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MISSING

The Canadian Engineer

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The Canadian Engineer

ESTABLISHED 1893

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

Montreal Office: B 32 Board of Trade Building. T. C. Allum, Business and Editorial Representative. Phone M 2797.

Winnipeg Office: 330 Smith Street. Amalgamated Press of Canada, Limited Phone 5758.

Vancouver Office: Representative: A. Oswald Barratt. 619 Hastings Street.

British Representative: A. Webster, 184 Chancery Lane, London, E.C.

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TORONTO, CANADA, OCTOBER 4th, 1907.

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THE QUEBEC BRIDGE.

Thus far the Commission that is investigating the Quebec bridge disaster, has not been able to arrive at any conclusion as to what the actual cause of the collapse was, while the verdict of the Coroner's Jury is, "We have not been able to adduce the cause of the collapse of the bridge, but believe it our duty to declare that, according to proof adduced at the inquest, all necessary precautions were taken to ensure the safety of the structure."

The evidence given up to the time of writing is to the effect that the design, shop work, and erection work on the site were given the best possible care, and nothing was left undone that would make the structure a worthy monument to the skill of the engineers. In the words of Mr. Holgate, Chairman of the Commission:—"As far as we have been able to learn, there had been the greatest care taken all along the line to ensure the safety and permanency of the Quebec bridge structure. The best engineers on the continent prepared the plans and specifications, and a wonderful care and accuracy in carrying them out was shown. We found absolutely no trace of dishonesty or graft in connection with the construction of the bridge. This seems to be the case of the best engineering brains on the continent and the very best accepted engineering methods being on trial."

At the time of the collapse it was said that the bridge went down without any warning. It has been shown, however, that the bridge showed signs of weakness, which were apparently neglected by the engineers in charge. Even the workmen gave more attention to these than did the men who were responsible for the safety of the structure. Many of the workmen have stated that the bridge showed signs of distress three weeks before the collapse. Of course, with the structure a tangled mass of steel at the bottom of the river, there is no evidence of this further than what has been stated by the men. If from the design this can be shown to be the case then those who had charge of the erection should be severely censured for the loss of life incurred, if not for the collapse itself.

The opinion of eminent engineers is that the bridge would have carried its load when completed, and that in this respect the design was all right, but the stresses on the finished structure, and those during erection are totally different, and it is these latter that were not properly provided for. At the time of the disaster the portion of the bridge hanging over the river (nearly 750 feet), practically constituted a long heavy lever. The finished bridge would have presented an arch, and on the lever and the arch the strains would be of an entirely different character. It is quite possible, too, that the bridge had a slight lateral motion, as there was a strong wind blowing at the time of the accident. The weight of the overhanging span, being thrown on one side, made an additional weight, straining the members beyond their factor of safety on the side to which the weight was thrown. In this case the bridge would appear to collapse vertically, but such would not actually have been the case. The side receiving the weight would have gone down almost straight, while the other side would have fallen inwards somewhat.

LUSITANIA'S ATLANTIC VOYAGE.

On her maiden trip the new Cunarder "Lusitania" did not make the speed generally expected, although from the standpoint of marine engineers she has carried out her part well. Many fully expected that the "Lusitania" would break all ocean records on her first voyage. This she failed to do since her average speed was only 23.01 knots per hour, while the average speed of the "Kaiser Wilhelm II." of the North German Lloyd on her record trip was 23.58 knots per hour.

In view of this fact the "Lusitania" has been subject to many scathing remarks which were not at all justified. The steamer made a record maiden voyage, which is all that could reasonably be expected of her, especially in view of the fact that her machinery was of an entirely new type, and required more than the ordinary carefulness and attention that is given to engines of the reciprocating type, with the operations of which marine engineers are fully conversant.

As every engineer well knows, it would have been very unwise, if not dangerous to run these new engines at their top speed on the first trip, and the fact that about one-quarter of the quantity of coal estimated as necessary, was not used was evidence that they did not do this. There can be no doubt, whatever, after what she has already done, that the "Lusitania" will do what has been expected of her. As we write report comes to hand that on the return trip between Sandy Hook and Queenstown, a distance of 3,080 miles, the average speed was 22.75 knots over the whole distance. The time for the total trip being 5 days 3 hours and 23 minutes, while the previous record for the same trip was 5 days 7 hours and 23 minutes.

The captain says he is of opinion that the "Lusitania" will do even more than has been expected of her, as soon as the right time comes to speed up.

EDITORIAL NOTES.

Mr. Francis Dagger, the telephone expert for the Saskatchewan Government, has been making inquiries in the province regarding the present telephone service, and he finds that the people are strongly in favor of Government-owned telephones. In many of the towns and districts of the province there are at present no telephone connections whatever, and in many places where telephones are installed, the charges are considered exorbitant. The population of this Western province is growing very rapidly, and the time is opportune for the establishment of an independent telephone service. Many of the places at present without telephone communication are very small, and what is required is a service that will give inter-communication between these small villages and towns. One letter received in answer to an inquiry of Mr. Dagger's regarding the telephone situation in one of the Western towns is very interesting, and reads as follows:—"The Saskatchewan Telephone Company provide the service (?) in our municipality. There is only one 'phone, so that we get no rates in a business or residential system. We pay 30c. for a service to Moosejaw, seventeen miles, and 25c. for a service to Mortlach, eight miles. The farmers in our neighborhood have no telephone service. The feeling among our community regarding the efficiency (?) of the present telephone service and the rates charged is in no wise complimentary to the company." After reading over the many replies received in answer to the inquiry sent out, one is inclined to believe that no other question, except, perhaps, the extension of railway facilities, would have brought out such an unanimity of opinion, and replies received certainly go to show that the Government has been very wise in taking up this all-important question.

The fact that the United States Steel Corporation has decided to erect a plant in Canada goes to show that it is alive to the enormous expansion of railways that will take place in this country within the next few years. It is safe to say that before a great while the vast iron ore resources of Canada will be taken full advantage of, and before long all the steel required for home use will be made in the Dominion. Railway development of the past year has been very great, but as yet this development has only just begun. There are still many districts covering a wide area that the railroad is unknown to. Sooner or later these areas will be one network of railway lines, and it is pleasing to Canadians to know that the enormous quantities of steel that will be used in construction will be "made in Canada," and that Canadian raw material will be used.

* * * *

According to a contemporary the Bethlehem Steel Company offers to furnish rails for a moderate advance on the twenty-eight dollar price, with .04 phosphorus, and a twenty per cent. discard from the ingot. From this it may be taken that the quality of steel rails is about to be improved. Rails similar to those offered would cost about twenty-five per cent. more than the ordinary rails, and as well as being reasonably safe, they would have a life more than double that of the rails at present in use. From this it will be seen that an improvement in the quality of rails purchased may be looked for. Apparently the attitude of the rail manufacturers has undergone somewhat of a change since they appear to be willing to manufacture a product that will come up to the specifications issued by the railroad company with very little extra cost. Indeed several of the manufacturers have discontinued operations until such time as standard specifications can be agreed upon by the makers and the railroad companies. Both the railroads and the rail makers have evidently come to the conclusion that they must reckon with the general public if they are to continue the carrying on of their business on a successful basis.

* * * *

Now that our schools and colleges have again opened, a word to the student who intends entering the engineering profession may not be out of place. According to Prof. V. Karapetoff, there are three essential requisites for a young and successful engineer. First, he should have a sound professional knowledge; second, a knowledge of business forms and of human relations; and last but not by any means least, a good and strong character. The young man in training should make it his business not only to know how to do things, but to know why they are done. If he does not cover his ground in this thorough manner, it is not likely that he will ever get to be anything more than a subordinate. The business side of an engineer's training should not be neglected. There are many engineers to-day, men who are exceptionally proficient as engineers, but who cannot write a creditable business letter, let alone make out a specification. Of course, the engineer is not expected to have the same knowledge of business forms that a man would have that had devoted himself to this particular line. At the same time he should know enough about them to enable him to handle the commercial side of any work that he might have in hand, almost as successfully as he would handle it from the engineering side. A good strong character is not the least important part of an embryo engineer's equipment. Unless an engineer has courage to carry out his work, and the perseverance to achieve results, his engineering training would be practically useless. He should make a study of being polite, and making his personality pleasing to those with whom he comes in contact. He will do well to bear in mind that all that is to be learned in the engineering profession, no matter what the subject may be, is not taught in schools and colleges. After a few years spent in the school of experience, he will find that there is much yet to be learned that he has not even dreamed of.

Certain British journals are solemnly warning their readers of the Cobalt "wildcat" proposition. Investors must be thoroughly sick of hearing of the Cobalt faker. If Cobalt from the first had been considered a mining district and nothing more, all would have been well. Certain interested people gave it a moral halo, with the result that people who knew not the difference between a stock certificate and an income tax account plunged wildly into the net of the first enterprising gentleman with unlimited cheek and an encyclopædic vocabulary. Investors have been told to discriminate when dealing with Cobalt. They ought to know that. The impudent will always prosper on the shekels of the ignorant. When Barnum was about to turn away thousands from his show one day he quickly fixed up a side show and admitted the overflow at the usual price. "This way to "the lioness" was the first sign, "This way to the "tigress" was the second, "This way to the egress" was the third. When people found themselves in the street they were surprised. Cobalt investors should keep clear of the side booth.

* * * *

In our issue of August 23rd we wrote editorially regarding the treatment of municipal engineers by councillors and others in municipal control. In another column, under the heading, "Municipal Engineers," we publish a letter on this subject from Mr. J. Grant MacGregor, from which it is evident that Mr. MacGregor is entirely in accord with what we said in the editorial above referred to. As the writer says: "Could anything be more humiliating to a member of the engineering profession than to have a board of men selected from the ranks of the trades and industrial classes preside over his deliberations in formulating plans which call for the display of the utmost scientific skill and ingenuity on his part?" The doctor's prescription goes unquestioned; the lawyer's seal is final. But the engineer's findings hardly, if ever, go unassailed "with friendly suggestions as to the cheapest and most practical way of performing the work." We do not advocate that an engineer's report on any subject should be taken as final, but when a man, who has spent the greater part of a lifetime in preparing himself and gaining experience in order that he may perform certain duties, is questioned, or given suggestions by men who know little, or nothing, regarding the subject, it is certainly ridiculous. Of course, the representatives of the people are responsible for work that is done, but no representative of the people is elected because he is a specialist in any one line. He should be elected on account of his ability to appoint experts for special works, and to decide on matters of general policy. No engineer will go ahead with a work of any magnitude before consulting his brothers in the profession, and these are the men who should say what is to be done. If they are not capable of doing this, certainly men unacquainted with engineering subjects are not able to do so.

BOOK REVIEWS.

Shaft Sinking Under Difficult Conditions.—By J. Riemer, publishers; John Wylie, New York. Size, 9 x 6, pp. 174. Price, $3.

This work consists chiefly of a revision and amplification of previous publications dealing with shaft sinking. It has been published in order that a wider circle of mining engineers will be interested as well as students of this branch of engineers. The authors have omitted in other works incorporated any matter that has become obsolete, and have used in place detail descriptions of more modern methods now requiring discussion. As the title would indicate, the only methods explained at length deal with shaft sinking under difficult conditions. The first methods described deal exclusively with modern methods of hand labor. The book gives a brief review of methods actually in use, and contains enough illustrations to explain all details of these methods. A particular feature of the work is a full description of details of each piece of work, giving the reader ample opportunity to form his own judgment. It contains eighteen engravings and nineteen plates. Among other topics dealt with in this book are the following:—Shaft sinking by hand, shaft sinking by the boring system, the freezing process, and drop-shafts.

* * * *

Grinding and Tapping.—By J. V. Woodworth. Published by Hill Publishing Co., New York and London. Price, $2.

This valuable work contains many engravings and half-tones of tools, machines, grinding fixtures, laps and lapping devices and arrangements, as well as combination fixtures for presenting duplicate work to grinding operations from the simplest to the most intricate in modern use. The use of these is not only described, but the design and construction is carefully explained. The work is explained in such a practical manner, that all grades of metal-working mechanics may be able to understand how to design, construct and use them for the economic production of the variety of machine parts and tools required to-day. An idea of the value of this work may be obtained from a synopsis of the fine sections into which the book is divided. Section 1, deals with grinding,—conditions, rules, methods, processes, machines, and attachments for accurate grinding as well as the use and preparation of abrasives. Section 2 has to do with taps and tapping,—construction and use of tools and processes for finishing gages, tools, dies and machine parts to accurate dimensions. Section 3, treats of construction, use and operation of grinding fixtures and jigs, for finishing repetition and articles of metal, small hardened and tempered steel parts and special work. Section 4 has to do with the hardening and tempering of interchangeable tool steel parts of delicate structure which require to be ground and lapped afterwards, while the concluding section deals with the percentage of carbon crucible steel parts, and tools should contain, temper colors to which they should be drawn; and degrees of heat for giving them proper temper. This book is of special interest to machinists, tool-makers, die-makers, and all connected with a metal-working plant will find it highly instructive.

MINING.

Ontario.

COBALT.—Ore shipments for the week ending September 28th were: Buffalo, 60,000 pounds; Foster, 128,000; Nipissing, 178,210. The shipments since January 1st now total 9,227 tons.

KINGSTON.—Owing to the exceptionally large attendance at the Government School of Mining this session it has been found necessary to make the following appointments: Mr. W. O. Walker, M.A., Toronto, lecturer in organic chemistry. Mr. J. B. McKay, B.Sc., of Queen's, assistant in mineralogy and metallurgy. Mr. E. W. Henderson, B.Sc., Pittsburg, Pa., a graduate of the school, lecturer in electrical engineering. Mr. Lindsay Malcolm, M.A., B.Sc., city engineer of Stratford, lecturer in civil engineering. Mr. Wyatt Malcolm, of Queen's, fellow in mineralogy.

The Independent Telephone movement in Canada is growing rapidly. The time is opportune for the establishment of a plant to supply equipment for the new companies that are springing up all over the Dominion. The Swedish-American Telephone Company have grasped the opportunity, and Mr. E. B. Overshiner, president of that company, has organized the Dominion Telephone Manufacturing Company, Ltd., with a capital stock of $250,000. The company will manufacture telephones and accessories for the use of Independent companies.

The location of the factory has not yet been decided upon, but according to the prospectus it will be in Ontario, and the site will be selected solely with regard to economical and efficient operation and distribution.

Full particulars may be procured by addressing the company at the King Edward Hotel, Toronto, where the temporary office is located.

CONSTRUCTION NEWS SECTION

CONTRACTS AWARDED.

Ontario.

KENORA.—The contract for the electric pumping apparatus has been let to the J. L. Neilson Co., on condition that they produce satisfactory specifications and guarantees from the manufacturers. The price is $2,750, and the pump will have a capacity of 1,250,000 gallons, with a one hundred horse-power Westinghouse motor.

LONDON.—Mr. John Hayman has the contract for building the addition to the Grand Trunk Railway shops, which will cost $51,000. Mr. W. D. Robb, Montreal, is supervisor of motive power.

Quebec.

MONTREAL.—The contract for building the concrete viaduct in connection with Montreal's water supply has been awarded to Mr. Patrick McGovern, of Boston, Mass., the contract price being $684,815. Mr. McGovern's tender was the lowest, the highest being $1,025,151.

MONTREAL.—Mr. J. B. Pauze, contractor for he new Montreal jail at Sault au Recollet, has given out several sub-contracts. The excavation and foundation work will be done by Messrs. Martineau & Prenoveau; the plumbing and heating systems will be installed by the Garth Company, while the steel work will be done by the Phoenix Bridge Company, of Montreal.

Manitoba.

BRANDON.—John Bradley has secured the contract for building the Regina Bulyea line of the C.P.R. The length of the new line is 45 miles, and it is expected it will cost about $300,000.

WINNIPEG.—Messrs. Buchanan & Company have been awarded the contract for erection of wooden Howe truss bridge across Winnipeg River, in connection with the power development, for $44,127.

TENDERS.

Ontario.

BRUCE COUNTY.—Tenders will be received by the Department of Public Works until October 18, for the extension of Lion's Head Wharf. Fred Gelinas is secretary.

TORONTO.—Bids will be received by the chairman of the Board of Control, Toronto, until October 8th, for the construction of asphalt pavements, asphalt block pavements, concrete pavements, brick pavements, and concrete walks. E. Coatsworth is Mayor, and C. H. Rust, City Engineer.

SOUTHAMPTON.—Tenders will be received by the Department of Public Works until the 25th inst. for the construction of an extension to the Southampton Harbor of Refuge. Plans may be seen at the office of J. G. Sing, engineer in charge, Confederation Life Building, Toronto. Fred. Gelinas, secretary.

Quebec.

MONTREAL.—Tenders will be received by J. R. Barlow, city hall, Montreal, for the construction of sewers in several of the city streets.

QUEBEC.—Tenders will be received until October 10th by Mr. L. E. Taschereau, 111 Mountain Hill, for the construction of the Notre Dame de Quebec system of waterworks.

Prince Edward Island.

CHARLOTTETOWN.—It is stated that tenders will shortly be issued for a new ice-breaker to work between Prince Edward Island and the mainland. It is understood the contract price is to be from $400,000 to $450,000, and the speed seventeen knots.

Manitoba.

WINNIPEG.—The controllers have decided to call for tenders for 10 to 15 miles of water pipe, tenders to be in by November 15, and the pipe to be delivered in the opening of navigation in 1908.

Alberta.

CALGARY.—Tenders will be received until November 1st by R. E. Speakman, C.E., city engineer, for the construction of about twelve miles of street car track and overhead trolley work in the city of Calgary; for building a steel bridge, with concrete abutments, over the Elbow River, in the city of Calgary, and for six semi-convertable cars, with electrical equipment, etc.

WETASKIWIN.—Tenders are being called for the erection of a new C.P.R. depot at Wetaskiwin.

MUNICIPAL.

Ontario.

BROCKVILLE.—The Independent telephone movement in Leeds County is meeting with general favour. A line is being erected between Smith's Falls and the village of Toledo, and upwards of twenty farmers have phones installed in their homes. In the western section of the county one hundred and twenty-five farmers are connected with the rural telephone exchange.

CLINTON.—A by-law to raise $53,000 to establish a system of waterworks was passed in Clinton on September 30th.

COLLINGWOOD.—The town are asking the Ontario Municipal and Railway Commission for permission to issue $4,000 waterworks debentures without submitting a by-law to the ratepayers.

GUELPH.—A complete set of filter or bacteria beds will be constructed here, covering about 1½ acres, at a cost that will likely exceed $10,000. The present septic tank capacity is about 200,000 gallons, and it is thought that this capacity will require to be doubled. J. G. Lindsay is city engineer.

LONDON.—Mr. John M. Moore, C.E., is the engineer in charge of the water system and power plant which it is proposed to install here at a cost of about $575,000. Date of opening bids for construction has not yet been decided upon. O. Ellwood is secretary.

SUDBURY.—The Railway and Municipal Board have approved a by-law for the raising of $10,000 for the extension of the waterworks at this place.

TORONTO.—The Board of Control has instructed City Engineer Rust to prepare a plan and estimate for a trunk sewer and disposal works by means of which the city's sewage can be treated chemically instead of being emptied into the lake as at present.

TORONTO.—Work in connection with the extensions to the waterworks is being carried out as quickly as possible. Of the $780,000 to be used in this work, $100,000 will be used in purchasing metres. Twenty-inch pipes will be laid on George and Bathurst Streets, and continued with 16-inch and 12-inch pipes. The other pipes laid will be 12-inch or 6-inch. The two new pumps to be installed in connection with these extensions will be of 6,000,000 and 16,000,000 gallons capacity.

TORONTO.—On Saturday last Dr. Amyot made the following statement regarding the city's drinking water: "The people of Toronto should still boil their drinking water, as the city water is bad, although I would not pronounce it very bad, in consequence of the presence of bacteria. We make every day bacteriological examinations of the city water, and have done so daily during the past

three years. The intake pipe at the present time extends beyond the island a quarter of a mile out into the lake, and it cannot extend farther, owing to the depth of water at that point—150 feet. But it is beyond question, for I have verified it, that bacteria can enter, and have entered, this intake pipe."

Quebec.

MONTREAL.—The question of placing all wires underground will be taken up shortly by the City Council. The Board of Trade are submitting a draft letter to the Council with regard to this question. It is understood that the Montreal Light, Heat & Power Company is agreeable to making the connection up to the line of private property.

British Columbia.

NEW WESTMINSTER.—A new steel bridge is proposed across the north arm of the Fraser River, connecting New Westminster with Lulu Island. The municipality desires to build a modern steel structure, suitable for vehicular and street car traffic.

VANCOUVER.—The Bridge Committee will soon submit a by-law appropriating $1,000,000 for bridge purposes, to be distributed as follows: Granville Street, $500,000; Westminster Avenue, $150,000; Cambie Street, $235,000; Coal Harbour, $55,000; and $60,000 for contingencies.

Saskatchewan.

HUMBOLDT.—This town will spend $7,000 in providing adequate fire protection.

British Columbia.

FERNIE.—Tenders for the construction of the septic tank for this city were opened on September 27th, and were as follows: H. Oldlord, Fernie, $5,510; Campbell & Gray, Fernie, $6,375; M. Kerr & Co., Fernie, $6,960; Hugh MacDonald, Victoria, $8,950; Wigglesworth & Todd, Fernie, $9,000. The contract was awarded to Mr. Oldlord, the lowest bidder. There will be 460 cubic yards of cement used in the work. R. Potter is city engineer.

VERNON.—The city council has installed, under Water Commissioner J. E. Ross, an additional pumping plant. The machinery was furnished and erected by the Vancouver branch of the Canadian Fairbanks Company.

INDUSTRIAL.

Ontario.

TORONTO.—A building permit has been granted for the erection of a brick boiler house, condenser house and smoke stack to the Consumers' Gas Company; cost of work, $60,000. Mr. W. H. Pearson is general manager.

TORONTO.—It is reported that a company is being formed here for the manufacture of railway cars. The plant will probably be located in Winnipeg.

Nova Scotia.

HALIFAX.—The Londonderry Iron Mining Company, who recently acquired the iron deposits at Torbrook are preparing to install an electric system for operating their mines. The power will be drawn from the Nictaux Falls, about a mile from their property. The mills which were formerly operated at the Falls, have been abandoned, to make way for the utilization of the water power for electrical purposes. The estimated cost of this plant is between $40,000 and $50,000.

Alberta.

EDMONTON.—Five hundred miles of Alberta's Government-owned telephone system will be in operation this year.

EDMONTON.—The Provincial Government telephone line has been completed in several parts of the Province, and work is proceeding briskly on the unfinished sections. The Calgary Hudson Bay Line is now completed, and instruments will be installed very shortly. The Macleod and Blairmore and Frank lines are almost finished and will be operated very shortly. The line from Wetaskiwin east to Hardisty will be completed this week, and the line from Lacombe to Stettler is complete.

British Columbia.

GRAND FORKS.—The full capacity of eight furnaces are in commission at the Grandby smelter, and are now all operating and treating a total of 3,200 tons of ore daily.

