from Antigonish through the Copper Lake district to connect with the New Glasgow and Country Harbor road at the foot of Lochaber Lake. When the prospective road will become a reality the transportation problem will be solved. See map No. 2. Dotted



⑥

line represents proposed road. In the meantime only ore of high grade can be profitably shipped, but if the low grade ores prove suitable for concentration, as is probable, the company will erect a concentrating plant and will thus be able to market the whole output. The fact that the mine is only 70 miles from the Pictou smelter, with which it will soon have direct railway connection, and that the smelters of the Eastern States can be cheaply reached by water, increase to a considerable extent the value of the property.

Economic Conditions.

The forests in the near vicinity of the mine have not suffered from the ravages of the portable sawmill, consequently there is an abundance of wood suitable for fuel, timbering and all mining operations available at reasonable prices. A number of skilled laborers trained in the gold and coal mines of the province are residents in the neighborhood and near localities, and their services are being obtained by the company at a moderate rate of wages. There is considerable water power available for all mining purposes in the near vicinity of the property, which can be developed and transmitted electrically to the mine. The country is a rich agricultural one, and when the considerable distance from market is taken into account, it is evident that superior farm produce can be obtained at low prices. In fine, all conditions which make for minimum expense in operation are the natural attributes of the locality in which the mine is situated.

Organization.

The Lake Copper Mining Co., Limited, is a company organized under the laws of Nova Scotia for the purpose of operating the Lake Vein deposit at Copper Lake, Nova Scotia, and other rich mineralized territory containing ores of copper. The capitalization of the company is $5,000,000, divided into 5,000,000 shares, each having a par value of $1.00, fully paid and non-assessable. There have been placed in the treasury 2,500,000 shares. Funds received from the sale of treasury stock will be expended for the further development and equipment of the company's properties.

There is no preferred, all is common stock; and it is a mutual company in which every stockholder will receive his proper percentage of the profit.

Conclusion.

From the facts above stated, which may be summarized as excellent working facilities, ore of superior quality, geological conditions considered favorable for "great vertical and horizontal continuity" by eminent geologists, and the fact that it is receiving financial support far above the most sanguine expectations of the promoters, it may be expected that it will in due time become one of the greatest copper producers in the east.

DESCRIPTION, INSTALLATION AND ECONOMY OF CO_2 RECORDERS.

Will F. McKnight.

In the operation of power plants the great aim of engineers, from the earliest times, has been to utilize as much of the energy generated as is possible. In the case of steam production the aim has been to utilize all the heat generated. The efficiency of the boiler and grate is the ratio of the heat absorbed per pound of fuel to the calorific value of a pound of fuel. If the combustion of the fuel is perfect and all the heat generated is utilized in the evaporation of the water, then we reach an efficiency of 100 per cent. for the boiler and grate.

This high efficiency is of course never realized in practice. With a well designed boiler and furnace in good condition an efficiency no higher than 75 per cent. has been reached, and it usually ranges between 60 per cent. and 75 per cent.

Assuming that a boiler has been properly designed, i.e., it is properly dimensioned for the work it has to do, and is also supplied with a furnace which can under proper conditions deliver the required amount of heat. Assume also that the flue is of the correct size and that we have sufficient draft to supply the grates. It is possible to take this apparatus and operate it in such a way as to give a very low efficiency, so that it is clear that efficiency does not depend upon design wholly, but mainly upon operation. This might be summed up in a few words: with a boiler and furnace of certain design there is a maximum practical efficiency, but by poor operation it is possible to fall far short of this mark.

It was at first thought that stoking was a very simple operation, and consequently very little attention was paid to it. The fireman who shovelled coal indiscriminately into the furnace, which belched forth dense clouds of black smoke, and was able to keep up the steam pressure, was supposed to be doing his duty. It wasn't thought that this affected the question of expenditure. Now we know that smoke means so much wasted fuel, and the aim has been to make the combustion of fuel as complete as possible.

The effort to obtain this condition has led to a great many improvements, among which might be mentioned changes in design of boilers, patent grates, both stationary and moveable, mechanical stokers, etc. It has been found that these appliances handle coal more economically than the old method of hand shovelling, but in addition they require a great deal of attention, and because of this the personal element is not entirely eliminated, so we are not always sure that good results will be obtained. In plants burning over 200 tons of coal per week a saving of from 30 per cent. to 40 per cent. can be effected, which is a decided advantage over the old method of hand firing.

In order to find out how a boiler is working, evaporative tests are taken. One object of such a test may be to determine the amount of fuel and water used per horsepower hour, or it may be to find the loss in each individual piece of apparatus which goes to make up the total loss. As these tests can only be made occasionally, they do not give the average performance of the boiler for a given time. During the time of the trial the boiler might have been working extremely well, and between the two trials it might be doing very badly, but the test would show good operation, which would be very incorrect. The ideal system is one by which we can at any time tell just how the boiler is working, whether the fire is too thin, whether it is getting too much air or not enough for perfect combustion. This has been done by means of an instrument, to be described fully later on, which analyzes the flue gases and automatically records the results, so that by merely glancing at the record we can tell if the furnace is working up to its requirements.

To go back to the subject of firing and fuel. The principal fuel used in steam production is coal, and there are many different varieties. Coal contains all the way from 50 to 95 per cent. of carbon; it is the chemical combination of this carbon with the oxygen of the air that supplies the heat.

An analysis of ordinary air shows about 20 per cent. oxygen, 79 per cent. nitrogen, the balance being made up of carbon dioxide, aqueous vapor, ammonia, etc., together forming a little over 1 per cent.

The main element of the air which we are to consider is the oxygen. Given a certain variety of coal, containing a certain percentage of carbon, to effect the complete combustion of a known quantity of this kind of fuel requires a certain amount of oxygen from an amount of atmospheric air, and just this amount of air need be admitted, no more. Ordinarily about 12 pounds of air are required to consume one pound of coal.

The percentage of carbon dioxide (CO_2) in the flue gases is dependent upon the quantity of air admitted to the grates, and it is this percentage of CO_2 which tells us whether or not the combustion is wasteful. It has been calculated that if flue gas analysis showed 21 per cent. CO_2 the combustion would be practically perfect.

In practice it is impossible to obtain perfect combustion. It is found that more air must be admitted than is actually needed for perfect combustion. The excess of air admitted over the theoretical amount has been found to be 35 per cent. to 40 per cent., and the highest percentage of CO_2 obtained in practice is 14 per cent. to 15 per cent., which means that the highest attainable heat from the smallest amount of fuel is 14 per cent. to 15 per cent. The majority of furnaces show about 7 per cent. or 8 per cent., corresponding to a fuel loss of 20 per cent. to 21 per cent.

The quantity of fuel wasted for a given percentage of CO_2 in the flue gases is shown by the curve attached. With 10 per cent. of CO_2 in the flue gas we have a waste of 18 per cent. of the fuel, and so on for other values; 12 per cent. fuel loss has been the best obtainable result. By keeping a continuous record of CO_2 analysis in the flue gases, it is thus possible to get an exact idea of the conditions under which the furnace is working.

Description of the Instrument.

The instrument can be divided into four distinct parts—

A—The motor or driving mechanism.

B—The gas pumps and valves.

C—The filter.

D—The Analyzer and Recorder.

The *motor* furnishes all the power necessary to drive the whole apparatus. The motive power is furnished by the chimney and the action of the motor depends upon the fact that the pressure of the gases in the flue is slightly below that of the atmosphere.

The motor consists of a water-tight tank T (see tracing A), which has an inner jacket J, also water and air-tight. The tank is filled up to the level shown by the red dotted lines. A bell, B, dips into this water and is suspended by a string passing over a grooved pulley, P, to a counterbalancing weight, W, and a small glass vessel which will be described later on. The tube marked X enters the tank at the bottom and comes out at O, which connects with the inside of the air-tight bell. The tube X is directly connected to the chimney through C, and when the valve V is open X is also connected with the air.

Suppose the bell is up to its full stroke, the space beneath it is full of air at atmospheric pressure. Now let the valve V

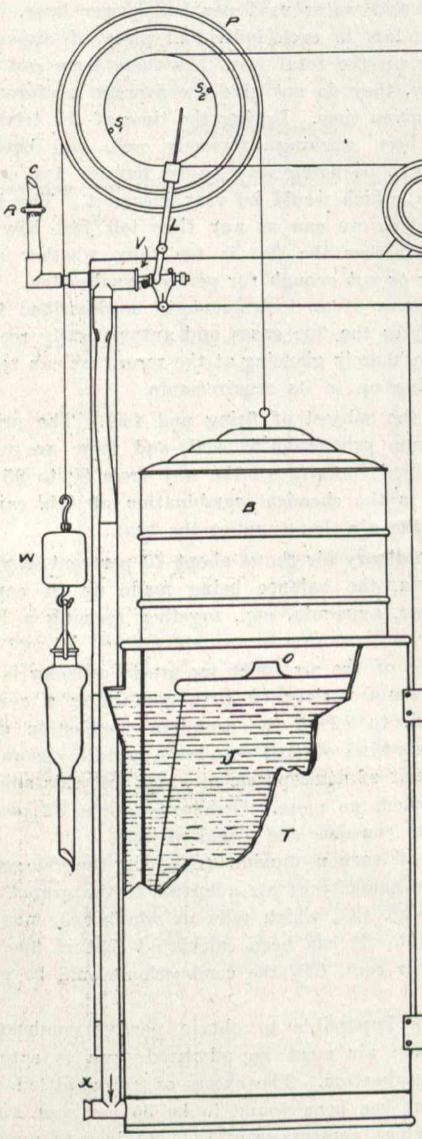


Diagram A.

be closed and we will have a direct connection from the bell to the chimney. As the pressure in the chimney or flue is less than that of the atmosphere, the air in the bell will be forced out into the flue and the bell will slowly descend.

When it drops so far the stud S_2 on the pulley engages the lever L, which automatically opens the valve V. This admits air under the bell and it immediately begins to rise. When it has risen to the proper height the stud S_1 engages the lever L and closes the valve V, which again connects the bell with the chimney and the air is again exhausted and the bell falls again. It is thus seen that this is entirely automatic, the motion of the bell is uniform, as there is no acceleration, except perhaps a little at the start and end of the stroke. C is a flexible rubber tube and is provided with a squeezer for controlling the speed of the bell; by squeezing the tube the motion can be made as slow as desired.

The pulley P is provided with a groove of smaller diameter than the one for the bell. In this groove a cord N runs and is led over two pulleys of the same diameter, and is connected to the plungers of the pumps showing in tracing B.

The *pumps* consist of two cylinders placed side by side, both of them are of the same dimensions. They are provided with plungers which are given a regular up and down motion by means of the cord N, which runs over pulley P as described above.

The inside of the pumps is constructed in the same way as that of the tank and bell previously described, with this difference, the tank is water-sealed, while the pumps are oil-sealed. Oil is used instead of water because the flue gases coming in contact with the water would cause a chemical reaction, especially if the water was alkaline. If this happened our analysis of the gas in the instrument would not be a correct one. By using oil this trouble is avoided.

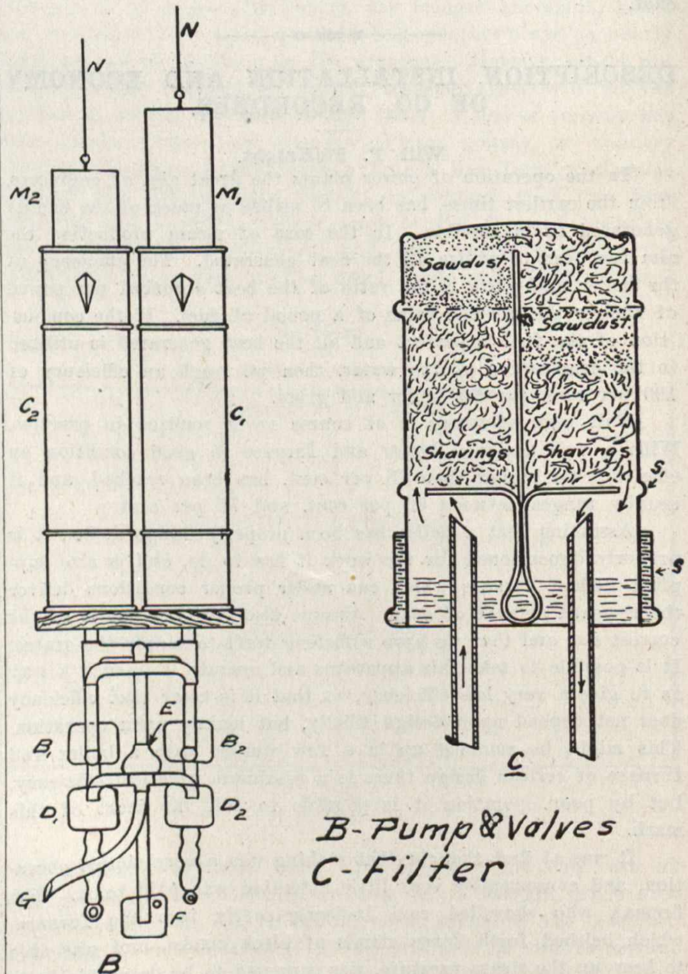
Suction tubes pass down the centre of each cylinder, and these lead to two sets of valves, B_1 B_2 and D_1 D_2. These valves are made of glass and are partially filled with glycerine, which offers enough resistance to prevent the gas returning to the pumps.

As the plungers move up and down alternately a continuous flow of gas is maintained through these valves. While one is sucking the gas into the valves on one side the other is forcing it out on the other through the pipe G into the analyzer. Any gas not needed for analysis can pass off into the air at F. If the flow of gas is interrupted in any way this can be detected by bubbles of air which will show themselves at the seal E.

The glycerine forms an ideal seal for the valves, as it is viscous enough to offer a slight resistance and also no chemical action will take place between it and the flue gases.

The gases which pass through the instrument should be as free from impurities as possible, and to purify them a filter is provided, shown in tracing C. The filter is connected directly on the supply pipe. It consists of an outside shell S and an inside one S_1, the space between being filled with glycerine to provide a seal so that there is no possibility of any air entering the filter.

The top part of the filter shown in section is filled with wood shavings and sawdust, through which the gas must pass before entering the pumps. At the bottom of the filter there is a



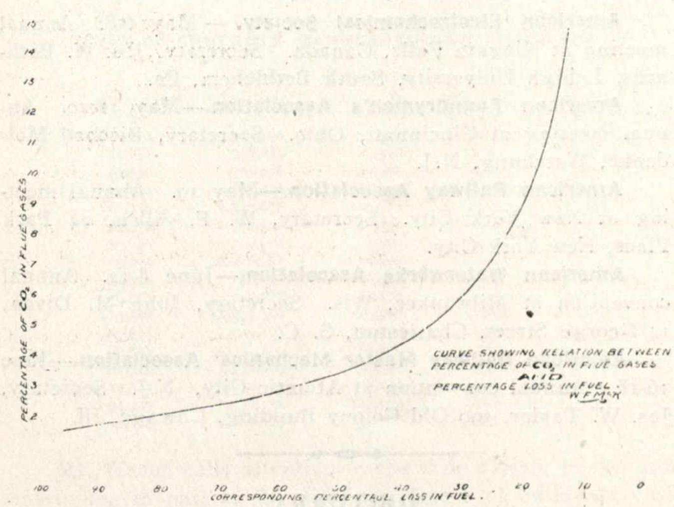
water separator, so that any water in the pipes may be collected and can be drained off at any time.

When the gas passes through the tube G it enters the analyzer (see tracing D). The gases pass down the tube T and into the tubes T_1, T_2. These tubes are connected through R to a bottle N, shown also in the first tracing. This bottle is partly filled with a mixture of glycerine and water. The bottle is attached to the weight W and is given an up and down motion as the bell moves up and down. When the bottle is lifted the level of the liquid rises in the tubes T_2 and T_1, which also contains the flue gases which came down by T. As soon as the liquid reaches the point where T enters T_1 the supply of gas is sealed off.

Inside of the enlarged tube T_3 is a tube K, which connects to the atmosphere. As the liquid rises this tube is also sealed. When this happens exactly 100 cubic centimetres of gas are trapped in the tubes T_1 and T_2.

The bottle N still continues to rise, and this 100 C.C. of gas is forced through the curved tube P into the vessel M, which contains a solution of caustic soda (Na OH) at a level X in the tube shown. The pressure of the gas on the solution causes the level X to rise into the vessel marked O. O contains a quantity of air, which acts on the cylinder Q, raising it.

The cylinder is connected by a small cord to the arm L, which is counterbalanced by means of a weight shown in the drawing.



As the arm L swings upward it carries with it a small pen I. The pen bears very lightly against a drum which is made to revolve horizontally by a clockwork mechanism. The drum revolves once in twenty-four hours.

On the surface of the drum a chart is placed which is calibrated in terms of percentage of CO_2, which reads from zero at the top to 20 per cent. at the bottom. The vessels M and O are of such a size that if none of the 100 C.C. of gas forced on the solution be absorbed, the pen will be raised to the zero point on the chart. If the gas contains some CO_2 it will be absorbed by the caustic potash solution and the pen will record on the chart the exact percentage absorbed.

The studs on the pulley P (tracing A) are so arranged that the motion is reversed as soon as the pen has reached its highest point. When this happens the liquid in the tubes T_1 T_2 begins to recede and the caustic potash solution comes back to its former level X and the gas which was trapped before now passes into the atmosphere through the pipe K. This operation is repeated at every stroke of the motor and a continuous visible record of the percentage of CO_2 is kept.

The readings given on the chart can be checked in the following manner to make sure they are correct and all adjustments have been properly made. On the tube T_2 there is a scale which corresponds to the scale on the chart. As the bottle N travels up the liquid in T_2 is under atmospheric pressure until it reaches the lower end of the tube K. In the tube K, where it remains under atmospheric pressure, it will rise quicker than in the tube T_2. When the level of the liquid falls again on the down stroke and will meet at the bottom of K if no CO_2 has been absorbed. If some CO_2 has been absorbed the levels will come together at some point up higher corresponding to the percentage of CO_2 absorbed. This reading should correspond with that recorded on the chart. Thus we are able to check our results and make sure they are correct.

Installation of the Apparatus.

The instrument is usually placed in the engine room in full view of those in charge of the boiler equipment. Each boiler can be connected, so that a record of the condition of its furnace can be taken as often as required. It is not necessary to have a separate instrument for each boiler, for by a correct arrangement of pipes and valves any boiler may be connected to the instrument.

The sample of gas to be analyzed must be an average sample, as at different points in the furnace it is known that we get different mixtures. The collecting pipe should be of good size to overcome this difficulty, ¾-inch inside diameter is sufficient and it should reach across the entire width of the furnace. This pipe is drilled with 40 ⅛-inch holes, equally spaced so that we are sure to get an average sample by this means.

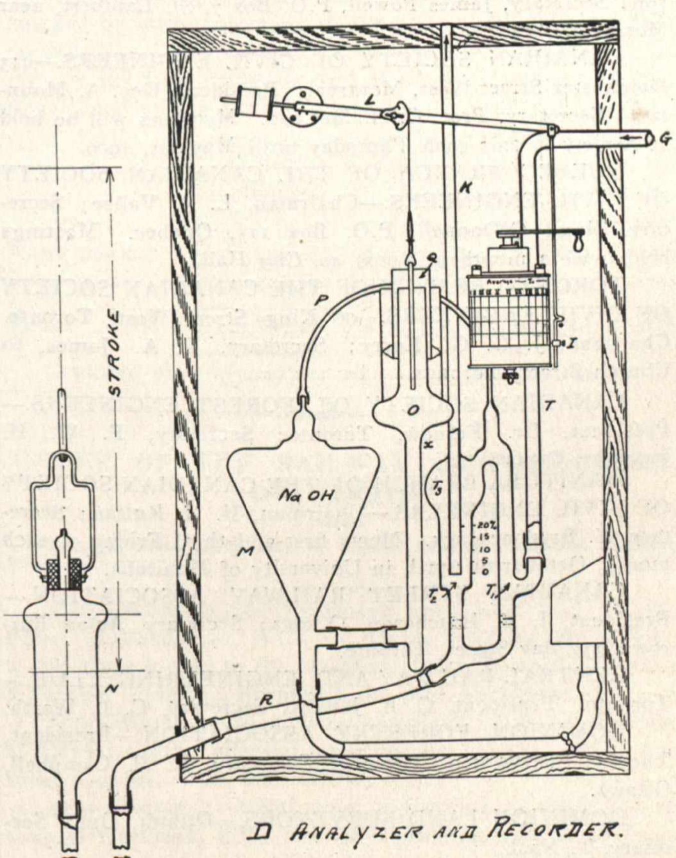
Does It Pay to Install CO_2 Recorders?

The value of good boiler records cannot be overestimated. By merely examining the record the fireman learns how his boilers are operating, and if not satisfactory, it can soon be remedied. As the record is open for inspection at all times, the fireman is sure to try and get the best results. This can only lead to one result, and that is economy of fuel with the best attainable operation.

One objection raised to the use of recorders is the amount of attention required by them. Recorders are now made which require no more attention for a twenty-four hours run than the winding of the clock mechanism and the placing on the drum of a new chart.

One machine is capable of recording the consumption of 20,000 tons of coal per year. Taking a very low figure of 5 per cent. saved in fuel, it will be seen that a large saving can be effected sufficient to pay for the installation in a very short time.

Attached to next page are some actual records taken from the CO_2 recorder. They are taken from Boiler No. 6, Angus shops. This boiler is equipped with mechanical stoker, with moveable grate. The test shows the following percentages of CO_2 in the flue gases, averaged for 24 hours: 11.8 per cent., 9.1 per cent., 11.1 per cent., with an average for the three tests=10.7 per cent. By looking at the curve a 10.7 per cent. CO_2 analysis shows a full loss of about 16 per cent. As 12 per cent. of CO_2 is the highest attainable in ordinary practice, the test at the Angus shops compares very favorably. The instrument shown in diagram and described is handled by the Canadian Instrument and Testing Co., and has proved itself to be very efficient and accurate. This type of instrument is the kind installed in the engine room at the Angus shops, and has met with the approval of both superintendent and firemen.



D ANALYZER AND RECORDER.

ENGINEERING SOCIETIES.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

COMING MEETINGS.

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

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

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

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

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

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

OBITUARY.

MR. THOMAS S. LUSCOMBE, a prominent contractor of Belleville, is dead, aged 75 years.

JAMES SIEVEWRIGHT, who for thirty-three years had been a trusted employe of the Quebec Central Railway at Sherbrooke, Que., for much of that time as master mechanic, died at his home last Wednesday week. He was 73 years old and had retired only last December.

MR. CLAUDE DE B. LEPROHON, Deputy City Surveyor, died on April 12th at Montreal, Que., after an illness of three months. He was over fifty years of age and had been over twenty years an official at the City Hall. He had also been the Brazilian Vice-Consul for Montreal since 1899. Mr. Leprohon was born on October 2nd, 1857, at Montreal, and was the son of Dr. Jean Lukin Leprohon and Mme. Leprohon (nee Rosanna E. Mullins), one of the best known literary women in Canada in her time. He was educated at St. Mary's College, afterwards taking the Science course at McGill. In 1876, he was appointed leveller on the engineering staff chosen by the Federal Government to survey the work of enlargement on the Lachine Canal, and held the post until the completion of this work in 1885. The following year he was entrusted, as assistant engineer, with the inspection of the construction of the dyke for the protection of the city against inundation. He was appointed to his civic position in 1892. Mr. Leprohon had been a member of the Canadian Society of Civil Engineers since 1889. He was a member of the 1st Battalion of the Prince of Wales Regiment, from 1880 to 1890, retiring in that year with the rank of captain. He was honorary secretary of the Montreal Engineers' Association.

The Canadian Rail Joint Company, Toronto, Ont., are introducing a reinforced angle bar. The angle bar is strongest where the greatest test comes, and deflection and deformation are prevented by the reinforcements, which give the maximum degree of vertical and lateral strength at rail ends. Besides giving strength at the minimum of cost this bar is easily attached and gives a safe durable connection.

A PAGE OF COSTS
ACTUAL, ESTIMATED and CONTRACTED

UNIT COSTS OF CONCRETE BUILDINGS.

In a recent paper on the "Cost of Reinforced Concrete Construction," Mr. Leonard C. Wason, President of the Aberthaw Construction Company, Boston, Mass., presents specific costs upon a large number of buildings, among which are several designated as factories, mills, etc. The figures relating to these have been arranged in the accompanying table which presents not only costs for given floor areas, but also unit costs per square foot of floor and per cubic foot of space. In some cases these figures are based upon exact total costs and in others upon bona fide bids.

COST OF CONCRETE MANUFACTURING BUILDINGS.

Job Cost.	Volume in cu. ft.	Floor area in sq. ft.	Unit Cost, per cu. ft.	per sq. ft.
$			$	$
12,774	112,440	7,519	.114	1.70
44,652	746,674	49,546	.060	.902
39,830	312,000	24,960	.127	1.60
19,292	212,400	15,000	.091	1.28
141,529	1,327,868	106,022	.107	1.335
91,377	1,380,500	90,240	.067	1.01
13,064	105,600	8,800	.124	1.485
75,604	1,211,364	74,604	.0625	1.01
23,332	180,000	16,394	.129	1.42
66,516	544,788	44,172	.122	1.51
113,288	1,271,300	129,920	.0891	.875
90,703	1,622,128	152,200	.056	.60
72,048	1,331,200	83,200	.054	.865
85,754	1,752,609	81,500	.048	1.05
122,128	2,641,000	98,059	.046	1.25
94,341	2,036,731	147,000	.046	.542
129,405	2,867,535	157,730	.045	.82

Mr. Wason calls attention to the wide variety in the unit costs, due in part to the different classes of buildings. He also points out the desirability of more careful and accurate methods of estimate such as are being followed by experienced contractors.

COST OF TIMBER WHARF.

The wharf was built at Wallace Bridge, N.S., and consisted of a rock bank 32 feet long, 24 feet wide, and 11 feet high, and in addition a solid cribwork 85 feet long, 15 feet high at the outer end, and 20 feet wide on top, with the exception of thirty feet of this length which was 40 feet wide.

The cost was as follows:—

Materials:—	
3,471 feet logs, 9-in. top, at 9 cts. per foot	$312 39
24 feet logs, 9-in. diam., 8 cts. per foot	1 92
450 feet logs, ballast poles, at 2 cts. per foot	9 00
20 ballast poles, at 60 cents each	12 00
634 feet logs, 6-in. at top, at 6 cts. per foot	38 04
94 lineal ft. sq. timber, 10 x 12, at 16c. per ft.	15 04
200 tons of stone at 50 cents per ton	100 00
737½ tons of stone, undelivered, 20 cents per ton	147 50
16 loads of stone at $1 per load	16 00
Smithwork	15 35
Hire of scow	10 00
Hardware	65 80
Total	$743 04
Labor:—	
1 Foreman 430 hours, at 25 cents	$107 50
Labor, 2,957⅓ hours, at 15 cents	443 63
Total	$551 13
Grand total	$1,294 17

COST OF HIGHWAY BRIDGES.

During 1908 there was erected in the Province of Nova Scotia a number of highway bridges. From information given in the Provincial Engineer's Report, the following table has been compiled.

A somewhat similar list for Ontario will be found in the Canadian Engineer. Vol. XV., page 503.

Kind.	Length between centre pins.	Width in clear.	Totals.	Cost per foot.
			$	$
Iron and Steel Span....	50 +	16	829.00	16.58
" " " "	60	15	688.00	11.43
" " " "	65	15	749.00	11.53
" " " "	75 +	15	1,019.00	13.59
" " " "	80	15	994.00	12.18
" " " "	85	15	1,135.00	13.36
" " " "	90	15	1,119.00	12.43
" " " "	90	15	1,073.00	11.92
" " " "	100	15	1,330.00	13.30
" " " "	100	15	1,349.00	13.49
" " " "	110	15	1,420.00	12.91
" " " "	113	15	1,539.00	13.62
" " " "	125	15	1,728.00	13.92
" " " "	125	15	1,900.00	15.00

+ These had a 4′ 9″ sidewalk on each side.

In addition to the above, there were fourteen stringer spans of wood, each 18 feet wide in the clear. Total length of flooring 402 feet. Crib abutments and piers cost $2,730.

COST OF PUMPING WATER, MONTREAL, QUE.

The total quantity of water pumped during the year of 1907 was 12,439,889,245 imperial gallons.

The following table shows the quantity and cost of water pumped by water-power and steam-power for the year, based on pumping-house charges, against a pressure head of 90 lbs., or 208 feet (being 169 feet static head and 39 feet frictional head on the force mains).

1907.	Gallons pumped.	Expenditure.	To raise 1 million gallons 208 feet including friction.	per foot.
Water power	3,135,444,053	$ 5,194.11	$ 1.657	.0079
Steam power	9,304,445,192	136,255.45	14.642	.0704
Total	12,439,889,245	$141,449.56	$11.370	.0546

Average price of coal per ton .... $4.32.

ORDER OF THE RAILWAY COMMISSIONERS OF CANADA.

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

6603—February 23—Dismissing application of C. T. W. Piper, of Vancouver, B.C., for Order directing the G.N.R. to construct a spur to the premises of the Britannia Trading & Lumber Company, Burnaby Lake, near Vancouver, B.C.

6604—March 5—Dismissing complaint of F. W. Godsal, of Cowley, Alta., alleging unsatisfactory train service between Cowley, Alta., and Nelson, B.C.

6605—March 5—Dismissing application of residents of town of Westbank, B.C., for Order directing the C.P.R. Company's mail boats call at Halls' Landing at least three times a week to deliver mail and passengers.

6606—March 5—Dismissing complaint of R. G. Sidley, of Sidley, B.C., that the V. V. & E. Railway unjustly discriminates against settlers in and around Sidley in the matter of railway facilities and in favor of points in the United States.

6607—March 5—Dismissing complaint of Vernon Fruit Company, of Vernon, B.C., alleging excessive freight rates charged by the C.P.R. from Peachland to Victoria, B.C.

(Continued on Page 531.)

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE-OF-WAY ASSOCIATION.

At the tenth annual meeting, held in Chicago, one of he most interesting reports was that on ballasting.

Ballasting.

The committee submitted new definitions for gravel and sand, to take the place of those heretofore recommended and published in the Manual.

The definitions adopted state that gravel is coarser than sand and that sand is finer than gravel, but fail to establish any limit of size below which worn fragments of rock cease to be gravel and become sand. Therefore your committee recommends the substitution of the following definitions:

Gravel.—Small worn fragments of rock occurring in natural deposits that will pass through a 2½-inch ring and be retained upon a No. 10 screen.

Sand.—Any hard granular comminuted rock material, finer than gravel, which will be retained upon a No. 50 screen.

Pit Gravel.

Stripping.—In general, the best method for removing the waste material is to use a steam shovel. When the depth of stripping is too shallow to permit the economical use of a steam shovel, teams with scrapers can be used to windrow the strippings, using a steam shovel to load the windrows. The cost of stripping a gravel pit with a steam shovel, using the material to widen embankments, when the haul does not exceed twenty miles, should not be more than 15 cents per yard.

Loading.—A heavy steam shovel with a dipper holding from 2½ to 3½ yards makes a most efficient machine for loading gravel. Too great stress cannot be laid upon the advisability of having a shovel which has a large surplus of strength in all its parts, as economy in maintenance and in the operation, resulting from lessening the loss of time occasioned by stopping for repairs, is very great. Centre-dump cars, which deposit the material where it can be used without any casting with shovels, are most economical; the larger the capacity of the car the better.

In connection with the centre-dump cars, ballast spreaders mounted under a flat car are a necessity. The practice of placing a tie or like obstacle in front of the wheels, allowing them to skid while the ballast is being pushed out of the way, is bad, resulting in flat wheels, as well as loss of time in distribution of the ballast. Where only a small amount of ballast is to be handled, a device which will be mounted by the wheels and will itself slide on the rails can be used to good advantage. Where only a very small lift or none at all is to be made, a great saving in time of applying the ballast can be made by the use of a distributing plow, which plows out the ballast close to the tops of the ties.

Cost.—It is impractical to give any approximation of the cost of preparing the gravel pit for operation, as local conditions will govern entirely. The cost of loading the gravel depends upon three conditions: (1) The size and efficiency of the shovel. (2) The depth of the bank from which gravel is being loaded. (3) The supply of cars maintained under the shovel dipper.

Where the bank is ten feet or more in depth the greatest efficiency of the shovel should be obtained. Not less than four pitmen should be used, that no time may be lost in shifting. Where the bank is less than 10 feet in depth it will generally be found that the frequent shifting of the shovel will materially reduce the output of gravel. It is assumed that the train service is sufficient to keep the shovel supplied with cars in order to make use of its full efficiency. With these conditions obtaining, from 2,000 to 2,500 cubic yards per day on an average can be handled, the cost of which will be approximately $0.025 per yard.

Distribution.—The length of haul regulates entirely the question of the number of trains and the number of cars to a train which should be used. The one hard and fast rule should be that the best of motive power be furnished for this service. Generally speaking, for hauls less than ten miles, one train in addition to the train at the pit is sufficient. Above ten miles and under thirty, two trains on the railroad will be sufficient. The only rule that can be stated is that, to get the most economical handling of ballast, train service enough should be provided to keep the shovel well supplied with empties at all times. Where the haul is short the best practice is to put into one train only so many cars as can be handled readily by the engines which are assigned to that service. There is a decided loss on short-haul work where more cars are put into a train than can be dumped without difficulty by the engine.

When the haul is long all the cars should be given to a train that can be moved over the division, and enough set off on the siding nearest the distributing point to reduce the train to such a size that the engine can readily handle it while dumping. This applies to the centre-dump cars, where the movement of the train when being unloaded is very much harder than when on the road. In some cases it will be found economical to provide a train for the purpose of taking the loaded cars at the end of a long haul and unload them. It frequently happens that unforeseen delays occur during the unloading which will seriously cripple the through movement of the gravel trains, and on very long hauls the unloading train can be economically employed.

The cost of movement from the pit and of distributing on the track depends wholly upon the length of the haul and congestion of traffic. The actual time consumed in distribution with centre-dump cars is immaterial, 30 minutes being sufficient time for the unloading of a train of from 400 to 500 cubic yards.

Washed or Screened Gravel.

The essential features of a plant for this purpose are:—

(1) Positive separation of material into definite grades.

(2) Capacity to furnish gravel in quantities sufficient for economical use as ballast.

(3) Economical operation.

(4) Economical disposition of the refuse, both boulders and fine material.

To fulfil the first requirement a plant must be so designed as to separate the material handled into dust, sand gravel and cobbles or boulders. If these grades are not separated the proper proportion of sand and gravel necessary for the best results cannot be obtained.

In distributing ballast on track it is obviously necessary to produce the gravel in large enough quantities to permit the organization of the track forces on an economical basis. A plant which will produce gravel at a cost which would make it commercially profitable may be too small to produce ballast economically.

In the preparation of quantities of ballast there is necessarily produced a large amount of mud, sand and boulders or cobbles. To work successfully, a plant must be so devised as to dispose of this rejected material. The stones should be run through a crusher and returned to the gravel for ballast, not only increasing the output, but improving the quality.

Plants for the washing or screening of gravel naturally divide into two types: (1) Those for handling material from submerged beds of gravel. (2) Those for handling material from upland gravel banks.

The plant of the Union Sand & Material Company, South Memphis, Tenn., is a typical submerged gravel-bed washer, and the Lake Shore & Michigan Southern plant at Pleasant Lake, Ind., is typical of the upland washer.

Cementing Gravel.

There are two principal points in the territory east of Memphis where cementing gravel is worked for the purpose of supplying ballast to railroads; one at Iuka, Miss., on the Southern Railway, known as the Tishomingo gravel pit, owned and operated by the Tishomingo Gravel Company, of Memphis, and one at Perryville, Tenn., on the Memphis & Paducah division of the Nashville, Chattanooga & St. Louis Railway, owned and operated by the Perryville Gravel and Ballast Company, of Memphis.

Tishomingo gravel is a water-born gravel lying in a compact mass requiring blasting before it can be handled with a steam shovel. It is composed of 20 per cent. clay, 5 per cent. sand, and 75 per cent. gravel. The cost in track is 47 cents a yard. The advantages of its use are: Small cost; quick cementing qualities; holds track in line and surface well under fairly heavy traffic; does not churn; very little dust, and has great resistance to erosion by water. Considered an excellent ballasting material. Has the disadvantage of growing prolific crops of weeds and grass, making it costly to keep clean.

Perryville gravel is an angular gravel lying in a compact mass requiring ballasting before it can be handled. It is composed of 10 per cent. clay and 90 per cent. gravel, with chemical analysis of 97 per cent. silica, 2.5 per cent. alumina, and .5 per cent. iron. There is found in this pit considerable large stone, which has to be crushed before suitable for use. The cost of this gravel per yard in track is 71½ cents.

Burnt Clay Ballast.

Under this head the committee describes in detail the making of burnt clay ballast, including selection of pit site, method of operation, conditions producing best product, loading, desirable size and capacity of pit, and other practical points. They also give the following table showing the cost of burnt clay ballast on several railways.:

Railway	Land	Fuel	Contract price	Loading	Train service	hauling	Putting under	Total per yard
A. T. & S. F.	....	0.100	0.200	0.058	0.237	0.140		73.5
C. & E. I.	....	.....	.....	.....	.....	.....		25-30
C. B. & Q.	0.45	0.135	0.17	0.06	.....	.....		41
C. M. & St. P.	....	.....	.....	.....	.....	.....		38-40
C. R. I. & P.	....	.....	17-30	.....	.....	.....		37-40
Union Pacific.	....	.....	.....	0.201	0.091	0.234		52.6
Wabash	....	0.038	0.240	0.040	.....	.....		31.8

Chats.

Chats are tailings from lead and zinc concentrators. The rock in which the lead and zinc occur is run through crushers and separators and thoroughly washed, after which it is discharged by means of elevators and troughs, forming huge piles. The desire of the lead and zinc operators to extract every ounce of ore from the rock has led to finer and finer crushing, so that chats coarse enough to make good ballast are becoming less easy to obtain each year.

A great deal of loading is done by hand under contract. The material is, however, most excellent for easy steam shovel handling, and much is loaded that way. Cost of loading is now about 16 cents per yard in the Joplin district, having been 14 cents for some years and at one time even cheaper.

Advantages and Disadvantages of Various Types of Ballast.

Under this head the committee first enumerates the functions of good ballast preliminary to discussing the extent to which the different materials perform these functions.

Crushed Rock.

After naming the advantages claimed for crushed rock by its advocates, the committee says: Users of large quantities of gravel ballast, however, do not admit of all these claims, particularly that of better riding track. It is said that when track is to be raised only a very small amount, it is difficult to do this on stone ballast and to properly tamp the tie to an even and uniform bearing. For this reason it is claimed that gravel makes a more smooth riding track. Likewise, it is more difficult and costs more to renew ties in stone, owing to the handling of the material. We have also heard it stated by foremen that it is harder to make and maintain very small adjustments of line and surface in rock than in other materials, but its good qualities far outbalance its poorer ones, and its use shows a material economic saving.

The best size for crushed rock is an unsettled question. Tests made on the Baltimore & Potomac Railroad indicate that there is a slight economy in the use of 2½-inch stone over 1½-inch, and a decided saving over ¾-inch.

A statement of results of physical tests of ballast stone is given in Appendix A to the report. This appendix also contains descriptions of the various tests, geological descriptions of the rocks examined and a study of the costs and comparative economy of some of the stones, as they apply to conditions on the Baltimore & Ohio.

"Characteristics of Stone Ballast" on the Cleveland, Cincinnati, Chicago & St. Louis are shown in Appendix B, which also contains some interesting comparisons of cost of stone and gravel ballast.

Gravel Ballast.

Following an enumeration of the advantages and disadvantages of gravel ballast the report says: These disadvantages however, exist in greatly varying degrees, and in carefully prepared gravel ballast disappear altogether. While it is true that some of the users of crushed rock maintain that it is superior to the best gravel, your committee feels that the evidence is not sufficient to warrant them in making an unqualified statement to that effect. Under extremely heavy traffic the indications are that crushed rock will stand better than the best gravel, but some of the best riding track in the country, with fast passenger service over it, and with reasonable maintenance expense, is put up on gravel.

Some physical tests of pit gravel on the Big Four have thrown light on the question of effect of sand and dust in gravel ballast, and the result of the tests is accordingly given here. These tests were made on small sieves by hand and must therefore be regarded as laboratory tests, rather than working tests under everyday conditions:

Percentage of Gravel, Sand and Dust by Volume.
(Compared to Original Volume)

Pit	Gravel	Sand	Dust	Remarks
Layfayette, Ind....	81.6	27.0	1.3	Very good
Mechanicsburg, Ohio	61.3	50.9	2.8	Fair
Mound City, Ill...	68.0	44.1	2.9	Good
Savona, Ohio	86.0	12.5	6.5	Poor — Cementing nature
Terre Haute, Ind..	56.0	62.0	2.0	Too recent to determine
Valley Junc., Ohio.	59.6	55.4	3.6	Good but dusty and excess of sand increases track labor
West York, Ill.....	58.7	49.1	12.9	Very poor. Only fit for sub-ballast

In what follows the term "dust" is applied to that material which is finer than sand upon the new definition recommended by the committee. All proportions have reference to the bulk.

Gravel having 3 per cent. or less of dust has been found to drain very freely, while gravel having an excess of 3 per cent. of dust is found to hold water to such an extent as to interfere with its thorough efficiency as ballast.

Gravel containing 2 per cent. of dust will make a fairly dustless roadbed, but after being disturbed by track work it will cause considerable dirt until washed by a heavy rain.

It has been found necessary to have about 30 per cent. sand to partially fill the voids in the gravel. Lack of at least 20 per cent. of sand permits the pebbles to shift under the load and an excess of 50 per cent. of sand prevents the ballast from becoming firm. In dry weather "pumping" or blowing takes place.

Your committee recommends, as a good practice, the following proportions:

For Class A Roads: Ten parts gravel and three parts sand. Where bank gravel contains more than 2 per cent. dust or 40 per cent. sand it should be screened or washed.

For Class B Roads: Ten parts gravel and six parts sand. Where bank gravel contains more than 3 per cent. dust or 60 per cent. sand it should be screened or washed.

For Class C Roads: Ten parts gravel and ten parts sand. Any bank gravel which does not contain an excess of 6 per cent. dust may be economically used.

Chats.

The principal advantages of chats is low first cost, although it has some excellent qualities as ballast in addition to this. It provides as good drainage as the best gravel, the coarser chats giving better drainage than the finer. It is very low in cementing qualities and there are therefore fewer pumping ties than in gravel. It is fine enough for ties to be tamped with a shovel or end tamper, permitting a fine surface with a light rise. Weeds do not grow in the chats and they will not grow in the ballast until sufficient dirt to support them has been collected.

The specific gravity of chats varies from 2.54 to 2.66 and the weight of a yard varies from 2,100 to 2,400 lbs., averaging about 2,300 lbs. Recently the ore has been ground finer in order to get out more of the lead and zinc, which makes a less desirable ballast than when it is coarser.

Some of the disadvantages of chats are that they sink into clay soil, blow out under heavy joints and do not keep tracks in good line and surface under heavy traffic. The better grades of chats, those made of the harder rocks and more coarsely crushed, have always been somewhat dusty under high speeds, say about 45 miles per hour. This objectionable feature has grown worse with the tendency to finer grinding, mentioned above, until it has reached the point where some chats piles are entirely unfit for ballast purposes. Some of the ore-bearing rock, also, is comparatively soft by nature, and, with clay which sometimes occurs in the interstices of the rock, makes a material which does not drain nor support track satisfactorily and which, therefore, should not be used except for sub-ballast.

Discussion.

Mr. Hanna: The vice-chairman of our committee made some actual separations with screens of different sizes and the result was to offer a definite line that should be drawn between those two classes of material. As he is not here, we cannot give the explanation of the work done in arriving at these screen sizes.

C. E. Lindsay (N. Y. C.): I would request that we have the definition for gravel, as given in the Manual, read to us.

The secretary read it.

L. C. Fritch (I. C.): It seems to me the percentage of sand in the gravel for Class A roads is a little high. It strikes me that 30 per cent. would be better.

Mr. Lindsay: I hope the definitions of the committee will not be adopted, changing the Manual. It seems to me that gravel is as it occurs naturally. Just last month I was attending upon a lawsuit where the question of the character of the ballast was in dispute and around which the question centred, and it was a question whether it was a gravelly sand or a sandy gravel. We claimed that it was the best that could be. obtained in that locality in its natural condition. If this association goes on record as saying that a gravel ballast is a mixture of a certain definite quantity of sand and gravel, it seems to me we are going along the wrong lines.