PHOENIX.—It has definitely been decided that the Dominion Copper Company will commence the work of enlarging its smelting plant located at Boundary Falls.

VICTORIA.—A brick manufacturing plant is one of the new industries of Vancouver Island. The plant has at present a capacity of about eighteen thousand per day.

RAILWAYS—STEAM AND ELECTRIC.

Ontario.

DEANS.—As soon as right-of-way can be obtained the Crown Plaster Company intend to build a spur from their gypsum property to the M.C.R. siding at Dean's Station. The track will be about four miles, and cost $15,000.

KENORA.—A company has been formed for the promotion of an electric railway to run from Kenora to Keewatin, and thence along the Winnipeg River, where it will connect with the railway. The Government has been applied to for the land necessary for the purpose, and the town's power will be utilized for that object.

SMITH'S FALLS.—The Grand Trunk survey party have completed work in the Smith's Falls section.

Quebec.

MONTREAL.—The Abitibi section of the National Transcontinental Railway will be built by the J. H. Reynolds Construction Co., the contract having been recently sublet to them by the Grand Trunk Pacific Company, which latter company obtained the contract some seven or eight months ago from the Government. The section is 150 miles in length, and starts at a point eight miles west of Abitibi River, and is consequently remote and difficult of access. The contractors will immediately locate their camps and lay down supplies. Rock-cutting will probably be carried on during the winter, and construction work will begin in the spring.

Manitoba.

PORTAGE LA PRAIRIE.—It is reported that the section of the G.T.P. between Portage la Prairie and Miniota is in operation this week. This section is 130 miles long, and is said to be one of the best pieces of road on the continent. The necessary rolling stock is already on the spot.

British Columbia.

NANAIMO.—Robert Kerr, passenger traffic manager of C.P.R., states officially that the line from Nanaimo to Alberni, on Barclay Sound, will be commenced immediately. The company will then have direct communication with the Oriental steamers without coming south to the Straits of San Juan, via Victoria.

Alberta.

EDMONTON.—There is a probability that the street railway here will be sold to capitalists, as the municipal ownership idea is losing favour.

British Columbia.

VERNON.—Messrs. Bainbridge, Morris & Rice, engineers, have just completed their tour of inspection of the proposed route of the Midway and Vernon railway between Midway and Vernon. It is reported that they are highly pleased with the line as already surveyed. It is expected that active construction work will be ordered in the near future.

The 1907-8 prospectus of the engineering department of the University of Manitoba containing the names of the University staff and officers, and a syllabus of the Course in Civil Engineering, has reached our office. The first two years of the electrical engineering course will be the same as that given for the civil engineering course. The syllabus of the work for the last two years will be prepared immediately upon the appointment of the Professor of Electrical Engineering.

LIGHT, HEAT, AND POWER.

Ontario.

GRAVENHURST.—The municipal power plant was formally opened on Thursday of this week, the Hon. Adam Beck being present.

Quebec.

SHERBROOKE.—The Sherbrooke Power, Light, and Heat Company have turned down the city's offer to buy the plant of the company for $260,000, paying in four per cent. bonds. The Special Light Committee will now proceed with the erection of an electric plant at Westburg Basin, $200,000 having been voted by the citizens for that purpose some time ago. Messrs. Ross & Holgate of Montreal, have been engaged as engineers, and will have the plans prepared immediately, so that a portion of the dam may be laid this fall.

Alberta.

EDMONTON.—The International Heating and Lighting Co., of Cleveland, Ohio, hold the franchise from Edmonton and Strathcona for the supply of artificial gas. Mr. Cyrus Eaton, Western manager, states that work on the plant costing $100,000 will be commenced shortly. The plant will be located in Strathcona and the product piped across the river to the city. Contract for the laying of mains in Strathcona are to be let shortly.

MARINE.

Ontario.

OTTAWA.—It is reported that the Dominion Government will shortly place an order for a new ice-breaker to operate between Prince Edward Island and the mainland.

TORONTO.—The Canadian steamer "Edmonton," of the Matthews line, which ran on the rocks in the St. Lawrence River, is at present in dry dock at the Ecorse Yard of the Great Lakes Engineering Works undergoing repairs.

TORONTO.—City Architect McCallum is in favor of a steel building to replace the old ferry shed. He and Property Commissioner Harris have gone to New York to inspect the ferry sheds there.

Quebec.

MONTREAL.—A new steamer for the lake carrying trade arrived in Montreal on Tuesday from Dundee. She is the "G. R. Cole," and was built for the St. Lawrence and Chicago Navigation Company.

MONTREAL.—The new boat designed for the Canadian Pacific lake service arrived in Montreal recently. The gross tonnage of the "Keewatin" is 4,300 tons, and her principal dimensions are: Length, 350 feet; breadth, 43 feet 3 inches; depth, 26 feet 9 inches. She is divided into eight watertight compartments. There are four decks, main, awning, promenade and hurricane. She has accommodation for 300 passengers. The new boat, which was built at the Fairfield works, is a sister ship to the "Assiniboia," which is now in Quebec, being cut preparatory to being towed to the lakes. Her engines are quadruple expansion, and will develop 3,700 indicated horse-power, with a speed of fifteen and a quarter knots.

MONTREAL.—The North American Wrecking Company have given out a report to the effect that the steamship "Bavarian," which was lifted off Wye Rock last spring, is to be repaired, and again put on the St. Lawrence route.

QUEBEC.—In a collision between the Allan Liner "Mongolian" and the "Hurona" of the Thompson Line, the former vessel was badly damaged, having a vertical rent cut in her side about 25 feet long.

The new Physics building in connection with the University of Toronto was formally opened during the past week by Lieutenant-Governor Sir Wm. Mortimer Clark, in Convocation Hall. This new building, which contains 80,000 square feet of floor space is absolutely fireproof, and is one of the finest on the continent.

The McCabe Elevator Company, of Minneapolis, Minn., has acquired from the G.N.R., Brandon, a site for one of its new line of elevators.

PERSONAL.

MR. M. S. BLAIKLOCK has been appointed to the newly-created office of engineer of maintenance of way of the Grand Trunk Railway.

MR. EDWARD RAMAGE, who is well known in Canadian shipbuilding circles, has reurned from a trip to Scotland, and will reopen his business at 267 Wellington Street West, Toronto.

MR. J. V. NIMMO has resigned the joint position of chief engineer of the New Canadian Company, Ltd., and resident engineer of the Atlantic Quebec and Western Railway, and W. Lyon Browne has temporarily undertaken to fill the position.

MR. COLLINGWOOD SCHREIBER, chief consulting engineer of the Department of Railways, is at present making an inspection of the western portion of the Grand Trunk Pacific Railway between Winnipeg and Edmonton. Mr. Schreiber is endeavoring to expedite the work.

MR. JAMES A. HORTON and MR. CHAS. G. COPE have formed a partnership and opened a patent and consulting engineering office at 35 Confederation Life Building, Toronto. Mr. Cope, who is an expert in agricultural machinery and implements, was previously connected with Charles H. Riches, while Mr. Horton was formerly engaged in electro-chemical and metallurgical work in New York.

SOCIETY NOTES.

An executive meeting of the Engineers' Club was held on October 3rd, when several matters of interest to the club were discussed. The first regular club meeting will be held on Thursday evening, October 10th.

The American Society of Mechanical Engineers will hold the first monthly meeting this fall on October 8th, in the auditorium of the Engineering Societies Building, New York. The subject of this meeting will be Industrial Education. College Technical Courses and Student Apprenticeship Courses will be discussed, and addresses by several prominent engineers will be given. This meeting will no doubt be highly instructive, and prove of exceptional interest.

TRADE INQUIRIES.

The following inquiries relating to Canadian trade have been received at the Canadian Government Office, 17 Victoria Street, London, S.W.:—

An old-established firm in Toronto desires to be placed in touch with British firms seeking a market in Canada for plumbers' lead traps and bends, solid porcelain sanitary fittings, enamelled iron fittings, plumbers' brass goods, gas and electric chandeliers, glass ware and globes, specialities for electricity gas, water, and air.

Inquiry is made by a resident of Ottawa for names of English manufacturing firms who may desire to be represented at that point.

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

A Canadian firm thoroughly experienced in the engineering and allied trades is about to open an office in Montreal, and would like to correspond with United Kingdom manufacturers of electrical and mechanical apparatus seeking resident agents in the Dominion. They could handle stationary engines (steam), boilers, condensers, and allied machinery, gas producers, gas engines, pumps, steam turbines, railway, mining, municipal and contractors' equipment, gas, water, and electric meters, galvanized steel and iron wire and wire rope, cast iron pipe, also brass rod tube.

RAILWAY EARNINGS.

Toronto Railway earnings for the week ended Saturday, September 28th, were $65,630, an increase of $6,865 over the same period last year.

MARKET CONDITIONS.

Montreal, October 3rd, 1907.

The markets for pig iron in the United States show perhaps a slightly firmer tone. Prices, however, continue steady, the tendency being rather upwards. It is practically impossible to quote anything like a fixed or firm price, everything depending upon the degree of urgency buyers or sellers may experience at the time of the transaction. There is a fair quantity of pig moving. Steel making iron continues very scarce and being held at high prices. It would seem that there is a likelihood of a shortage in Bessemer steel ores, owing to the late miners' strike in the Lake Superior district, the consequence being that steel-makers are becoming anxious regarding the available supply of metal during the winter months, while prices are being held at a high level.

The English pig iron market is steady, and somewhat higher prices are being asked. Shipments of considerable quantities are being made to America and the Continent and available stores continue to be drawn upon. This reduction in available stock tends to make producers firm in their views and it now looks as though the chances for a reduction in price in the present year are very small, in fact, some dealers are looking for a further advance. Freights to the St. Lawrence are difficult to obtain, the result being that quotations for lots for late delivery here are somewhat higher than they were a few weeks ago. Scotch metal is firm with a good business passing.

In the local market, good orders continue to be placed for fall and even for winter delivery. The Londonderry furnace is again in operation and has commenced delivery.

This plant is booking good orders, particularly for delivery in the Maritime Provinces. Large quantities of metal are now arriving at Montreal and are being distributed as rapidly as dock and car facilities will permit. Fortunately these are good at present and it is hoped will continue so till the end of the season. Scotch metal is coming in every week and importers are hoping to get the bulk of the goods in during this month. Last year a great deal of trouble was experienced through the iron arriving late, and there is every desire this season to avoid a repetition of the experience.

Antimony.—At the moment the market shows a tendency to higher prices, and, as a matter of fact, quotations have advanced a fraction, at 14½ to 15c.

Copper.—The market for copper continues at the same level as a week since, prices being in the vicinity of 17c. Dealers seem to think that this figure is slightly lower than it should be, just as previous figures were higher than they should have been. Consequently, they would not be at all surprised to see a slight advance at any time.

Bar Iron and Steel.—The market shows a rather easy tendency and prices have declined from 5 to 10c. all round. The cause of the decline is unquestionably the falling off in demand recently experienced. At the moment the situation is steady. Quotations are: Bar iron, $2.15 per 100 pounds; best refined horeshoe iron, $2.55, and forged iron, $2.40; mild steel, $2.20 per 100 pounds; sleigh shoe steel, $2.20 for 1 x ⅜-base; tire steel, $2.30 for 1 x ⅜-base; toe calk steel, $2.95; machine steel, iron finish, $2.30.

Boiler Tubes.—Trade is active and prices are steady. Quotations are: 2-in., 8 to 8½c.; 2½-in., 10¼ to 10¾c.; 3-in., 12c.; 3½-in., 15 to 15¼c.; 4-in., 19¼ to 19½c.

Cement—Canadian and American.—There is practically no Canadian cement for sale. Canadian prices are steady at $1.90 to $2 per barrel, in cotton bags, and $2.20 to $2.30 in wood, weights in both cases, 350 pounds. There are four bags of 87½ pounds each, net, to a barrel, and 10 cents must be added to the above prices for each bag. Bags in good condition are purchased at 10 cents each. Where paper bags are wanted instead of cotton, the charge is 2½ cents for each, or 10 cents per barrel weight. American cement is steady at $1.10 per 350 pounds, basis Lehigh mills, conditions being the same as in the case of Canadian mills, save that when the cotton bags are returned in good condition, only 7½ cents is allowed for them.

Cement—English and European.—English cement is unchanged at $1.80 to $1.90 per barrel in jute sacks of 82½ pounds each (including price of sacks), and $2.10 to $2.20 in wood, per 350 pounds, gross. Belgian cement is quoted at $1.75 to $1.90 per barrel, in wood. German is $2.52 to $2.55 per barrel of 400 pounds for Dyckerhoff.

Iron.—Demand for iron continues active and prices are steady. Londonderry is only offering for future shipments, and is quoted at $24, f.o.b. Montreal, for No. 1. Toronto prices are about $1.25 more. Summerlee iron is arriving, and is quoted at $23.50, f.o.b. on cars, Montreal, for No. 2 selected, and $25 for No. 1. No. 1 Cleveland is quoted at $21 on cars, Montreal and Clarence at $19.25 to $19.50.

Lead.—Prices of lead show no change at $5.25 to $5.35 per 100 pounds. Market, however, is quite firm, the supply being light and the demand active.

Nails.—Demand is on the dull side and prices are steady. Quotations are $2.50 for cut and $2.55 for wire, base prices.

Pipe—Cast Iron.—Prices are firm at $37 for 6-in. pipe, $38 for 5-in., and $39 for 4-in., at the foundry. Gas pipe is quoted at about $1 more than the above.

Pipe, Wrought.—Demand is good and mills are behind with orders. Quotations and discounts for small lots, screwed and coupled, are as follows: ¼-inch to ⅜-inch, $5.50, with 57 per cent. off for black and 42 per cent. off for galvanized The discount on the following is 66 per cent. off for black and 56 per cent. off for galvanized: ½-inch, $8.50; 1-inch, $16.50; 1¼-inch, $22.50; 1½-inch, $27; 2-inch, $36; and 3-inch, $75.50.

Steel Shafting.—Notwithstanding the general easiness of the market for iron, prices of steel shafting have advanced, or, what is the same, the discount from the list has decreased to 25 per cent., from the former 30 per cent. Demand is active.

Steel Plates.—Demand is fair and supplies limited. Prices hold steady, for small lots, at $2.75 for 3-16 and ⅛, and $2.50 for ¼ and thicker.

Spikes.—Railway spikes are not only in very good demand, and prices are steady at $2.75 per 100 pounds, base of 5½ x 9-16. Ship spikes are steady at $3.15 per 100 pounds, base of ⅝ x 10 inch and ⅝ x 12 inch.

Tin.—The market shows very little change, being quoted at 40c. or perhaps 41c. for small quantities. It is likely that both these figures might be shaded for large lots. Today's prices are firm, the market being slightly firm at the moment.

Tool Steel.—The situation is fairly active and firm. Base prices are as follows: Jessop's best unannealed, 14½c. per pound, annealed being 15½c.; second grade, 8½c., and high-speed, "Ark," 60c., and "Novo," 65c.; "Conquerer," 55 to 60c.; Sanderson Bros. and Newbould's "Saben," high-speed, 60c.; extra cast tool steel, 14c., and "Colorado" cast tool steel, 8c., base prices.

Zinc.—The market has firmed up somewhat, following the recent decline. Prices are firm at $5.85 to $6 per 100 pounds, being the same as a week ago.

* * * *

Toronto, October 3rd, 1907.

It is worthy of note that, while the approximate value of buildings erected in Toronto during nine months of this year is $12,204,000, and their number 4,363, as compared with $9,566,000, and 3,515 in the like period of 1906, the value of permits issued by the city architect in September was only $763,000 for 2,023 buildings, compared with $902,000 for 421 buildings a year ago. This decline is, in part at least, attributable to the financial stringency prevailing in late months, which has prevented builders from obtaining advances with which to erect new structures.

While the case of Toronto is a very marked one in this respect, like conditions prevail elsewhere. Not so markedly in Montreal, but in the smaller cities and chief towns a perceptible falling off in building activity is seen at a time of year when it is usually pronounced. This affects every description of business.

The supply of lumber and timber in the city is fair, but the mills of Ontario are by no means over-stocked with pine. By reason of a recent slacking off in building, explained

elsewhere, the demand for dimension pine is less lively and the market a little easier. Sound common pine lumber, No. 1, brings $30 to $33; No. 2, $24 to $25; spruce, dimension stuff, is still in fair supply at $23 to $24 in city yards, or say $18 to $20 at Quebec mills; hemlock is in fair request at $24 to $25, costing a dollar or two more per thousand if in extra lengths.

In metals, despite a reported lessening of building operations there is an active movement, especially of heavy goods. Deliveries are now obtainable from United States mills in from 2 to 3 months instead of 4 to 6, and structural materials are more readily obtained. There is still a scarcity of certain kinds of black and galvanized wrought pipe, but boiler tubes are in pretty good supply.

An improved tone is announced in the Glasgow pig iron warrant market by latest mail advices, and the closing price a little higher. Stocks of Cleveland pig in Connal's stores are reduced from 167,000 to 157,000 tons on the week, and there is very little Scotch pig on hand. A large tonnage is besides fixed for loading within the next few weeks.

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

American-Bessemer Sheet Steel.—14-gauge, $2.70; 17, 18, and 20 gauge, $2.80; 22 and 24 gauge, $2.90; 26 gauge, $3; 28 gauge, $3.25.

Antimony.—The London market has advanced, as stated; we now quote 13 to 13½c. here.

Bar Iron.—$2.30, base, from stock to the wholesale dealer.

Boiler Heads.—25c. per 100 pounds advance on boiler plate.

Boiler Plates.—¼-inch and heavier, $2.50. Supply limited, and quotations still firm.

Boiler Tubes.—Lap-welded steel, 1¼-in., 10c.; 1½-in., 9c. per foot; 2-in., $9.10; 2¼-in., $10.85; 2½-in., $12; 3-in., $13.50; 3½-in., $16.75; 4-in., $21 per 100 feet; a very fair supply now on hand.

Bricks.—Common structural $10 per thousand. In steady demand. Red and buff pressed, at Don Valley works, $18 per 1,000, and moving freely.

Cement.—Star brand, $1.95 per barrel, f.o.b., Kingston, National, $1.95 per barrel, Toronto, in car lots; retail price, $2.15; English, Anchor, $3 per barrel in wood.

Fire Bricks.—In steady request; English, $32 to $35; Scotch, $30 to $35; American, $25 to $40 per 1,000.

Ingot Copper.—Quiet and with a downward tendency, Toronto price; Lake, 18c.; casting, 16½ to 17c.

Lead.—Demand less strong; goods scarce for immediate delivery; market quite strong.

Nails.—Wire, $2.55 base; cut, $2.75; spikes, $2.75. A fair supply on hand; prices steady.

Pig Iron.—Summerlee No. 1, to arrive, steadily in demand but hard to obtain, still quotes, nominally, $27; No. 2, $26; Cleveland, No. 1, $23.50, $24; Clarence, No. 3, not obtainable, but worth $24.

Steel Rails.—80-lb., $35 to $38 per ton. Steel beams, channels and angles, 2¾ to 3c. per pound.

Sheet Steel.—Firm, 10-gauge, $2.70; 12-gauge, $2.80; in moderate supply.

Tank Plate.—3-16 in., $2.65; Tees, $2.90 to $3 per 100 pounds; angles, 1¼ by 3-16 and larger, $2.75 to $3.

Tin.—Unable to report any change in price here, but markets abroad are easing off; pig 40 to 41c.

Tool Steel.—Jowitt's special pink label, 10½c. per pound; Capital, 12c.; Conqueror, highspeed, 70c. base.

Wrought Steam and Water Pipe.—Trade prices per 100 feet are: Black, ¼ and ⅜-in., $2.37; ½-in., $2.89; ¾-in., $3.90; 1-in., $5.60; 1¼-in., $7.65; 1½-in., $9.18; 2-in., $12.24; 2½-in., $22.15; 3-in., $30.00. Galvanized, ¼ and ⅜-in., $3.19; ½-in., $3.74; ¾-in., $5.06; 1-in., $7.26; 1¼-in., $9.90; 1½-in., $11.88; 2-in., $15.84; 3½-in., black, $39.00; 4-in., $42.85. In galvanized, ½-in., and in black 2-in., are at a premium; 3 and 4-in. black are also scarce.

Zinc.—Sheet zinc, a moderate business doing at steady prices. Toronto, slab, $6.25; sheet, $8.

NEW INCORPORATIONS.

Ontario.

Simplex Gas Company, Toronto, $40,000. H. H. York, S. King, J. Murphy, Toronto.

Haileybury Brick and Tile Company, Haileybury, $50,000. A. J. Murphy, B. C. Beach, Haileybury.

Jenks Dresser Company, Sarnia, $50,000. W. G. Jenks, A. A. Dresser, R. M. Norton, Port Huron, Mich.

Anthes Foundry, Toronto, $100,000. L. L. Anthes, H. C. Sparling, H. Wilson, W. W. Vickers, Toronto.

Ideal Foundry Company, Toronto, $100,000. H. E. Pearce, W. H. Smith, A. Gate, M. Irving, Toronto.

Grand Manitoulin Oil Company, Toronto, $500,000. C. S. MacInnes, G. B. Patteson, W. R. Skey, Toronto.

Hamilton Steel and Iron Company, Hamilton, $5,000,000. R. Hobuson, W. Southam, J. Milne, A. E. Carpenter, Hamilton.

Windsor Belt Dressing Company, Windsor, $40,000. W. H. Oakes, W. H. Bradt, W. Richards, P. A. Dewart, Windsor.

Union Brass Goods Company, Toronto, $150,000. M. P. Vander Voort, T. H. Best, F. J. Stanley, W. A. W. Smiley, Toronto.

Canadian Gypsum Company, Toronto, $20,000. J. S. Lovell, H. Chambers, R. Gowans, S. G. Crowell, W. Gow, Toronto.

Chatham Carriage Company, Chatham, $100,,000. I. Teeter, A. Cooke, F. E. Fisher, O. L. Lewis, W. G. Richards, Chatham.

Dickson Bridge Works Company, Campbellford, $40,000. J. H. Caskey, Campbellford; F. W. C. Macann, F. C. Downey, Toronto.

Oil and Gas Securities Company, Toronto, $25,000. F. Watts, H. A. Menet, J. L. Galloway, J. C. Colling, W. E. Sampson, Toronto.

New Liskeard Concrete Company, New Liskeard, $40,000. S. Jewell, V. E. Taplin, W. H. Carruthers, J. E. Whyte, New Liskeard.

Canadian Northern System Terminals, Toronto, $2,000,000. G. Ruel, A. J. Mitchell, J. B. Robertson, R. P. Ormsby, F. C. Annesley, L. W. Mitchell, Toronto.

Producers Natural Gas Company, Hamilton, $100,000. F. R. Lalor, Dunnville; W. Southam, J. Milne, H. S. Lees, F. A. Magee, Hamilton.

Canadian Smelting and Refining Company, Toronto, $2,500,000. J. D. Pringle, D. D. Grierson, A. G. Robertson, W. M. Wallace, Toronto.

Canada.

Opasatica Mining Company, Montreal, $500,000. J. M. Mitchell, G. E. Beauchamp, J. R. Beaudry, J. Ferres, Montreal.

Ingersoll Sergeant of Canada, Montreal, $20,000. H. D. Lawrence, W. Morris, A. F. Plant, R. F. Morris, Sherbrooke.

Ideal Smoke Consumer Company, Montreal, $49,000. J. A. O. Labadie, O. Papineau, A. E. Demers, A. S. Deguire, Montreal.

Calkins Tile and Mosaic Company, Montreal, $20,000. W. J. Henderson, A. L. Smith, J. W. Hannah, A. C. Calder, J. W. Graham, Montreal.

Montreal Engineering Company, Montreal, $100,000. F. C. Clarke, A. J. Nesbitt, C. C. Giles, I. W. Killam, H. A. Porter, Montreal.

Atlantic Shipping Company, Port Maitland, N.S., $12,200. G. N. Crosby, Beaver River, N.S.; G. E. Crosby, C. K. Thurston, Port Maitland.

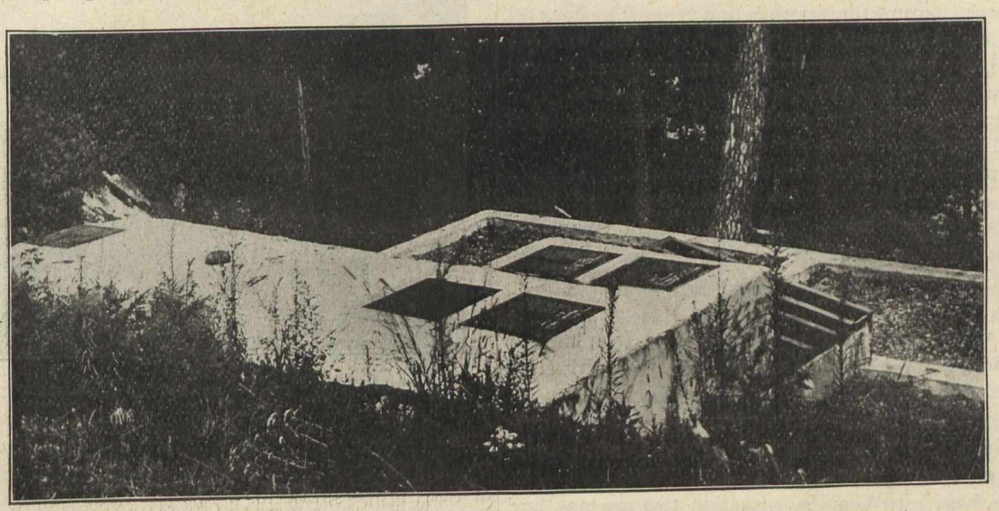
PORT ARTHUR.—The contract for the new Government registry office here has been awarded to Contractor White. The work will be commenced at once and will be completed before the end of the year.

COBALT.—Shipments of ore from Cobalt for the week ending September 21st were as follows:—Buffalo, 60,000; Coniagas, 64,000 pounds; LaRose, 127,750 pounds; Nipissing, 147,640 pounds; O'Brien, 60,760 pounds; 9,044 tons have been shipped since January 1st of this year.

SEPTIC TANKS FOR THE ROYAL MUSKOKA HOTEL.

With the introduction of the Septic Tank system of sewage disposal, already described in the Canadian Engineer, there is no longer any reasonable excuse for jeopardizing the health, and often the lives, of guests at summer hotels and similar resorts, through failure to provide safe and efficient methods of sewage disposal. It too often happens, however, that consideration of this important question is neglected until emphasized by the outbreak of an epidemic with its attendant loss of business and prestige.

Among the first to realize the importance of protecting their guests by adopting up-to-date sanitary methods is the well-known Royal Muskoka Hotel, beautifully situated on Lake Rosseau, Ontario.



Small Plant Showing Reinforced Concrete Roof.

The Royal Muskoka Hotel is built on the south-east end of an island, and consists of twelve long wings; one extending north-west, the other south-west. The existence of a rocky ridge running east and west from the junction of these wings, made it necessary to provide two systems of sewers; one discharging south of the hotel, the other, and the larger system, being carried westward. The sewage from both systems is passed through septic tanks, and the tank effluents are subjected to aerobic bacterial contact before being discharged, odourless and clear, into the lake. Both plants were designed by the Cameron Septic Tank Company, of Chicago, Ill.

Capacity of Works.

The larger plant is designed to provide for a daily flow of sewage amounting to 25,000 gallons, and consists of two septic tanks and four aerobic bacterial contact beds, all built in concrete, and so arranged that either of the tanks can be cut out without interference with the operation of the other, thus allowing for various flows.

The main sewer from the hotel discharges into an inlet chamber; from this chamber the sewage is admitted through sluice valves to each of the tanks.

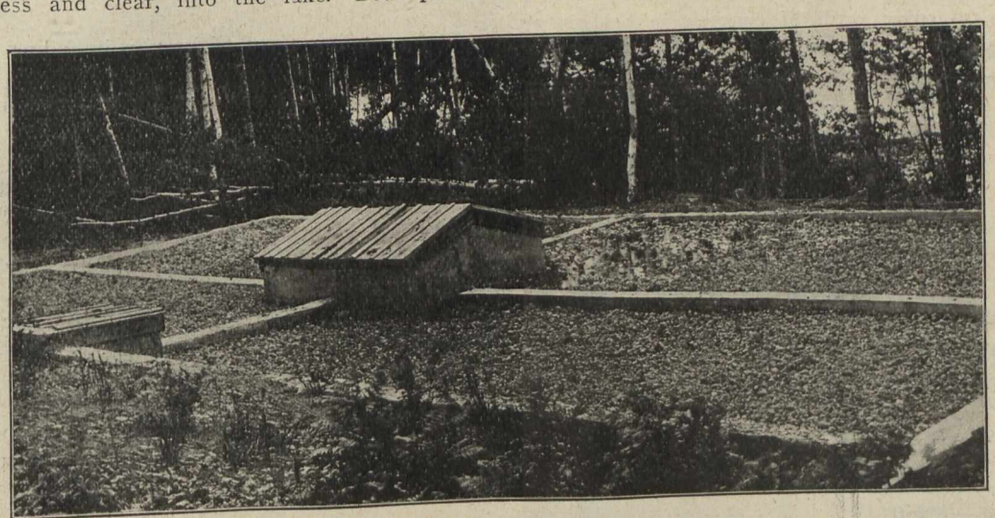
Septic Tanks.

The septic tanks are each 36 feet long, 7 feet wide and 3 feet deep below the water level, and are covered with reinforced concrete roofs. In the tanks the solids present in the sewage are separated and retained, and the organic matter is acted upon by the liquefying micro-organisms present, by which it is broken down into simpler substances. The liquid effluent, thus freed from solids in suspension, passes off through a line of 3-inch pipes laid horizontally, 12-inch center to center, through a wall near the end of the tank, 2 feet below the water line, into the effluent chamber.

Contact Beds.

There are four contact beds, 29 x 15 feet, all filled to a depth of four feet with slag. The tank effluent is distributed over each contact bed by lines of farm tile laid in the filtering material and fed by main distributors. The filtered effluent is collected by lines of farm tile laid on the floor of the contact beds, discharging into main collectors. The latter are connected with cast-iron discharge wells in the gear chamber.

The tank effluent is delivered to each in turn through its admission valve. Meanwhile the discharge valve is closed so that the interstices of the filtering material are filled with the tank effluent. The effluent remains in the contact beds for a period of about two hours, according to the rate of flow, during which the impurities present in solution are oxidized by the bacteria attached to the surface of the filtering medium. The discharge valve is then opened, when the filtered effluent escapes, drawing down after it a supply of air into every crevice of the contact bed. The latter then drains and aerates while the remaining contact beds of the set are filling, after which it is again filled in turn. This



Contact Beds of Large Plant Built in Concrete.

method of working renders the contact beds self-cleansing, so that they retain their purifying power unimpaired.

Automatic Alternating Gear.

The alternate filling and emptying of the contact beds is effected automatically by means of the alternating gear, known as the Central-Basin Four-Filter Gear. As soon as bed 1 is filled, a small quantity of filtered effluent overflows from its discharge well into a float chamber, lifting the float, at the same time opening the admission valve and closing the discharge valve of bed 2. When bed 2 is filled, this operation is repeated, the flow of tank effluent diverted into bed 3, and the discharge valve of bed 1 is opened and its contents built upon a cast-iron bed plate and enclosed in a small chamber to protect it from the weather and from interference.

The works being automatic throughout, and the working of the contact beds being controlled by apparatus of proved reliability, there is no risk of temporary breakdowns such as occur where the working of an installation is dependent upon the fidelity and vigilance of an attendant.

The small plant south of the hotel has a capacity of 5,000 gallons daily, and consists of one septic tank and three aerobic bacterial contact beds. The septic tank is 17 feet long, 6 feet wide, and an average depth of 5 feet below the water level. It is covered with a reinforced concrete roof.

Contact Beds.

There are three contact beds averaging 15 feet long, 7 feet 6 inches wide, and all filled to a depth of 4 feet with slag.

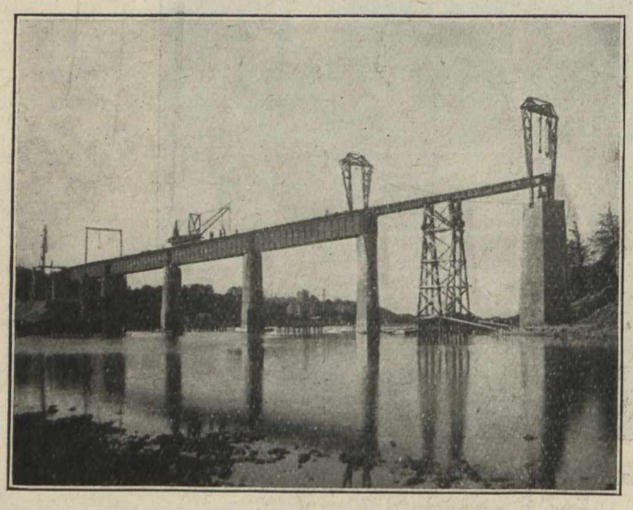
The method of operation is practically the same as already described for the larger plant, excepting that a Three-Filter Alternating Gear is used instead of the Central-Basin Four-Filter Gear, above described.

Both plants have now been in operation two seasons and are giving entire satisfaction.

THE GUELPH AND GODERICH RAILWAY.

By J. Grant MacGregor, C.E.

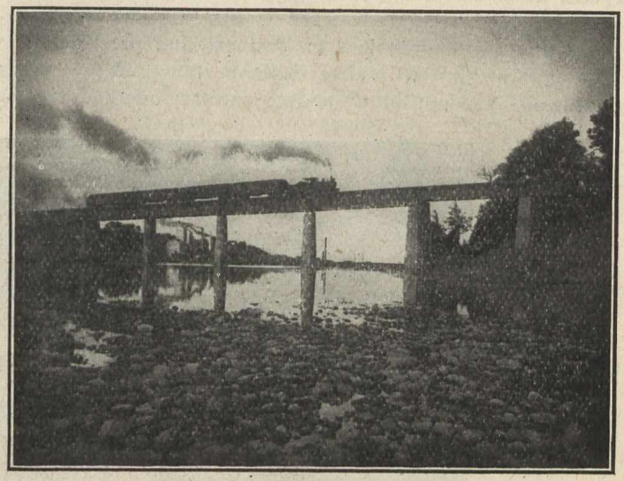
The Guelph and Goderich Branch of the Canadian Pacific Railway was formally opened for traffic on the 12th inst., exactly three years from the date of turning the first sod. As this may seem an unusually long time in which to build 80 miles of railway, the permanent character of the work must be considered, together with the severe winter, and the extensive work on the Goderich end where the line crosses the valley of the Maitland River. This portion of the work alone consisted of 10,450 cubic yards of concrete in bridges and retaining walls, and 265,000 cubic yards of earthwork in



The Maitland River Bridge, nearing completion.

embankments. The distance from Guelph to Goderich is 80 miles, and with the exception of 20 miles at the Goderich end the work of location presented but few difficult engineering problems. The location of the last 20 miles, however, was repeatedly revised, leaving no doubt whatever as to the final location being the most favourable one.

The limits of grade and curvature were fixed by rules and diagrams issued by the Canadian Pacific Railway for the use of velocity grades wherever practicable, such limitations being based on experiments made on an extensive scale by the Northern Pacific Railway, and from which the diagrams referred to had been prepared. The application of the diagrams to the original grade profiles eliminated much heavy work and established on an economic basis a virtual 0.60 per cent. profile for eastbound traffic, for a minimum speed of 10 miles per hour with a train load of 1,630 tons. In extreme



The Completed Bridge.

cases the above limitations may have been exceeded, depending perhaps on an increased acceleration to overcome some of the higher summits.

In order that the effect of such acceleration could be determined the experimental diagram had to be dispensed with and the usual theoretical rule substituted. This necessitated a comparison to be made of the data obtained by experiment with results obtained by theory, in expectation of effecting a change in the 0.60 per cent. and 10 mile per hour requirement to embrace the new conditions, but it was impossible to do so with the class of locomotion expected to be put in operation on the division.

The requirement had therefore to be departed from in some cases, reducing the speed at summits to 6 miles per hour and even lower. The velocity heads given on speed diagrams were substantially those given in Table 118 of Wellington Railway Location, and are derived from the formula for finding force of gravity in falling bodies, $h = \frac{v^2}{2g}$ to which is added 6.14 per cent. for the rotative energy stored in the wheels.

The work of construction on the first 60 miles from Guelph was comparatively of a light character, such as is usually encountered in undulating country; the average quantity of earthwork per mile being 18,300 cubic yards. The work on the last 20 miles was much heavier, the average quantity per mile being 42,000 cubic yards. No rock had been encountered throughout the whole line. The classifications specified were "solid rock," "loose rock," and "common excavation," the latter embracing all materials which could not be classed as loose rock.

To avoid disputes and simplify questions arising from the calculation of overhaul, the usual clause was annulled and a fixed amount included in contractor's tender to cover all overhaul, such amount being previously determined by the extra cost of removing from line excavation the quantity in gullets of sufficient width to permit of the extra widening being done by steam shovel and train haul.

The structures are absolutely of a permanent character, and are built entirely of concrete, the only exception being the upstream faces of cutwater piers, which are faced with cut stones. The proportions of concrete used were for piers and abutments one, four, seven, and for arch culverts and foundations under water one, three, five. The standard designs of the Canadian Pacific Railway were adhered to as closely as circumstances would permit. The graceful form of the piers of the larger structures evolved from the appli-

cation of the convexed starlings of cutwaters, it being found that a circular end above the cutwater permitted of a shorter base. This form of cutwater, in addition to being a more massive form for concrete work is probably the only practicable one which offers least resistance to the current.

There are altogether 29 bridges, with steel superstructures, and although four of these are of considerable magnitude, there are no lattice spans, plate girders being used exclusively up to 110 feet length of girder. This feature in the design of the larger structures imparts to them the appearance of strength and stability.

The station buildings and terminals are built in conformity with the substantial character of the work already described. The entire road is laid with 80 lb. rail, and excellent ballast was available at convenient intervals along the line.

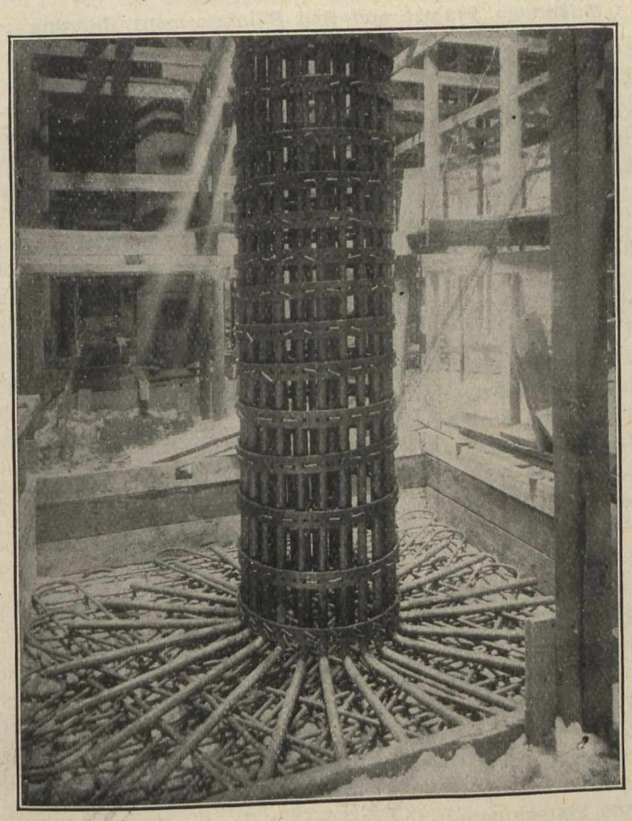
The whole work was carried out under the direction of Mr. P. A. Peterson, as chief engineer, Mr. J. M. Leonard being president of the company. The organization of the engineering staff being an assistant engineer and accountant at headquarters, one divisional engineer and two residences to each 20 miles of line. For construction purposes the work was divided into 10 mile sections. The contractors for sections 1, 4, 5 and 6 were Messrs. Campbell & Folinsbell, Strathroy, Ont., and for sections, 2, 3, 7 and 8, M. A. Pigott & Company, Hamilton, Ont.

THE MUSHROOM SYSTEM OF REINFORCED CONCRETE.

BY C. A. P. TURNER.*

In his treatise on "Reinforced Concrete Construction" Chas. F. Marsh makes these interesting observations: "When properly combined with metal, concrete appears to gain properties which do not exist in the material when by itself, and although much has been done by the various experimenters in recent years to increase our knowledge on the subject of the elastic behavior of reinforced concrete, we are still very far from having a true perception of the characteristics of the composite material.

"It may be that we are wrong from the commencement in attempting to treat it after the manner of structural iron work, and that although the proper allowances for the elastic properties of the dual material is an advancement on the



A Reinforcement for a Column, Designed to Carry a Working Load of 1,000 Tons.

empirical formulae at first employed, and used by many constructors at the present time, yet we may be entirely wrong in our method of treatment.

"The molecular theory, i.e., the prevention of molecular deformation by supplying resistances of the reverse kind to the stresses on small articles may prove to be the true method of treatment for a composite material such as concrete and metal. This theory is the basis of the Cottancin construction which certainly produces good results and very light structures, and M. Considere's latest researches on the subject of hooped concrete are somewhat on these lines."

The writer's experience in the design of several million dollars worth of reinforced concrete work for a great variety of purposes leads him to heartily endorse the opinion of Mr. Marsh regarding economic construction and to add thereto the statement that "his experience and observation further justifies the assertion that a fair regard for the lives of the workmen and the safety of the work during construction demands a type of construction in which the work is so tied together that a sudden collapse cannot occur after the concrete has had even six or seven days in which to set.

In no type of building construction can the materials be as promptly obtained and the work more rapidly constructed than reinforced concrete, in skillful hands. In the writer's experience in steel construction for the last fifteen or twenty years, there have been quite a number of men who have lost their lives from time to time in the course of the erection of the work, while in reinforced concrete construction, we have not had a single accident to a workman employed on this class of construction. We attribute our success in this respect primarily to the type of design used together with the fact that the workmen have a solid floor upon which to work at all times instead of a grid of steel beams, from which, the least carelessness on the part of the workmen, results in a serious and too often a fatal fall.

The system of reinforced concrete which it is the object of this article to describe is novel in the following respects: It consists essentially of slabs supported directly by columns, the slabs being reinforced directly and diagonally from column to column, thus forming a plate with the reinforcement so arranged that it will act approximately along the lines of the flat plate theory, the distortion in the concrete by compression due to one system of rods being offset, to a certain extent, and reduced by the compression due to another system. Again, carrying the reinforcement over the mushroom head where the moment in the slab is negative fixes the slab rigidly at the supports.

A feature of this new construction from which it derives its name is the formation of a so-called mushroom at the top of each column by extending its reinforcing rods laterally some four feet or more out into the slab in a radial direction and supporting on these ring rods which in turn carry the lighter reinforcement for the slab construction. The top of the column is enlarged, forming a neat capital, which assists in taking the additional stress which comes upon it in supporting the entire slab at this point. The slab reinforcement consists of parallel rods of small diameter running between adjacent mushrooms, both at right angles and diagonally, and of a width equal to the diameter of the mushrooms. The slab rods are strung over the mushroom frames and are given the necessary sag to bring them near the bottom of the slab between the columns. They are further wired together at their intersections to hold them securely in place, while the concrete is being poured. In

* Inventor, M. Am. Soc. C. E., Minneapolis.

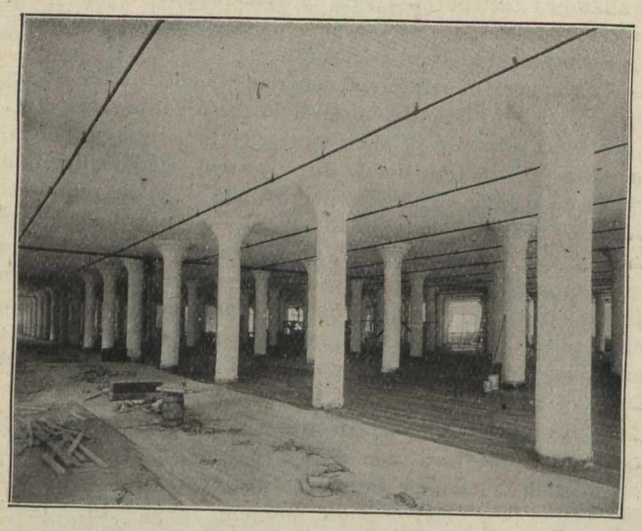
this manner, the steel reinforcement is well distributed through the slab, which is thereby made continuous in all directions.

The mushroom head is adapted to framing around almost any kind of an opening. For example, half-mushroom, a quarter-mushroom or a three-quarter mushroom, as the case may be, can be made, the radial rods being folded around in a fan shape.

The arrangement of the metal in the columns preferably consists of a fair amount of vertical steel thoroughly hooped and banded by welded bands. The strength developed by this type of column has been well illustrated in a number of tests of full sized columns, recently made at Phœnixville, Pa., by the writer, up to 700 tons capacity. The columns were 10 feet 6 inches long; diameter of hoops 14 to 16 inches; vertical reinforcement of eight rods ranging from ⅞-inch to 1-⅛-inch rounds; bands 1¾-inch x 3-16-inch and 1¾-inch x ¼-inch spaced from 8 to 13 inches centres; strength developed from 5,000 to 8,000 pounds per inch of core area. These columns were about the lightest which we ordinarily use. The difference between the failure of this type of column and that in which spiral hooping only is used lies in the fact that the concrete does not commence to shell or crack at as early a period in the test.

We illustrate herewith the reinforcement used for a column to carry a working load of 1,000 tons; hoops 27 inches outside diameter; column 30 inches, octagonal in section, vertical rods 1½-inch in diameter. The working stress on the concrete in the core area developed by the bands at 15,000 pounds per inch on imaginary verticals of 2.4 the volume of the hoops, allowing 500 pounds per inch on the concrete proper, is 2,500 pounds per square inch working pressure. The mixture of the concrete used was one cement, one and one-half coarse sand and three and one-half parts pebble ranging from ¼-inch to ⅝-inch in diameter. A view shows the mushroom frames very clearly and the rod reinforcement running over them. The column spacing in this view is 14 feet 10 inches x 17 feet; floor slab 8 inches thick; slab rods ⅜-inch rounds.