Mr. Hanna: The idea of the committee was to draw a definite line between sand, gravel and dust. It is true that gravel is a natural deposit; so is sand a natural deposit. Ordinarily there is not any confusion in anybody's mind as to what these things are; but when it came to a discussion of them for ballast purposes it seemed to the committee that there was an advantage in having some definite test that the material could be put to which would determine which class it would go into. That would have been clearer, I think, if we had here the samples of the material itself, that would show just exactly what is got by making the separation by the use of these screens that we have named in these definitions. I think in the absence of the actual material before you to see what it means to draw this line, that it is very difficult to convey to anyone else the right impression about it. The report gives the proportion of parts of gravel and sand. I am not able myself to say just what led to these particular proportions. They were determined by Mr. Paquette, who is chairman of the sub-committee, and they are the results of his work in using these different sizes of screens. The idea was that the proportion of sand should be as large as possible, keeping in mind the desirability of filling the voids between the stones of the gravel, and that the sand should not be in a large enough proportion, to permit dust, or permit the sand to be drawn out by the air going along with a moving train. At high speed the trains would naturally pick up particles of a larger size than slower trains, and the idea was that for first-class roads there would not be enough sand to be at the surface of the gravel. Naturally the finer stuff works down through.

Maurice Coburn (Van.): I think that the percentage of sand suggested is too high. The larger the amount of sand the more dust we are going to have and the less the life of the gravel is going to be and the poorer the drainage. The reason for washing gravel is to minimize all those results. With our present gravel, the dust is a very serious matter in the summer time. I am very glad to read what the committee has had to say about the comparison beween gravel and stone, because it agrees with my own conclusions. Gravel ballast will give us first class track for considerably less than we can have with stone, and we have stone and gravel both on our line.

Mr. Fritch: Our road has had considerable experience in river gravel, where we could get any desired quantity of sand, and our practice has been to limt the quantity of sand to from 30 to 35 per cent., which gave very good results. I think for high speed track, anything in excess of that would make a dusty track.

Willard Beahan (L. S. & M. S.): There is more sand in gravel than you would think. If you would screen it you would be surprised at the result. I did not suppose I would ever advocate 40 per cent. sand, but in the way we arrived at it we mixed it up, and considered how that compared with the results from our washers and our pits, and that percentage represents simply the practical judgment of the gravel men on your committee. It is not the sand that has so much damaged our gravel. It is a little film of clay that surrounds each particle of gravel.

Mr. Lindsay: In regard to the committee's recommendation to substitute the definition in the report for the one in the Manual; let us determine what will be called gravel, then we can determine what kind of gravel to use for the different classes of track. I move that the definition for gravel be rejected and that the definition in the Manual be retained.

There was no second to this motion.

Mr. Lindsay: With regard to the definition for sand, I move to omit the words "finer than gravel" and substitute the words "passing through a No. 10 screen."

W. M. Camp: I am in favor of drawing a line between gravel and sand, and when we define it as passing a No. 10 screen and being retained on a No. 50 screen, it seems to me that does draw a line. When you speak about ballast containing so many parts gravel and so many parts sand the association is compelled to define what sand is and what gravel is.

H. McDonald: There is another committee which will probably consider the definition of sand, and it is possible they may have already recorded themselves in the Manual, and that is the committee on Masonry. Are we to understand that this definition of sand applies to ballast only, or if we adopt it to-day will it be applicable to sand for use in concrete and masonry also? For my own part I would be perfectly willing to see it stand for both uses, as amended by Mr. Lindsay.

Mr. Hanna: Our committee looked at this from the ballast point of view only.

Mr. McDonald: Then they should define sand for ballast?

The President: The question on the definition of sand. Mr. Lindsay's amendment is to eliminate the words "finer than gravel" and to add "will pass through a No. 10 screen," so that the amended definition would read: "Any hard grabular comminuted rock which will pass through a No. 10 screen and be retained upon a No. 50 screen."

The amendment was adopted.

Mr. Camp: I move that the definition of gravel be adopted as it stands.

Mr. Hanna: I move that the recommendations on proportions of gravel ballast be adopted.

Mr. Osgood (C. of N. J.): I would like to ask why, in stating proportions of gravel and sand, it is thought best to make them specific and not to state that the amount of sand shall not exceed a certain percentage? It would naturally occur to me that in specifying gravel it would be desirable to have it as near gravel as possible, and limit the amount of sand, and certainly it would be so in regard to some gravels, even under the specification of the committee. It might be wiser to say the proportion of sand shall not exceed a certain amount; then say it shall be such an amount, as is specified here.

Mr. Fritch: I would like to amend the motion by changing class A to read, instead of 40 per cent., a maximum of 35 per cent.; for class B a maximum of 50 per cent. instead of 60 per cent.

Mr. Coburn: I agree with this recommendation. On our road we pick up with our fast trains a very large part of the material which is classed as sand by the committee.

Mr. Hanna: I believe that Mr. Fritch is under a misapprehension with regard to the committee's proportions. Ten parts of gravel and three parts of sand would make 13 parts in all, and the three parts sand is less than 25 per cent. I confess I think it would be better to put it in the shape of percentages.

Mr. Byers: In regard to washed river gravel there should be a minimum. The river gravel, with insufficient sand in it, acts a good bit like shelled corn, and it is impossible to keep the track in proper shape. We have had some experience with that, with some gravel, that I think contained about 15, or possibly 20 per cent. sand, but we have had a good deal of trouble to maintain the track with that material. Since that we have increased the percentage of sand and find the result very much better.

The President: The question is on the amendment to change the percentage on the class A roads from 40 to 35 per cent. and on class B roads from 60 to 50 per cent. maximum.

Mr. Hanna: I would not like to see it go through in exactly that form. I think in view of what Mr. Byers has said about his experience—and others have had the same—that we ought to have a maximum and minimum limit, and before the convention finally settles on this, we ought to have the experience of other roads and know what their minimum limit has been, what has proved to be a good minimum limit. Then I think we would better rewrite this, so that the whole recommendation will be expressed in percentages and not in parts. The committee will do that.

H. R. Safford (I. C.): My experience in Mississippi River gravel has taught me that a maximum of 35 and a minimum of 28 per cent. are proper limits. We started out with a specification 25 per cent. and found that was not sufficient, and gradually increased it to 30, to 35, and with that character of gravel we find no trouble with the sand being picked up by moving trains. Our recommendation would be, minimum 28, maximum 35.

The amendment offered by Mr. Fritch was voted upon and was defeated.

Mr. Hanna: I would like to get a more definite expression of the convention on the maximum and minimum question. I would like to have some sort of a vote that will fix those two limits.

Mr. Fritch: I move that the recommendations of the committee for ballast for the different classes of roads be referred back to the committee for further recommendations.

Motion carried.

The net profits from the Leicester, England, municipal gas undertaking this year amount to $34,065. Since 1885 the gas works have provided $688,952 towards the relief of the rates.

The Great Northern Railway has now in its service four big electric locomotives. This movement marks a new era in the history of electric traction on this continent, as it means the use of the three-phase system for heavy traffic work, as well as the first attempt to handle the entire traffic on a main trunk line with electric power.

BANK OF NOVA SCOTIA, KINGSTON, JAMAICA.

Robert T. H. Sailman.

The appended thesis is a short description of certain points of interest in the design and construction of the new premises of the Bank of Nova Scotia, in Kingston, Jamaica, B.W.I.

The chief interest centres around the fact that the building is intended to withstand any repetition of the earthquake of January 14, 1907, which wrecked the former premises of the bank, to say nothing of the rest of the town.

As in San Francisco, the damage by fire after the shock, was very great, and the new building is to be fireproof as well as earthquake-proof. Both these objects are provided for in the design of the building, which is a very fine example of modern reinforced concrete construction.

The construction work is in the hands of the Walker-Fyshe Company, of Montreal, to whom I am indebted for all data and photos which accompany the thesis.

The architects for the building are Darling & Pearson, of Toronto.

The design of the reinforcement is due to the Walker-Fyshe Company.

Dimensions and Construction.

Building, 150 by 75 feet. Main banking room, 75 by 60 feet. Two storeys in front and rear. Main banking room, one storey. Extreme height of building above street, 56 feet.

Structural steel and reinforced concrete is used throughout. All concrete used is mixed in proportions of one part cement, two parts sand and four parts stone broken to a 1-inch ring. The stone actually used, however, was not always broken stone; but sometimes river gravel of the same size was used. The gravel gave a better sample of concrete, as seen by the tests below; these tests were made at the Jamaica Government Railway Testing Laboratory, in Kingston.

Test of Cement Concrete Blocks on Wheel Press, Jamaica Railway.

Blocks 29 days old: 7 days in water and 22 days in air. All the blocks were 6-inch cubes.

Composition of Block.		First Fracture at lbs. per sq. in.
1.2.4	River. . .	3717
1.2.4	Gravel. . .	3186
1.2.4	Broken. . .	1416
1.2.4	Stone . . .	1327
1.2½.5	Stone. . .	991
1.2½.5	and Gravel mixed equally	938

Broke at lbs. per sq. in.	Average first fracture at lbs. per sq. in.	Average of breaking Wt. at lbs. per sq. in.
....	3451	....
....		
1593	1371	1593
1593		
1239	964	1239
1239		

Best American Portland cement was used, bought under test in New York and not paid for till tests are reported satisfactorily.

In the case of this particular work a test of the cement used (Alsen's) was made by the Public Works Department of Jamaica for their own satisfaction, before allowing the work to proceed. Copies of both these tests are shown below.

Test on American Alsen Cement, by Dr. C. F. McKenna, New York.

(Neat) Tensile Strength			(Sand) Tensile Strength		Soundness
1 day	7 days	28 days	7 days	28 days	
229	519	746	117	216	Good
195	549	756	119	241	"
195	511	738	109	235	"
228	579	686	147	260	"
93	441	715	115	252	"
183	538	761	148	282	"
139	510	721	118	267	"
138	540	722	123	242	"
187	561	725	185	289	"
194	582	774	135	252	"
229	627	725	127	240	"
216	575	734	147	246	"
239	591	739	164	266	"
239	517	699	127	220	"
219	330	715	116	197	"
201	519	688	118	242	"
195.3	543	734	132.2	246.6	"

Date	Fineness Sieve 100	Fineness Sieve 200	Setting Time Initial	Setting Time Final	S.G.
Jan. 10	96.3	81.0	2 hours	7 hours	3.11
Jan. 9	96.9	81.7	2 "	7 "	"
Jan. 9	96.2	81.2	2 "	7 "	"
Feb. 6	96.1	80.4	3 "	8 "	"
Feb. 6	96.3	80.0	3 "	8 "	"
Feb. 7	96.4	80.5	3 "	8 "	"
Feb. 7	96.0	80.3	3 "	8 "	"
Feb. 7	95.9	79.9	3 "	8 "	"
Feb. 8	96.1	80.0	3 "	8 "	"
Feb. 8	96.3	80.4	3 "	8 "	"
Feb. 8	96.2	80.0	3 "	8 "	"
Feb. 13	96.0	80.9	3 "	8 "	"
Feb. 13	95.2	80.3	3 "	8 "	"
Feb. 13	95.2	80.0	3 "	8 "	"
Feb. 13	94.9	80.2	3 "	8 "	"
Feb. 13	95.0	79.8	3 "	8 "	"
Average	95.6	80.6			

From 68 tests from 3,000 barrels.

Six tests made by the Public Works Department of Jamaica from a sample of Alsen's American Portland cement, blocks seven days old:

1	1071
2	1153
3	1031
4	1035
5	1050
6	1163
Average	1084 per 1½ in. square
Average	482 per 1 in. square

Setting time, 3½ hours.
Residue on a 76 sieve, one-half of 1 per cent.
5.5.08. (Int.) J. F. B.

All reinforcing steel consisted of indented steel bars, with an elastic limit of 50,000 pounds per square inch, and ultimate strength of 80,000-100,0000 pounds per square inch.

All main walls are 18 and 24 inches thick, reinforced with two systems of reinforcement one on each side, consisting of identical rods set horizontally and vertically 9 inches centre to centre both ways. See photos 37, 13, 8.

All partitions are 4 inches thick, reinforced in the centre with ½-inch bars horizontally and vertically, 9 inches centre to centre both ways.

All walls at corners were given extra reinforcement vertically, and the horizontal bars were bent round the corner with a lap of 18 to 24 inches, so as to give as much strength as possible to the corner. Moreover, to strengthen the bond between the first and second storeys, which were not put in at the same time, the reinforcement in the first storey was carried up about three feet into the second storey, i.e., the rods were cut rather long in the first place and the upper ends would project about three feet into the concrete of the second storey when that was cast.

The reinforcement in the columns in front consisted of seven ⅞-inch rods set vertically with ½-inch rods wrapped in a spiral, 4-inch pitch round them; see photos 28, 25, 13. The steel was covered by about three inches of concrete.

The columns on the sides of the building were reinforced vertically in the ordinary manner; see photo 33. The horizontal reinforcements consisted of rectangles formed of two pieces bent to the right shape, properly lapped and wired together and fitting outside the vertical rods, nine inches apart.

All the arches were reinforced on the concave side with ½-inch bars bent to the curve of the arch, set about six inches apart and as close down to the forms as possible without showing when the centres were removed.

The floors were reinforced as seen in photo 32, the reinforcement consisting of ½-inch bars laid six inches apart both ways. The bars were run into the heavy main walls, wherever possible, to a depth of from 9 to 12 inches.

The floors were all designed to carry a live load of 200 pounds per square foot, exclusive of dead load, with an absolute factor of safety of four on dead and live loads.

The concrete roof on the steel frame was designed for a live load of 80 pounds per square foot.

The concrete roof was four inches thick, reaching from one inch above the upper edges of the steel purlins seen in photo 37 down to the centre of them.

The reinforcement consisted of ⅜-inch corrugated steel running at right angles to the purlins six inches apart with similar bars running parallel to the purlins, six inches apart. The bars first mentioned were bent at the upper end so as to hook over the highest purlin (see photo 37), and they were also given a "U" bend at each purlin so that they might rest about one-half inch from the form work of the roof, thus reinforcing the tension side of the roof.

The rods shown projecting from the walls in photo 37 were left long on purpose, so that they might be bent down into the roof and help out the bond. In fact, it was a general principle all over the work to run extra reinforcement from any portion of the concrete into the adjacent portions so as to strengthen the joint wherever a joint was unavoidable.

The main trusses over the banking room were of 60-foot span, and the end reactions of these trusses were carried directly by steel columns to the foundation, taking the load off the tops of the walls; see photos 14, 23, etc. These trusses, as will be seen from the photos mentioned, were of a very heavy and rigid type; in fact, they weighed very nearly seven tons each.

There were also seven smaller trusses of the same general type, four on the back and three in the front, turned at right angles to the main trusses. These rested directly on the tops of the walls and were secured by anchor bolts let into the concrete. They weighed about three tons each. All the trusses were swung into place by the donkey engine and the derrick, as seen in photos 14, 16, etc.

The trusses carrying the roof were designed for a total load of 150 pounds per square foot of roof; and in order to ensure against failure of riveted connections by rocking (such as an earthquake might produce) an excess of 50 per cent. of rivets was allowed in all connections. Of necessity, a large number of the connections had to be made on the spot. Some of the large trusses were riveted up by a local firm under contract, and the rest by our own men brought from Montreal to erect the steel.

The foundations were made as large and as heavy as possible, the soil pressure not exceeding 3,800 pounds per square foot anywhere. The depth of the foundations varied from five to ten feet, according to the condition of the soil.

There were four large vaults in the building above ground and on the same floor level as the banking room. They were naturally of very much heavier construction than the rest of the building and thus more liable to settlement. On this account wherever the vault walls, foundations or roof butted up against any other part of the structure great care was taken to prevent any bond between the vault and the rest of the building. To effect this a layer of heavy tar paper was introduced between them.

In designing the building it was considered of prime importance to introduce the strongest possible ties, rail bracing and horizontal bracing, so that the structure, in case of earthquake shocks, would act as a whole and would be able to withstand lateral stress, which are the most serious effects of earthquake shocks. Thus the roof and the two main walls were rigidly connected by means of the heavy brackets attached to the ends of the trusses, as seen in photo 37. The particular part of the roof referred to is not shown; the photo indicates where it is to go and how it grips the brackets and the two walls.

Further, though it is not expected that the building will be able to stand a very severe shock, such as would occur in case of a fault developing in very close proximity to the building, such stresses being impossible to provide against, the result of such a shock will not be such as to cause collapse of the building but will only cause more or less severe cracks in the walls and floors.

It would be impossible for any part of the concrete to come down on account of the great amount of reinforcement in all directions.

This latter is a very desirable feature, for numbers of people were killed in the middle of the streets by falling bricks, etc., in the great earthquake of January 14, 1907.

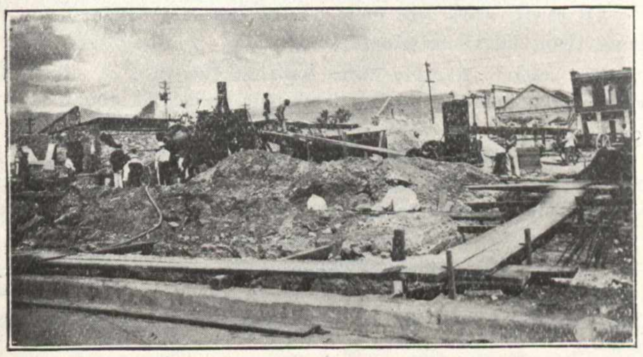
After the preceding discussion of the design of the building we shall take up some points of the practical construction work which may prove interesting.

In the first place we shall treat generally of the form work, which was made of 1-inch rough pine lumber and pine scantling ranging from 2 by 2 inches to 4 by 4 inches. The system on which it was put up is admirably shown in photos 22, 28, 29, 31, 33. As will be seen, the boards were placed inside a row of upright scantlings held up by a system of horizontal belts and slant bracing.

The belts, besides being braced, were connected to those on the other side of the wall by ½-inch steel bolts of suitable length. Some of these bolts are visible in photos 22 and 29. The slant bracing butted up against a horizontal piece laid on the ground, as seen in photos 29, 33, etc.

The form work on the inside was braced in a similar manner, as indicated in photo 10.

When the forms were being taken down off the first storey care was taken to leave the uppermost belts and the bolts connecting them intact, so that when the forms were being put up for the upper storey the scantlings could be drawn up inside these belts and the bolts screwed up, thus securing them rigidly against the concrete which had already set; see photo 34.



Placing First Concrete, 18th February, 1907.

The form work for floors or horizontal ceilings was, of course, a very simple matter, consisting merely of a floor properly blocked up underneath.

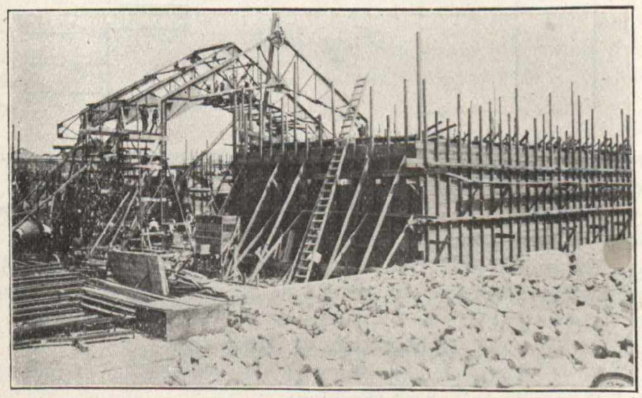
The form work for the roof was supported off the bottom chords of the trusses and horizontal bracing, and when finished appeared as in photos 36 and 37.

The form work was put up by a mixed gang of native and Canadian carpenters.

The reinforcement was usually put in after the form work was up, except in the case of certain partitions four inches thick. In this case the form work was put up on one side, and then the reinforcement strung against it, the other side of the form work being put up afterwards.

We shall now treat generally of the concrete used on the work and how it was mixed and handled. The accompanying tracing shows the arrangement of our material and plant.

As will be seen, we had two elevators for hoisting the concrete and the plant was thus reversible, one elevator serving the front of the building and the north wall, while the other served the back of the building and the south wall.



Rear View, Bank of Nova Scotia, Showing Three Vents Erected.

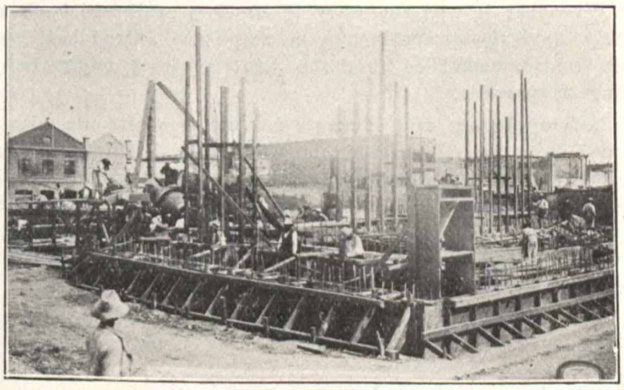
The mixer used was a No. 2 Smith mixer, and the hoisting engine an ordinary donkey engine.

The concrete when mixed was tipped into a skip and hoisted to the required level and there dumped into a hopper, seen in photos 30 and 32, from which it was run into barrows and poured from them into the forms.

An essential to the concrete work is the gangways for the barrowmen. The tracing shows the arrangement we used on the upper storey in the front of the building. The partitions were all four or five feet lower than the tops of the outside walls, and being only four inches wide it was impossible for any barrowman to pour into them from that height. We therefore fixed a 2 by 2-inch scantling parallel to the gangways, which was on one side of the partition, and rigged V-shaped gutters between the scantling and the gangway at intervals along the partitions into which the concrete might be dumped and thus run into the partitions.

Where any portion of a wall or partition was covered over by the gangways we used a long light trough of U section, handled by two men, the end being placed where the concrete was required and the barrowmen dumping into the upper part of the trough. We found this simple apparatus very good when properly handled.

We shall now treat of the organization of the men when the mixer was being run and the forms filled. In the first place we shall consider the crew that ran the mixer and hoist down on the ground. We had two engineers, one for each engine, and one helper, who looked after their coal and water supply and kept a tally on the empty cement bags, thus counting up the number of batches turned out. Besides these there was a man who tipped the mixer and signalled the engineer to hoist. Next there were two men on the mixer platform (see tracing) one of whom looked solely after the mixing of the concrete, putting in the water and seeing to it that the proper quantities of sand and stone were put into the mixer, and signalled the man below to tip the mixer. The other man looked after the cement, shaking the bags, and kept the barrels on the platform full of water all the time. We also had two men wheeling in the cement from the shed, six men wheeling in stone and four men wheeling in sand. There were outside the building ten men with shovels, six to load stone and four to load sand. All these shovellers and barrow runners were under an under foreman who was supposed to keep them on the job.



Showing Forms, 12th March, 1907.

Upstairs, on the floor, we had, besides the foreman, who had charge of the whole concrete work, seven barrowmen and five men who looked after the dumping of the concrete from the skip into the hopper and the loading of the barrows.

They were distributed thus: There was one man on top of the hopper who, when the skip was hoisted, slipped a ring attached to a rope over a hook in the door of the skip (see photos 30 and 32), giving a signal to two men on the platform to pull on the rope and open the door of the skip. He also saw to it that neither the skip nor the hopper became fouled, and signalled the engineer to lower away the skip.