An interior view shows columns and slabs; the finish in this building, except first storey, was merely a white coat of



Interior View Showing Columns and Slabs.

cold-water paint. The centering used was sheet metal for the column forms and corrugated steel, suitably supported, for the slabs.

The illustrations are sufficient to give a fair idea of the construction outlined. It is being used in some of the largest buildings that are being erected in the United States and Canada. In Toledo, Ohio, a hardware building 220 feet square, eight storeys high, is being constructed on this system, the advantages claimed for this system are the marked saving over older types of design; in fact the favor which it has met has been due primarily to its economy, combined with the advantage that the system gives a free and unobstructed illumination from the windows, permitting the placing of partitions anywhere, without the interference of ribs; giving great stiffness and solidity due to the fact that the slabs are somewhat thicker than is usual where ribs are used, with the consequent reduction in the transmission of sound.

From the nature of its reinforcement, the system is particularly well fitted to be used in the construction of ware-

Mushroom Frames and Rod Reinforcement Running Over Them.

houses or similar buildings where, due to the presence of aisles and passage ways for trucks between the columns, the load is concentrated around the columns just where the mushrooms with their heavy reinforcement are placed; and it is a rather interesting fact that the heavier the loads to be carried the more economical this form of construction becomes as compared with the more common beam-and-slab method. For warehouses, where the capacity of the floor is 300 pounds per foot and columns 18 or 20 feet centres, the mushroom system of reinforced concrete is as cheap as first-class timber construction. As an illustration of this fact, Butler Brothers, general contractors, of St. Paul, Minnesota, bid $10,000 less for the Lindeke-Warner building in that city on the mushroom system of reinforced concrete than they did on the architect's design for timber construction. This building is 234 feet x 165 feet and seven storeys in height.

As to its fireproof properties, the fact that there are no exposed ribs to be unequally heated or concentration of reinforcing metal in the form of large rods inefficiently protected, gives this system a claim for consideration on the ground of superior fire-resisting properties. Where, owing to the character of the goods to be stored, sprinkler systems are used to keep down the insurance rates, it may be noted that the smooth ceilings such as are formed by the mushroom system permit the spacing of the sprinkler heads to cover the maximum amount of area possible, thus materially reducing the cost of the equipment.

An economy in this system lies in the fact that it does not require expensive forms for girders and ribs, with the attending waste of lumber, but simply a smooth slab support requiring little labor to construct and remove and involving a minimum waste of the lumber in the centering. There is less liability of the reinforcement being misplaced in erection than with usual forms of construction and less opportunity for faulty work in concreting. Where the loads are heavy, there is a very material saving in the quantity of material required, both in concrete and in steel.

ENGINEERING NEWS FROM GREAT BRITAIN.

(From our Own Correspondent.)

London, September 25th.

Railway Truck Brakes.

In April, 1906, Mr. Lloyd George, the President of the Board of Trade, appointed a Departmental Committee to enquire into the whole question of safety of railway employees. This committee has just presented a report upon their investigations into either side brakes on goods wagons. The following conditions are laid down as necessary before any such brake can be adopted:—Ease of application; ease of release; security in locking the brake after application, although subjected to such shocks as may be incurred in working; means of holding off the brake under similar conditions; uniformity in the position of the levers on both sides of a wagon, namely, on the right hand side of a man when facing the wagon; simplicity of design; and sufficiency of braking power. Altogether the committee have examined 51 models on design and 69 full-size brakes, but in no instance does the committee feel justified in recommending compulsory adoption. The committee, however, take the view that a brake which can be applied from either side is absolutely necessary in the interests of railway employees, and the following is therefore suggested as an additional rule under the Railway Employment (Prevention of Accidents) Act, 1900. (1) All wagons constructed after a certain date, (say three months from the date of the rule), shall be fitted with a brake lever on each side in the "cross-cornered" position, in such a way that sufficient brake power can be applied to the wheels of either of such levers. (2) All wagons which are at present fitted with a brake lever on one side only shall, within a period of seven years from the date of the rule, be fitted with an additional lever in the "cross-cornered" position on the other side in such a way that sufficient brake power can be applied to the wheels by either of such levers, and all wagons which are at present without brakes shall be fitted with two levers in a similar manner within the same period. (3) All wagons at present fitted with a brake lever on each side in the "single ended" position shall, within a period of ten years from the date of rule, have levers rearranged in such a way as to comply with the conditions in (1) and (2) and (4). No wagon for service shall be fitted hereafter with an either side brake as defined in this report unless it has been approved by the Board of Trade on the advice of the committee.

Reinforced Concrete.

Bearing upon my note on this matter last month, I am able to state that reinforced concrete has been employed to a considerable extent both at Woolwich dockyard and Woolwich arsenal. The material has been made use of in foundations, in piling, and above ground, and is considered by the War Office authorities to be satisfactory and economical. The first instance of its use there was in the construction of a storehouse at Woolwich Dockyard, erected between October, 1904, September, 1905. In addition to the above reinforced concrete has been employed by the War Office in the construction of a roof and stairway in Cairo in 1905, and was found economical and satisfactory. Evidently, therefore, the War Office does not share the pessimistic views of the Local Government Board as to the lasting and economic properties of this form of construction. Apropos to this matter also is the report of a committee appointed by the Royal Institute of British Architects to draw up rules as a guide to architects in using reinforced concrete. This committee was presided over by Sir Henry Tanner, I.S.O., of His Majesty's Office of Works. The aim of the committee has been the production of a good working guide, the laying down of the necessary conditions and setting safe rules for a proper disposition of the parts. The rules proposed are by no means revolutionary; in fact they are the same principles that are being adopted abroad, but with some variation of detail. There is not sufficient space here to deal with the report at great length, but it may be pointed out that the results of a large number of tests are embodied, including some by Prof. W. C. Unwin, F.R.S., whilst there is also a large amount of information regarding the design of beams and columns.

Surface Contact Tramway Experiment in London.

The decision of London County Council to adopt the surface contact system of electric traction upon one of the present horse tram routes in the east end of London marks a change of policy in tramway matters which is very welcome. Political considerations enter largely into municipal government now-a-days, and no doubt for this reason, the London County Council in 1900, owing to the elections which were then about due, inserted in a tramway bill promoted that year, a provision that in no district should the overhead system be adopted without the consent of the local authority. In consequence of the lavish adoption of the conduit system in the south of London—a good portion of which later experience has proved to be unnecessary—the local authorities in the north equally determined to have nothing but the conduit system, or some similar system. Consequently, by reason of many attempts on the part of the London County Council to get the local authorities in the various boroughs to change their attitude, considerable delay has been experienced in converting some of the lines on the north of the River Thames which have been in the County Council's hands for some time. The most obstinate of all has been the Poplar Borough Council, and as the only course, it has now been decided to instal the Griffiths-Bedell surface contact system, which has, for nearly two years, had a good trial at Lincoln. The average cost of this system is put at £10,500 per mile of single track, against £17,000 for the conduit system, and £9,500 for the overhead system. The route in the borough of Stepney, which has been selected for the experiment, is about 3½ miles long, and the total cost, including special equipment of cars, cables, car shed, etc., being put at £122,210. The company operating the "G. B." surface contact system agree to withdraw the equipment at its own cost if the County Council are not satisfied with the results. If the County Council, when it first became the tramway authority in London, had shown less desire to consider the wishes of the borough councils, and more disposition to economise in the general interests of the ratepayers, considerable expense would have been saved both on the conduit system and on parliamentary expenses.

Ice Problem in Engineering Work in Canada.

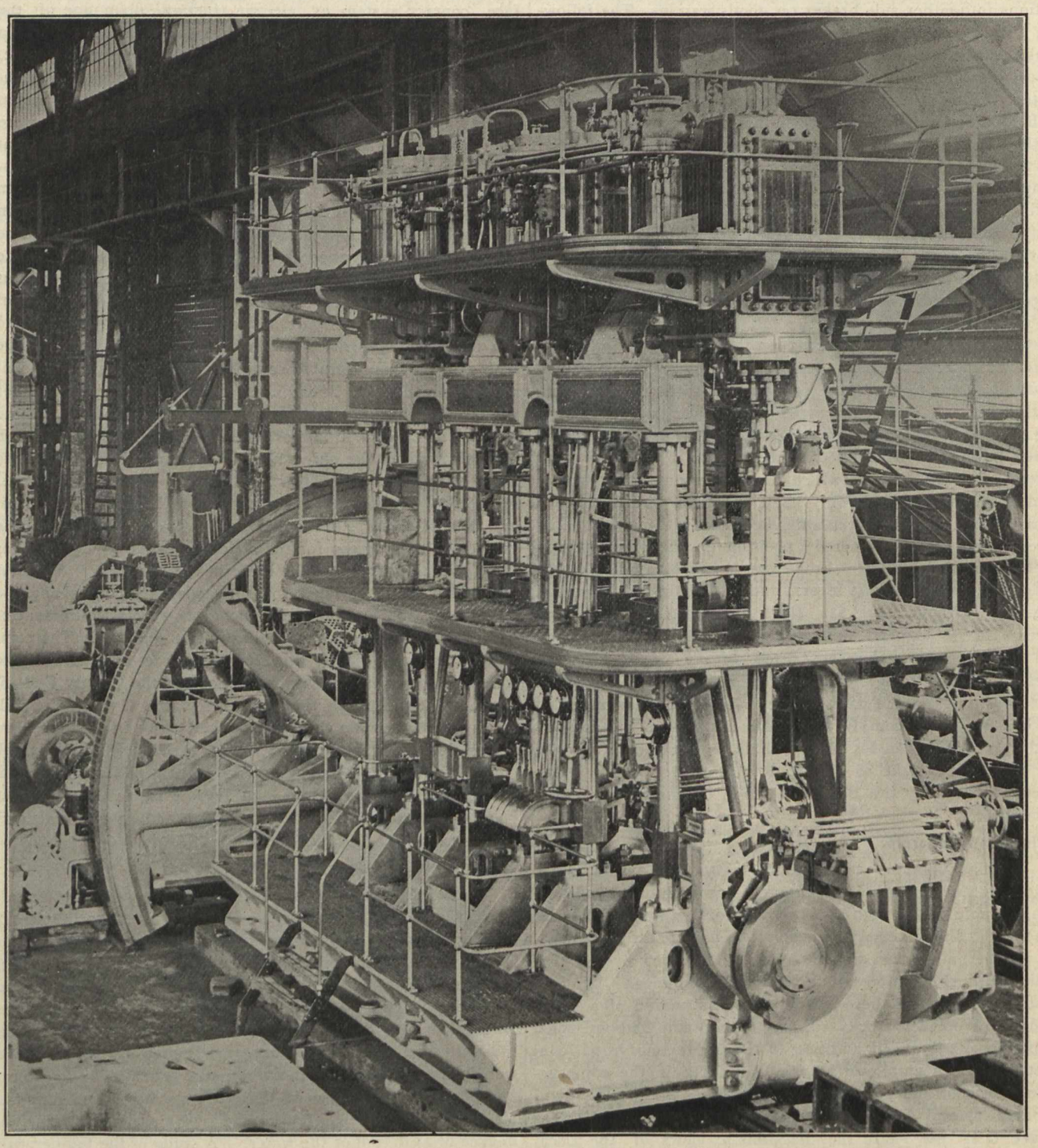
Before the British Association meeting at Leicester last week, Dr. H. T. Barnes of the McGill University, Montreal, read an interesting paper on the ice problem in connection with hydro-electric installations in Canada. He said there were three kinds of ice to be reckoned with, namely; (1) surface or sheet ice; (2) specular ice, or as it is called in Canada, frazil ice; (3) anchor ice. Frazil ice, which gave the most trouble in hydraulic work, was formed by surface agitation in the more turbulent rivers and waterfalls, and accumulated in great quantities in the quieter waters. It varied in size from thin plates to fine needle crystals, depending on the degree of agitation of the water. A study of the temperature conditions in the water during the production of these forms of ice showed that it was accompanied by a small temperature depression in the water amounting to a few thousandths of a degree Centigrade. During the severe weather, the water was thus thrown into a slightly super-cooled state, during which time the ice crystals are growing rapidly by continued freezing, and giving rise to the agglomerating stage, when they stick together into lumps and spongy masses, and adhere to the racks or to the machinery of the wheel gates or turbines. Fortunately it was only a small temperature depression which brought about these conditions; consequently the action of the sun during the day was sufficient to prevent the ice from gaining a foothold. At night, however, it had been found

most important to have available a system of steam injection, or electric heating, which can be readily applied about the machinery, in order to prevent it from becoming super-cooled. It was not found necessary to warm the entire volume of water passing through, which would be very costly and difficult, but by applying the heat in the racks or wheel cases, or blowing steam about the affected parts, the ice is prevented from gaining a foothold. In places where the steam injection system is installed, Dr. Barnes says that no trouble is experienced, even in the most severe weather; thus completely demonstrating the feasibility of coping with a situation which, for many years, has been regarded as involving inevitable interruption to the continuous operation of the plant. Many interesting photographs of machinery choked with ice were exhibited, and also a diagram showing method of steam injection into wheel cases to prevent frazil ice sticking to the metal. The paper concluded with the remark that it may be safely said that the ice problem in Canada is no bar to the future development of her vast water powers.

British Association Meeting in 1909.—The Council of the British Association has accepted an invitation to hold its meeting in the year 1909 in Winnipeg. In 1908 the Association meets in Dublin.

Submarine Signalling.—Trinity House, having received the necessary financial sanction of the Board of Trade to an expenditure of £1,200 for submarine bell signals, steps will be taken for fitting, as soon as possible, of this form of fog signal on board three of the Corporation's vessels.

The Poplar (London) Borough Council installed, twelve months ago, an installation, upon the Hermite process, for the manufacture and supply of electrolytic disinfectant, and the results of the first year's working now published are extremely satisfactory. The system adopted at Poplar is to mix a certain quantity of fluid in an elevated tank and then to allow this fluid to flow through four double troughs, or cells, placed one above the other, so that the liquid descends continuously by gravity. Each trough is divided laterally by a partition, and in each of the two divisions, five distinct "elements" (consisting of one positive and two negative plates) are suspended. The positive plates are of thin platinum wire wound upon slate slabs, and the negative plates are zinc. There are thus four troughs, each containing ten elements,



Brighton Corporation Pumping Engine, Built by Messrs. Fleming and Ferguson, Paisley, Scotland.

or 40 cells in all. As the liquid passes through the troughs it is subjected to the action of a regulated current of 15 to 17 amperes at 230 to 250 volts, being 5.7 to 6.2 volts per cell. The balance sheet shows that 17,000 gallons of fluid have been manufactured of a strength between 4.0 and 4.5 grammes of available chlorine per litre—1,000. There have been required 2,543 units of electrical energy at 1½d. per unit.; 4 tons of salt at 25 shillings per ton; two tons of chloride of magnesium at £3 17s. 6d. per ton; caustic soda, costing £4 os. 8d.; together with water costing £2 15s. 8d. After making allowance for the small quantity sold, the cost to the borough for this disinfectant which is given away, has been £597 14s. 3d. for the past year, compared with £664 2s. 9d. in 1903; £711 6s. 11d. in 1904; and £862 5s. 7d. in 1905; these latter figures being, of course, for carbolic disinfectant.

London Traffic.

The appointment of a Royal Commission to enquire into any particular subject is more and more becoming regarded as a means of delay. A glaring example of this is the Royal Commission on London Traffic, which sat from 1901 until 1904, taking evidence, and even now its recommendations have not been acted upon. In consequence, so acute has a certain aspect of the traffic question become that the companies giving transportation facilities have joined forces and have created a standing committee to deal with urgent questions. The Board of Trade has also established a temporary department to give assistance and advice on matters relating to traffic in London generally.

Wireless Telegraph Convention.

The decision of the Government to ratify the wireless telegraph convention signed in Berlin last October, without further discussion, and on the strength of a report carried by a majority of only one, has given rise to considerable adverse criticism, even The Times taking sides against the Government. It is suggested that the Government has acted precipitately in the matter, and should have summoned a conference of the colonies before coming to any definite decision. At the same time it should be pointed out that it still rests with the colonies to adhere to the convention or not as they think fit. The action of Great Britain in no way binds them. The committee in their report find themselves unable to admit that the Marconi Company will be injuriously affected, but recommend compensation on the basis of three years' profits at the British stations, should financial damage be proved after the convention is put into operation.

A Large Pumping Engine.

The illustration herewith depicts a set of pumping engines supplied by Messrs. Fleming & Ferguson, of Paisley, to the Falmer pumping station of the Brighton Corporation. It has a capacity of 50,000 gallons.

Messrs. Yarrow's New Works.

Operations have been commenced at Glasgow in connection with the new works which the well-known firm of Yarrow & Co. are building in substitution of their present London establishment. The land is at Scotstown. So advanced is the work that the keels of two new torpedo boats have been laid down. All the shops are constructed of steel filled with brick. There is a river frontage of 780 feet. All the machinery will be electrically driven, power being supplied by the Clyde Valley Electrical Power Co., and many of the motors will be transferred with other machinery, from London. The launching slips occupy 350 feet of the river frontage, the slips being inclined at an angle of 60 degrees. There is an engineers' shop 210 feet long, a boiler shop 300 feet long; a platers' shed 180 feet long; a galvanizing shop, patternmakers' and joiners' shops, smithy, etc. The main reason for the transfer from London was the heavy rates and high cost of land.

The new German torpedo boat, "G. 137," is declared to be the fastest war vessel afloat. She has attained a speed of 33.9 knots, with Parsons turbine engines. Another torpedo boat, with turbine engines of the Curtis type, is being built at the Vulcan yards at Stettin. It will thus be decided which type of turbines will be adopted by the German Navy.

INVESTIGATIONS OF STRUCTURAL MATERIALS BY THE UNITED STATES GEOLOGICAL SURVEY.*

With the problems arising from the growing scarcity and consequent increase in the price of wood, principally lumber used in building construction, the search for a desirable substitute becomes a matter of prime importance and justifies the work now being done by the United States Geological Survey at it structural materials testing laboratories at St. Louis.

The increased use of concrete in many forms during the past few years, especially for building purposes, has created a great demand for information regarding the structural value of this material. For a number of years limited investigations designed to obtain this information have been carried on by a number of investigators throughout the country, but no serious attempt at co-operation in this work had been made until a few years ago, when the United States Geological Survey, recognizing the need of information and co-operation, procured a small appropriation for making tests of structural material and invited various technical societies to take part in the work.

A committee, called the Joint Committee on Concrete and Reinforced Concrete, was invited to assist in outlining the work at the laboratories. This committee is composed of members of the American Society of Civil Engineers, the American

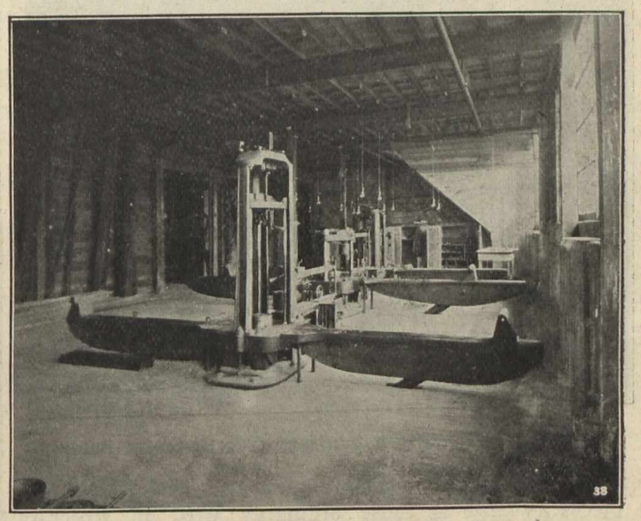


Fig. No. 1.—Three Concrete-beam Testing Machines.

Society for Testing Materials, the American Railway Engineering and Maintenance of Way Association, and the Association of American Portland Cement Manufacturers. The leading professors of engineering from almost all of the large colleges in the country are members of this committee, and they exercise general supervision over the work.

An Advisory Board, composed of leading engineers throughout the country was at once created, and has had general supervision of the work.

Tests are being carried on to determine the value of different sands, stones, and other materials used in the manufacture of concrete. The material is shipped from all parts of the country by geologists connected with the work, and a complete record of the material is sent in by them. At the laboratories this material is made into mortar and concrete by using the different percentages ordinarily employed in practical work, and following as closely as possible practical conditions.

In addition to the study of the constituent materials of mortars and concretes, structures of various kinds similar to those used in buildings are made and tested.

The equipment of the laboratories at St. Louis for carrying on this work is very complete. In addition to all needed smaller apparatus there are four testing machines of 200,000

*Written by Richard L. Humphrey, engineer in charge of the structural material division United States Geological Survey.

pound capacity and one of 100,000 pound capacity, suitable for testing beams and other structures used in buildings. These machines will test beams up to twenty feet in length and are equipped to make tests of the different materials used in construction work. Three of these machines used in the beam division are shown in Fig. 1.

In addition to the above machines a very large machine, having a working capacity of 600,000 pounds, will in a few weeks be installed at the laboratories at St. Louis. As far as known at this time there is only one other machine in the United States similar to this. This machine will make it possible to test columns, beams, and, in fact, all the different kinds of construction material now used. It will test very large reinforced concrete girders up to spans thirty feet in length and concrete columns up to thirty feet in length.

The value of such tests as these is readily apparent, since their results can be applied directly to practical work. A very serious objection to the use of results obtained in tests made by private investigators is due to the fact that the tests were applied only to small specimens not nearly approaching in size the parts or pieces used in actual construction. Heretofore it has been necessary to consult the results of these small tests in order to have some basis for design, but it is now clearly recognized that the best results can be obtained only

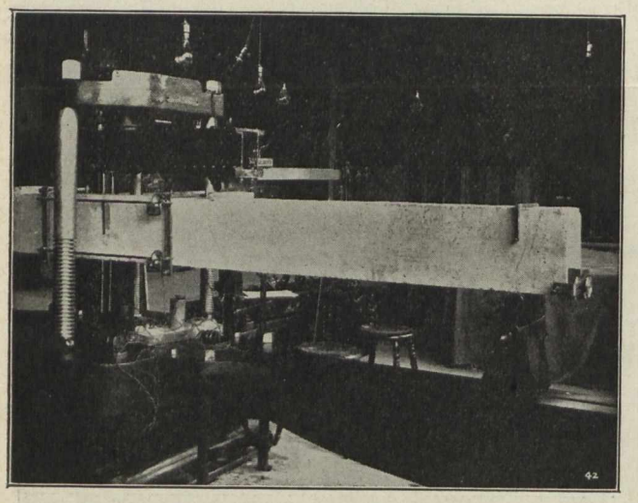


Fig. No. 2.—Testing a Thirteen-foot Concrete Beam.

from tests made on members as large as possible, or at least on pieces as large as those ordinarily used in structural work.