There were, besides these two other men, one of whom worked the lever opening the hopper and the other helping him from in front with a shovel to load the barrows.

One of the men on the rope swept down the gangways with a wire broom every little while, this being very important, as small pebbles on the gangways are very liable to give the barrowmen serious trouble, and may tie up the work now and again for a few minutes.

Next we shall consider the tampers and the importance of their work. In the first place we came to the conclusion that with the class of labor used (a proviso which should perhaps be emphasized in all cases) two tampers should be provided for each barrowman to get good results when running the mixer at full capacity. We thus had fourteen tampers in all.

In the case of all ordinary walls nothing particular need be said, except to call attention to the very great importance of proper tamping.

However, when pouring thin walls, such as our 4-inch partitions, we found it best only to use very soft concrete and to detail our most intelligent men to do the tamping, giving them all the time they thought necessary (up to a certain point), and not pouring in very much concrete at a time. It was generally agreed amongst us that it did not pay to rush thin walls, ceilings, roofs and floors, of which more later.

We always tried to carry the concrete in all the forms up to the same approximate level every day in successive layers

Front View, Bank of Nova Scotia, August, 1907.

not exceeding 12 to 18 inches in thickness, so as to avoid unequal pressure on the formwork.

Whenever it was necessary to break a wall which should rightly have been continuous, a step was introduced with extra reinforcement so that the joint at least might be as strong as possible.

Before placing new concrete on old concrete we always washed down the old surface, cleaning away all chips, etc., and while it was still wet poured a layer of strong grout over the surface to make the joint strong. When this was properly

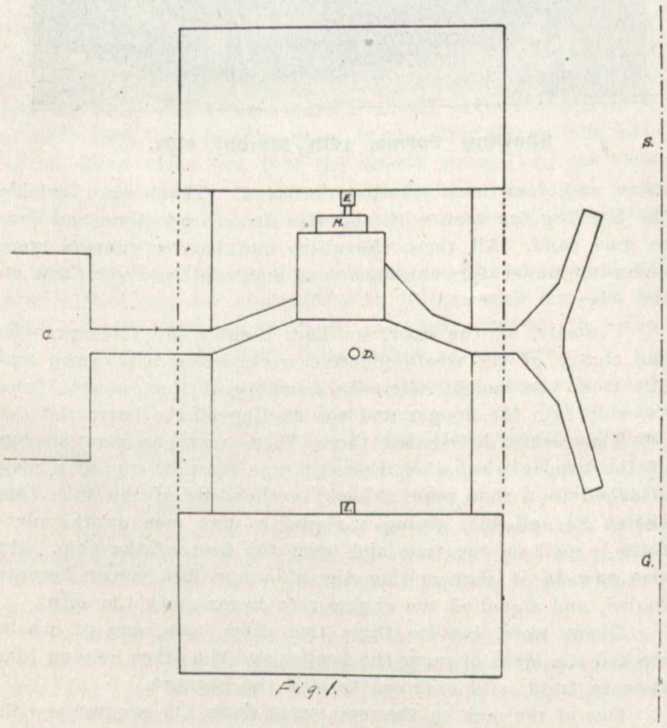


Fig. 1.

done the joint was often very hard, I might say, impossible to detect.

Of all the concrete work that came under my observation a floor appeared to require the most care. In the case of floors of such size as that in photo 32 we laid the reinforcement on ½-inch wooden blocks, then we worked a layer of concrete under the rods, taking out the blocks as we went along. When a sufficiently large surface had been thus treated more concrete was dumped on top and spread out to the required level.

In the case of such small ceilings as that in photo 37 we adopted another plan.

We first spread a thin layer of concrete, not more than one-half inch thick, on the floor, and then laid the steel right on top of this, completing the ceiling in sections as the steel was laid. This method, of course, is only applicable where the work is small and the reinforcement not very heavy.

We always aimed at finishing our floors from the same mix on the same day, and worked overtime when necessary to do this. We never made a joint in a floor except over a wall.

A half-inch coat of rendering inside and outside was provided for to complete the building.

All rough work was done by natives of the island and we found them fairly satisfactory laborers.

The native laborers were paid at the rate of about six cents per hour; the native tradesmen received about twelve cents per hour.

The Canadian workmen received about the same pay as prevails in Montreal, as they were engaged during the hard times. Their passage to and from Jamaica was paid, however.

All the work was carried out under the supervision of foremen brought from Montreal.

In conclusion let me make a few remarks not of a technical nature perhaps, but interesting, I hope, to all McGill men as such.

The work was being executed by a firm very closely allied to the College, in fact, consisting solely of McGill graduates,

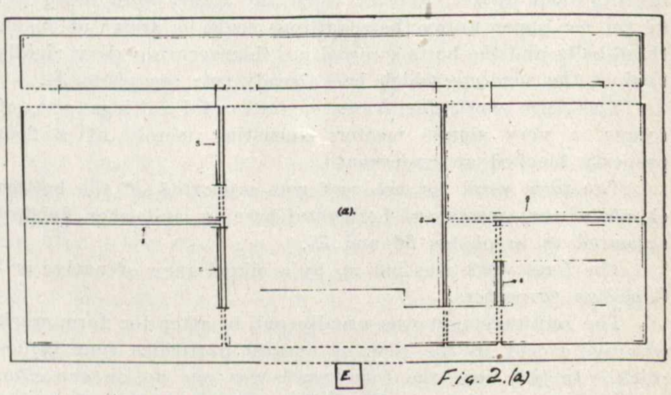


Fig. 2.(a)

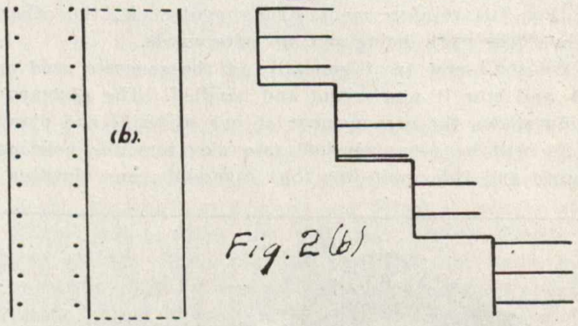


Fig. 2(b)

some of whom had been on the staff of our Science Faculty not so very long ago.

Moreover, the engineers in charge on the spot were graduates of not more than four years' standing.

The ability and care they displayed on the work attracted very great attention and served as an advertisement not only of the firm but of the University to which they belonged.

Explanation of Diagrams.

No. 1 is intended to illustrate the distribution of material and the arrangement of the plant.

E represents the elevators.

M represents the mixer.

D represents the hoisting engine.

C represents the cement house.

S and G are respectively the centres of the sand pile and the gravel pile.

No. 2 (a) shows the arrangement of the gangways relatively to the walls and partitions used on the upper storey in the front of the building.

In this sketch E represents the elevator as before and the red letter "s" indicates the 2 by 2-inch scantling mentioned in connection with this sketch.

2 (b) shows a typical step, also mentioned before.

THE

Sanitary Review

SEWERAGE, SEWAGE DISPOSAL, WATER SUPPLY AND WATER PURIFICATION

MONTREAL A HYGIENIC DISGRACE TO CIVILIZATION.

Two thousand eight hundred lives would be saved annually in Montreal if the death rate could be lowered to the average rate occurring in other cities of the same size. This enormous annual sacrifice of life is entirely due to the indifference of the public to all matters appertaining to hygienic engineering, and absolute weakness of the Legislature in refusing to frame laws of any hygienic value to the community.

Dr. Lachapelle recently stated the death rate of Montreal is 25 per 1,000, the average for similar cities being 18, and in many cases as low as 14.

Compared with the averages of similar cities, **seven people out of every 1,000 have to pay the death penalty every year** for the privilege of being a citizen of one of Canada's greatest cities.

For the year ending June, 1908, deaths from contagious diseases occurred in Montreal as follows: Diarrhœa, 1,551; typhoid, 142; measles, 70; scarlet fever, 20; whooping cough, 71; diphtheria, 74; tuberculosis, 907; grippe, 71.

Total deaths from contagious diseases in Montreal, 2,899, at the rate of 7.9 per thousand.

Total deaths from contagious diseases for the Province of Quebec, apart from Montreal, 6,803, at the rate of 4.8 per thousand.

Three people out of every one thousand as compared with the Province, or a total of 1,101 lives would be annually saved to the Province of Quebec if Montreal was only blotted off the map, or if those responsible for operating the rates were only capable of recognizing their responsibilities.

The above statements are no exaggeration. They are given because it is criminal to hide them. The man who does not know them should know them. They are simply compiled from the Provincial Board of Health report for the year 1907-1908.

Wilful neglect, public carelessness, and municipal degradation have resulted in what should have been one of the fairest cities on God's earth being a veritable death trap.

Should a community be allowed, even if they voluntarily wish to, year in and year out, drink their own diluted sewage, and offer it to the stranger within their gates?

Dr. Lachapelle, president of the Provincial Board of Health; Dr. Pelletier, Dr. Starkey, Dr. Adami, Dr. Bernier, and, in fact, every man in Montreal and in the Province who has even the most elementary knowledge of hygiene knows that Montreal's abnormal death rate is due to causes which are preventable, and are simply the result of neglect.

The corporation of Montreal are fully aware of the facts; they have just received a report, as they have received many before.

The sewers of Montreal are the patched-up framework of the city's birth. They present neither system, cleanliness, methods of control, flushing, efficient ventilation, or, in fact, any of the attributes which belong to a modern system.

The water supply of Montreal is simply the ancient and almost defunct method of pumping up raw river water, contaminated with organic matter and sewage, infected with bacteria, and delivering it direct, without the slightest attempt at purification, to the mouths of the people.

It is said that by custom a person may become immune to what is ordinarily an over-dose of poison, but let us show mercy to the stranger, whose alimentary canal may not be trained to digest filth.

Will the corporation of Montreal continue in the path of criminal civic neglect? If so, then it is up to the people to turn them out as being absolutely incapable of regarding an annual sacrifice of close on 3,000 lives as an important item in their efforts after municipal legislation.

The time is past to stand still and gape with a brain-softening senility of wonderment at a winter outbreak of typhoid such as Montreal has just experienced.

If typhoid had never occurred before in Montreal it might be interesting and useful to look for the direct cause; but typhoid infection is as endemic there as oxygen is a component of the atmosphere. It is in the excremental collected filth of a defective, leaking city sewerage. It is in the sewage-polluted subsoil on which the city stands. It is in the sewage-discharge, polluted waters which surround what should be the very queen of islands.

What would be thought in the case where a bank manager left the safe door open, the windows unprotected, the main door to the street open the skylights unbolted, and no watchman on the premises, and then in the event of a robbery that the bank authorities should spend valuable time, debate and enquiry as to whether the thief really entered by the door, the window or the skylight, or dropped from heaven down th chimney?

Let the people of Montreal awake to the fact that their doors and windows are thrown wide open to the thief, that their watchman (the corporation) sleepeth. Then, and then only, will that thief of lives, "Insanitation," be dealt with firmly and severely by a life sentence.

HYGIENE IN THE PROVINCE OF QUEBEC.

Report of the Provincial Board of Health, 1908.

The fourteenth annual report of the above Board of Health is before us.

It contains useful and interesting information, carefully and clearly compiled, and if only studied and made use of by the citizens of the Province will result in much benefit.

Vital statistics comprise the greater portion of the publication, such are generally considered uninteresting and we are afraid seldom read. We should like to see these figures more fully edited, deductions drawn, and comparisons made with the average figures of other Provinces, or even with the past years in the Province in question.

With the exception of the marriage, birth and general death rate no historical comparative data are given, and there are no figures to show either increase or decrease of zymotic diseases. Referring, however, to the previous year's report we compute the death rate from contagious diseases for the whole Province at 5.8 per 1,000, while the present report shows 5.0 per 1,000. It should be noted that whooping cough and grippe are now rightly included as contagious diseases, but were not so previously; we have, therefore, ignored these diseases in the above. A comparison in this respect between two years only, conveys little data of value as to general hygiene improvement.

The general death rate for the Province is given for the years 1900 up to and including the year ending June 1908. The average death rate being 18.69 per 1,000, with a minimum rate in 1902 of 17.56 and a maximum of 19.92 in 1900. The year ending 1908 being 18.07. Comparing these rates with those of the State of Massachusetts we find them higher. In the latter State the death rate has averaged 16.33 for the last 5 years, with a minimum of 15.76 in 1904 and a maximum of 16.81 in 1905.

The difference means that 2⅓ more persons per thousand die annually in the Province of Quebec than in the State of Massachusetts.

This certainly points to greater activity being required in promoting measures for the prevention of disease. If the death rate in the Province of Quebec could be brought down to that of Massachusetts it would mean an annual saving of the lives of 4,100 people, and a consequent increase in population.

The report also gives useful and practical information on sources of water supply, dealing particularly with well waters in a manner which the general public should easily understand.

Analysis of various drinking waters are given, which generally speaking show high contents of chlorine, pointing to sewage polluted or surface contaminated well sources.

Tuberculosis and its relation to unhealthy dwellings receives practical and instructive attention.

Sewage disposal and purification are referred to as something of the dim and distant future, the report stating, "It is a fact that the municipalities have never 'proprio motu' submitted to the Board of Health plans for the purification of their sewage, even when watercourses were evidently to be contaminated by the discharge of crude sewage." It is evidently felt that it is easier to make this confession in Latin than in plain English.

Interesting data are, however, given with respect to 273 towns, villages and townships, which fairly well explain the extra 4,000 or so unnecessary deaths during a year period.

It would appear that certain questions have been formulated and circulated throughout the Province. From the answers published we may take it that these questions were approximately as follows:

(a) As to amount of population.

(b) As to number of houses.

(c) Name of executive official.

(d) As to whether there are any municipal or private wells, and if none how is water obtained by the individual.

(e) As to any sewerage system.

(f) As to any method of purifying the sewage from the sewage system.

(g) As to number of water closets or privies.

(h) As to removal of garbage.

(j) As to number of butter and cheese factories or other industries.

(k) As to whether an isolation hospital is provided.

(l) As to whether there are any apparatus for disinfection.

Two hundred and seventy-three localities have evidently filled in these forms and returned them. The simplicity and uniformity of the replies are remarkable. The great majority simply read thus:

Warwick Township.—Population, 1,400; houses, 400; executive officer, Joseph Desrochers; no waterworks, ordinary wells; no sewage system; privy pits everywhere; no municipal removal of garbage; 6 cheese and butter factories; no isolation hospital; no disinfection station; no apparatus for disinfections.

The report makes no attempt to edit or analyse the conditions at the above 273 localities. They are just given for what they are worth, and no deductions are drawn from them of any kind. We have, however, taken the trouble to make some sort of a rough analysis which may be of interest to those interested in the health of the Province.

Out of the 273 localities—

(d) 100 are provided with either municipal or private water supplies, in the majority of cases supplying only a small portion of the population. The remaining 173 depend on brook, river, well water or spring water. A glance at the analyses given of artesian well waters, gives a fair idea of the contaminated character of such waters.

(e) 29 are provided with main sewers for the most part, sewering only part of the district. The remaining 244, 71 of which have water supplies, have no system or method by which sewage is removed from the neighborhood of dwellings; presumably they may have cesspools which will tend to keep the wells supplied.

(f) 3 sewer systems have sewage disposal works, and the remainder discharge the raw sewage into the nearest water course.

(g) 104 of the towns are provided with water closets of a variable number, the remaining 167 have ordinary privies everywhere, and the remaining 2, to complete the balance, report that they have neither water closets or privies, these represent populations of 3,000 and 2,500. The people apparently lead a sort of pastoral life of an Adam and Eve character. Practically all the towns with water supplies have water closets, 29 of which only have sewerage systems.

(h) There is practically no municipal removal of garbage.

(j) Nearly all the towns are enthusiastic about having butter and cheese factories.

(k) 7 have isolation hospitals, the remaining 266 being without.

(l) Disinfecting apparatus is as rare as the egg of the great Auk.

No sanitarian will doubt but that the Provincial Board of Health have got virgin ground to work upon, and they have certainly got their work set to bring the number of sanitary improvements required up to the magnificent record of butter and cheese factories.

Now this is the fourteenth annual report. What is the reason that it is still a mere report of things " as you were?" How is it that there are no signs of life and progress to illuminate its pages? A simple photograph or description of primitive antiquities, with a few text book suggestions thrown in as to how dwellings should be constructed.

We look in vain for the scientific research, enlightenment, pulsating sanitary life, which mark the pages of the State Board of Health reports of our neighbors over the border.

The fault does not remain with the gentlemen who constitute the Provincial Board of Health. They represent in their number a part of the most enlightened, enthusiastic, scientific and practical sanitarians of Canada. The fault lies in the basic principal of the sanitary laws of the country, which is constituted in the term "you may" and not in the term "you must."

The Provincial Board of Health of both Quebec and Ontario are birds with their wings clipped. They are there for a direct purpose; they are given neither the money or the legal machinery to carry out this purpose. As compared with the reality of the local Government Board of Great Britain, or the State Board of Health of the United States they are but visionary.

People are allowed to vote by by-law as to whether they may voluntarily continue to feed themselves and their children with the bacilli of typhoid, and spread the germs of consumption as the confetti is thrown at a Roman carnival.

Signs of awakening are not wanting. But nothing can be done till our legislators can find a little time, apart from the amusing game of accusing each other of graft, for devotion to the real interests, health and welfare of the people.

THE DUTIES AND DIFFICULTIES OF A MEDICAL OFFICER OF HEALTH.

Dr. T. A. Hutchinson, Medical Officer of Health of the City of Westmount, Quebec, contributes an interesting and instructive article in the Bulletin Sanitaire.* This publication is of a propagandist nature, containing articles on sanitary subjects in both French and English, calculated to create a public interest in these important questions of hygiene which so closely affect the health of the people.

The Provincial Board of Health recognizes the fact that any improvement in hygienic conditions throughout the Province rests to a great extent with the people, and just that extent of enlightenment which exists in the public mind will be interpreted by legislation. It is no use passing a law to prohibit swine from placing their forefeet in the trough while feeding. The swine must be taught that the action is not one of necessity or good taste.

While not attempting to give the whole of Dr. Hutchinson's article on account of lack of space, we may be permitted to quote what we deem of special interest.

How the Government Fulfils Its Duty.

"In older countries, especially in England, France and Germany they have now an established system, controlling all questions affecting the health of the people. In Canada we are only beginning this work. The Governments, both Provincial and Dominion, take little interest in the subject and it is remarkable how apathetic the general public appear to be, about all matters tending to improve the hygienic conditions of the community. The Provincial Board of Health is cramped in its efforts of usefulness by a niggardly grant from the Provincial Government. How is it possible to do effective work over this large Province on a grant of $12,000.00 Lately this had been raised to $20,000,00. In Ontario the grant is just double this amount, viz., $40,000.00."

Notification of Diseases.

In dealing with the subject of notification the doctor forcibly shows how a certain sect are a menace to the public health, he says: "Another objection to notification comes from certain peculiar people calling themselves 'Christian Scientists.' (Why so-called I do not know, I fail to see anything Christian or scientific about them.) They are like the animal called the guinea-pig, which has nothing about it resembling a guinea or a pig, so with the Christian Scientists, there is nothing Christian about them as far as I can see, and I am very sure there is nothing scientific. They deny the existence of disease, yet take money from fools for pretending to cure disease. These people are a menace to the community. The only proper remedy is the strong arm of the law and a strict enforcement of our regulations."

We do not attempt to judge these people on the quality of their Christianity, but if what the doctor says is true, that the so-called, scientific part of their faith leads them to ignore the presence of contagious diseases, we must concur with the pronouncement that they are a menace to the general welfare of the community.

Our Water Supply.

"It is the duty of the medical officer of health to inform himself as to the character of water supplied in his district and he, therefore, should have a bacteriological examination of the water used for domestic purposes every autumn. There are few facts more certainly established in the etiology of disease, than the dissemination of typhoid fever by contaminated drinking water.

"This important subject will have to be dealt with in this Province. Many of our cities, towns and villages are using river water, but this will have to be discontinued before long or the people will suffer from certain diseases, especially typhoid. As you are all aware the cities and towns along the course of the rivers, empty their sewers into these streams and thus contaminate the water which we use for drinking purposes. Evidence has accumulated on all hands and in all civilized countries that polluted water frequently causes an epidemic of typhoid. That this pollution is going on year after year and will increase as our towns and cities grow, should arouse us to take some action to change our water supply, or purify the sewage before it reaches the rivers.

"Typhoid is to a great extent a preventable disease, as the cause is well known and the chief cause is contaminated water.

"Every year, during the autumn and winter months typhoid occurs in great numbers on the Island of Montreal. The water used by the citizens of Montreal and its suburbs is St. Lawrence or Ottawa River water and as long as sewage is poured into both rivers, so long will typhoid be prevalent. During the last 3 or 4 years typhoid has been greatly on the increase, doubtless due to the drinking water being polluted with sewage. As an example of pollution of the drinking water by sewage and followed by a terrible scourge of typhoid, let me site the epidemic at Fort William, Ont., in February 1906.

"This town is situated at the head of Lake Superior on Thunder Bay and the greater part of the population exists along the northern bank of the Kaministiquia River. Fort William derives its water supply from this river, about 2 miles from its mouth. The intake of the water pipe is about 35 feet from the shore. One sewer has an outlet into this river 1,400 feet above the intakes, also higher up the river large electrical works were under construction employing several hundred men. Again about a mile above the intake a dock exists where many boats are loaded and unloaded. The sanitary arrangements were very bad and this river was a receptacle for the refuse and excreta of the whole community.

"Typhoid seems to have been endemic in this locality for several years. In September 1905 typhoid seems to have been rather prevalent and the Provincial Medical Health Officer advised the boiling of water and asked the local Board of Health to prevent the pollution of the river above the intake. A notice was put in the local papers instructing every person to boil all water used for drinking purposes. After a month this was withdrawn by the council of the town. However, typhoid increased daily and in February 1906 the town authorities realized that an epidemic had set in.

"It was decided to open an artesian well to supply the public with drinking water, and four large tank-carts were constructed for distribution.

"From this date cases began to get fewer day by day. The extent of the epidemic may be stated as follows: The total number of deaths from the 1st of January to 16th April was 69; of these 36 were Canadian, 8 British, and 22 foreign; and the average age 24. A census showed that 840 cases had occurred in a population of less than 8,000 and all inside of 3 months. This typhoid epidemic is an object lesson of what can result from a stream being polluted by sewage and the water of this same stream used for drinking purposes."

The fact of the above epidemic at Fort William is well known, and although the recitation of the particulars may be stale in the shape of news, the lessons taught by the tragedy have yet to produce their effect, generally, in Canada.

In connection with this question of typhoid and water supply so ably treated by Dr. Hutchinson it may be of interest to compare the death rates from typhoid at the following cities, etc., relative to water treatment:

Locality.	Deaths from typhoid per 100,000.	Water Supply.
Montreal	38	Untreated river
Quebec Province, apart from Montreal	28	Various sources, untreated
London, England	17	Filtered river
Rotterdam	5	Filtered river
Havre	2	Filtered Dune water
Berlin	9	Filtered river
Hamburg	18	Filtered river
Breslau	11	Filtered river

Throughout the State of Massachusetts of late years a considerable reduction of the death rate from typhoid has followed the introduction of methods calculated to preserve the purity of water supply. The death rates for the State

* Bulletin Sanitaire, 1908. Publication issued by the Provincial Board of Health of Quebec, along with Annual Report.

from typhoid per 100,000 since 1891 have shown a decrease as follows:—

1891-1895	34	per 100,000	
1896-1900	26	"	"
1901-1905	19	"	"
1906	17	"	"

Mr. Allen Hazen * has to say: "The proportionate number of cases of typhoid fever among the users of a polluted water varies with the number of typhoid germs in the water. Excessive pollution causes severe epidemics, continued high death rates, according as the infection is continued or intermittent. Slight infection causes relatively few cases of fever. Pittsburg and Allegheny, taking their water supplies from below the outlets of some of their own sewers, have suffered severely (103.2 and 127.4 deaths from typhoid fever annually per 100,000 respectively, from 1888 to 1892). Wheeling, W. Va., with similar conditions in 1890, was even worse, a death rate of 345 per 100,000 from this cause being reported, while Albany had only comparatively mild epidemics from the less directly and grossly polluted Hudson." "Abandoning the shore inlet near the mouth of the Chicago River in 1892, resulted in the following year in a reduction of 60 per cent. in the typhoid fever death rate." "The conditions which remove or destroy the sewage bacteria in a water tend to make it safe. The most important are: (1) Dilution; (2) time, allowing the bacteria to die (sunlight may aid this process, although effective sunshine cannot reach the lower layer of turbid waters or through ice); (3) sedimentation, allowing them to go to the bottom, where they eventually die; and (4) natural or artificial filtration. In rivers, distance is mainly useful as affording time, and also, under some conditions, in allowing opportunities for sedimentation. Thus a distance of 500 miles, requires, a week for water travelling three miles an hour to pass, and will allow very important changes to take place. The old theory that water purifies itself in running a certain distance has no adequate foundation as far as bacteria are concerned. Some purification takes place with the time involved in the passage, but its extent has been overestimated. The time required for bacteria to die simply by natural causes is considerable; certainly not less than three or four weeks can be depended upon with any confidence."

With reference to filtration as practised in Europe, Mr. Hazen states, "under all proper conditions, over 99 per cent. of the bacteria can be removed from water." In practice, however, under all conditions this efficiency is not obtained. There is no doubt, however, that the places using filtered water have, in general, extremely low death rates from typhoid fever.

Dr. Hutchinson's argument "the relation of typhoid to water supply" should, in the light of present knowledge, require little backing. A patient has typhoid fever; the bacilli which are found in the alimentary tract pass out along with the excreta, it finds its way into the drains, or sometimes, worse still, on to the surface of the soil near a well or some other source of water supply. The bacillus may continue to multiply in the organic matter of the sewage, from which it ultimately finds its way into the water, and although such water may appear pure (often beautifully clear and sparkling), as soon as it is taken into a slightly disordered intestinal canal, it gains a foothold, and another patient is attacked. This may happen simply through the rinsing of a milk pail.

The typhoid germ is not easily and is rarely detected in water, the presence of sewage, as indicated by the presence of B. coli, another more easily detected bacillus, points to a water which may at any time give rise to typhoid conditions. The question of whether the typhoid germ is saprophytic or not (that is, can multiply in water) is not material. The knowledge that it can exist in water and so give rise to epidemics is quite sufficient.

Authorities should be compelled to submit samples of water for bacteriological examination periodically. Such samples should be packed in ice, and if possible delivered to the laboratory not more than ten hours from the time of bottling.

By legislation, a great deal can be done towards annually saving the lives of a large number of the population. But, as Dr. Hutchinson states, very little can be done on a paltry sum of $20,000 a year in a province such as Quebec, a sum which would not pay out of pocket travelling expenses in order to make thorough annual inspection and sanitary surveys.

* The Filtration of Public Water Supplies.

A MEDICAL OFFICER OF HEALTH ADVISES ON SEWAGE DISPOSAL.

An Ontario medical officer of health who poses as a sanitary expert, lately undertook to give advice to a municipal engineer of the same province on the question of sewage disposal.

The question at issue was the rate per day at which sand land could be made to purify sewage by the process known as "intermittent land filtration."

With buoyant optimism, he assured the engineer that 600,000 gallons per day per acre could be successfully treated by this process.

Fortunately, the seed fell on barren ground, the only result of this expert advice, being as far as we know, that, for a day it formed a good joke with the officials of the Provincial Board of Health.

In the event of the medical sanitary expert in question, noting this paragraph, we advise that he obtain data on this subject before offering advice in future. He may turn to paragraph 195, page 143 of the Royal Commission's Report on Sewage Disposal, and read as follows:—"Generally speaking, the evidence points to a maximum rate of 30,000 gallons per acre per day with the best land, after preliminary treatment, although witnesses have put it at the rate of 60,000."

He may further turn to the extensive experiments made lately by the Hamburg State Institute of Hygiene, also to experiments and practice of the Massachusetts Board of Health, and in fact to all recognized authorities, wherein and whereby he may learn that the maximum flow which has ever been treated successfully for any continued period on the most ideal gravel or sand land does not exceed 100,000 gallons per acre per day by "intermittent filtration."

If doubts still remain, why not a visit to the Berlin, Ontario, (intermittent land sand filtration plant)? Or a consultation with Dr. Amyot, (the Provincial Board of Health Analyst), who was to a large extent responsible for these works, who can supply him with the necessary data.

After this period of research, he may find, that, he holds a position of peculiar isolation in the sanitary world, comparable to the isolation of the North Pole from civilization.

The above has been repeated to us under good authority, of course, errors or slips may be easily made. However, when it is a question of the expenditure of large sums of money on important public health work, men holding responsible positions as advisers on health questions, should use care in handing out data, especially, of the extravagant character of the above.—Ed. "Sanitary Review."

QUESTIONS AND ANSWERS

Questions or Suggestions are welcomed. They will be carefully considered by experts

J. A. J., Saskatchewan.—By this time you will have received our last number, stating that we have no information or data in bacterial removal or sterilisation efficiencies relating to "ozone treatment" in practical operation. We are endeavoring to obtain such, and will publish at once when obtained. We will endeavor to publish the results of the plant at Lindsay, when such are determined by the Provincial Bacteriologist. We cannot agree with you that the presence of harmless bacteria are necessary to drinking water. Distilled water, of course, is not palatable, and would prove harmful. Drinking water should contain in solution certain salts, and be of a certain hardness. Ozone treatment does not mean, turning out a water comparable with distilled. It is said to effect a rapid and thorough oxidation of organic matter in solution, and the sterilisation of microscopic organisms. This is what is attempted by all purification processes.

Municipal Engineer.—Your question is not an engineering one, but a legal one. We cannot either undertake to answer it or advise you upon it. The question of "whether the septic tank patents would be upheld as valid in this country;" is a question for a judge and jury to adjudicate on. We know pretty well what a septic tank will and will not do, and so have attempted to explain in former issues. We don't know what a jury will or will not do. We would advise you to write direct to the city clerk of Hamilton, with reference to the latter part of our enquiry.

Ed. "Sanitary Review."

RAILROAD ORDERS.

(Continued from Page 519.)

6608—March 5—Dismissing application of the V. V. & E. Railway for authority to construct a branch line to connect with its main line with the International Boundary near Myncaster, B.C.

6609—March 5—Dismissing complaint of R. Robson, of Mayook, B.C., complaining of the poor and unsatisfactory train service furnished by the C.P.R. on its Crow's Nest Branch between Mayook and Cranbrook, B.C.

6610—March 5—Dismissing application of the city of Revelstoke, B.C., for Order directing the C.P.R. to provide a traffic bridge in connection with its proposed new railway bridge across Columbia River at Revelstoke, B.C.

6611—March 22—Authorizing the C.P.R. to use and operate bridges on its Esquimalt and Nanaimo Branch at four different points.

6612—February 23—Directing on complaint of J. A. Maddaugh, of Vancouver, B.C., that the G.N.R. to file and publish tariffs of rates on lumber, shingles, and articles taking the same rates via New Westminster or Vancouver, in connection with the C.P.R., viz.:—from points on the V. V. & E. Railway and Navigation Company lines between Vancouver and New Westminster, not inclusive, to points on the C.P.R. west of Winnipeg, except such points as may be rates direct by the G.N.R. and its connections, rates based upon one cent per 100 lbs. higher than rates maintained from Vancouver, by the C.P.R., the V. V. & E. Railway and Navigation Company to be allowed two and a half cents per 100 pounds.

6613—February 23—Directing on complaint of the British Columbia Timber and Trading Company that the G.N.R. to file and publish tariffs of rates on lumber, shingles, and articles taking the same rates via New Westminster or Vancouver in connection with the C.P.R., viz.;—from points on the V. V. & E. Railway and Navigation Company lines between Vancouver and New Westminster, not inclusive, to points on the C.P.R. west of Winnipeg, except such points as may be rated direct by the G.N.R. and its connections rates based upon one cent per one hundred pounds higher than rates maintained from Vancouver by the C.P.R., the Vancouver, Victoria and Eastern Railway and Navigation Company to be allowed two and a half cents per 100 lbs.

6614—February 25—Dismissing application of the V. V. & E. Railway and Navigation Company for Order sanctioning the placing and maintaining of crossings over Lot 23, Group 2, New Westminster, B.C.

6615—February 23—Dismissing application of the V. W. & Y Railway for Order approving of the place and mode of crossing of its branch line No. 2 from False Creek to Burrard Inlet, over Powell Street, in the City of Vancouver, B.C.

6616—March 22—Directing the C.P.R. to construct and operate a spur from the main line of its railway to the premises of the Okotoks Milling Company and the Electric Light Company, Okotoks, Alta.

6617—March 22—Directing the C.P.R. to construct spur to the premises of the Western Canada Pressed Brick & Tiles Company, Limited, and the Pugh & Livingstone Lumber Company, at Okotoks, Alberta.

6618—March 18—Dismissing application of J. G. Wilson, of Dana, Sask., for Order directing the C.N.R. to pay him $95 damages for cattle killed on the tracks of the C.N.R.

6619—March 8—Dismissing complaint F. W. Godsal, Cowley, Alta., re excessive passenger rates on the C.P.R. Company's steamers between ports of call on the Kootenay and Arrow Lakes, British Columbia.

6620—March 5—Authorizing the Kettle River Valley Railway Company to construct its railway across the alleyway situated in Block 26A, and lying between Fourth and Fifth Streets, Grand Forks, B.C.

6621—March 5—Dismissing complaint Greenwood Board of Trade, B.C., against the freight and passenger rates charged by the V. V. and E. Railway and Navigation Company, as unjustly discriminating against points on the C.P.R. Company's railway in British Columbia, and in favor of points in the State of Washington.

6622—March 8—Authorizing the town of Claresholm, Alta., to secure Lots 15, 16, and 17, or portions thereof, and do the grading necessary in connection with the carrying of Centre Avenue across the tracks and yard of C.P.R. in Claresholm.

6623—March 5—Dismissing complaint of Nelson Board of Trade complaining against freight rates charged by the C.P.R. Company on shipments to and from Nelson, B.C.

6624—March 5—Dismissing complaint of Okanagan Board of Trade against present rates charged by C.P.R. Company on fruit shipments in British Columbia.

6625—March 23—Authorizing the Manitoba Government Telephones to place its wires across the C.N.R. tracks ½ mile west of Scarth, Man.

6626—March 23—Authorizing the Municipality of Miniota, to place its wires across the C.P.R. tracks 100 yards west of Miniota Station, Man.

6627—March 23—Authorizing the Municipality of Miniota, Manitoba, to place its wires across the C.P.R. tracks 4 miles west of Grandall, Man.

6628—March 23—Authorizing the Princeton and Drumbo Telephone Company to place its wires across the G.T.R. tracks at Town Line between Townships of Blenheim and Dumfries, Ont.

6629—March 23—Authorizing the Municipality of Hamiota to place its wires across the C.P.R. tracks 3 miles west of Hamiota, Man.

6630—March 23—Approving C.P.R. plan of proposed viaduct on the Richmond Road, Ottawa, Ont.

6631—March 23—Authorizing the C.P.R. Company to use and operate seven bridges on the Windsor Section of its line of railway.

6632—March 23—Authorizing the C.N.R. Company to construct a spur track to the mill of the Rosthern Flour Mills Company, in the town of Rosthern, Sask.

6633—March 23—Authorizing the British Columbia Telephone Company, Limited, to place its wires across the tracks of the E. and N. Railway Company at Nanoose Bay, B.C.

6634—March 1—Authorizing the E. and N. Railway Company to construct a spur to the premises of the B. Wilson Company, Limited, in the city of Victoria, B.C., subject to certain terms and conditions.

6635—March 24—Authorizing the C.P.R. Company to construct a branch line across Higgins Avenue, to and into the premises of the Northern Electric Company, Winnipeg, Man.

6636—February 11—Dismissing application of settlers along Pheasant Hills Branch of the C.P.R., for an order directing C.P.R. Company to provide a siding at or near the north-east quarter Section of Tp. 17, R. 32, W. 1 M., Sask.

6637—February 27—Authorizing the South Wellington Coal Mines, Limited, to place certain air and steam pipes under the tracks of the E. and N. Railway, at a point between

Victoria and Nanaimo, Sec. 14, R. 6, Cranberry District, British Columbia.

6638—March 8—Amending Order of Board No 5261, dated September 2nd, 1908, in re application C.P.R. for authority to make diversions on its Crow's Nest Branch between Peigan and Crow's Nest, Alta.

6639—February 27—Directing the E. and N. Railway Company to remove the section-foreman's house at the crossing of the company's line at Duncan, B.C., in order that there may be a clear view of 75 feet from the right-of-way.

6640—March 8—Directing the Calgary and Edmonton Railway Company to put the crossing of the Township Road between Townships 11 and 12, south of the town of Claresholm, Alta., in proper and safe condition, and to widen the partial diversion on the north-east quarter section 36, Tp. 11, R. 27, and make the same safe and proper in accordance with the regulations regarding railway crossings.

6641—March 24—Authorizing the Nelson & Fort Sheppard Railway Company to construct a suitable station and freight shed at Fruitvale, B.C., and to install a telephone in the said station building.

6642—February 27—Authorizing the Council of North Cowichan, B.C., to construct and maintain a highway across the E. and N. Railway, at mile-post 41 + 6½ ft., and rescinding Order of the Board No. 5737, dated November 26th, 1908.

6643—February 19—Refusing application of C.P.R. for an Order to amend Order of Board No. 5608, made on the application of the city of Edmonton and the Strathcona Radial Tramway Company, Limited, by providing that the city of Edmonton and the Strathcona Radial Tramway Company shall install a half-interlocking plant at the crossing at White Avenue, Strathcona, Alta.

6644—March 25—Authorizing the Municipality of Miniota to place wires across the C.P.R. tracks at Crandall, Man.

6645—March 8—Directing that the sum of $1,650 be paid by the North-West Jobbing & Commission Company to the C.P.R. for the construction of a spur to the warehouse of the said Jobbing and Commission Company. Also directing that the said company pay to the C.P.R. Company the sum of $250, being the balance of the sum of $1,900 agreed upon; and further ordering that accrued interest on the said deposit of $1,650 be paid by the Bank to the North-West Jobbing and Commission Company.

6656—March 23—Authorizing the C.P.R. Company to cross with its second track the tracks of the Ottawa and New York Railway Company, at Finch, Ont.

6647—March 5—Amending Order of Board No. 3814, dated October 23rd, 1907, and authorizing the Kettle River Valley Railway Company to construct its railway across Main Street, in the city of Grand Forks, B.C., as shown on plans filed with the Board under Case No. 2343A, which are approved.

6648—March 5—Amending Order of Board No. 3813, dated October 23rd, 1907, and authorizing the Kettle River Valley Railway Company to construct its railway across Bridge Street, Grand Forks, B.C., as shown on plans filed with the Board under Case No. 2344A, which are approved.

6649—February 27—Dismissing complaint of R. Carter, Courtney, B.C., complaining of the through rates charged by the C.P.R. Company on freight to Comax, B.C.

6650—March 5—Amending Order of Board No. 3807, dated October 23rd, 1907, and authorizing the Kettle River Valley Railway Company to construct its railway across Victoria Avenue, Grand Forks, B.C.

6651—March 5—Amending Order of the Board No. 3811, dated October 23rd, 1907, and authorizing the Kettle River Valley Railway Company to construct its railway across Sixth Street, Grand Forks, B.C., as shown on plans filed with the Board, under Case No. 2350A.

6652—March 5—Amending Order of Board No. 3812, dated October 23rd, 1907, and authorizing the Kettle River Valley Railway Company to construct its line across Winnipeg Avenue, Grand Forks, B.C., as shown on plan filed under Case No. 2345A.

THE DATUM PLANE.

Otto Klotz, LL.D.

Let us dwell for a moment on the position modern science occupies and its relation and influence on modern thought. Sir William Hamilton says: Science is a complement of cognitions, having, in point of form, the character of logical perfection, and in point of matter, the character of real truth.'' The science as thus defined, which we have inherited from the ancients, is confined almost exclusively to mathematics as developed from the Pythagorean to the Alexandrian School. Modern science is confined to the past century, during which time there has been an awakening of faculties of the human mind that lay dormant for the preceding 2,500 years. To these faculties is due the evolution of mathematical physics, made illustrious by such names as Faraday, Clerk, Maxwell, Helmhotz and Kelvin. Speculation of the cloisters has given way to investigation, to the unrelentless war of error and to the search for truth and facts. Nature, with her multifold secrets, is continuously on the witness stand, while the scientist with his battery of apparatus is busy wresting them from her. This probing, this searching, this gathering of facts and truths, and their correlation into laws of nature, this is modern science. A law of nature is not an abstraction, it is simply an expression for the connection between similar observed facts; a law is always secondary to the facts. This spirit of investigation and search for facts has pervaded the whole range of activities of the human mind, be it in literature, in philosophy, or in history, and some have viewed this, and probably rightly, with some concern.

The spirit of modern science has invaded every realm, realms that were apparently sacred by the dust of ages. It has been said that the constant and extreme devotion to facts and facts only tends to have a somewhat benumbing influence upon the imaginative faculty. Science is undoubtedly the great ameliorator of mankind, yet poetry and philosophy and history and art are necessary too for the rich and many-sided development of the human intellect.

The history of the world shows us various periods when flourished science, literature and art. Like huge billows they swept over the human race and passed away. To-day we are on the crest of the wave of modern science and our progress moves apace. As so much of the amelioration of mankind and the amenities of life depend upon modern science, the stimulus and incentive for its continued development seem secured forever.

Let us now return to our theme, taking the Intellectual Datum Plane first. Let us define it as the plane upon which you stand when you leave the University with a certain equipment to begin life's work. What should that equipment be, what qualifications should you have acquired in those four precious years of college work, what stores of knowledge should you have laid up that you can draw upon most frequently in after years and receive the most benefit therefrom? These are most important questions, and a retrospect by men who have led an active life since their Alma Mater bade them godspeed should be welcome. These questions might be considered under two aspects—the humanistic, and practical or material. On this occasion we shall confine ourselves to the latter, although the former is one worthy, too, of consideration, and one that should not be lost sight of or neglected. As students of Applied Science with its many branches and divisions, your ultimate spheres are divergent, yet for all of them certain basic principles are convergent, whether railway curves and bridges, or ohms and amperes, or atoms and chemical affinity, or electrical affinity, as the new knowledge has it, be dealt with.

I shall confine myself more particularly to those who are following the engineering course. In dealing with this question the viewpoint of the student shall not be lost sight of. In general his starting-point or initial desire may be expressed in one word—livelihood. Macaulay says: ''In every human breast there is a wish to ameliorate his condition.'' The large majority of science students after they enter college are impatient to learn to do things, things that they know have a commercial value, and then are impatient to go and do them. This incentive is but natural, especially under conditions that obtain with us, limited personal resources and unlimited opportunities in the development of our country. This brings us immediately to a vital point of our discussion: the student unconsciously longs to become a craftsman, a tradesman instead of an engineer; he is following an art instead of a science; he is pursuing the how instead of the why.

We must not forget that if we simply learn how to do things, without knowing the underlying principles, we are mere artisans, but if we can do things because we know the principles and laws of nature upon which the thing done depends, then we are engineers. He does not appreciate that the knowledge of one why will produce a score of hows; he is so intent on building a frame house instead of laying a good foundation for a future massive structure. That same spirit pervaded me nearly four decades ago and shows my attitude at the time towards the various studies presented in the curriculum.

In the practical equipment of the engineer there is no subject that stands out so prominently as "Mathematics," excepting common sense. Permit me to relate an incident. Some years ago I was a guest at an annual dinner of engineers. To one of the toasts the Professor of Engineering of a prominent university on this side of the Atlantic was called upon to respond. He made an able address, and one of the most striking things he said was to this effect: We teach almost everything at the university, except one thing we cannot teach, and that is common sense. And this is very true. Thrice fortunate is the man who beside his college education is gifted with common sense.

To the engineer and man of applied science mathematics is a tool, however much this term may grate on the ear of the pure mathematician. It is something by means of which the engineer can accomplish a desired end. The usefulness of a tool depends more upon the man using it than upon the tool. The question is very properly asked, How much mathematics does the engineering student require, of what kind should it be, should he possess himself of it only sufficiently to be able to turn up a given formula when required, or should he be so thoroughly conversant with the mathematical principles and elements that formulæ will readily be deduced for any particular case? It is a small minority that will have occasion in actual practise to use much of the higher mathematics; the majority will require only the fundamentals in algebra, geometry, trigonometry and calculus. Too high a value cannot be placed on these. Learn to appreciate the principles, the elements of mathematics, let them become part and parcel of yourself, don't try to remember formulæ. It is the fundamental principles that are the key for unlocking and solving the many and complex problems that present themselves in actual practise. Unless those elements are most thoroughly absorbed and digested, mathematics is not the helpful tool that it should be.