All the concrete used at the laboratories is mixed in three Chicago cube concrete mixers, each of which is mounted on skids, geared to a motor and equipped with charging hopper. One of these mixers has a capacity of one cubic yard, and the others will contain one-third cubic yard each. After the concrete is mixed it is carefully tamped in moulds to form the different pieces on which the tests are made, such as cylinders, cubes, and beams.

The laboratory also uses five hollow concrete block machines, used for making concrete blocks similar to those used in actual construction, and the several different divisions,—the constituent materials division, the beam division, the concrete block division, the permeability, the shear and tension and the chemical division are equipped with all apparatus necessary for conducting their tests.

Although reinforced concrete is used to a remarkable extent at the present time, and both concrete and reinforced concrete construction is becoming more and more popular every day, it is evident to any one familiar with construction work that these materials will be more generally employed within the next few years. Many engineers are prejudiced against the use of concrete and reinforced concrete, but this prejudice is rapidly being removed by the obtainment and publication of reliable data regarding this material. Without doubt, in a very few years, when most of the principles underlying the use of concrete and reinforced concrete have been fully established from tests and investigations, there will be little prejudice against the use of concrete; the present prejudice evidently being due to lack of information.

The longest beam thus far tested in the beam division has been thirteen feet in length. Beams of this length tested are made without steel, that is, of solid concrete beams, and also with varying proportions of steel, ranging from very small percentages up to three per cent. A full size beam in the testing machine is shown in Fig. 2; the load is applied at the top of the beam at points four feet from each end. The men conducting the tests watch the beam very closely while it is in the testing machine, and examine its surfaces with magnifying glasses in order to locate the fine cracks as they appear. In the beginning a load of about 5,000 pounds is applied and the machine is stopped with this load on the beam. After the observers have examined the beam carefully and made a record of the cracks appearing at that time, the load is increased, and after every 1,000 pounds additional the beam is again examined until the maximum load is applied.

In a very large number of tests the beam shows no cracks that are visible to the eye until the maximum load is reached, when the steel reaches its elastic limit and begins to stretch fast, this result ending the test. The cracks that appeared on the beam and the loads at which these cracks appeared are recorded by photographs.

In beginning tests of reinforced concrete simple round rods were used, as it was thought that more uniform results could thus be had than if any of the patented systems were used. After a complete series of tests with the round rods has been made, it is proposed to take up tests of the different forms of bars that are used in practical work, and the results will be published from time to time by the Geological Survey. Tests will be made of beams ranging from six to twelve feet in length, and because of longer span will be tested later, if necessary, in order to get results that can be applied to almost all practical conditions.

The concrete used in the different beams tested, as described above, is moulded into cylinders and cubes, which are tested in order to get the direct strength of the concrete. These cylinders and cubes are all tested at different ages, generally at ages of 7, 28, 90, 180, and 360 days. The cement, sand, stone, gravel, or other material composing the concrete is carefully proportioned by weight, the correct percentage of water is used and the whole mass is placed in a mixer and thoroughly mixed. It is then deposited very carefully in moulds or forms, which, after twenty-four hours, are removed. The concrete is then moved into a storage room, and is there sprinkled with water three times each day. Each test piece is numbered on a card index, which tells where information relating to the test pieces can be found and also indicates the dates on which the different pieces are to be tested.

A branch of the work that should be of interest to everybody, especially the small home-builder, is the investigation of cement building blocks. Many houses are now built of cement blocks in preference to wood, because generally cement block construction is cheaper and better than wood, since it is fireproof, more durable and less expensive to maintain. The exterior surfaces of wooden buildings must be painted, and clap-boards must be added from time to time; but when the cement block building is finished, the surface is there once for all; no further treatment, no repairs, no maintenance are necessary.

All the cement blocks used in these investigations are mixed in concrete block machines. The concrete is mixed in a one-third cubic yard cubical concrete mixer and deposited on the floor of the testing room. It is then shoveled into the hollow block machines and compacted very firmly in the forms. Varying proportions of concrete, sand, and stone are used in order to determine the relative value and economy of using different mixtures. Some blocks are made of wet concrete, others of concrete very dry, and still others of concrete having a consistency medium between wet and dry. In actual practice, concrete blocks made from comparatively dry concrete is usually preferred by the manufacturers, for these blocks harden quickly and the forms may be removed almost as soon as all the concrete is placed in the machine. By this practice it is possible to use the same machine for making a large number of blocks each day, whereas when wet concrete is used, the blocks must remain in the machine for a much

longer time before they can be removed. When the concrete blocks are removed from the forms they are placed in the storage room and tested at different ages. Cylinders are also made from the same concrete that is used in the blocks, and the results of tests of the cylinders and of the blocks establishes a relation between the strength of the concrete in the cylinder and that of the concrete in the block.

When the blocks and cylinders are placed in the storage room, each test piece is numbered and its number is filed away on a card in a card index. Each card bears the date on which the test piece is to be tested and the cards are filed in chronological order. This brings the current date at the front of the drawer each morning, when cards bearing the same date are taken out and the pieces are taken from the storage room and tested. The results are compiled on forms and later published in reports issued by the Geological Survey.

Concrete blocks are tested at the laboratories in two different ways; first as shown in Fig. 3, to see how much of a centre load each block will stand. Although blocks are not actually subjected to a load of this kind in practice, the results of this test make it possible to compare the relative values of different building blocks. Second, after the block has been broken at the centre by this load, each half is placed in the testing machine and crushed, in order to find the crushing strength of the block. The results of this crushing test show how much pressure similar cement blocks will stand when used in actual building construction.

The results of the great fires at San Francisco and at Baltimore demonstrated very clearly the fact that modern

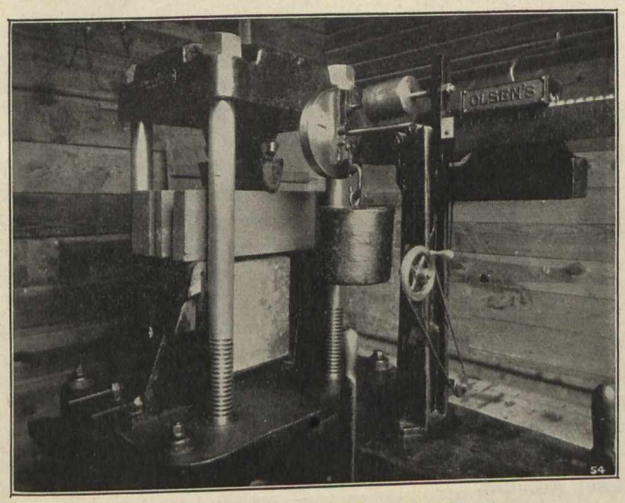


Fig. No. 3.—Testing Concrete Blocks.

buildings are not so nearly fireproof as they should be, and as they can be made. The lack of fireproofing in the past has been due somewhat to the reluctance of owners to add a small percentage to the cost of their buildings by properly fireproofing them. The failure to employ fireproof construction more generally, however, was due in part to the fact that proper information was lacking, and many engineers, architects, and owners who tried to make their buildings fireproof used all the information at their command at the time of building.

The art of fireproofing has been developed rapidly within the last few years, but there is still much to be done, especially in relation to the fire-resisting properties of concrete. In order to obtain information to meet these needs a series of fire tests are being carried on by the Geological Survey at the Fire Underwriters' Laboratory at Chicago.

For this purpose a hanging door, having a steel frame and a one-foot wall of fire brick inside of it, is used. At the centre of this frame there is an arched opening of about the size of an ordinary door. For the fire tests this opening is built up successively with different materials, ordinary building brick, fire brick, hollow tile blocks, the different kinds of cement building blocks, stone, concrete and terra cotta. After the opening is filled, a flaming gas jet is played all over the door for a long time, and when the heated surface is very hot, the gas is turned off and the door allowed to cool. In some tests the cooling takes place slowly, in others a stream of water is played on the door immediately after the gas is turned off in order to reproduce as nearly as possible the actual conditions in a fire.

When these tests are completed, the results will not only show engineers and architects what material is best for fireproofing, and how much should be used to procure the best results, but will also teach the small builder, the builder of a home, what kind of a cement block is best adapted to make his house fireproof.

It is the consensus of opinion among engineers that a reasonably fireproof building can be constructed, and it is hoped that the art of fireproofing will be so developed in the next few years that the public will also be convinced that this is true. It is also desirable that the public should be thoroughly informed as to fire-resistive qualities of the various classes of building materials, and it is expected that the work being done by the United States Geological Survey will furnish reliable information, not only on this subject, but also in regard to the strength and other properties of these materials.

TELEPHONES IN THE LUSITANIA.

For probably the first time in the history of telephony, passengers on a steamship were able to talk direct to London, Paris, and other important centres. The occasion was the sailing of the Cunard liner "Lusitania," which, on hauling alongside the Princess Landing Stage to embark passengers, was immediately connected by cable with the shore. This ship, together with the "Mauretania," now being completed by Messrs. Swan Hunter, and Wigham Richardson, has been fitted with a central battery, private branch exchange, designed to be connected with the Liverpool and New York telephone exchanges when the ship is in port. Ten pairs of wires are carried from the distributing frame to a specially designed box at each side of the ship. It is through these boxes the connection with the shore exchange is made. They contain ten pairs of platinum-tipped bronze springs carried on an ebonite slab. The ten pair cable is taken through a nozzle in the box, and the conductors are connected on to their respective terminals. Three similar boxes are fitted, in small chambers, on the landing stage in pits beneath the deck, each having ten junction lines from the town exchange terminating on them. Ten pairs of wires are carried in a flexible cable fitted at each end with a cable head. The head consists of a gunmetal casting fitted with ten pairs of platinum-tipped studs carried on an ebonite slab. The cable is passed through a brass nozzle and the conductors connected to terminals inside the cable's head. When the cable head is in position on the fixed terminal box an automatic spring catch secures the contact of the studs and springs, thus connecting the exchange junction through to the ship's switchboard. In connection with the sailing of the "Lusitania" a device designed for landing the passengers' baggage on the deck from the landing stage was for the first time brought into operation. This consists of a steel lattice framework capable of telescopic extension carrying an endless band fitted with cross battens. The upper end is lifted on to the ship's rail and the band set in motion, and the luggage is placed on the traveller and carried up to the deck. The machine is driven by means of an independent electric motor. It worked excellently, and carried the baggage on board at the rate of about 3,600 packages per hour.

ELECTRIC IRRIGATION.

The first electric irrigation system ever used in Southern British Columbia has just been installed. A pumping station has been erected, and the electric energy used to work this plant comes over the West Kootenay Power Company's line from phœnix. It is considered that the establishment of this plant will, in a great measure, solve the problem of the irrigation of several thousand acres of fruit lands in the Kettle Valley.

THE COST OF POWER AS A FIXED CHARGE.*

By L. C. Read, M.E.

Note.—This paper was received just before going to press, and to put it in the available space, it has been found necessary to omit some, and change the wording of other parts.—[Editor.]

The cost of power as a fixed charge in manufacturing is a subject which has gone so long without expert treatment by the average manufacturer that he has come to look upon his coal bill as an item of expense with which little or nothing can be done, except pay it.

I take it for granted that most of you are generating your own power, in your own premises. That some of you are purchasing power from hydroelectric sources. And that all of you are interested in the question—"Can I produce my own power at a lesser cost than it can be purchased for from the outside?"

Every manufacturer is in intimate touch with the business side of his concern, but as for power—beyond his coal bill and what he pays his engineer the average manufacturer does not know and, in my opinion, does not make a proper effort to know the exact cost.

Since nearly every manufacturing plant which produces its own power is equipped with a steam plant, let us take as an illustration a moderate sized, ordinary steam plant and assume that it operates on a basis of ten hours per day for 300 days in the year, and the average actual power required throughout each day of ten hours is 200 horse-power, coal being $3.50 per ton.

The coal bill for one year in such a plant will be not less than $4,200. You will pay your engineer $1,000. Fireman $720, and after the incidentals have been added—for oil, packing, waste, etc.—the total will amount to $6,200. Then, adding for interest and depreciation will easily bring this amount up to at least $7,000, or, say, $33 per horse-power for the average of 200 horse-power. There is not, perhaps, one manufacturing plant in fifty making its own power for so low a cost as $35.

What does this $7,000 per year as a fixed charge for power stand for? $7,000 represents the net profits on perhaps from $75,000 to $100,000 of finished product. It represents a fixed charge against your business, equivalent to $140,000 of 5 per cent. bonds, and it is needless to say that you would give much serious thought to the question of the issuance of such an amount of bonds, and that you would analyze all the vital elements in your business before you decided to incur such a burden upon your earnings. In the face of this you pay $7,000 a year for power, without having given anything like a corresponding consideration to the question as to whether or not $7,000 per year for an average of 200 horse-power is the right price.

Look only at the coal bill of $4,200. Perhaps most of you do not know that of these $4,200 burned under your boilers, $3,800 are lost—absolutely non-productive; that out of every dollar's worth of coal burned, over 90 per cent. goes up the chimney and out of the exhaust, without doing work of any kind. This is what is happening every day in the average plant.

It is obvious that to get the cost of your power down to a point where the outlay in that department is consistent with the economies demanded in the science of modern manufacturing you must either secure a reduction in the price of coal or you must generate your power on less coal. The first alternative is at present out of the question, but to materially reduce the amount of coal required to produce your present horse-power is an easy matter if you will give this department the expert treatment which it deserves.

What Is a Horse-Power?

We hear on every hand, "so much per annum per horse-power." "Cost per horse-power hour." What is a horse-power hour? If all the power in this little piece of coal (shows specimen) could be utilized, if all its latent energy could be converted into actual work, it would lift 1,980,000 lbs. one foot high in one hour, or nearly 1,000 tons of dead weight off the ground for one hour. It weighs but 2¾ ounces, and yet could lift a weight twelve million times greater than itself. In other words, it contains the net equivalent of one horse-power hour.

Now let us digress for a moment and make this point clear. I have taken two pounds to represent the best average economy of the fire. The Simplex Reciprocating Steam Engine, the Compound Condensing Steam Engine, the Steam Turbine, the Gas Engine, and the Oil Engine. Each has its place; each has its just claims, and no one type will ever supplant any of the others.

When you undertake to convert this amount of latent energy into the actual driving of machinery, I will not say that you must burn, but that you do burn a piece this size (5 lbs). We cannot convert all of this latent energy into actual work, because nature demands a premium on what she gives us, and a big premium. On the other hand, however, she does not ask us to pay any such price as this (5 lbs.) for one horse-power hour.

We know that a horse-power hour of actual work can be produced for 2 lbs., it therefore becomes apparent that in the average plant there is being burned unnecessarily and without return the difference between 2 and 5 lbs.. or 60 per cent. more coal than is required by present day methods. If, therefore, six per cent. of this $4,200 coal bill can be saved, or say $2,500 per year, you may then consider you have retired an obligation of $41,500. Would you not consider a department worthy of expert treatment which unnecessarily places upon your business the equivalent of a $41,500 obligation at six per cent?

If you will treat your power as a department, and if you will give to that department the attention it deserves, you will easily confirm the claim that modern practice and actual results will place this great economy within your reach.

This subject of power cost must be approached as a fixed charge in your manufacturing with a serious mind. You must ascertain what your load factor is, and know what actual horse-power it takes to drive your plant, and when you know this you have got the key which will open the door to an important department in your business—a department which you have hitherto neglected.

To ascertain the load factor a diagram covering the daily run must be made by an expert. This diagram must show the horse-power output from your engines at every hour during the day's run, and, preferably for a number of days in succession, so that the load factor may be arrived at—the average actual horse-power you require.

Power Account.

A power account should be opened, and into that account charge that part of your capital invested in engines, boilers, pumps, dynamos, power house, chimneys, foundations, piping, shafting, belting, and every part of your equipment which either generates or transmits power, together with all its accessories. This item will show you how much of your capital has been invested in your power department, and then you will know upon what amount to charge for depreciation. Charge against this account your fuel, engineers' and firemens' salaries, oil, water, repairs, upkeep, and all the incidentals which in the average manufacturing plant are lost in other accounts. Some may say "Yes, but all these items come out at the end of the year in some other account. So what is the difference?" The difference is simply this: that in order to manage your power department in a way that will insure your getting power at the right price, you must know all about that department, just as you know and insist upon knowing all about the other departments in your business.

With the load factor known, and with all these items charged into this account, it then becomes merely a matter of dividing the total number of dollars footed up by the average horse-power taken from your power diagram—for one year—and the quotient will be your cost per annum per horse-power.

It may not be for me to set down an arbitrary amount per annum per horse-power as representing the price at which you would be justified in generating your own power

* Paper read before the Canadian Manufacturers Association at Toronto, September 26, 1907.

instead of purchasing it from outside sources, but I will assume the responsibility of saying that unless you can purchase from outside sources, after charging interest and depreciation and everything which is properly chargeable to such motor equipment and appliances as may be necessary for you to utilize outside power, you must not pay more than $25 per annum per horse-power, and only upon your average load and not upon your maximum load, and with no stand-by charges! I will, however, place a minimum limit upon your load factor; that is to say, your average horse-power requirement should be at least 60 per cent. of your maximum load. Or, in other words, with a maximum of 100 horse-power and a minimum of 20 horse-power—or a load factor of sixty per cent.

In your plant you would contract to pay $1,500 per year and no more. For, obviously, if it can be shown conclusively that you can produce your power on this basis, at this price—why should you pay a higher price than this for it from some outside source?

Whatever you may pay to outside sources in excess of this price represents just that much dead loss in your business, and when you consider that a reduction in your fixed charges of even $2 per day is equivalent to your going to your bank and paying off $10,000 of oustanding six per cent. paper you will realize that the earning power of money, like the latent heat in coal, is fraught with great possibilities, when given the proper treatment.

Power Company's View.

Now let us take the point of view of the power company, which sells its power as a public utility. Some think that the development of water powers will solve this great problem of power cost. But it has already proved itself a difficult problem. In the first place water powers are not always located at desirable points. Let us take a hypothetical case. Suppose we develop a water power with a maximum of 100,000 horse-power. Our total investment will amount to at least $65 per horse-power initial cost, or say $6,500,000. We contract to deliver power to thousands of users. Our whole equipment is designed and installed, with all our transmission lines, our transforming stations with all the local equipment required at points of destination; our management and our organization are based upon $6,500,000 actual investment. We will say that our peak load; that is, the top notch of our output each 24 hours, reaches the 100,000 horse-power mark.

It is safe to say that the load plot, that is a diagram showing the horse-power output at each hour during the 24 hours, will average not more than 40,000 horse-power. In other words, the total amount of power we sell equals a load factor of forty per cent.

Now 40,000 horse-power multiplied by $65 per horse-power (initial cost) equals only $2,600,000, and you will see at once that the price which must be charged per annum per horse-power must be an amount sufficiently high so that an average output of 40,000 horse-power (or $2,600,000 of our investment) will earn a return sufficient to carry the entire $6,500,000. This is the condition which usually prevails when a water-power is developed and expanded into a public utility.

On the other hand, if a water power is developed for local use, by an individual concern, obviating the necessity of long transmission losses and the low average horse-power output, you will readily see that, under these conditions, water power serves its best and most practicable purpose. The ten best water power developments in the world—including the cheap water powers of Canada—show an average cost of $10 to $12 per annum per horse-power. This is cost, not the price at which the power is sold.

Suppose, after allowances for transmission, transformer losses, fixed charges and a fair profit, it were delivered to the consumer for $20 per horse-power on the usual flat rate basis. You contract to pay for a certain amount of power whether you use it or not (say 100 horse-power). At the end of the year you will find that since your own load factor will probably not average over sixty per cent (for you, as well as the big power company, have your peak load and your minimum load and, consequently, your average horse-power requirement), what you have paid for what you have actually gotten equals $33.33 instead of $20. Because $20 multiplied by 100 horse-power equals $2,000, and $2,000 divided by your actual average load of 60 horse-power equals $33.33 per horse-power, or, sixty-five per cent. more per annum per horse-power than the rate named in your contract. You pay the power company $1,200 for power you do get, and $800 for power you do not get.

The Gas Company—a public utility—charges you for the exact amount of gas you use and no more. The Water Company—a public utility—does the same. Even the Street Railway Company charges you only when you ride. Now when a power company elects to expand itself into a public utility, on what theory has it the right to demand this premium of $800, this sixty-five per cent. for something it does not deliver? Is it because "the power is there, if you want it?" Then, so is the gas "there if you want it!" So is the water. Is it because of the power company's low per cent. of load factor? Then why have not the Gas Company and the Water Company an equal right to make the consumer pay the difference between their average output and their maximum capacity?

The answer is—that the sale of power—as a public utility—is a new enterprise. The consumer has overlooked the importance of this department. Hence the power companies make hay while the sun shines.

But there are exceptions where the average load factor in a plant is equal to and more than the minimum amount of power contracted for; but these exceptions are few, and you will find that a public power company avoids such contracts.

Now, just one final word. The key to this whole question is the load factor, the average actual horse-power required throughout the day's run. Do not confound this with your maximum horse-power requirement.

When you talk of "so much per horse-power per annum," I insist that it be based upon the average horse-power and not the maximum rating. And I insist that with a load factor of sixty per cent. it should not cost you—whether you make it yourself or purchase it from the outside—more than $25.

Discussion.

My answer to the point "when a power company sells power through a meter, making no other charge except a certain rate per kilowatt hour," its charge is so exorbitant that it can well afford to waive all other considerations.

On such a basis the power company usually charges from five to ten cents per kilowatt hour, and taking the average manufacturing day of ten hours and 300 days in the year, a charge of five cents per kilowatt hour is equal to $100 per annum per horse-power; or if ten cents per kilowatt hour is charged, the power company gets $200 per annum per horse-power for the amount of current actually delivered.

Since it can be conclusively demonstrated that the manufacturer can produce his own power—and that too on the average horse-power basis—for $25 per annum per horse-power, it is evident that if current is purchased from a power company through a meter only, the charge paid by the consumer is from four to eight times higher than he can produce it for himself.

This also answers the point raised that the power company is entitled to a return on its total investment (which of course, is conceded), but it is certainly not entitled to many times a just return on its investment.

Haiti has long been known as a country which has important resources capable of extensive development, even though its area is somewhat limited. Among its riches are the extensive iron ore deposits, which are now attracting considerable attention. The Government of Haiti, according to the "Bulletin" of the American Republics, has just granted a valuable concession for the exclusive right and privilege of exploiting these deposits in the district of Limonade, and it seems probable that further concessions will be presently granted that will develop other valuable fields of ore.

PROPOSED CENTRAL UNION PASSENGER STATION, AND TERMINAL HOTEL, OTTAWA, ONT.

In securing its entrance into the Capital City of the Dominion of Canada, the Grand Trunk Railway inherited the conditions imposed upon and accepted by its predecessor, viz.; to erect a Union Passenger Station. Vice-President Hays proposes voluntarily, in addition, to erect a first-class modern up-to-date tourist hotel, provided a suitable site can be found, which can be connected (by subway) with the station. This hotel would not only accommodate members of parliament, but visitors from far and near, and would help to develop and improve the beautiful city of Ottawa.