This is a most important point that I wish to impress: the appreciation of the value of thoroughly understanding and possessing the elements of mathematics. It may seem trite to insist on something that seems axiomatic, but the truth remains that students do not view the basic principles with that seriousness that they deserve. The higher analysis, differential equation, therodynamics, may pass away like a dream, and probably will, but if the fundamentals are riveted the engineer is well shod. Quality rather than quantity is wanted in mathematics, as in everything else, for a successful career. On this point a Professor of Engineering recently said: "The school is not a restaurant, but a gymnasium; not a place where a student comes to be filled up, but a place where he finds apparatus and the instruction, by making use of which he may strengthen his mental muscles." The man that has a thorough command of the principles will be able to apply his mathematics to a far wider range than the man that only knows certain formulæ. Memorizing mathematics or formulæ is love's labor lost, for the human mind has an unlimited capacity for forgetting; but the principles once mastered are a lasting asset. Understanding the principles gives confidence in their use and makes one independent of all formulæ. As an illustration of this latter, I might cite the case of the old school engineers, who almost without exception when they wish to determine the astronomic direction of a survey line, will sit up to all hours of the night to await Polaris, the pole star, reach elongation, instead of observing it at a seasonable and convenient hour in the early evening. The latter involves confidence in one's self, in knowing what you are doing; the other is simply following a rule of thumb.

When the mathematical elements are not thoroughly grasped and absorbed, the student, although he may be loaded with mathematical lore, will not know what to do with it; he is unable to see a problem in its proper perspective, he is unable to think mathematically because he lacks the command of the fundamentals. I have seen recent graduates laboriously applying the calculus, when a simple equation would have solved the problem. That's a case of cracking walnuts with a sledge hammer.

With all this insistance on the appreciation of the value of basic principles, it is by no means intended to convey the idea that an engineer should be an expert mathematician—far from it, for very few have occasion in their profession to use very abstruse mathematics. I am speaking of the general run of engineers, who should be able to deal with the many problems that present themselves and which will yield to the application of comparatively elementary mathematics. As it is, many of them are not solved or only by approximation, for want or inability of handling the mathematical tool. The mathematics here considered is such and only such that can be directly applied to concrete problems, and not abstractions involving mathematical gymnastics. Students as a rule fail to realize the importance of the apparently small or elementary things, the fundamental principles upon which all their other work depends. Some years ago Professor Newcomb, the eminent astronomer and man of affairs, gave a short and pithy address to graduates and undergraduates, in which, among other things, he said: Learn to multiply correctly. The underlying idea here is accuracy. Nothing is so unpardonable as blunders, avoidable errors, through carelessness. In college a misplaced decimal or a wrong figure may not count for much, but in practise it is a very different matter. Every student can undoubtedly do his work accurately, the desideratum is to get the habit of doing it accurately. Do not forget that when you begin actual work your accuracy will be put to test long before you will be asked to design a cantilever bridge.

The consideration of the accuracy in computations leads to another field of accuracy which has not been cultivated as much as it deserves, it is the cultivation of our mother tongue, English. The value of the correct use of English by an engineer may not be apparent to you. However, it is of the greatest importance that an engineer should know the precise meaning of words, so that the descriptions, specifications, reports and contracts drawn up by him may be precise, clear, succinct and void of ambiguity. Talleyrand says that "language was given to man to conceal his thoughts"; this may perhaps apply to statecraft and diplomacy, but to the engineer written language is to incorporate his thoughts and in an unmistakable manner. A proper command of the English language is a valuable asset to an engineer, without considering its humanistic and cultural value, which opens avenues of intellectual enjoyment, adds to the amenities of life, and stands the engineer in good stead in his social relations. The strenuous pursuit of modern science has militated not only against the study of English, but still more has militated against the appreciation of the value to the engineer in his professional capacity of a proper knowledge of the English language. Particular stress has been laid on three things with reference to the Intellectual Datum Plane, and that stress pertains not to the knowledge of the three subjects, but to the appreciation of their value to you in your professional capacity. The importance of the other subjects of your diversified curriculum undoubtedly receives from you proper appreciation and gives your Intellectual Datum Plane its proper position and elevation. To give it stability three points of support are necessary. Let the plane rest on the principles of mathematics, on accuracy, and on command of the English language. There will then be no question of your success in life, and of becoming important factors in the development of Canada. There has recently been issued a series, entitled, the "Makers of Canada," among whom are generals, statesmen and explorers, but not an engineer nor a scientist. When in the future another series is written with the same title, I am confident it will contain names of men who have made two blades of grass grow where one grew before; of men who have led the way in the development of our vast resources, yet but imperfectly known; and of men, who by their creative ability and the application of modern science, have become benefactors to mankind. I look hopefully to you, when graduates of Applied Science, to enter the list of the Makers of Canada.

In taking up the second part of our subject—the Physical Datum Plane—I shall refer to specific work dependent thereon. In the first place, let me define the Physical Datum Plane as used here. It is the surface of water, of a liquid in a state of rest or in equilibrium. This plane is invariably the reference plane for all instrumental work undertaken by the engineer, whether he builds railways, or bridges, or tunnels, or canals, or industrial plants; this surface of equilibrium gives him his starting point. Let us enquire for a moment what this surface means, why it occupies a particular position with reference to the earth and surrounding objects. As the surface is dependent upon a liquid, and the molecules comprising the latter are free to move in response to any applied force, it follows that when the liquid is at rest we have the resultant of all the applied forces. The force to which the position of the surface is due is that of gravitation, and as gravitation is inherent in matter, it follows that the position of the surface assumed by any liquid is dependent upon the distribution of all matter relative to it. So that if we change the distribution of matter, but leaving the liquid in the same place, we will change the position of the surface of that liquid. The most obvious illustration of this we find in the tides, where the change of position of the attracting bodies of the moon and the sun, in opposition to the attraction of the earth, causes a continual deformation of the surface of the ocean.

When the engineer has therefore his instrument adjusted by means of the level tube, about which I shall say a few words presently, the position of the bubble is due to the integrated attraction of every particle of matter composing the earth; strictly speaking, of every particle of matter in the universe. However, in the latter we are only able to trace, and that only to a vanishingly small quantity, the effect of the moon and the sun. In considering the position the level may assume, it is necessary to have some fixed plane of reference. This we obtain by the assumption of a homogeneous earth, a spheroid of revolution whose form is due to the force of gravity and the rotation of the earth. At any point on the surface the plane perpendicular to the normal at that point would be our plane of reference, and a deviation from this plane is called technically "deflection of the plumb line," for the plumb line is simply a vertical to a liquid surface at the same place as the former. To give a concrete case immediately: Supposing you were to measure the elevation of the spire of Notre Dame, and imagine it possible to remove the mountain behind us here, and again measure the height of the spire, you would find a measurable difference. To do so it would undoubtedly require a very delicate and sensitive level. As you well know, a level is not a bent tube, but a glass tube having the upper inside surface ground to the curvature of a circle of large radius; the larger the radius, the more sensitive is the level. The levels we employ for refined work read to about a second of arc for a division, the divisions being about one-tenth of an inch apart. This would mean a radius of about 1,720 feet, so that while the vertical circle of the instrument has a diameter of probably six or eight inches for reading elevations, the refined elevations are read, we may say, by means of a circle of 3,400 feet diameter.

I may draw your attention to another form of instrument beside the level, for measuring deflections of the vertical, an instrument we have at the Ottawa Observatory; it is the horizontal pendulum. By means of the one mentioned we can read a deflection of $+$ ″.004. To give an idea of the minuteness of this quantity, we may express it by saying that it is equivalent to a grade of one inch in 800 miles. It is by means of this instrument that the direct attraction of the moon has been recently measured, and the quantity thus obtained was found to be about two-thirds of that deduced from theoretical considerations, showing that a part of the attraction is involved in the deformation of the earth itself, and this amount necessitates a rigidity equal to that of steel—a conclusion that had already been arrived at, but by different methods. If the earth were absolutely non-rigid and homogeneous, then there would be no movement of the pendulum relative to the surface, for the pendulum and surface would move together, and similarly there would be no tides, for land and water would rise or fall together. It may be noted that in the above observations the pendulum, or rather the two pendulums, as two were mounted at right angles to each other, were placed in a room some 80 feet beneath the surface in order to eliminate the deformation of the surface due to the diurnal effect of the sun's radiation.

The practical effect of the change of position of the Physical Datum Plane as defined, or deflection of the plumb line, I thought could not be better illustrated than by work done not only in our own country, but as affecting its political position, i.e., the position of the part of the boundary line between Canada and the United States, viz., the 49th parallel.

We will begin by quoting two paragraphs from the Romanes Lecture, Frontiers, delivered by Lord Curzon at Oxford on Nov. 2 of last year:

"I wonder, indeed, if my hearers at all appreciate the part that frontiers are playing in the everyday history and policy of the British Empire. Time was when England had no frontier out the ocean. We have now by far the greatest extent of territorial frontier of any dominion in the globe. In North America we have a land frontier of more than 3,000 miles with the United States. In India we have frontiers nearly 6,000 miles long with Persia, Russia, Afghanistan, Tibet, China, Siam and France. In Africa we have frontiers considerably over 12,000 miles in length with France, Germany, Italy, Portugal and the Congo State, not to mention our frontiers with native states and tribes. These frontiers have to be settled, demarcated, and then maintained. We commonly speak of Great Britain as the greatest sea-power, forgetting that she is also the greatest land-power in the universe."

In discussing the various classes of frontiers: (1) The natural frontiers—the sea, deserts, mountains and rivers; and (2) the artificial frontiers, Lord Curzon says of the commoner forms of the latter: "These are three in number: (1) what may be described as the pure astronomical frontier, following a parallel of latitude or a meridian of longitude; (2) a mathematical line connecting two points, the astronomical co-ordinates of which are specified; and (3) a frontier defined by reference to some existing, and, as a rule, artificial feature or condition. Their common characteristic is that they are, as a rule, adopted for purposes of political convenience, that they are indifferent to physical or ethnological features, and that they are applied in new countries where the rights of communities or tribes have not been stereotyped, and where it is possible to deal in a rough and ready manner with unexplored and often uninhabited tracks. They are rarely found in Europe, or even in Asia, where either long settlement or conflict has, as a rule, resulted in boundaries of another type.

"(1) The best known illustration of the astronomical line is the frontier between Canada and the United States, which from the Lake of the Woods follows the 49th parallel of latitude to the Pacific Coast, a distance of 1,800 miles. (1,270 O. K.) This line well illustrates both the strength and the weakness of the system. As a conventional line through unknown territories, it has answered its purpose. But its demarcation on the spot was so laborious and protracted that, fifty years after the conclusion of the treaty which created it, the joint surveyors were still at work, clearing a strip 100 yards wide through the primeval forest, and ornamenting it with iron pillars and cairns, at a cost to both countries which was enormous. Similar lines have been employed to define the boundaries of Canada and Alaska, to separate many of the Australian colonies from each other, to determine European spheres of influence or Protectorates in Africa, and, quite recently, to define the Russian and Japanese shares of the Island of Saghalin. Such lines are very tempting to diplomatists, who in the happy irresponsibility of their office chairs think nothing of intersecting rivers, lakes and mountains, or of severing communities and tribes. But even in the most favorable circumstances they require an arduous triangulation on the spot, and until surveyed, located and marked out, have no local or topographical value."

The above quoted two paragraphs contain very interesting statements, and the second one is particularly pertinent to our subject.

By Article II. of the Convention of Oct. 20, 1818: "It is agreed that a line drawn from the most northwesterly point of the Lake of the Woods, along the forty-ninth parallel of north latitude, or, if the said point shall not be in the forty-ninth parallel of north latitude, then that a line drawn from the said point due north or south, as the case may be, until the said line shall intersect the parallel of north latitude, and from the point of such intersection due west along, and with the said parallel shall be the line of demarcation between the territories of the United States and those of His Britannic Majesty, and that the said line shall form the northern boundary of the said territories of the United States, and the southern boundary of the territories of His Britannic Majesty, from the Lake of the Woods to the Stony Mountains'' (Rocky Mountains). This line is 860 miles long.

In passing, it may be remarked that in the above description is contained the explanation why Minnesota projects into Canada at the north-west angle, because the north-west angle happened to lie north of the 49th parallel; a connection had to be made between a physical feature and a fixed astronomic line.

The remaining part of the international boundary along the 49th parallel is described in Article I. of the treaty concluded at Washington on June 15, 1846, as follows: From the point on the ''forty-ninth parallel of north latitude, where the boundary laid down in existing treaties and conventions between the United States and Great Britain terminates, the line of boundary between the territories of the United States and those of Her Britannic Majesty shall be continued westward, along the said forty-ninth parallel of north latitude, to the middle of the channel which separates the continent from Vancouver's Island, and thence southerly through the middle of the said channel, and of Fuca's Straits, to the Pacific Ocean.'' This line is 410 miles long, making a total in round numbers of 1,270 miles along the 49th parallel.

The part from the Lake of the Woods to the Rocky Mountains was surveyed and marked by monuments by an international commission during the years 1872-3-4, while on the remaining part to the Pacific an international commission determined individual points on the 49th parallel and erected some monuments during 1857 to 1861, but the boundary line was not then wholly surveyed owing to the mountainous character of the country; this, however, has recently been effected by another international commission.

Let us dwell for a moment on the meaning of the word latitude and on the method of determining it. Latitude may be defined as the elevation of the pole, or its height in degrees above the horizon, and the method is to measure with a suitable instrument from the horizon the angle to the pole. Next let us enquire what is the horizon from which we measure; and the answer is, the plane at right angles to the vertical. And finally we ask, what is the direction of the vertical? The answer is, It is the integrated result of the attraction of the individual particles composing the mass of the earth, and hence the position is affected by the relative distribution of them. We may therefore say that the unsymmetrical distribution of the particles, whether on the surface as mountains or valleys, or in the thin crust, is the cause of the ''deflection of the plumb line'' or vertical from its theoretical position, and latitude observations will be affected by just this amount of deflection. In some instances we are quite prepared to find local deflections of the plumb line; for example, when observations are taken on the plains at a point near a more or less isolated upheaval, as the Three Buttes or Sweet Grass Hills in Montana, just south of the international boundary. These hills, as we shall see later, pulled the 49th parallel out of its theoretical position about 800 feet. On the other hand, large deflections show themselves without any visible reason or cause as evolves from numerous observations and their geodetic connection. From such it must be concluded that there exists beneath the surface of the earth matter of abnormal density.

All observations for the determination of positions upon the earth depend upon the direction of the vertical. Latitude and longitude observations, the surveyor's and engineer's operations, all have their zero of reckoning in the centre of the level bubble, and any displacement of the latter, which is equivalent to the displacement of the plumb-line, affects the results, and will show discordances when widely separated observations are geodetically connected.

A word about our definition of latitude—the elevation of the pole. This is on the assumption that the pole or axis of the earth is fixed with reference to the geometrical figure. But this is found now not to be the case. So that for refined latitude observations, which of course are referred to the instantaneous axis of rotation, a reduction to the mean position is necessary. The change in latitude is a small quantity, every place on the earth apparently slides north and south about 25 feet from its mean position in about 16 months.

When a boundary is defined by a parallel of latitude, the question invariably arises, in the demarcation of it, whether the astronomic or mean parallel is to be adopted. The astronomic parallel is that line on the surface of the earth on which direct observations for latitude give the same elevation of the pole; geometrically, for the spheroid or ellipsoid of revolution, it is the angle made by the normal to the surface of the earth with the major axis, or it is the angle made by the tangent cone with the minor axis. Principally owing to the local deflection of the plumb line, points astronomically determined in latitude will not ''close,'' that is, the line projected or determined as a parallel from one station will not meet the next point or astronomic station.

That line with reference to which the sum of the discrepancies north is equal to the sum of those south, is the mean parallel.

However, as the latter can only be determined *after* the location and connection of the astronomic points, entailing revision of the whole work, and besides the difficulty of re-establishing points on the mean parallel in case of loss or disappearance of monuments and marks, it has generally been decided to adhere to the simpler and more readily established astronomic parallel. All such parallels traced upon the earth are irregular curves.

On the line from the Lake of the Woods to the Rocky Mountains, 860 miles, 40 astronomic stations were established and 388 monuments erected.

After due consideration the commissioners for this part of the parallel agreed upon the astronomic parallel. The recommendation for this, by the chief astronomers of the commission, was based on the following grounds: ''1st, that the portion of the parallel of 49 degrees included within the operations of the commission, being only about one-twentieth of the entire circle of latitude, was not sufficient to fix, with any mathematical accuracy, the true position of the mean line of 49 degrees, and that, therefore, if such a parallel were described, depending on the mean of the astronomic stations, no known point of the boundary would be in latitude 49 degrees; 2nd, that as the amplitude of the arcs, included between the mean and the astronomical parallels, would in many cases be very considerable, grave errors and complications might arise in the subsequent re-survey of any lost portion of the boundary; 3rd, that the definition of a mean line would involve a readjustment of the whole boundary after the first careful survey should have been completed, and consequently a very considerable increase of expense, without any practical benefit accruing; 4th, that for every purpose except that of geodetic computation, a parallel of points determined astronomically (instrumental errors aside), is a true parallel of latitude, and therefore fulfils the stipulations of the treaty under which the joint commission was organized.''

Accordingly, astronomic positions were determined at approximate intervals of twenty miles. These stations were connected by tracing upon the ground tangents or the prime vertical circles at each successive point. From these tangents, checked and corrected for errors of azimuth, the calculated offsets to the small circle of latitude were measured at convenient intervals, varying from one to three miles. From the last mentioned offset the relative station error (deflection of plumb line) was found and distributed between the two stations in the ratio of the distances where offsets were taken. From this method it results that the boundary line, as actually traced, is an irregular curve, affected at each astronomical point by instrumental errors and by the local deflection of the plumb line, making the closest probable approximation at every point to a true astronomical parallel.

Of the forty astronomical stations on the 49th parallel, four were observed jointly, seventeen by the United States astronomer, and nineteen by the British. The mean of the probable errors of the British stations was + .″088, and of the United States + .″059. The average of the probable errors is, then, a little over seven feet.

The greatest difference of station errors is 13.″89, or 1,407 feet, being in a distance of 97 7-10 miles, between the Cypress Hills to the north of the boundary, and the Three Buttes or Sweet Grass Hills near, and to the south of the 49th parallel. The station error of the former is + 5.″94, of the latter — 7.″95, that is, the Three Buttes pulled the 49th parallel 805 feet south, and the Cypress Hills 602 feet north of the mean parallel. The greatest discrepancy between adjacent stations, about twenty miles apart, is 7.″28, or 738 feet, near the Three Buttes.

(Continued Next Week.)

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.

Quebec.

MONTREAL.—Tenders will be received at the office of the Board, Room 32, Montreal Street Railway Building, up to 12 o'clock, noon, on the twenty-fourth day of April, 1909, for all works in connection with the erection of the buildings for the Montreal Technical School. Plans and specifications may be seen in Room 31, Street Railway Building. W. J. White, Secretary-Treasurer.

WESTMOUNT.—Tenders will be received up to Thursday, 22nd April, 1909, at noon, for (a) vitrified sewer pipe, (b) farm tile, (c) gravel, (d) sand, (e) paving brick, required by the corporation. Information as to conditions and specifications may be obtained on application at the office of the City Surveyor in the City Hall. A. D. Shibley, City Clerk.

Ontario.

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

BRANTFORD.—Tenders will be received by the undersigned, until noon, April 21st, for improvements at the Police Court Building. Plans and specifications can be had at the office of Geo. W. Hall, architect. H. F. Leonard, City Clerk.

BRANTFORD.—Tenders will be received up till noon on Saturday, April 24th, for the construction of the following works for the Township of Brantford: (1) A reinforced concrete arch bridge, span 65 feet over Whiteman's Creek, at what is known as Burrows' bridge; (2) a concrete pier on pile foundation and 2 concrete abutments for a bridge over Fairchild's Creek, near the residence of Daniel Whiting, Esq.; (3) a concrete arch, span 21 feet over Houlding's Creek, at what is known as the Atkinson Bridge. This work also includes the excavation of a new channel for the creek and the filling in of the old bridge; (4) a concrete arch, span 8 feet, opposite the property of Charles Ireland, Esq., near the schoolhouse in section 21. Plans and specifications may be seen at the office of W. H. Fairchild, C.E., Township Engineer, 54 Market Street, or at the office of James A. Smith, Esq., Township Clerk, Court House, Brantford.

KENORA.—Tenders will be received up to noon of the 20th April, 1909, for 32,000 jackpine and tamarac railway ties, 650 cords of four foot slabs, 113,000 feet of inch lumber, 45,000 feet of inch rough edge lumber, and 2,000 railway ties (in the log), situate in the district of Rainy River and province of Ontario, and piled on the right-of-way of the National Transcontinental Railway, in the millyard near the sawmill of Gardner & Bates, on the shore of Gun Lake, and within about half a mile of the Winnipeg River crossing of the Grand Trunk Pacific Railway, north of Kenora, the logs being in Pistol Lake, near Gun Lake. Tenders may be made for the whole of the above ties, lumber, etc., or for portions thereof. The ties will run about 80 per cent. No. 1, and 20 per cent. No. 2. H. E. Armstrong, Manager of the Traders Bank of Canada.

TORONTO.—Tenders will be received until Monday, April 19th, for the construction of two concrete abutments and a reinforced concrete and paving brick floor for a steel bridge. Address Frank Barber, C.E., Engineer, Township of York. (Advertised in The Canadian Engineer).

TORONTO.—Tenders for underground conduit will be received until April 30th, by the Electrical Department, city of Toronto.

Manitoba.

SHOAL LAKE.—Tenders for all work and materials required for the erection of a brick veneer church on stone basement in Shoal Lake, will be received up to April 26, 1909. Estimated cost, $7,000. Plans may be seen at the office of the undersigned, or at the office of the architect, A. F. Nesbitt, Shoal Lake, or at the office of Builders' Exchange, Winnipeg. Dr. A. J. Fraser.

WINNIPEG.—Tenders wanted for excavating and putting in concrete or stone foundations. Canadian Oil Companies, Elmwood.

WINNIPEG.—Tenders will be received up till noon on Saturday, 17th April, for all of the work required in connection with the erection and completion of a bank building for the Royal Bank of Canada. J. H. G. Russell, Silvester-Willson Building.

Saskatchewan.

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

CONTRACTS AWARDED.

Nova Scotia.

HALIFAX.—The contract for heating the new technical college building was awarded to Longard Brothers.

New Brunswick.

GRAND FALLS.—One of the largest contracts for cement ever placed in the Dominion of Canada, has just been placed by the Frank B. Gilbreth organization with the Vulcan Portland Cement Company, whose works are at Longue Pointe, Quebec. The order covers the entire cement requirements for the Grand Falls work at St. John, N.B., and will amount to nearly 100,000 barrels of cement which will be tested at the company's storage bins, where it will be reserved under seal and shipped in carload lots to the job as required, thus assuring the contractor that the cement will be up to the standard requirements when received.

MONCTON.—At the last meeting of the Water and Light Committee the City Engineer read communications from Drummond McCall Company, John McDougall Caledonian Iron Works Company, and Canada Foundry Company re amended tenders for turbo electric pumps, which were as follows: Drummond McCall Company, $5,334.40; the John McDougall Caledonian Iron Works Company, and Canada Foundry Company, $4,500. The tender of the Canada Foundry Company was accepted in accordance with specifications for the sum of $4,500.

MONCTON.—The tender of Wm. McK. Weldon for coal at $4.60 per ton was accepted by the city. Other tenders were: W. G. Jones, Inverness screened coal, $4.85 per ton; Run of mine, $4.70 per ton. W. McK. Weldon, Springhill screened coal for stove and furnace use, 2,000 pounds per ton, $4.60, delivered as required; picked coal for fire steamers, $4.80 per ton, delivered, Run of mine for steam, $4.06 per ton, f.o.b. cars at Moncton, or $4.35 delivered where required in the city. John LeBlanc, screened coal, delivered at Maccan, $3.55 per ton; Run of mine in car lots at Maccan, $3.30; culum at Maccan in car lots, $1.90; screened coal delivered in small lots at Moncton $4.74; Run of mine delivered in small lots at Moncton, $4.20; delivered in small lots in city, $3.00; tons, 2,000 pounds.

Quebec.

MONTREAL.—Contracts were awarded at the meeting of the Roads Committee in the City Hall on Wednesday for the supply of asphalt, of flagstones for sidewalks, and other material required this season. No decision was reached regarding the supply of paving blocks, as the committee was not satisfied with the way the tenders were made out. As regards asphalt pavement, it was found that the Sicily Asphalt Company and the Barber Paving Company were close together in prices. The Sicily Company, at $2.29 for ordinary Bermudez asphalt, was the lowest, and when streets are to be paved from curb to curb with asphalt that tender will be used. The price for the same asphalt offered by the Barber Company was $2.37. The tender price of the Barber Company for block-stones was $2.02 a square yard, and that of the Sicily Company $2.06. Both companies tendered for asphalt laid on six inches of concrete as well as on nine inches and on twelve inches. It was thought advisable to accept both tenders of these companies. For the supply of scoria blocks, the firm of F. D. Lawrence was granted the contract. Their price for bricks of ordinary size was $45.95 a thousand. This firm, in fact, was the only tenderer. Hyde & Webster asked $45.50 a thousand; W. McNally & Company offered the same bricks for $42.25; and the Sicily Company at $41.70. The matter was left in abeyance. The Laurentian Granite Company wanted $1.79 a square yard for ordinary blocks, which the Sicily Company offered to the city at $1.43. The latter company offered three kinds of blocks at the same figure. The committee were practically agreed that they wanted Laurentian blocks, but in view of the difficulty it was resolved to leave the matter over. For ordinary blue stone flags F. D. Lawrence was the lowest at $1.65. The next was that of Laurin & Leitch, at $1.69. The lowest tender for Danforth stone was La Compagnie de Construction et de Pavage Modernes at $2.15 a square yard. A sidewalk flag with a fine grain surface was also included in the list. It is called "Silex" and costs $3.21. The committee does not bind itself to accept these flags. It asks the authority of council to purchase as needed. Three tenders were accepted for laying curbstones. They were B. Beaucage at 11½ cents a lineal foot; F. D. Laurence at 11½ cents, and L. Giguere at 11¼ cents. For laying flagstones the tender of L. Giguere at 37½ cents a square yard being the lowest, was accepted. For laying flagstone crossings the tender of Leclaire and Payette at 8½ cents a lineal foot being the lowest, was accepted. F. D. Laurence offered to lay scoria blocks on sand at 49 cents a square yard. It was accepted. The supply of asphalt in bulk was accepted from the Elder Albano Company at $29.75 a ton. It was the lowest.

Ontario.

NEW DUBLIN.—The Township have awarded the contract for crushing and delivering 1,000 cords of stone to J. D. Truesdell, Spring Valley, at $2.80 per cord. Other tenders were: Warren & Randell, Landsdowne, $2.85, and Albert Boyd, Algonquin, $2.75. The latter does not include cost of delivery.

TORONTO.—Messrs. Laurie & Lamb, Montreal, Canadian agents for Messrs. Belliss & Morcom, Birmingham, England, have recently received an order from the University for a Belliss Engine for use in the Hydraulic Laboratory of the Faculty of Applied Science. This engine will operate a couple of centrifugal pumps by belt.

WATERLOO.—The following recommendations of the Board of Works have been adopted: That the tender of Allen Shoemaker & Company for tile and cement be accepted; that the tender of Philip Gies for castings be accepted; that gravel be purchased at 80 cents per load and that no contract for its supply be entered into; that the tender of John Scheutz for the construction of cement walks at 9¼ cents per square foot, including crossings, be accepted, he to use cement satisfactory to this committee.

Manitoba.

WINNIPEG.—The tenders of the Eli Sand Company and the Marchand Sand Company were the lowest for the supply of sand for the city, both firms naming $1.05 per cubic yard as the contract price. The engineer recommended that a contract be made with each at from 4,000 to 10,000 cubic yards with the distinct understanding that if the sand is not satisfactory the contract may be terminated at any time. The city engineer's report was adopted.

Saskatchewan.

LANIGAN.—C. McCartney has been awarded the contract to build the town hall. Work will commence in a few days. The tender of the Beamis Lumber Company was accepted for lumber, and extensive sidewalk extensions will be built at once.

British Columbia.

NEW WESTMINSTER.—The contract has been closed for the building at the Royal City dockyards of the largest vessel, except, perhaps, the dredge Ajax, ever built at this port. The vessel will be about 100 feet in length by 21 feet 6 inches moulded beam, and 8-foot hull, and is being built for Messrs. L. & J. Rogers, who will use her in the local and coast line shipping trade. The steamer will cost $25,000. It is expected that the keel of the new boat will be laid within a few days, the order for the material having already been placed by the builders.

VICTORIA.—Arrangements have been made with the B. C. Sand & Gravel Company for a supply of gravel for the city for the current year. The gravel will be taken by the city at the waterside bunkers, and the price to be paid is 95 cents per cubic yard for fine gravel and 80 cents per yard for coarse gravel. Finishing can be had for 80 cents also if it is required.

Foreign.

NEWBURY, ENG.—Messrs. Plenty & Sons, Limited, have placed an order with the D. P. Battery Company, Limited, of Bakewell, for a large renewal battery at Benham Park. This plant is to take the place of a D. P. Battery, which has been in continuous use for over ten years.

SANTIAGO, CHILE.—The contract for the construction of the railroad connecting Arripa, Chile, with Bolivia, has been awarded to the firm of Sir John Jackson & Company, London. This line is to be part of the longitudinal railway. It will be 600 miles long and will cross the Andes mountains at a height of 12,000 feet above the level of the sea. It will cost about $15,000,000.

RAILWAYS—STEAM AND ELECTRIC.

Ontario.

BROCKVILLE.—At a meeting of the Town Council on April 13th a letter was read from Mr. T. M. Kirkwood, of Toronto, asking the council to agree to guarantee the interest on the bonds of a company for twenty years to an amount of $25,000 per mile for an electric railway from Toronto to Montreal, mileage to be for all miles or fractions as running in this county, providing the company agree to carry all passengers to all points on the line at just half the present rates by rail. It was pointed out that the company was not asking for a bonus in money. The council took no action. A few years ago an electric railway between Montreal and Ottawa was proposed but the scheme was dropped.

COBOURG.—The Town Council has granted the request of the Provincial Steel Company to construct a line of railway from its plant to the lake front. The Cobourg, Port Hope and Havelock Electric Railway Companies have also been granted franchises to enter the town.

COBOURG.—The surveyors employed by the Grand Trunk on the proposed new branch of the Midland Railway to Cobourg are now at work between Bewdley, a village at the head of Rice Lake, and this town. The surveying party is expected to soon reach Cobourg.

HAMILTON.—The Street Railway will shortly commence the reconstruction of its James Street tracks.

OTTAWA.—It is stated that as soon as the snow has gone, work will be commenced on the laying of tracks for the new electric railway from Morrisburg to Ottawa, passing through the townhips of Williamsburg and Winchester in Dundas County and the townships of Osgoode and Gloucester and Carleton, the southern terminus, as proposed to be the exhibition grounds here.

ST. MARY'S.—Blanshard and Usborne townships voted on April 12th on by-laws to bonus the St. Mary's & Western Ontario Railway to the extent of $20,000 for each township. In Blanshard the by-law was defeated by eighteen, but in Usborne it carried by a large majority, probably over one hundred. These by-laws were designed to carry this railway, which connects with the C.P.R. at Embro, one step farther on its projected route to Sarnia. It is thought that the by-law in Blanshard may be submitted again to the electors.

Manitoba.

ABERDEEN.—Stockyards, an extension to C.N.R. station, freight shed, and also a 100 feet extension of the platform, and a passing track will be constructed here immediately.

CARLYLE.—The route of the C.N.R. extension, to be built this year, is the all absorbing topic of conversation here. Surveys have been made by the way of Manor as far as Moose Creek.

WINNIPEG.—The C.P.R. will extend the Mowbray branch in southern Manitoba to connect with the Soo line at Adams, N.D., thus giving them another direct line to the Twin Cities. The work will be proceeded with at once.

Saskatchewan.

WINNIPEG.—R. A. Hazelwood, manager for the J. D. McArthur Company, states that the track laying outfits are about to start westward from Superior Junction on district F of the N.T.R., and that from next week on an average of a mile to a mile and a half will be maintained until the outfits meet the track laying gangs which will shortly start from the Winnipeg River eastward.

WINNIPEG.—On September 1st, this year, the Great Northern Railway Company will have a line into Winnipeg connecting with the Hill system at Emerson. This was determined definitely on April 6th, when James Fisher, Hill's legal representative, filed plans and specifications with Premier Roblin as railway commissioner. The plans show an air line from the boundary about sixty-five miles, and work will start at once on a depot on land owned by the Great Northern on Pauline Street between Pacific and Ross; the intention being to have a line in operation by the date mentioned. Hitherto, the Great Northern has been entering the city over the Canadian Northern line. The new route will save several miles.

British Columbia.

VANCOUVER.—Ballasting on the nine miles and a half of railway just constructed by the C.P.R. between Eburne and New Westminster along the northern bank of the North Arm of the Fraser River has been completed, and as soon as the electrification of the road has been accomplished by the British Columbia Electric Railway Company the line will be ready for operation.

VANCOUVER.—General Manager Chamberlain, of the Grand Trunk Pacific, announced on April 5th, before leaving for North Bay, that an air line would be built to Vancouver, involving the abandonment of the proposed north and south branch line now roughly surveyed, from the vicinity of Port George on the main line. It will reach here from the north-east. The northern junction will be at the point of the main line near the Yellow Head Pass.

LIGHT, HEAT. AND POWER.

Quebec.

MONTREAL.—Messrs. Laurie & Lamb, Engineers, of Montreal, have placed with Messrs. Belliss & Morcom, of Birmingham, England, an order for two 150 K.W. Belliss Engines for installation at McGill University, for their power plant. These engines will be direct connected to generators. They are of the two-crank compound type, with a special expansion gear fitted so as to care for overloads and still maintain economy of steam consumption.

Ontario.

BERLIN.—The by-law to raise $50,000 for the electrical machinery necessary to distribute Niagara power to consumers as soon as transmitted by the Hydro-Electric Commission was carried on Monday by a majority of 458. A by-law to raise $8,000 for new gas mains was carried by 470 majority.

BERLIN.—The ratepayers of this town voted this week on two money by-laws, which were defeated at the municipal elections, but carried by large majorities. The by-law to raise $40,000 to purchase the necessary machinery for the distribution of Niagara Power, when it is transmitted to Berlin, carried by a vote of 683 for and 225 against, and the by-law to raise $8,000 for new gas mains had 680 votes for and 210 against.

LONDON.—The Street Railway Company are now considering the advisability of putting in a producer gas plant, and not taking Niagara power. The Colonial Engineering Company has inspected the company's plant, and is prepared to furnish the power at $22 per horse-power.

British Columbia.

FERNIE.—The municipality is contemplating the ownership of the electric light and water plant, which is at present owned by the Crow's Nest Pass Electric Light and Power Company, Limited.

VANCOUVER.—Bonds of the Stave Lake Power Company have been underwritten to the extent of $2,500,000, and the work of completing the station at Stave Lake will be pushed. Power will be delivered in Vancouver and Westminster within eighteen months. This announcement was made recently by William McNeill, secretary of the company, Large Eastern Canadian interests are represented by C. H. Cahan, of Montreal and Halifax.

TELEPHONY.

Manitoba.

ROSEWOOD.—A meeting was held here on April 3rd of the Rosewood Telephone Company, and it has been decided that the line should be completed to Ste. Anne immediately the frost is out of the ground. The manager is G. Claydon.

Saskatchewan.

CONDIE.—Tenders closed on April 15th for the construction of the Condie Rural Telephone System.

CARLYLE.—The Government trunk telephone line is now in operation between all towns from Forget on the west to Antler on the east. Connections can also be made with Souris, Brandon and Winnipeg. It is proving a great convenience to merchants, professional men and the public generally.

MIDALE.—It is hoped that a rural telephone system will be in operation here in the near future. Meetings are being arranged at which the matter will be discussed and arrangements made for beginning work.

MISCELLANEOUS.

Ontario.

HAMILTON.—The city will likely do the work of putting its fire and police alarm system wires under ground instead of making an arrangement with the Bell Telephone Company. The company esimated the cost for the cable at about $1,000 a mile, and it is said it would charge the city $264 a mile a year rental for the conduit. Mr. Barrow, consulting engineer, thinks the city can put the wires under ground for about $1,300 a miles.

British Columbia.

VANCOUVER.—At a recent session of the Board of Works, City Engineer Clement recommended block-paving a number of streets.

VICTORIA.—The semi-annual examination for applicants desiring to qualify as land surveyors opened at the Parliament Buildings last week. There are some forty candidates, from all portions of the Province, taking the tests, either preliminary or final. The board of examiners comprise: W. S. Drury, Nelson; Messrs. Cleveland and Herman, Vancouver; W. S. Gore, Victoria, with the surveyor-general, Mr. E. B. Mackay and S. A. Roberts, the secretary.

Saskatchewan.

PRINCE ALBERT.—The City Council, at a meeting last Thursday, passed estimates for $50,000 to provide for paving all the business streets.

PERSONAL.

MR. FRANK BARBER, County Engineer for York County, has been appointed township engineer for King Township.

CAPT. A. J. MIDFORD, of Toronto, has just returned from Regina, Sask., where he gave expert evidence in connection with important arbitration matters.

MR. W. H. SHILLINGLAW, City Engineer of Brandon, Man., leaves shortly for a six months' visit to Europe, when he will examine carefully into modern methods of dealing with the problems of what the city engineer has to face.

MR. R. W. ANGUS, Professor of Mechanical Engineering, in the University of Toronto, has left for an extended trip to Europe. His object primarily is to inspect the thermo-dynamic and hydraulic laboratories of the universities of Great Britain and the continent, with a view of incorporating their better features in our new laboratories, now nearing completion. As Prof. Angus has already visited those of the leading American and Canadian universities and as no reasonable expense has been spared, it is to be expected that the Toronto ones will rank among the best.

MARKET CONDITIONS.

Toronto, April 14th, 1909.

Some revival in trade in going on outside, and hardware and metal dealers report a good many orders, but mostly small ones. In the city there is unusual building activity; roofing felt, building paper, lime and bricks are all moving freely. One prominent brick maker says he has witnessed no such demand for brick at this time of year since 1891. Lumber is in good request, and there is more demand for pig-iron. As to steel, the latest advices from the States say that there is a curtailment in output of structural, for while the Steel Corporation have put in four blast furnaces since February 1st, the independent companies have blown out ten.

Other metals are showing an improved state of market. Copper, lead, tin and zinc are all more active, tin distinctly higher in price here, while lead is higher in the States, with an advance predicted there for tin and spelter.

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

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

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

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

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

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

Bricks.—Not for a dozen years has there been such a demand in Toronto for bricks as now. The price has advanced. We now quote $9.50 to $10.50 for common. Pressed also selling freely. Red and buff pressed are worth, delivered, $18; at works, $17.

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

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

Copper Ingot.—Firm and active, both abroad and here. Local price contiues at 13½c. to 14c.

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.—Some little requests of late, principally for repairing. Price maintained at $1.80 per 100 lbs.

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

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

Galvanized Sheets.—Apollo Brand.—Sheets 6 or 8 feet long, 30 or 36 inches wide; 10-gauge, $3.05; 12-14-gauge, $3.15; 16, 18, 20, $3.35; 22-24, $3.50; 26, $3.75; 28, $4.20; 29, $4.50; 10¾, $4.50 per 100 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; ¾-inch, $2.63; ¾-inch, $3.16; 1-inch, $4.54; 1¼-inch, $6.19; 1½-inch, $7.43; 2-inch, $9.90; 2½-inch, $15.81; 3-inch, $20.76; 3½-inch, $26.13; 4-inch, $29.70; 4½-inch, $38; 5-inch, $43.50; 6-inch, $56. Galvanized, ¼-inch, $2.86; ⅜-inch, $3.08; ½-inch, $3.48; ¾-inch, $4.31; 1-inch, $6.19; 1¼-inch, $8.44; 1½-inch, $10.13; 2-inch, $13.50. Makers are holding prices stiff, and talk of an advance.

Lead.—Prices steady outside. 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. Small but steady consumptive demand.

Lumber.—We quote dressing pine $32 to $35 per thousand; common stock boards higher at $26 to $30.00; cull stocks, $20; sidings, $17.50. Norway pine is neglected in favor of Southern, which is much stronger in fibre and the price well maintained. Hemlock continues to sell pretty freely, and in car lots brings $16.50 to $17.00. Spruce flooring is worth $22.00 in car lots with stiffer feeling. Shingles firmer, price for British Columbia, $3.20. Lath higher at $4.25 for No. 1 and $3.75 for No. 2 white pine 48-inch; the 32-inch were in market at $1.30, but that is absurdly low, and they are likely to bring much more; spruce laths are no longer seen here. A moderate movement continues.

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

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

Pig Iron.—There is more activity and prices are maintained. Clarence quotes at $20.50 for No. 3; Cleveland, $20.50 to $21.00; in Canadian pig, Hamilton quotes $19.50 to $20.

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

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

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

Sewer Pipe.—

	4-in.	6-in.	9-in.	10-in.	12-in.	24-in.
Straight pipe per foot	$0.20	$0.30	0.6	$0.75	$1.00	$3.25
Single junction, 1 or 2 ft. long.	.90	1.35	2.70	3.40	4.50	14.65
Double junctions	1.50	2.50	5.00	....	8.50	.....
Increasers and reducers	....	1.50	2.50	....	4.00	.....
P. traps	2.00	3.50	7.50	....	15.00	.....
H. H. traps	2.50	4.00	8.00	....	15.00	.....

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

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

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

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

Tank Plate.—3-16, $2.40 100 lbs.

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

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

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

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

* * * *

Winnipeg, April 13th, 1909.

Building permits in Winnipeg are increasing every day, and already for this month have reached large proportions. Dealers in all lines of building material report a greatly improved demand, and the general tone of business as being much better. The structural iron and steel plants and bridge workers are exceptionally busy for this time of year. The Manitoba Bridge and Irons are building a large addition to their plant to take care of the increased demand for large bridge material in the West, and the Dominion Bridge Company are also doubling the capacity of their Winnipeg works.

A brisk demand is also noted for all lines of builders' hardware, nails are brisk, also roofing and felt paper; prices for which are quoted at usual figures. Considerable discussion has been taking place regarding the price of lumber, and rumors are about of its taking a rise, but nothing definite, or no new prices are yet quoted.

Railway supply dealers report business to be only fair as yet, but expect very shortly that things will begin to move more rapidly in their line when the frost gets out of the ground.

Winnipeg quotations are as follows:—

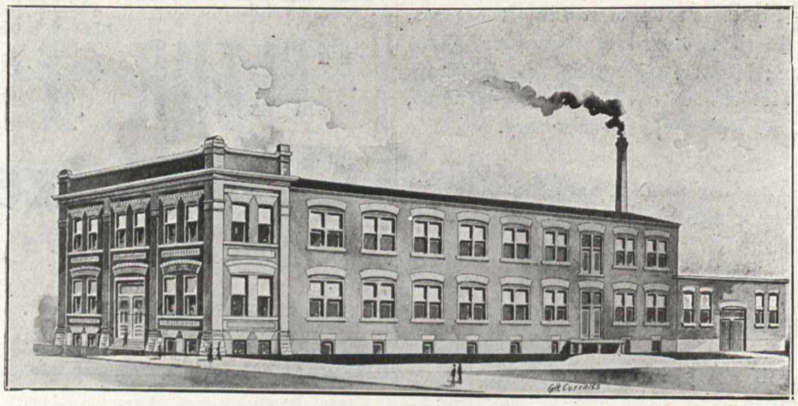
Anvils.—Per pound, 10 to 12½c.; Buckworth anvils, 80 lbs., and up, 10¼c.; anvil and vise combined, each, $5.50.

Bar Iron.—$2.50 to $2.60.

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

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

(Continued on Page 43.)



AMONG THE MANUFACTURERS

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

NEW GENERATORS.

A new advertisement appeared in last issue, that of Messrs. Lawrence Scott & Company, Limited, of Norwich, England, the well-known contractors to the Admiralty and War Office.

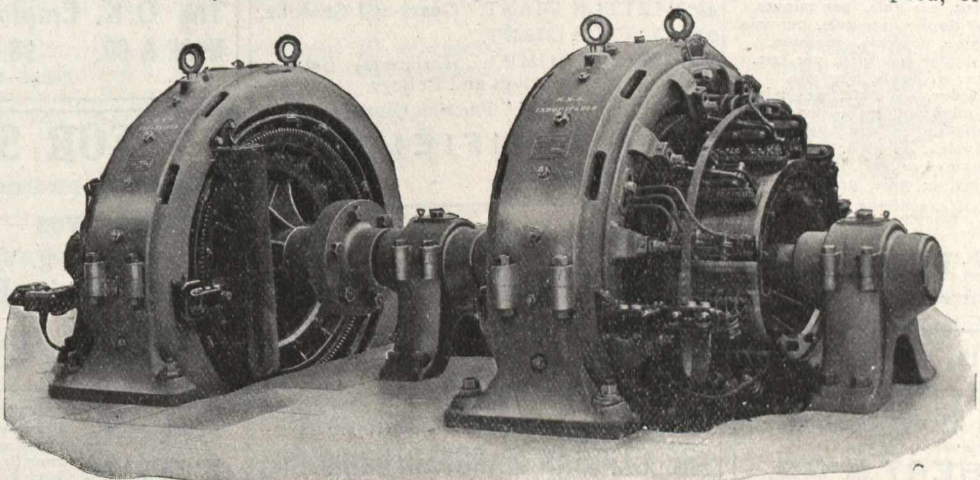
They have lately decided to increase their works to take care of the Canadian trade, as it is anticipated that they will be the recipients of considerable business from this country.