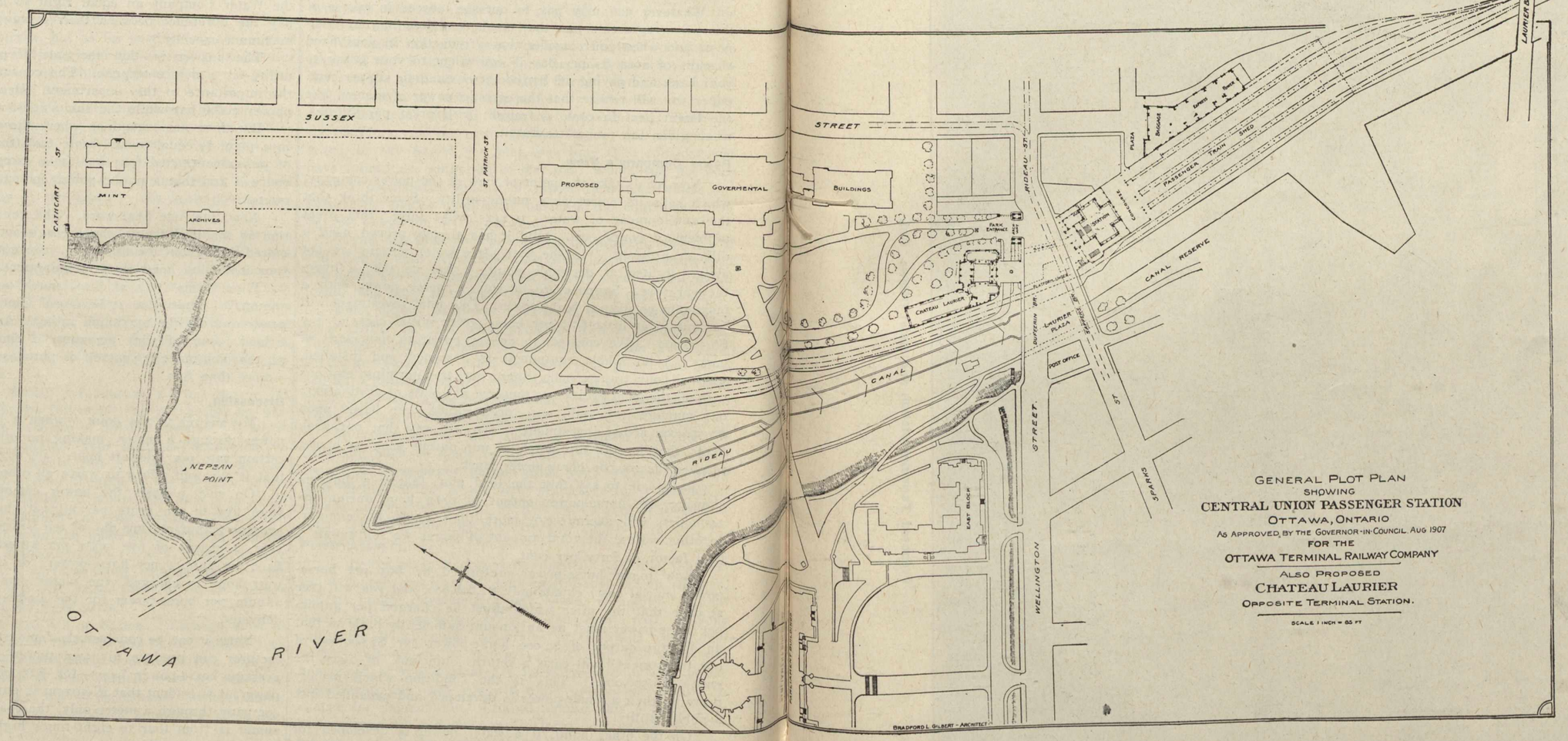
The Premier, Sir Wilfrid Laurier, before and since his recent trip across the continent and through England, has used every effort to help this problem along, and to his untiring zeal is due, in a great measure, the fact that this vast improvement is at last assured, and preliminary work has already begun on the site, and foundations for both structures will be put in position this fall.

The plates show the general ground plan and track layout, and two views; one from the roof of the station, looking towards the hotel, and the other from the post-office, looking towards the Plaza, and showing both buildings on either sides; from the design of Bradford Lee Gilbert, architect, of New York and Ottawa, who was selected on account of his experience as having solved many difficult terminal problems; among which may be mentioned the Grand Central Station, New York, the Illinois Central Station, Chicago, New York and New Haven at Fall River, etc.

Mr. Gilbert is also at present engaged in remodelling the Windsor Hotel at Montreal; Mr. Hardenbergh being associated with him, the latter being the architect of the world-famed "Waldorf-Astoria," "Manhattan," "New Plaza" Hotel, etc. The work at Ottawa will be looked after by local architects. Thus Ottawa will shortly possess railroad terminal facilities and hotel accommodations of which it may well feel proud, and which will help more than anything to develop the city's growth in attracting tourists and others to this beautiful, but so little visited section of the Dominion. Although a comparatively new city, Ottawa possesses many advantages over its sister cities, as to location and natural beauty. What is still more to the point, both the station and hotel, (the latter appropriately named "Chateau Laurier") will be located in the very heart of the city, both facing the Plaza formed by the intersection of Dufferin and Sapper's Bridges with Rideau Street. The hotel stands at the south-west corner of Major's Hill Park, overlooking Parliament Buildings, Ottawa River, Rideau Canal; in the distance, Chaudiere Falls, the Gatineau Valley, and the Laurentian Mountains encircling all; a combination view unsurpassed in Canada.

The union station and railroad office building as designed for the Ottawa Railway Terminals Co., (which is controlled by the Grand Trunk Railway), is approximately 150 feet square; main waiting room, ticket office, concourse, etc., being located on the track level adjoining a new station plaza 90 x 180 feet, for hacks, baggage wagons, street cars, etc., similar to the Bonaventure Station Plaza at Montreal

Adjoining this plaza and the station proper, the train shed 150 feet wide by 800 feet long, will extend alongside the Rideau Canal; the passenger platforms 20 feet wide, and over 1,000 feet in length, and covering 9 tracks with connection to Alexandra Bridge. This train shed is designed to be used for the accommodation of the Grand Trunk Railway, the Canadian Pacific, New York Central, and future connections.



The Rideau Street level is approximately 22 feet higher than the tracks. At the centre of the building at this level is a wide interior portico and lobby with a commodious stairway to waiting room below; also ample elevator service. The wide generous exit stairway from the train shed and concourse will be used for this purpose only, and extend to the intersection of Sapper's Bridge at the Rideau Street level, as at present from the old station.

The Mezzanine between grades contains the train despatcher and station master's offices, service rooms, etc. The upper floors are arranged for railroad offices, with all modern accommodations. The structure in all its details will be fireproof throughout, with framework of steel, and exterior of stone. A modern up-to-date structure with all accessories for convenience and comfort.

A separate annex is located at the axis line of Sussex Street, (which it is likely will be widened by the city), and contains baggage and expressrooms, also rooms for conductors and train men, mail, customs, power plant, etc.

The area of the principal rooms is approximately as follows; viz.:—General waiting room 52 feet square, with wide wings, each 50 x 50 ft., and 40 ft. in height. Woman's room, 52 x 32 ft., with rest room, lavatory, etc. Men's smoking room, 32 ft. square. Union ticket office, 52 ft. square. Lunch room, 52 x 35 ft. Sleeping car, telegraph office and information bureau each 15 x 20 ft. Train despatcher's, 52 ft. square. Phone booth, news stand, parcel room, etc., as required; also second class accommodation. Public concourse, 155 x 50 ft.; union baggage room, 90 x 70 ft.; express, 50 x 50 ft. etc.

The total ground area utilized for terminal station, approaches, etc., amounts to over 300,000 sq. ft. Thus Ottawa will possess when completed in 1909, a union station larger in comparison than any other city of its size either in the United States or Canada.

The "Chateau Laurier" will contain over 300 bedrooms and 125 baths in addition to ample service and public rooms, private banquet halls and ball rooms, special and royal suites, etc., also terraces on the ground floor overlooking the park, with lamps similar to the Bois du Boulonge, Paris.

In addition to all modern conveniences, accommodations and furnishings, which go to make up a first-class and successful hotel, it will be operated and maintained "par excellence."

In keeping with the Parliament Buildings, which dominate the local architecture, also the new Departmental Buildings soon to be erected, the station and hotel for the Terminals Railway Company, have been designed in a free gothic, which will all help towards the future realization of "the city beautiful." The foregoing information was kindly furnished by Mr. R. S. Logan, assistant to second vice-president of the Grand Trunk Railway.

THE TALLEST CHIMNEY.

According to "Power," September, 1907, the Eastman Kodak Company recently finished a brick chimney 366 ft. high, 19 ft. 6 in. inside diameter at the base and 9 ft. inside diameter at the top, lined throughout with a 4-in. acid-proof lining, with a 2-in. air space between the walls. The construction is of Custodis brick. This chimney is 1 foot higher than that of the Orford Copper Company at Constable Hook, N.J., and consequently is the highest in the United States, but will be greatly exceeded by the new chimney of the Boston & Montana Mining Company at Great Falls, Mont., which is now under construction.

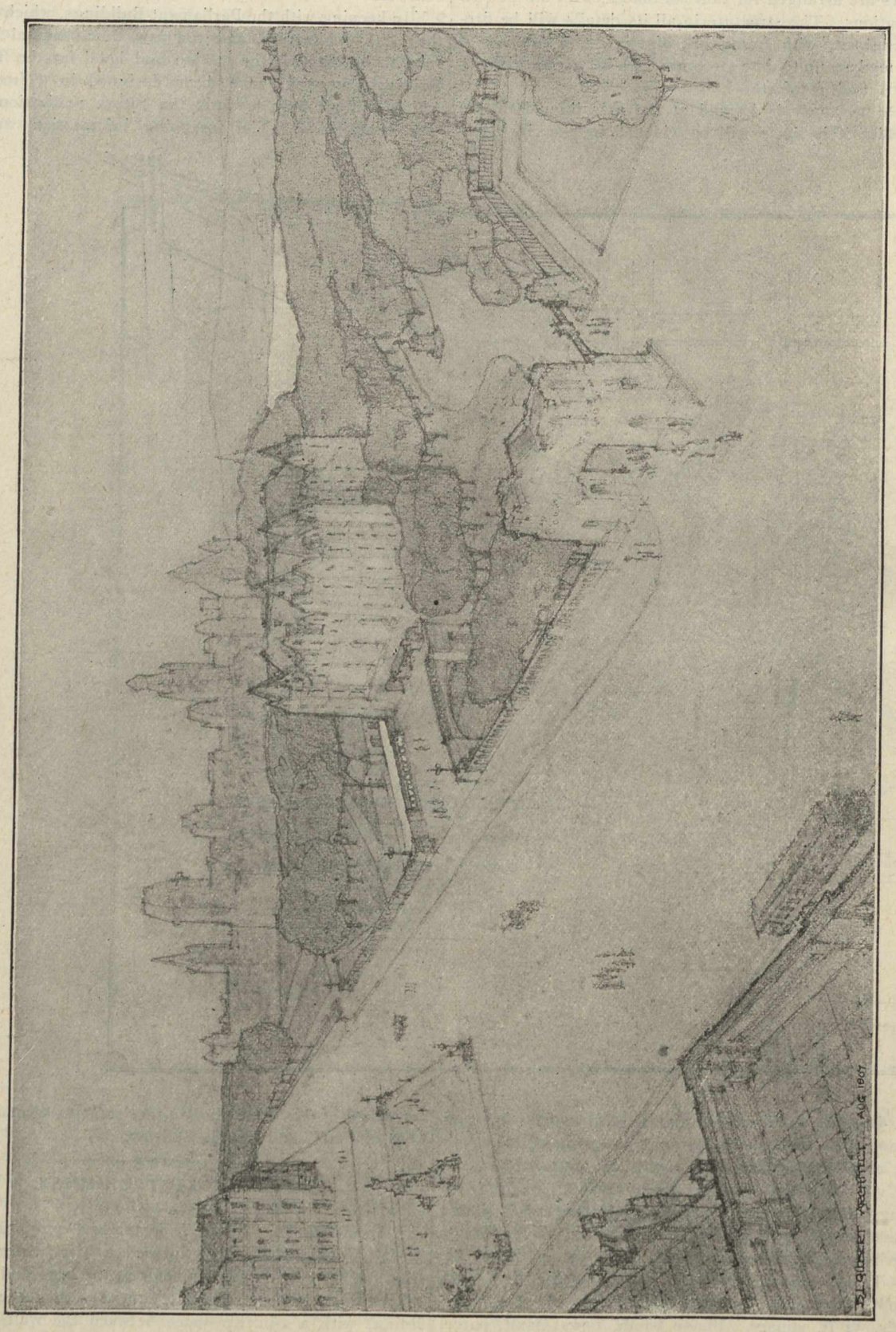
MINERAL RESOURCES OF NEW ZEALAND.

PART VII.

Antidotes for Cyanide Poisoning.

Cyanide plants are often situated in places some distance from a doctor's residence. The action of this poison is swift, and even with telephonic communication it would in most cases be impossible to bring a medical man upon the scene in time to apply any remedies. Freshly precipitated carbonate of iron has been suggested (1) and a mixture of caustic soda, ferrous sulphate, and magnesia (2). Peroxide of hydrogen has also been advocated, and nitrate of cobalt has been put forward and condemned. An authoritative pronouncement on the nature of the best antidote and re the advisability of promoting vomiting is urgently required.

As yet no one has been fatally poisoned in New Zealand by swallowing cyanide (3) by accident. Such an occurrence might, however, take place at any moment, as familiarity is beginning to breed contempt in the handling of this dangerous substance. In some cases family dwellings are within easy reach of the plant, and it often happens that small plants are left for hours at a time in charge of a youth from whom so much carefulness can hardly be expected as from a grown



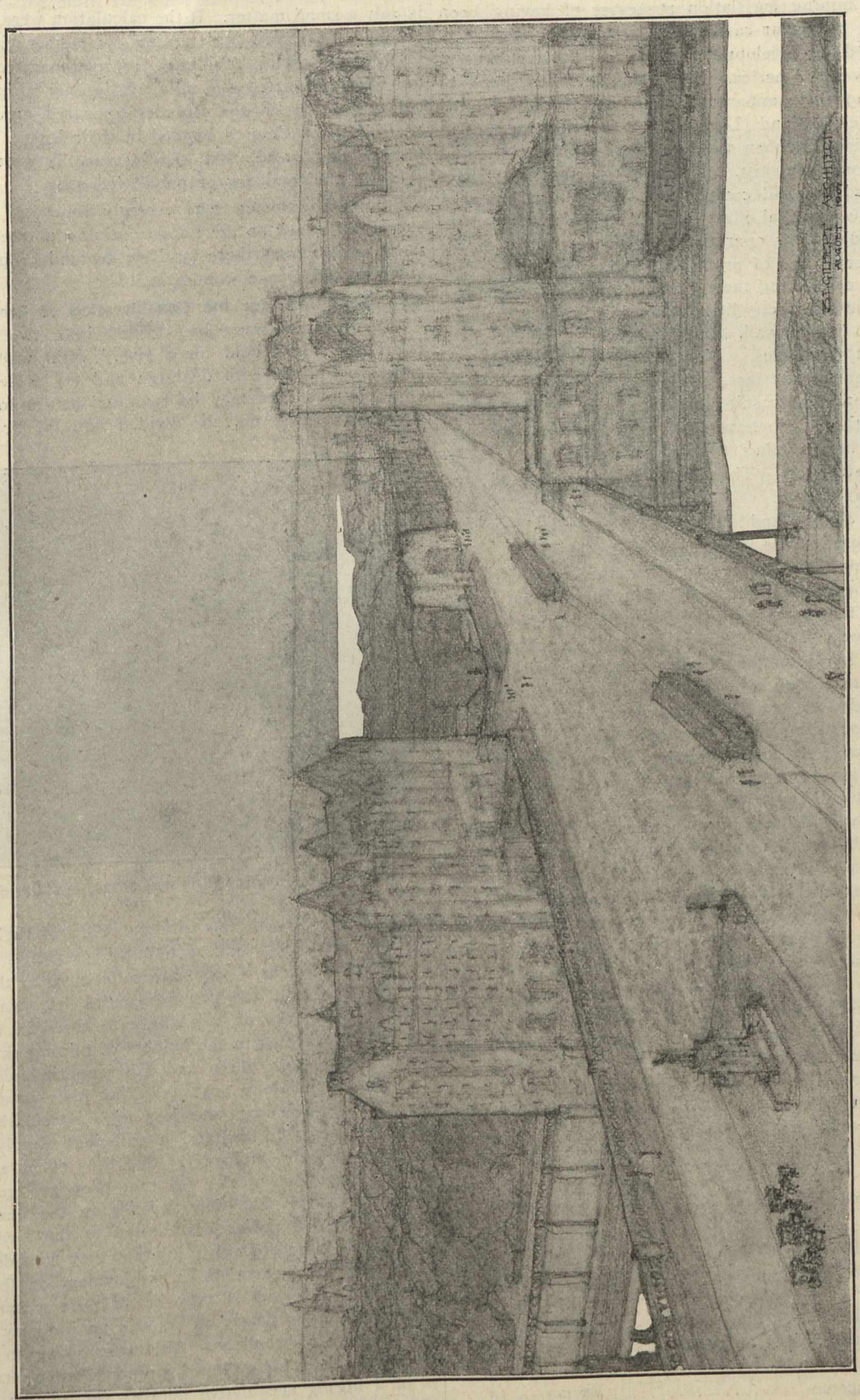
Proposed Terminal Station and Hotel Ottawa, Ont.

man. Very frequently small but sufficient quantities of solution are left standing about awaiting test. The cost of the remedies mentioned above would be trifling, but it is to be feared that they will not be provided until instructions are issued by the Minister.

Warnings might also be issued against the danger of inhaling fumes from the acid treatment of zinc slimes. Four people have already been killed in New Zealand by arsenuretted hydrogen, two of them in cyanide plants.

Penalties for Non-use of Gazetted Appliances.

The miner may understand that certain regulations have been made for his benefit, and that to work under insanitary conditions may be bad for his health; yet he would go back to the face and resume work although the smoke had not been properly cleared away, because he would know that if he did not return when expected he would lose his job. But if he realized that by working in a contaminated atmosphere he was rendering himself liable to a fine of, say, £5, he would have a good reason, or at least excuse, for refusing duty, and so would any man sent to replace him. In one authenticated case miners engaged in drilling with a machine refused to use a water-jet provided for them "because it made the place all wet."



Proposed Terminal Station and Hotel Ottawa, Ont.

Legislation.

Mining companies generally in New Zealand complain that too many returns are demanded from them—far more, in fact, than are necessary. Such restrictions can, however, be borne with equanimity if only big profits are forthcoming,

and will never force out of business a company which sees its way to a dividend. But when an operator is considering a property he has to set off against the good points any features which appear to be against successful working. Any trifling regulations, then, which appear likely to hamper his business will be taken duly into account, and in the end may be partly responsible for an adverse decision. This, however, is a small matter compared with the unfortunate appearance that certain recent mining legislation possesses of having been framed to suit particular cases. It is just this which has hitherto dwarfed the development of most of the republics of Central and South America. For example, the "bank to bank" Act of 1905 was apparently aimed at the Consolidated Goldfields of New Zealand (Limited). It is quite true that in one of their mines the men were underground for eight and three-quarter hours per shift. It is also true that the miners complained—and are still complaining—of the ventilation of the mine. The principal effect of the Act was that the company suspended mining operations for nearly four months, thus losing over £3,000 of profit (4), and expended another £4,000 or so in connecting their working to the surface. The men used to live in a pretty little village within easy distance of "town," but had to walk something over a mile along a level to reach their homes. Now they are delivered, a few minutes after leaving the face, at the top of a steep hill some 2,000 ft. high, and as a result most of the married employees with houses in the locality have sold out and left in preference to keeping two homes going, their places being to a large extent, taken by strangers. Thus little good was effected, and some £6,000 was wasted.

One clause of the Land and Income Tax Amendment Act popularly supposed to be directed against the Waihi Gold-mining Company (Limited). Whether the supposition is well founded the writer cannot say, but there is no doubt as to the effect that its tenor will have upon the mind of the ordinary investor. It will appear to the latter as a very strong hint that he will not be allowed to make very big profits and that if the existing law is insufficient to provide for this it will be amended to suit. As already argued, 7s. 6d. per acre is a ridiculous rental for a successful mining company to pay for its ground; so that, taking into consideration certain other facts (5), it may be proved to the satisfaction of a large number of people that the proposed law is not inequitable. Yet the fact that it differentiates companies which have returned to contributors the original paid-up capital from those in less fortunate case cannot fail to have a chilling effect upon foreign markets. It will be at once said that investors in New Zealand mining scrip will be freely permitted to lose as much as they like, but will be prevented from gaining more than the Government of the day may consider just.

As showing the extraordinary mental attitude which individual sections of the community assume towards gold-mining, it may be of some value to quote the following instance: Some months ago the Blank County Council promoted a Bill for the restoration of the gold duty within its borders. Apart from subsidies from consolidated revenue for specified works, its income for 1905 was made up as follows:—

	£	s.	d.
General rate	1,919	4	6
Rates on mining properties	2,605	3	8
Goldfields revenue	1,369	5	4
	3,974	9	0
Publicans' licenses	784	11	0
Miscellaneous refunds on works, etc.	1,435	5	4
Total income	£8,113	9	10

The expenditure was—

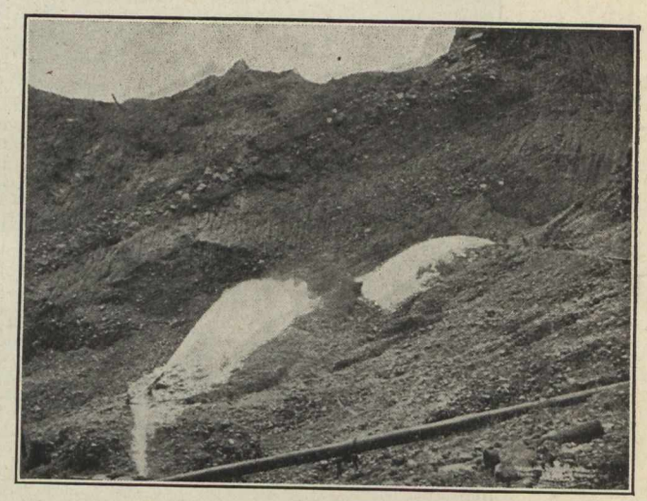
	£	s.	d.
Administration expenses, salaries, travelling expenses, etc. (6)	2,358	11	11
Works, etc.	5,338	11	11
Reduction of overdraft	416	6	0
	£8,113	9	10

The rateable value of the county is over £300,000. The restoration of the gold duty of 2s. per ounce would result in the substitution of £4,500, roughly, for the £2,605 now raised in rates on gold-mining property. One mine is situated twenty miles out, but its cartage is merely nominal; the biggest mines are served by one road under seven miles in length, and one under four miles. Their cartage—except for certain short stretches over which coal and timber travel—is only a small matter. If the calculation were made, it could probably be shown that mining companies within the Blank County pay several shillings for road-maintenance for each ton which is carted one mile. It is only right to say that—vide public Press—the Premier appeared amused when the Blank County Council handed in their Bill. No action was taken; but, for all that, the instance is worth quoting, as showing the tendency of public feeling.