The firm of Messrs. Lawrence Scott & Company, Limited, were the pioneer manufacturers of direct current apparatus in England. This will be readily understood when it is stated that they manufactured machines with slotted armatures as early as 1883. After this the octagonal four-pole enclosed motor became prominent, but this was in 1900 replaced by the circular design which is now familiar with engineers and users of direct-current motors. About this time laminated pole-pieces were added so that they have been for many years exponents of the latest practice and their experiments have resulted in standardizing their apparatus with so much success that it has achieved world wide renown. In the early part of this decade the use of electric motors was very largely extended as consumers of power were quick to realize the great advantages to be derived by the grouping and individual driving of machines by electric motors and as a natural consequence prices for motors were reduced considerably. This became more evident when business reached the inevitable reaction and competition among the larger manufacturers became very keen. The reduction in price was also partly due to the cheapened methods of production that are possible owing to the larger demand, but it is also due to the very large number of new makers that have come into the field, to whom the necessity for securing orders is paramount. Many of the old established makers, in order to meet this drop in prices, have reduced cost by reducing finish, and, it is to be feared, taking risks as regards the margin that their customers allow for actual working conditions, and Messrs. Lawrence, Scott & Company had to carefully consider the question whether they should not bring out a cheaper line of motors, with less finish and less margin on their specifications; to enable them to meet the present demand for a cheap motor; but after most careful consideration they have decided that it will be more to their interests in the long run to take a smaller profit during these times of over-production and maintain their admittedly high standard, both as regards finish and performance in actual work.

They have resisted the temptation to cheapen the recent designs, at the expense of finish, and the various advantages that it offers, such as the splitting of the pulley end brackets, the inspection plate for getting at the armature, the machining of the commutator end bracket, and specially easily accessible and easily inspected ring oiling bearings.

Their methods of insulation are of the highest possible standard. The large amount of Admiralty work that they do makes this imperative, because for Admiralty work, although the voltage is low, the conditions are obviously very severe, and only the very highest possible standard is allowed, and this they make their standard, as they have only one system of insulation in their winding shop. They have micanite in every case between "live" conductors and "earth" and each of their formed armature coils is impregnated and waterproofed by a special system of their own that has proved an unqualified success. They made a large number of experiments on this subject about three years ago, and have adopted the present system, which is now being brought out in America as an entirely new thing.

The chief development in continuous-current motors has been in the direction of variable-speed, or, as they prefer to call them, adjustable-speed motors, and the re-introduction of commutating poles has assisted this development considerably.



Generators for H.M.S. "Inflexible" and "Indomitable." Capacity 2,000 amperes, 105 volts.

It is evident from the above that the price of their motors cannot be cut down to the lowest of their competitors, but for actual value, when the liability and risk is taken into consideration, even without allowing for the admittedly superior finish of their machines, they do claim that they give the best value in the trade.

That those who know Messrs. Lawrence, Scott & Company, Limited, appreciate this is proved by the fact that during the depression and over-production of the last few years they have not only kept their shops full, but have had to extend them. They have largely increased their testing and they have just built a large additional shop specially for testing, with a high lifting tower in it for testing the electric lifting appliances that they are specialising.

FEED PUMP.

The cut herewith shows a pump which is accomplishing rather unusual service inasmuch as it is used to withdraw the water from the hot well if a surface condenser against a vacuum of 28-inch on the suction side. This vacuum of 28 inches would be equivalent to about a 32-foot lift, which would not be advisable for a pump of this small size if operating under this suction lift.

That the pump operates successfully is due to the fact that it is placed lower than the hot well of the surface condenser, and for this reason water flows by gravity to the

(Continued on Page 44.)

NEW INCORPORATIONS.

Strathcona, Alta.—A. B. Gaalin Co.
Okotoks, Alta. — Knowles Planing

Alix, Alta.—Alix Agricultural Hall Co.
Fraserville, Que.—Fraserville Navigation Company, $50,000; L. Fortin, J. Hamel, G. G. Grundy.

Calgary, Alta.—Calgary Amusement Company.

TENDERS CALLED FOR

TENDERS FOR BRIDGE

Tenders will be received by the undersigned up till noon on Saturday, April 24th, for the construction of a steel bridge of 82½ feet span over the River Speed, in the Township of Puslinch, and also for the construction of concrete abutments for the same bridge.

Plans and specifications may been seen at my office or at the residence of any member of the Township Council.

JAMES HUTCHEON,
Engineer, Guelph.

April 5th, 1909.

TENDERS FOR BRIDGE ABUTMENTS

Tenders will be received at the office of the undersigned up to twelve o'clock noon of Monday, April 19th, 1909, for the construction of Two Concrete Abutments and a Reinforced Concrete and Paving Brick Floor for a Steel Bridge over the Black Creek on the Weston Road on Con. 4, Township of York.

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

The lowest or any tender not necessarily accepted.

FRANK BARBER, C.E.,
Township Engineer.

Toronto, April 10, 1909.

TOWN OF ESTEVAN

PROVINCE OF SASKATCHEWAN.

Tenders Wanted

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

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

No Tender necessarily accepted.

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

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

(Continued from Page 539.)

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, $11.35; 1½-inch, $13.60; 2-inch, $18.10. Lead, 6½c. per lb.

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

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

Plaster.—Per barrel, $3.

Roofing Paper.—60 to 67½c. per roll.

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

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

Tool Steel.—8½ to 15c. per pound.

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

Boards.—Common pine, 8-inch to 12-inch wide, $38 to $45; siding, No. 2 white pine, 6-inch, $55; cull red or white pine or spruce, 6-inch, $24.50; No. 1 clear cedar, 6-inch, 8 to 16 ft., $60; Nos. 1 and 2 British Columbia spruce, 6-inch, $55; No. 3, $45.

* * * *

Montreal, April 14th, 1909.

The pig-iron markets of the United States are very quiet. In the southern market, prices are sagging off just a little, and $10.50 is now being named for round lots, on board cars, Birmingham. To meet this, Buffalo and Lake furnaces are now shipping via Erie Canal to New England and eastern points. The result is that Pennsylvania and New Jersey furnaces are being compelled to accept low rates or to store their iron. The general market is quiet and somewhat unsettled, with the report in circulation that several Valley furnaces will have to blow out unless market

TENDERS WANTED

CITY OF SASKATOON

Sealed Tenders addressed to the undersigned will be received until 5 o'clock p.m., Wednesday, April the 28th, 1909, for the following:—

(a) One Brick, Steel or Concrete Smokestack with a height of 100 feet and inside diameter of 66 inches, together with corresponding smoke connection to boilers.

(b) Bricking in two 250 horse-power Robb Mumford water tube boilers.

Plans and specifications may be seen at the office of the Electrical Superintendent.

A marked cheque for $100 must accompany tender.

The lowest or any tender not necessarily accepted.

E. L. WHITE,
Electrical Superintendent.

J. H. TRUSDALE,
City Clerk.

CONDUIT

TENDERS FOR UNDERGROUND CONDUIT will be received up till April 30th by the City of Toronto, Canada. For specifications and form of tender apply—

ELECTRICAL DEPARTMENT,
City Hall.

PATENT NOTICE

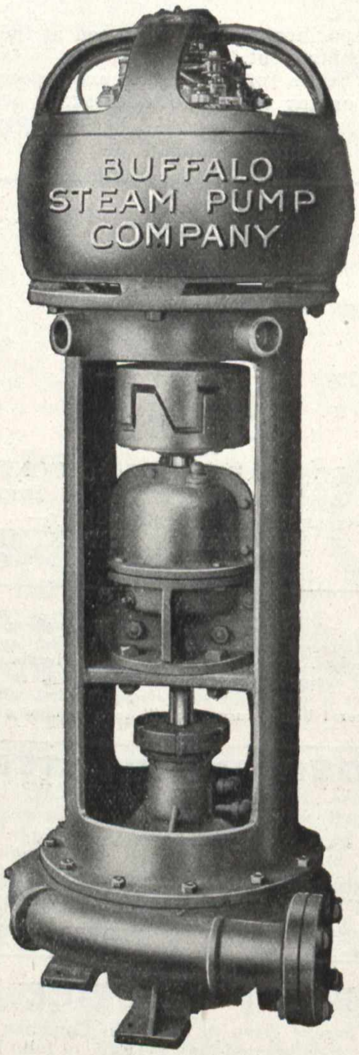
Notice is hereby given in regard to Canadian patent No. 98961, Flour Bolter, granted May 15, 1906, to John F. Harrison, that Allis-Chalmers-Bullock, Ltd., Montreal, owners of rights under said patent, is prepared to supply devices covered by this patent.

(Continued from Page 541.)

pump notwithstanding that there is a vacuum on the suction.

The pump is a 3-inch Class "A" Centrifugal type, manufactured by the Buffalo Steam Pump Company and driven by a 10 horse-power vertical shaft, 600 volt Crocker Wheeler motor operating at a speed of 1,260 R.P.M. The pump has a normal capacity of 215 gallons per minute, against a total head of 78 feet, which, please note, includes a discharge lift against which the pump handles the water.

Upon the lower flange end of the main frame is bolted the pump casing, in which runs a brass impeller machined all over. The brass impeller withstands the extra strains imposed by the hot water. At the top of the main frame is mounted the motor which drives the vertical pump shaft through a flexible coupling. About midway of the main



frame the removable thrust bearing housing is suspended from a heavy rib cast integral with the main frame.

This pump is fitted with ball-bearing type of thrust and a five-jaw flexible coupling, but can be furnished with any type of ball, roller or disk thrust bearing and the flange style coupling with rubber in cased driving pins if desired. It is readily seen that the thrust bearing suspends the weight of impeller shaft and one half of flexible coupling. The stuffing box on the pump shaft bearing is sealed against the vacuum, which the pump is working against by water pressure through the small pipe shown, the other small p'pe providing grease for the bearing.

It is an exceeding simple design affording access to every part without seriously disturbing the other parts. Owing to the careful design and machining of the runner there is very little loss by shippage and the combined efficiency is very high.

B. S. P. A.

The name of the Manitoba Iron Works has been changed to the Manitoba Bridge and Iron Works.

conditions improve. So that it seems to have come to the point where, unless the actual cost of production is considerably reduced, thereby permitting the acceptance of lower prices, with profit to makers, furnaces will bank or blow out in preference to going ahead with production and storing up supplies at present prices. A most significant feature of the situation is that the volume of business transacted by the United States Steel Corporation during March was the largest on record, these remarks applying particularly to structural steel material. This is interpreted as indicating a feeling among consumers that prices are extremely low and that purchases made at present prices will be justified by developments of the near future. Should this opinion become at all general, the trade would doubtless witness an extraordinarily active demand immediately, as stocks in the hands of consumers throughout the entire country are exceedingly light.

Hardware merchants are reporting great activity, some of them, apparently, having all they can do to attend to the shipping of their orders. This, of course, is the active time of year, owing to the opening of navigation, but merchants are unanimous, apparently, in the opinion that trade is very encouraging and away ahead of that of a year ago. A few price changes have taken place, thus indicating an awakening of interest, once more. Following is the list of prices:—

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

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

Boiler Tubes.—The market is steady, quotations being as follows:—2-inch tubes, 8½c.; 2½-inch, 10c.; 3-inch, 11½c.; 3½-inch, 14¾c.; 4-inch, 19c.

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

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

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

Copper.—The market is about steady at 14½ to 15c. per lb. Demand continues limited.

Explosives and Accessories.—Dynamite, 50-lb. cases, 40 per cent. proof, 18c. in single case lots, Montreal. Blasting powder, 25-lb. kegs, $2.25 per keg. Special quotations on large lots of dynamite and powder. Detonator caps, case lots, containing 10,000, 75c. per 100; broken lots, $1. Electric blasting apparatus:—Batteries, 1 to 10 holes, $15; 1 to 20 holes, $25; 1 to 30 holes, $35; 1 to 40 holes, $50. Wire, leading, 1c. per foot; connecting, 50c. per lb. Fuses, platinum, single strentgh, per 100 fuses:—4-ft. wires, $3.50; 6-ft. wires, $4; 8-ft. wires, $4.50; 10-ft. wires, $5. Double strength fuses, $1 extra, per 100 fuses. Fuses, time, double-tape, $6 per 1,000 feet.

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

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

Iron.—The outlook is steady. The following prices are for carload quantities and over, on cars, Montreal, delivery from dock being 35c. less; 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.—Trail lead is firmer, at $3.75 to $3.85 per 100 pounds, ex-store.

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

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

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

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

Pipe.—Wrought and Galvanized.—The market is steady, moderate-sized lots being: 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. The discount on the following is 69 per cent. off for black and 50 per cent. off for galvanized; ½-inch, $8.50; ¾-inch, $11.50; 1-inch, $16.50; 1¼-inch, $22.50; 1½-nch, $27; 2-inch, $36; 2½-inch, $57.50; 3-inch, $75.50; 3½-inch, $95; 4-inch, $108.

Rails.—Quotations on steel rails are necessarily only approximate and depend upon specification, quantity and delivery required. A range of $31.50 to $32.50 is given for 60-lb., 70-lb., 80-lb., 85-lb., 90-lb., and 100-lb. rails, per gross ton of 2,240 lbs., f.o.b. mill. Re-laying rails are quoted at $27 to $29 per ton, according to condition of rail and location.

Railway Ties.—See lumber, etc.

Roofing.—Ready roofing, two-ply, 64c. per roll; three-ply, 86c. per roll of 100 square feet. (See Building Paper; also Tar and Pitch).

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

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

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

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

Telegraph Poles.—See lumber, etc.

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

Tin.—Prices are 32c. to 32½c.

Zinc.—The market is steady at 5¾c.

THE CANADIAN CASUALTY AND BOILER INSURANCE COMPANY TORONTO

Owned by the

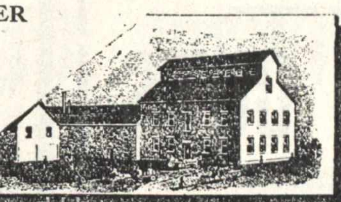
GENERAL ACCIDENT FIRE AND LIFE ASSURANCE CORPORATION Limited, of Perth, Scotland

The following letter from one of our assured refers to a "blow out" from one of their boilers in their Glove Factory at Acton, Ontario, which caused very considerable damage to stock and building in every room of their factory which consists of three floors.

The Company were notified of the loss on Thursday, 4th of March, 1909.

Loss investigated and adjusted by the Company's experts on Friday, 5th March, 1909.

Cheque in payment of loss in assured's hands on Monday, 8th March 1909.



SOLE PROPRIETORS STOREY'S EUREKA GLOVE SPRING PAT. 1879 1880. SOLE MANUFACTURERS IN CANADA OF THE CELEBRATED PAT. NAPA BUCK GLOVE.

W. H. STOREY & SON, LIMITED

MANUFACTURERS OF GLOVES, MITTS, MOCCASINS OF EVERY DESCRIPTION OF STYLE AND MATERIAL.

TELEPHONE COMMUNICATION. ACTON, ONT. March 8th, 1909

Messrs. Canadian Casualty & Boiler Insurance Co.,

Toronto, Ont.

Dear Sirs,--

We are in receipt of your cheque for $1,207.40, covering damages wrought to stock and building through our recent trouble wrought by the blow-off pipe attached to our boiler.

We are more than surprised at the prompt manner in which you have settled for this claim and we are desirous of renewing policy as soon as same expires, as we feel that by insuring with your Company we will have no trouble in collecting for any damages that might arise through the disablement of our boiler.

We wish to express to you our thanks for taking this matter up and remitting for same this day. We might add that we notified you on March 4th and we find that your cheque is dated March 8th, which is the most prompt settlement of any insurance that we have ever heard of.

Yours very truly,

W. H. STOREY & SON, LIMITED

ACN/KJS

Per

[signature]

PROMPT SETTLEMENT IS OUR HOBBY

WHERE TO BUY

An Engineering Trades Directory.

FOR INDEX TO ADVERTISERS SEE PAGE 3.

Air Compressors
Mussens Limited, Montreal, Que.
Reavell & Co., Ltd., Ipswich, Eng.

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

Automatic Railways
Babcock & Wilcox, Ltd., Montreal,

Bars, Steel.
Priddle, Arthur San Francisco, Cal.

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

Belting
McLaren, D. K., Ltd., Montreal, Que.
McLaren Belting Co., J. C., Montreal,

Boilers, Marine, Stationary and Water Tube
Babcock & Wilcox, Ltd., Montreal,
Petrie, H. W., Ltd., Toronto, Montreal, Vancouver.

Bonding for Concrete.
Canada Wire Goods Mfg. Company, Hamilton, Ont.
Priddle, Arthur San Francisco, Cal.

Books, Technical
John A. Hart & Co.,

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

Bridges, Roof Trusses, etc.
Canadian Bridge Co., Ltd., Walkerville, Ont.
Cleveland Bridge & Engineering Co., Ltd., Darlington, England.
Dominion Bridge Co., Ltd., Montreal,
Hamilton Bridge Works Co., Ltd., Hamilton.
Pennsylvania Steel Co., Steelton, Pa.
Stewart, Jas. A., Hamilton, Ont.
Structural Steel Co., Ltd., Montreal Que.

Buckets (Clam Shell, Coal and Concrete)
Mussens Limited, Montreal, Que.

Cableways
Mussens Limited, Montreal, Que.

Car Hauls (Wire Cable and Chain).
Jeffrey Mfg. Co., Montreal, Que.

Cement, Machinery
Mussens Limited, Montreal, Que.

Coal Cutters.
Jeffrey Mfg. Co., Montreal, Que.

Coal Crushers
Babcock & Wilcox, Ltd., Montreal,

Coal Handling Machinery
Northern Engineering Works, Detroit, Mich.

CoalTipples and Screenes.
Jeffrey Mfg. Co., Montreal, Que.

Contractors
Cleveland Bridge & Engineering Co., Ltd., Darlington, England.

Concrete Mixers
Mussens Ltd., Montreal, Que.
Rogers Supply Co., Toronto.

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

Conveyors
Babcock & Wilcox. Ltd., Montreal.
Jeffrey Mfg. Co., Montreal, Que.

(Continued on page 50.)

NEW INCORPORATIONS.

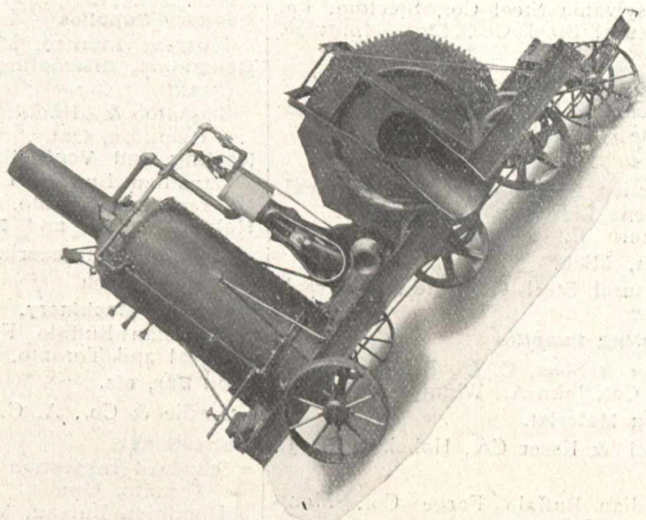
(Continued from Page 7)

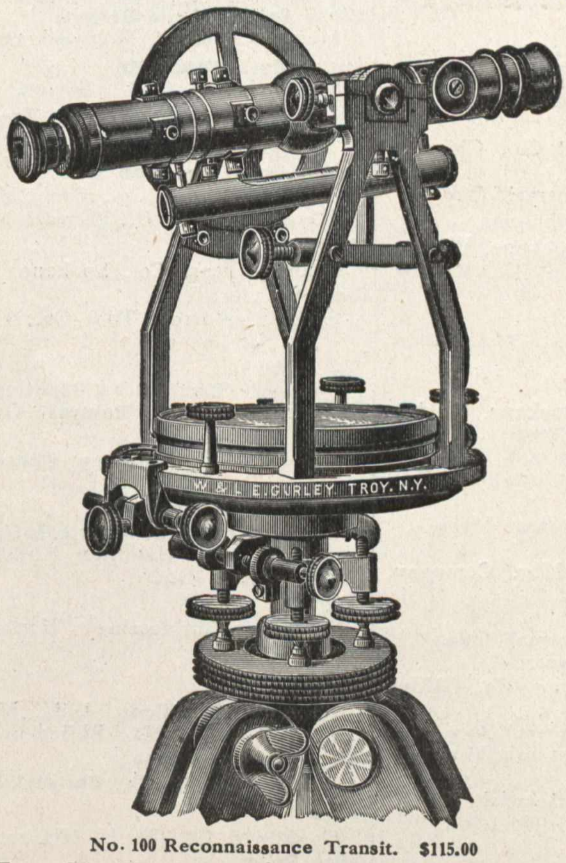
British Columbia.—Aetna Investment & Trust Company, $100,000. British Columbia Lumber, Logging and Forestry Association. Fossil Oil Company, $1,500,000. North British Columbia Navigation Company, $35,000. Okanagan Lake Boat Company, $25,000. Rupert City Realty & Information Bureau, $25,000. Sandon Mines, $25,000. Vancouver Investment Corporation, $10,000. Western Pacific Development Company, $500,000.

EXPLOITING A PROFESSIONAL REPUTATION.

To the ethical sense of the conservative professional man there is something disquieting in the thought of deliberately exploiting a reputation. Yet only upon his reputation can he depend for increasing his opportunities. He says perchance "let my work speak for itself," he dislikes to feel that any one is deliberately paid to speak for it. Yet through many subtle and untraceable channels he is securing publicity which redounds to his credit and his financial betterment. It comes only because he is worthy of it. Fully realizing the result though, perhaps with no deliberation of purpose he increases his reputation through public utterance and professional papers, and through the acceptance of official appointments he places himself in the public eye and the papers help to do the rest.

But there are perfectly proper and legitimate channels through which even this wide spread reputation may be further widened, channels which the engineer and the chemist, those who as individuals or concerned with industries in many fields are already utilizing.—Walter B. Snow, Publicity Engineer, Boston, Mass., in the Selling Magazine.




W. & L. E. GURLEY. TROY, N.Y.

WHERE TO BUY.

(Continued from Page 48).