Some gentlemen who recently returned from an unsuccessful attack on the London mining market declared that there is no money there for New Zealand propositions. Can any reasonable man wonder at it?

B.—Suggestions for the Consideration of Employers.

Mine-owners may be divided into two classes, viz., (1) Those who "hold for a rise," with whom this essay makes no pretence of dealing; and (2) those who hold as an investment and may be regarded as employers of labor. The latter again may be divided into (a) Proprietors, who deal personally with the administration of their mines, and (b) shareholders in limited liability companies.



Hydraulic Sluicing, Ross, Westland.

Proprietors, as a rule, are fully alive to their own best interests; if not, the disease carries its own cure. The following remarks do not apply to them in anything like the same degree as to the holders of mining scrip, and their general managers, mine and mill superintendents, etc.

The suggestions are: (1) That they treat mining as more of an industry, and less of a speculation; (2) that they provide good air and a sufficient supply of tools to the men in their employ; (3) that they encourage their men to turn out good work; (4) that they get good men and keep them; (5) that they investigate the question of the form of motive power best suited to the local conditions, and install it accordingly; (6) that they consider the claims of metallurgical chemists to employment on their staff.

Mining for metals may be as pure a speculation as, say, roulette, or nearly as prosaic an industry as, say, the manufacture of woollens. Although, owing to the vagaries of lodes, each undeveloped property when standing alone is of a highly speculative nature; yet, taking the whole of the industry, by and large, it offers a reasonable return for the capital invested. The chances of success in New Zealand should be particularly good, for the deepest mine in the colony—the Energetic, at Reefton—is only down some 1,300 feet, while in other parts of the globe 3,000 feet is often exceeded, and mines are even working at a profit at over 4,000 feet. There is no geological reason why New Zealand reefs should fail to persist in depth. A large area of metalliferous country has never been prospected at all, pros-

pectors having confined their attention for the most part to creek-beds, and then looking only for gold, while hundreds of quartz reefs are known whose development has hitherto been confined to the floor of the Stock Exchange.

If the investor wishes to reap the maximum benefit from his scrip, then he must be prepared to conduct mining on the same fundamental principles as he would any other business. For example, he should not cause a reduction plant to be erected until he knew he had some valuable ore to treat. At the best he is to some extent gambling, and must be prepared to face a loss with equanimity; but if he gambles wildly, then his losses may be ruinously high. Even roulette may be played in an unbusinesslike manner (e.g., a player may carelessly leave some of his winnings behind on the table). The surest way to increase profits is to decrease operating expenses. In other words, profits must come out of savings, and shareholders and managers will doubtless direct all their efforts to the devising of economies.

What should we think of, say, an engineer or millwright who refused to encourage his men; who publicly declared that they were a worthless lot, yet sneered at—or, at least, refused to reward—those who were trying to raise themselves by education or otherwise; who set them to work in such an atmosphere that they could only compass a fraction of the labor of which they were capable, or under such conditions that when possessed of valuable experience they would be compelled by ill-health to leave his service; who provided an insufficient supply of tools, because "if the men had too many they would lose them or throw them away"; who, when times became hard, permitted the shop-buildings and plant to fall into disrepair and decay from motives of economy? We should think that the sooner such a man was out of business the better for everybody. Yet many mine-owners deal so with the property they are operating.

Too often, also a person is placed in charge whose only claim to the position rests on relationship by blood or marriage to some large shareholder in the proprietary. This is, of course, a matter of domestic economy, and it would not be mentioned here at all except to show how the mining industry is handicapped.

Lost Lodes.

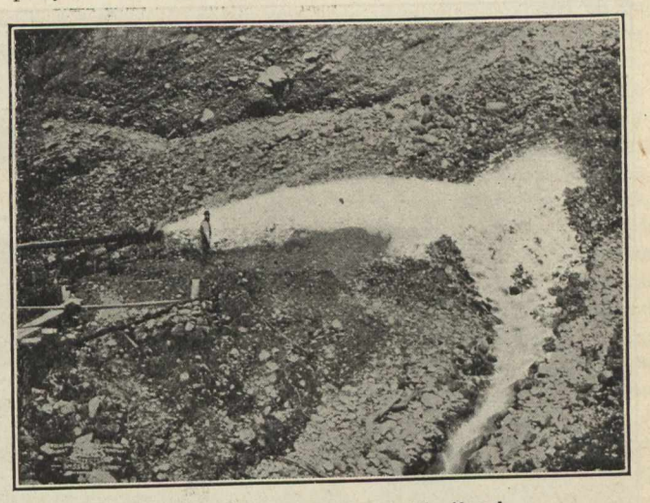
But it may be objected that lodes behave very queerly, that they are so liable to dislocations of different kinds, and their mineral value varies so much that their exploitation does not partake of the nature of an industry at all. It often happens certainly that a working has been driven along a reef for many days, when suddenly there is no more lode stuff. It is usually assumed that there has been a dislocation in the surrounding country rock, and that a huge mass of material has been thrust down or up as the case may be. Certain mathematical rules—which would answer well enough if a lode were a stratified deposit—are applied, and a drive put in at a different level. Often the lode is regained, but often it is not. A certain amount of "blind stabbing" is then indulged in, usually without avail, and if the mine is dependent to any great extent on this particular reef it has to close down.

"Lodes," "veins," and "reefs" are practically synonymous terms referring to fissures in the crust of the earth which have become filled with mineral matter. Like everything else, they must finish somewhere, but it is by no means to be assumed that in cases such as those just mentioned the fissure has reached its termination. Owing to some slight variation in the material in which it was formed it may have been diverted in almost any direction, but it always leaves some indications.

It is in circumstances such as these that the intelligent and well-inclined miner can prove that he is worth the apparently high wages he has been receiving. Some little distance back he has noticed tiny threads of quartz which seem to lead from the main body into the enclosing rock. Under present conditions a miner would not mention such a fact to his superiors, and this for one of many reasons, such as: (a) He was ignorant of its possible importance; (b) he was well aware of its significance, but had mentioned similar points at this or other mines, and had been snubbed for his pains; (c) he had stowed the knowledge away in his mind, either for the benefit of some actual or possible shareholder in the concern, or with a view to taking up a tribute himself at some future date; (d) "what business was it of his, anyhow?"

If, however, the mutual attitude of the miner and his knowledge of his business were the same as those of an ordinary tradesman, he would be as keen to note any point and as anxious to further the interests of his firm as, say, a machinist in an American small-arms factory, and in the hypothetical case stated his intelligent watchfulness would very probably result in the lode being picked up again.

These indications are, however, very delicate, and rapidly become obscured by trickling water, by dynamite



Hydraulic Sluicing, Ross, Westland.

smoke, or by mere weathering. Eventually they may be covered up by timber or by "filling," and once lost they are very hard to recover.

Cost of Mechanical Ventilation.

First, as to the expense incurred in insuring a regular and sufficient supply—irrespective of atmospheric conditions—to the main airways. A concrete case will be cited, the one chosen having probably the most extensive workings for its output of any mine in the colony:—

Blank Mining Company, Limited.

Description of operations: Quartz mining for gold.

Output per diem: Forty tons.

Number of men in each shift: Forty.

Quantity of air required: 40 ft. × 100 ft. = 4,000 ft. per minute.

Airways: Set No. 1—6 ft. × 3 ft. 6 in. in the clear; 6,000 ft. long. Set No. 2—Passes each 2 ft. 6 in. × 3 ft., about 1,100 ft. in length; where the whole body of air is passing, three alternative roads are left open, and the area may thus be taken as 7 ft. 6 in. × 3 ft. Set No. 3—Upcast shafts and levels never less than 6 ft. × 3 ft. 6 in., and 2,500 ft. long.

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(1) Park: "Cyanide Process."

(2) 1905, Transvaal Chamber of Mines.

(3) The fatalities mentioned in Park's "Cyanide Process" were due to inhalation of prussic-acid vapor.

(4) It is probable that the returns for the year will show but a slight decrease from the usual annual net profit. To secure this result more or less "picking" of stone must take place, the "life" of the mine being correspondingly shortened.

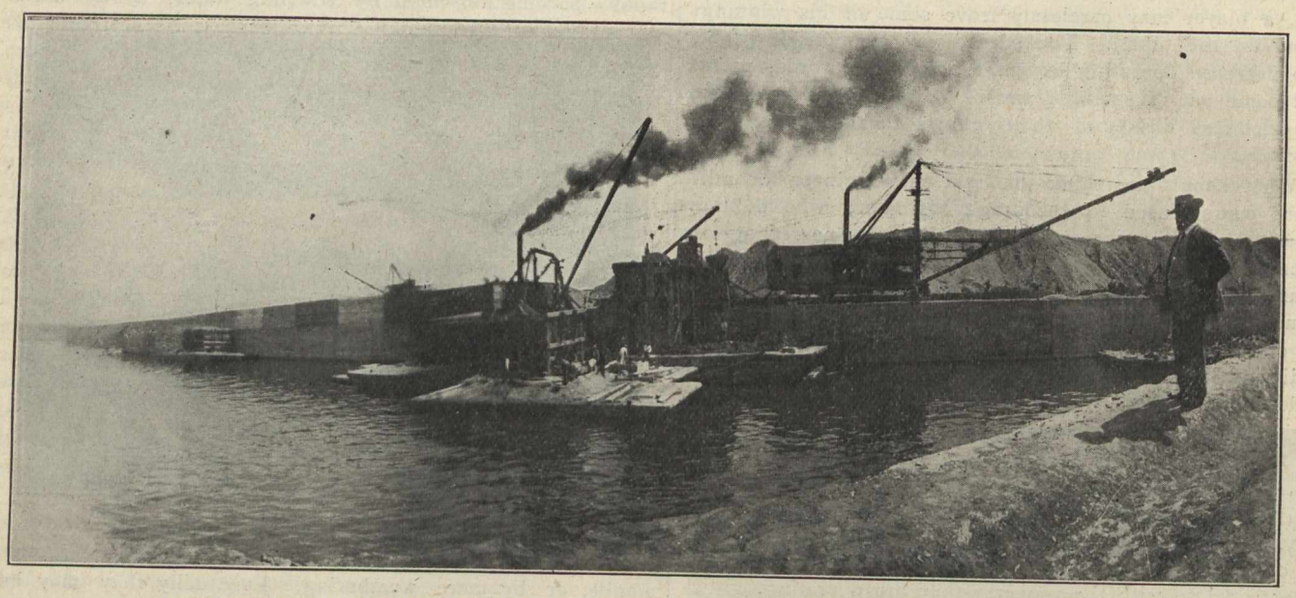
(5) For example, the Act aims at the withdrawal of a concession, not at the imposition of a new and exceptional tax.

(6) This includes £400 for charitable purposes, hospitals, etc., and £178 for members' travelling-expenses, which is not inordinately high. It also includes £63 for deputations.

Don't be afraid to impart what you know to others, when it is something that may help them without hurting you. Pointers that are kept to one's self get useless like the gold-pieces that a miser stows away in a dark crevice. Gold was brought into the honest daylight and minted for the express purpose that it should circulate for the benefit of all—and the same is true about the facts that men dig from the mines of experience.—Salesmanship.

A CONCRETE PIER AT MONTREAL.

A short time ago was completed in the lower portion of the Harbor of Montreal, on the dividing line between Hochelaga and Maisonneuve, a large engineering undertaking, known as the "Tarte" pier. The Tarte high level pier, or wharf, lies between the "Southerland" pier, to the east, and the "Laurier," to the west, and is one of the largest piers in America. Its dimensions are 1,000 feet long on the upper side, 850 feet on the lower, or eastern side, 325 feet in width, 65 feet in height above the bottom of the river, and 26 feet above the mean summer level. It runs out from a shore wharf, having a length of 1,225 feet, and stands about 20 feet higher than the low-level piers, above mentioned, situated at either side of it.



Looking Towards East Side of Tarte Pier, Showing Concrete Plant Making Monolithic Blocks.

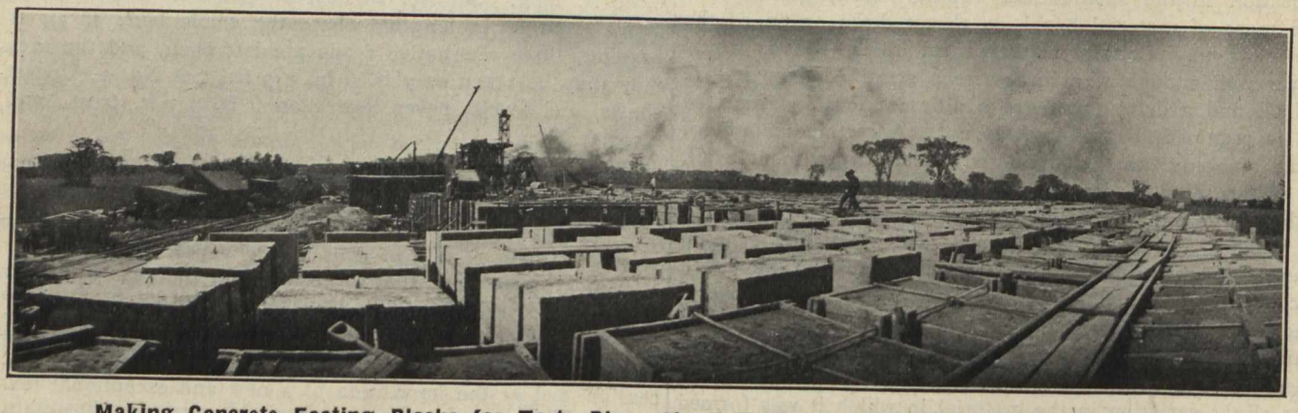
The construction of the pier was undertaken and carried to a successful issue by the W. J. Poupore Co., Limited, after some six years' work. The original contract price was in the vicinity of $700,000, but extensive alterations on the part of the Government brought the total cost to somewhere in the vicinity of a million dollars.

Cement and concrete is playing a part of ever increasing importance in works of this nature, and in the construction of the Tarte pier the W. J. Pouport, Limited, used over 65,000 barrels of cement, making 39,640 tons of concrete. Some details of this portion of the work will be of interest.

First of all, a trench, to the depth of 45 feet below the mean water-level, and 75 feet in width, was dug. This necessitated the removal of about 750,000 cubic yards of solid material from the bottom. Into this trench was emptied broken stone to the depth of four feet. Cribs were then built of twelve-inch square pine timbers, sheathed with 12 x 12 Arkansas oak. The cribs were 150 feet long, 40 feet wide at bottom, 20 feet at the top and 32 feet high. On the cribs were placed 1,240 concrete blocks, each weighing 15 tons. The dimensions of the blocks were 6 feet by 6½ feet by 5 feet. These blocks were 1:2:4 concrete and were moulded at the Poupore Company's quarry, about three-quarters of a mile back from the shore. The forms were set up on the ground; truck railway lines were run from the concrete mixer along the surface of the forms to a turntable and thence to all points where concrete was required. Cars or trucks were filled at the mixer and wheeled to the required point and dumped into the forms. If the blocks had been placed touching each other they would have covered an area of 7,500 by 8,120 feet and stood five feet high. The combined weight was 18,600 tons, or considerably more than the weight of the steel which fell in the collapse of the Quebec Bridge a few weeks ago.

This large field of concrete blocks was run down to the shore on the company's own steam railway, and there the blocks were placed on the cribs. A layer of broken stone was then filled in between the rows of blocks. The addition of these blocks brought the structure to the level of the water.

A floating plant for mixing concrete and casting it into monoliths was then placed in position on scows, and the walls were brought up to the required height by monoliths with dimensions of 30 feet in length, 15 feet in width and 25 feet in height, each monolith weighing 200 tons. As the two sides and the end of the wharf, together with the bulkheads or shore wharves, measure a total of 3,105 feet, about 100 of these monoliths were required. These would give a total weight of 20,000 tons, in the monoliths alone. This combined with the supporting locks would give a total weight of concrete of 38,600 tons. The concrete used in the monoliths was 1:3:5. All the exposed faces of the sides of the wharf were made of granolithic concrete, composed of a mixture of one part of cement to four parts of finely broken rock. This mix-



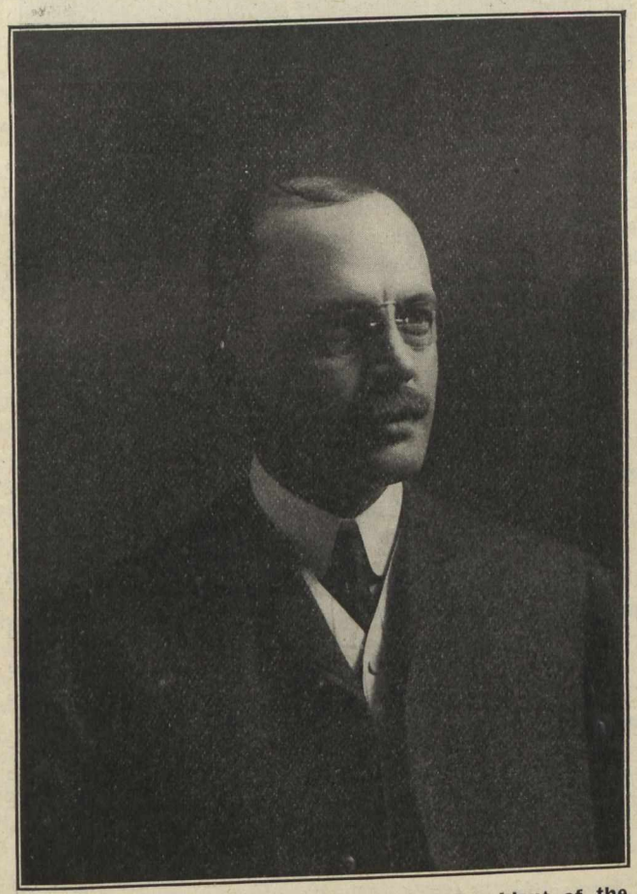
Making Concrete Footing Blocks for Tarte Pier, Showing Track for Trucks on Top of Blocks.

ture was put into the moulds with the main mass and tamped so that the two formed a monolith.

Between the up-stream and down-stream walls of the wharf, over 1,000,000 cubic yards of dredging material was filled in. Although the walls, even without a backing, successfully resisted the ice shoves of six seasons, while the work was going on, it was decided to give them additional strength, before handing the wharf over, by anchoring them to cement blocks placed midway between them. Accordingly some 52 blocks of concrete, each weighing 20 tons, were buried along the centre of the wharf, and, by means of steel rods, the walls of the wharf were anchored to them. This would add 1,040 tons to the weight of concrete used in the wharf, making a total of 39,640 tons. In addition to this, were used 26 million feet, b.m., of timber, and two million pounds of iron, in bolts. The quantity of broken stone used for all purposes was 200,000 cubic yards, and the quantity of cement 65,000 barrels.

NEW PRESIDENT OF ELECTRICAL ASSOCIATION.

Mr. R. S. Kelsch is the choice of the Canadian Electrical Association for the position of president. The other officers elected at the meeting held in Montreal were W. N. Ryerson, Ontario Power Company, first vice-president; and R. M. Wilson, of the Montreal Light, Heat and Power Company, second vice-president; T. S. Young, Confederation Life Building Toronto, secretary.



Mr. R. S. Kelsch, C.E., newly-elected President of the Canadian Electrical Association.

Mr. Kelsch is well deserving of the honour he has received. He has had some 20 years' experience in electrical engineering work, half of which was gained in the city of Chicago. In 1907 he came to Montreal to erect and operate the Lachine Hydraulic system, and when that company was absorbed by the Montreal Light, Heat and Power Company he opened an office as consulting engineer and was retained by the M. L. H. & P. Co. to consolidate the two systems. The systems differed vastly from each other, one being three-phase 60-cycle system and the other a two-phase 66-cycle system.

Mr. Kelsch has also paid considerable attention to the problem of frazil ice, and has designed a number of power plants, among which are the following: The Kaministiqua Power Co., Fort William; The Ottawa and Hull Power and Manufacturing Co.; The Sherbrooke Power Light Heat Co.; The Quebec Railway Light and Power Co.; and Brantford Electric Light Co. Mr. Kelsch was prominently connected with the organization and carrying out of the Canadian Electrical Exhibition Co., being its vice-president and managing-director.

MUNICIPAL ENGINEERS.

Goderich, Ont., Sept. 25th, 1907.

Editor Canadian Engineer:—

Sir,—No doubt many of your readers would have hailed with delight your timely reference in a recent number to the position of municipal engineers in relation to councils employing them in a professional capacity and afterwards dictating to those experts who have made their profession a life-long study the manner in which their duties should be performed. Could anything be more humiliating to a member of the engineering profession than to have a board of men, selected from the ranks of the trades and industrial classes, preside over his deliberations in formulating plans which call for the display of the utmost scientific skill and ingenuity on his part? We seldom hear of a case where a doctor has been called upon to change his prescription or a surgeon criticized by the patient for the manner in which his skill enables him to perform a successful operation,—and when a lawyer sets his seal to a document there is an end of all strife, but not so with the unfortunate engineer, whose best efforts are continually assailed with friendly suggestions as to the cheapest and most practical way of performing the work. The time is now opportune when municipal authorities should be put in possession of facts in regard to what our engineering societies have done for the profession, in raising its standard and excluding from its ranks the untrustworthy and incompetent,—thereby placing at the service of corporations men who are capable of being entrusted with the economic expenditure of money in the construction of public works. Our engineering societies are well organized to cope with the hazards of the situation in question, but the writer knows of no legislation which protects the public from being imposed upon when the question arises of employing the services of a competent engineer. Unfortunately, too frequently, the situation is swayed by political influences, or perhaps personal ill-feeling from some petty cause, such as the question of social distinction, or it may be the inadvertent maladministration of public affairs. These are circumstances over which legislation has evidently no control, and as the engineer is pretty much in the same position as the doctor or lawyer in respect of being left free to accept engagements when called upon, the public will always be to some extent in ignorance of the professional standing of the men who are entrusted with their affairs. It may so happen frequently, notwithstanding all this uncertainty that the right man may be procured, but he may not always find himself in the right place. To preserve harmony and sustain a clear reputation, he may be called upon, under these circumstances, to exercise those qualities which have enobled the profession and made it the virtuous handmaid of science and genius, notwithstanding the humiliations to which he may be subjected.

We have arrived at an age in the history of this country which calls for a display of the utmost ingenuity and skill on the part of its engineers, and one often wonders if the period will be of transmutation of a purely metallic form or a retrogression to that of a composite type. Although this is pre-eminently the steel age our best efforts are nevertheless frequently attended with disaster, not so much the result of miscalculation in directing the forces in nature as in our misconception of the nature of the materials which contain them.

We occasionally hear mutterings of the possibility of the public loosing confidence in the ability of our engineers to cope with the great problems of the age. I may say right here that it will be a woeful day for the progress of the countries when confidence is lost in the members of the engineering profession, who have always been foremost as pioneers of

civilization and progress. Just what part the engineers alone have played in the development of the country, or how much of its prosperity is due to their efforts is not for the writer to define, but the monuments said to be erected to themselves at the public expense are surely not idols standing in a desert, without usefulness and convenience to mankind. What we really do require is greater and unabated confidence, and if legislation should be enacted to enable the public to make a more careful choice of the men to be entrusted with their affairs the results would no doubt be gratifying. The engineering profession as a body are well organized to consider such legislation, but at present its members can only offer themselves as guardians of the public safety, when called upon to do so in a professional capacity, the selections being made invariably through outside influences.

Faithfully Yours,

J. Grant MacGregor.

MODERN AMATEUR MACHINE SHOPS.

By W. L. McLaren.

Part III.

The following pictures were taken in the private workshop of Dr. A. Martin, of Ottawa, Canada. For its size this is the finest and most completely equipped shop to be found. At the time the photos were taken the doctor was engaged in building two miniature locomotives, one (Fig. 1), about 3 feet long, and the other, about 2¼ feet. The only variation between these and their relatives which pull the fast expresses, is that the smaller one has no tubes in the boiler and burns alcohol, but the larger one does not vary even in these particulars having charcoal for its fuel. They both have air brake pumps which break the tender, as in so small a machine it was found next to impossible to put on an exact copy of the brake on a regular engine. One point where they both differ from the standard, is the absence of injectors. To make an injector of the proper proportions would be to have a useless article so far as any inspirating went, so pumps had to be used instead. The larger engine has cylinders of 1½-inch diameter, with about the same stroke. The parts

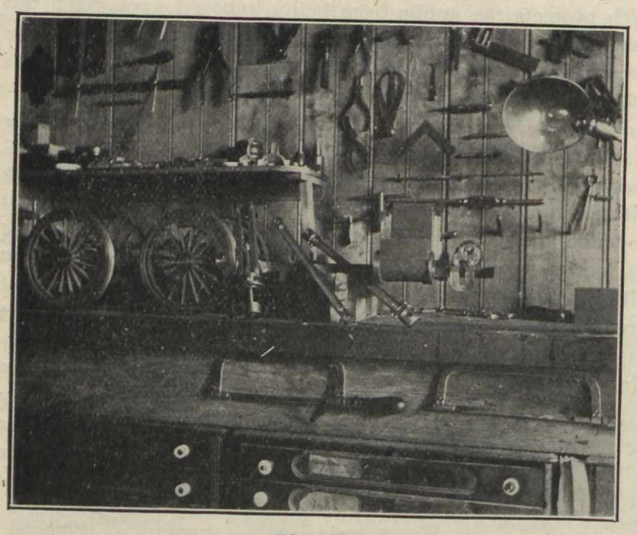


Fig. 1.

are all made as nearly as possible of the same material as in the large ones, this being carried so far as to have the cross heads, rods, etc, of steel. Even the brasses in the rods are made to take up wear. These can be plainly seen in Fig. 1, leaning against the frame. The maker's aim is to construct as nearly as possible a machine which shall resemble the ones in every day use, even as regards the finish on different parts. Fig. 2 shows a section of the shop, which outside of a store room, is contained in one room about 18 x 18 feet. In this picture can be seen part of a 11-inch Baldwin Lathe made over twenty-five years ago, in Laconia, N.H., the builder having since gone out of business. In the centre of the picture is a Hendry Norton 15-inch shaper, on the wall beside which can be seen a counter shaft, this is for a special milling attachment which the doctor designed himself. The ordinary head of the shaper being removed this attachment is put in its place and belted to the counter-shaft shown, a swivel vice on the shaper table giving every solid adjustment imaginable. Besides the tools already mentioned there is a 14-inch Henry Norton lathe, a Boynton & Plumber upright drill, and a Barnes Friction Drill. These are driven by a 2 horse-power Canadian General Electric D. C. Motor. Fig. 1 gives a good idea of how the bench is arranged so as

Fig. 2.

to use all available space. The doctor once got his hands on a 6 horse-power gas engine which was too heavy for his liking, so he proceeded to chip, file, and turn 43 lbs. of metal off the various parts without impairing the thing in the least. The doctor never lets his interest in his shop interfere with his practice, allowing only evenings and Sundays to his very interesting and instructive amusement, or hobby, as one may choose to call it.

CATALOGUES AND CIRCULARS.

Air Compressors.—A catalogue having to do with air compressors has been issued by Broom & Wade, Limited, High Wycombe, with offices at London and Glasgow. Besides giving sizes and dimensions it also contains data of interest to engineers interested in compressors.

Steam Engines.—A very attractive catalogue has been issued by the Goldie & McCulloch Company, of Galt, Ont., treating with Ideal high-speed steam engines. Size, 6 x 9, pp. 55.

Prairie Type Locomotives.—The American Locomotive Company has just issued the tenth of their series of catalogue pamphlets, which illustrates and describes the Prairie type locomotives built for various roads. This pamphlet contains half-tone illustrations, and the principal dimensions in tabulated form of fifteen different designs of locomotives of this type, ranging in weights from 136,000 to 245,000 pounds. The usual style of pamphlet adopted by this company is followed, beginning with the description of this class of locomotives and presenting the advantages which it offers for fast freight and passenger service.

Crushing and Road Machinery.—The 1907 catalogue of the Climax Road Machine Company, of Marathon, N. Y., has been received. It describes and illustrates stone crushers, road machines, road rollers, and other kinds of machinery used in road making. Size, 8 x 10¾, pp. 24.

Blow-off Valves.—The Lunkenheimer Co., Cincinnati, Ohio. A pamphlet devoted exclusively to blow-off valves as manufactured by this company. Size, 3½ x 6, pp. 24.

Electrical Supplies.—Canadian General Electric Co., Toronto, Ont. Two circulars have been received from this company descriptive of electric specialties handled by this company, including gas lighters, pocket flash lights, battery connectors and batteries. Size, 3½ x 6, pp. 16.

FRAZIL AND ANCHOR ICE*

By John Murphy, M.A.I.E.E., A.M.C.S.C.E.

Until a very recent date it was generally believed that in Northern latitudes the operation or the stoppage of hydraulic power plants at the beginning of each winter was determined by the absence or the presence of Frazil or Anchor Ice.

Ten years ago—at the Niagara Falls convention of this Association in 1897—in a paper relating to the operation of hydro-electric plants, I ventured to offer some advice to those whose plants were subject to ice difficulties. The gist of this advice was to the effect that an auxiliary steam power station of similar capacity to the hydraulic plant affected by ice was a necessity if continuous uninterrupted service was desired. In other words, my opinion at that time was that if Frazil or Anchor Ice entered a power plant a shut-down must follow.

Three years ago at the Hamilton meeting, in reply to a query in the Question Box entitled, "How do you get rid of Anchor Ice?" I answered: "We do not get rid of it." This reply, however, was not published, although the editor knew it was absolutely true. From the year 1885, when electric lighting was begun at Ottawa, until two years ago, the annual experience had been that frazil had tied up or completely shut down the power plants every winter for periods varying from 15 to 40 hours. At the suggestion of the editor of the Question Box, I amplifred my answer by stating that it was my opinion that if the exposed parts of the racks and draft tubes of hydraulic plants were protected from the action of cold air, many of the difficulties usually experienced would be eliminated. In support of this opinion, I pointed out that in the absence of the suggested protection the unimmersed parts of the hydraulic equipments became ice manufacturing plants by introducing into the already freezing water temperatures much below the freezing point.

To-day, by reason of the knowledge gained by study and experiment, I ask permission (1) to retract what I said ten years ago; (2) to reiterate the advice given three years ago; and, (3) to supplement that advice by stating that no hydraulic plant need now be tied up by frazil if the simple remedy of applying a moderate amount of heat to the vulnerable parts of the equipment be resorted to.

At the outset it may be well to direct attention to the precise meaning of the two terms "Frazil" and "Anchor Ice" as they are herein used. Many persons use these terms as synonyms and others describe almost everything in the form of ice as anchor ice. For an authority as to the correct use of the two terms I cannot do better than refer you to the notable work of Dr. Howard T. Barnes, entitled, "Ice Formation."† At page 109 of his remarkable book Dr. Barnes says: "The birth of frazil is in the water itself by surface cooling, through wind or rapid agitation and by radiation. . . The term anchor ice we shall use to designate all ice found attached to the bottom, irrespective of its nature of formation. . . Anchor ice may form "in situ" on the river bed, and may grow by attaching to itself frazil crystals brought down by currents, and (it may grow) by the process of radiation." On the same page an extract is given from the report of the Montreal Flood Commission, published in the year 1888, as follows:—"Frazil as distinguished from anchor ice is formed over the unfrozen surface. . . wherever there is sufficient current or wind to prevent the formation of bordage ice."

From the preceding paragraph it is evident that, while frazil and anchor ice may, upon inspection, prove to be identical in appearance and character, it is the surface-formed frazil that sticks to and interrupts the operation of hydraulic plants, while it is the bottom-grown anchor ice that attaches to itself frazil crystals and sometimes blocks the flow of streams, thus causing floods similar to those experienced at Montreal.

A review of the ice difficulties at Ottawa, Ontario, will, I believe, prove to be a fairly accurate description of those encountered in any northern latitude by the operators of hydraulic power plants. The Ottawa River, from Lake Deschenes to the Chaudiere Falls, which are situated between the cities of Ottawa and Hull, serves as a boundary line between Ontario and Quebec. Lake Deschenes is a large body of water unbroken by rapids, and it is navigable throughout its entire length. It empties into the Deschenes rapids, where there is available for power purposes a working head of 9½ feet. Adjoining these rapids, in Deschenes village, several hydraulic plants are in operation and these plants are all tied up by frazil as regularly as the winter season comes around, in spite of their supposedly ideal location—at the foot of a smooth lake. Of course, little or no difficulty from frazil is experienced after the lake is covered by surface ice.

About three miles below Deschenes rapids are the Remoux rapids, and about one mile lower down the river are the Little Chaudiere rapids. There are now no power plants at either of these latter rapids. Another mile further down stream are the Chaudiere Falls, where the power developments have been made from which Ottawa, Hull and the surrounding country secure most of the energy which is used for domestic, commercial, and industrial purposes. At the various plants heads from 22 to 33 feet are available under normal conditions. These figures represent normal working heads and not variations in head caused by the variations in the flow of water in the Ottawa River and its tributaries at different seasons. A dam prevents, or is intended to prevent, water from flowing over the falls when the river is low, and, consequently, frazil formed in the rapids above is guided into the power plants.

Up stream there is, in my opinion, an ideal place for producing frazil. The spray thrown up by the rapids is immediately crystallized in cold weather, while the whole body of water in the river becomes chilled, or "super-cooled," by the winds that sweep across the stream from the northwest. The resulting mass of ice crystals and freezing water is kneaded, in the rapids, from top to bottom, and from bottom to top, until the whole stream becomes at times a mass of frazil. On several occasions the rapids were almost completely blocked up in a single night, and the majority of the plants below were shut down for the greater part of two days. The blocking of the rapids is an exceptional event, as the frazil is usually carried by the current into the power plants.

In addition to the troubles caused by frazil, there is another with which the operators of northern hydraulic plants have to cope in the winter time. It is primarily due to a shortage of water. The surface ice continues to grow as winter advances, and the space between the surface ice and the bed of the stream becomes more and more clogged up with anchor ice and frazil; then when the river's level falls—as it invariably does after a couple of months of severe frost—the weighty surface ice descends upon the mass of mushy ice beneath it and packs the latter into such a solid mass that water cannot percolate through it. The falling of the river level each winter seems to be the natural result of the freezing up of the river's sources and the absence of surface drainage on account of the continued cold weather. The "area drained" is a factor which has perhaps most to do with determining how much power is available on any stream, but hydraulic engineers, when estimating such power, seem to lose sight of the fact that little or no drainage occurs during a great part of each winter in northern latitudes.

It is chiefly with frazil as it affects hydraulic power equipments that this article has to deal, but, by following the line of thought above indicated and by extending the method hereinafter described for combating frazil, it is, in my

*Paper read at the annual convention of the Canadian Electrical Association, Montreal.

†"Ice Formation," by Howard T. Barnes, M.A., D.Sc., F.R.S.C.: John Wiley & Sons, New York and London. In Canada, Renouf Publishing Company, 61 Union Avenue, Montreal.

opinion, possible to prevent the blocking up of streams in the winter time by the use of reasonable amounts of energy in the form of heat.

The usual effect of frazil on hydraulic power plants is to block up the racks, tie up the gate mechanism, and reduce the output of the water wheels or shut them down altogether.

It is common practice among hydraulic power operators to await the action of the sun for relief from the above conditions.

To quote from my own experience alone in regard to the amount of trouble caused by frazil, it may be mentioned that I have seen frazil silence the hum and bustle of the grist mill, the saw mill, and the pulp and paper mill; I have seen waterworks pumping systems frozen up so that they could not supply a single drop of water for domestic or fire purposes; I have seen electric cars left standing in the streets until the lubricant was frozen solid in the journals; I have seen and heard electric generators speeding up and up as the load curve dropped towards midnight, until it seemed providential that they did not fly to pieces—while the increasing speed frightened the users of motors to such an extent that they added to the danger at the power plants by shutting them off, and I have also on occasions too numerous to enumerate seen the solid flange-like appearance of the spiders of generators gradually changing as they slowed up and finally stood still altogether, like the inert spokes of a barrow's wheel which had been deserted by its propeller. This last sight I was often obliged to view by the light of a coal oil lantern, althought upwards of 10,000 kw. of generating apparatus were within a stone's throw of the viewpoint. Those who were responsible for the supply of water to the turbines remarked as they gazed at the silent machinery: "The river will be frozen over before morning and there won't be any more trouble this winter." After the ice was removed from the penstock fires were built around the wheel cases or brine was used for the purpose of loosening the gates. Some who had steam at hand used it for the purpose of loosening the gates after the ice had been hewn out of the penstocks. While frazil is immersed it remains soft and mushy, but when exposed to temperatures below freezing point it immediately becomes solid.

The first trouble which frazil usually causes at a hydraulic plant is to clog up the openings in the rack or screen. This may to a great extent be alleviated by the use of a motor-driven rake. The more usual practice is for men to use hand rakes, but as their best efforts are so often futile something better is required where the continuous operation of services is a necessity.

When the racks are kept open by raking the frazil passes through and forms like adhesive plaster around the gates and gate mechanism, thus preventing speed regulation. If the run of frazil continues long enough it shuts the wheels down altogether.

Anchor ice makes trouble for the hydraulic plant in another manner. When the sun is shining anchor ice rises from the bottom of the stream where it has been formed, bringing with it loose rocks, etc., and is carried by the current into the forebay of the plant. Here it is held against the rack by the pressure of the water, and while it is not adhesive or very cohesive at such times, if it is not broken up by raking and passed through it will stop the flow of water. Floating anchor ice seems to be frazil with its tentacles short off or turned in—in this condition it has no sticky propensities.

As there are a great variety of hydraulic plants in the Ottawa district, and as none of them up to two years ago were free from ice difficulties, this proved to be a good place to study the ice question. I had frequently noticed that one plant invariably held out longer than any of the others against the onslaughts of frazil, although waterwheels of the same size and type were operating near by. The plant in question was protected by wooden racks which, although they would clog up with frazil as quickly as those which were made of iron, were more easily cleaned. The fact that iron was the better conductor of heat and that the temperature of the iron racks below the water was likely reduced by the cold air chilling the tops of the bars were reasons advanced by the writer in explanation of the difference in susceptibility to frazil between these iron and wood racks. The effect of cold air on other parts of the hydraulic equipments, in particular upon the draft tubes and penstocks, was also noted. Waterwheels which had their tail races enclosed so that the cold air could not sweep in were more slowly affected by frazil than others not so protected. Waterwheels set in wooden penstocks were more immune from frazil attacks than those set up in concrete chambers, if the concrete were exposed to the action of the atmosphere.

For a number of years I had observations made and data collected regarding weather conditions in the hope of being forewarned of the approach of frazil. However, it was not until we added the records of water temperature variations to the other data that we really knew when to expect frazil. We found when the sun was not shining, when the wind was blowing from the northwest, and when the temperature of the water was being lowered to the freezing point, frazil was being formed. It was further observed that so long as cold weather continued and the temperature of the water remained at the freezing point, practically no further frazil difficulty was likely to occur, no matter how low the temperature of the air became, but if the temperature of the water rose above the freezing point as the result of a thaw a recurrence of the frazil trouble would certainly be experienced again upon the approach of cold weather.

An ordinary thermometer, which had a scale with divisions of one-sixteenth of an inch to a degree, was used for the measurements which we made, and it was found that the temperature of the water usually remained exactly at the freezing point from the beginning to the end of the winter.

"Ice Formation and Precise Temperature Measurements" was the title of a paper presented by its author, Dr. Howard T. Barnes, at a meeting of the American Society of Mechanical Engineers, which was held at New York in the spring of 1905. With the aid of the Callendar thermometer, which is capable of indicating with accuracy variations as small as one ten-thousandth of a degree, Dr. Barnes had found that changes of the temperature of the water in the Lachine Rapids during cold winter weather actually did take place, and that when these changes amounted to only a few thousandths of one degree they were accompanied by "tremendous physical effects." While the temperature of the air had varied from 28 degrees above to 40 degrees below the freezing point, during many of Dr. Barnes' tests, he found that the temperature of the water never varied as much as one one-hundredth of a degree! If the temperature of the water fell ever so little below the freezing point frazil formed rapidly in great quantities, while if the water's temperature was raised a fraction of a degree above the freezing point huge masses of anchor ice arose from the bed of the river.

From the data contained in Dr. Barnes' paper and from our own observations and experiences I became convinced that by applying a moderate amount of heat to the racks and other parts of hydraulic equipments which are subject to the attacks of frazil, the difficulties caused by the latter could be obviated. With this end in view experiments were carried out which proved beyond doubt that this theory was correct.

When solid ice is formed upon a piece of metal—or in a mould, as in artificial ice-making—the bond between the ice and the metal is as close a union as the imagination can conceive. The ice grows on the metal, and it is practically impossible to separate them so long as the temperature of the metal remains at or below the freezing point. However, the application of a small amount of heat in the form of hot water or steam to the metal—or to the mould, as in ice-making—results in a severance of the bond, and a separation of the ice and metal is effected with ease. The freezing point is the flux that creates the bond between metal and frazil.

As an illustration of the lack of sympathy with my frazil combating proposals, and the skepticism which prevailed amongst hydraulic power people to whom I presented them, one institution which suffered greatly from frazil refused to carry out some simple experiments, although they had a steam plant within 50 feet of their racks and waterwheels.

A hydraulic engineer, who has designed a great many Canadian power plants, expressed the opinion that a reason-

able amount of heat applied to the interior of a penstock, while the waterwheels were standing still, for the purpose of removing an accumulation of frazil, was probably practicable, but he refused to express any opinion whatever regarding the feasibility of attempting to make an impression upon the contents of a penstock through which the water and ice rushed.

There are probably two excellent reasons why hydraulic engineers have made no serious attempt to cope with the frazil and anchor ice difficulties. The first is their familiarity with the formidable forces of Nature, and the second is their knowledge of the physical properties of water. When a whole river can be blocked by the action of the air in a single night in forming ice, some idea of the extent of the forces of nature which are at work may be imagined, and some figures in connection with the second point, viz., the physical properties of water, may assist in showing why combating frazil seemed so unattractive an undertaking. The output of the Ottawa Electric Company's No. 1 power house is ,000 horse-power, and it is operated by water under a head of 25 feet. The quantity of water which passes through this plant is, roughly, 100,000 cubic feet per minute. One cubic foot of water weighs 62.4 pounds, therefore, 6,240,000 pounds of water pass through this plant every minute. One B.T.U. is required to raise the temperature of one pound of water one degree Fahrenheit. One horse-power is equivalent to 42.41 B.T.U. Therefore, if it were contemplated to raise the temperature of 6,240,000 pounds of water one degree, it would be necessary to employ 147,000 horse-power. In other words, it would require the total output of 49 stations, each having a capacity of 3,000 horse-power. Startling as this illustration may be, it pales into insignificance when placed beside another which, after all, is the real one to be considered. The latent heat of fusion of water is 142.6 degrees, i.e., it requires the introduction of 142.6 B.T.U. into one pound of ice in order to change it to the liquid state without accomplishing any rise in its temperature. The energy is expended in merely making a change in the molecular arrangement of the water. Bearing the above facts in mind, it may be seen that if the amount of water consumed in the 3,000 horse-power plant had to be converted from the solid to the liquid state, without changing its temperature at all, it would be necessary to employ the output of 7,000 stations, each having a capacity of 3,000 horse-power.

Figures showing the amount of energy necessary to change water from the solid to the liquid state (in the case of the 3,000 horse-power station above referred to, this amount being 21,000,000 horse-power) were used by an eminent engineer at a meeting of a technical society* in order to show the impracticability of a proposed scheme for preventing ice from clinging to the rack of a power plant.

In the fall of 1905 I attempted to put into practical operation my theories in regard to frazil combating. The success of the undertaking was assured from the first experiment. With the aid of an old boiler, which has been operating a couple of steam drills, to which pipes were attached a 3,000 horse-power hydro-electric station which had been tied up every winter from the date of its erection was kept in operation throughout sieges of frazil which shut down or tied up every other waterwheel in the Ottawa district.

The winter of 1905-06, as may be recalled, was a remarkable one on account of there being no long-continued spell of cold weather. As a result the temperature of the water in the Ottawa River on several occasions rose above the freezing point. As each mild spell was succeeded by a moderately cold one, many frazil difficulties were experienced each month. An unusual and excellent opportunity was thus afforded for the thorough testing of this method of frazil combating, and the success of the work may be gauged by the fact that the customers of the Ottawa Electric Company were one and all convinced that no ice troubles had been experienced because, as they said, "the winter had been such a mild one." They spoke from their own knowledge only—their standard of judgment being the excellence of the service that had been maintained. These people overlooked the fact that while the services of the Ottawa Electric Company had not been interrupted, the other hydraulic plants on all sides of them were tied up for several hours on many days during every month of the winter from November until March.

After demonstrating in the above described manner the feasibility of combating frazil in the waterwheels, some experiments were carried out at the racks. With the temperature of the air 15° Fahrenheit—17 degrees below the freezing point—it was only necessary to expend 180 watts, the amount of energy required to light three or four incandescent lamps, upon an iron bar in a rack made up of strips three and one-half inches wide, and one-quarter of an inch thick, in order to detach solid ice which otherwise could only be removed with great difficulty with a chisel or an axe. The section of the rack warmed in this manner was about 5 feet long. This experiment was repeated for the benefit of many skeptics, and in every case it showed that a very small amount of heat energy will detach ice from a surface to which it is frozen, and that a much smaller quantity of heat will prevent ice from attaching itself to any surface. In other words, my method proves the truth of the homely adage that "prevention is better than cure."

In justice to frazil combating methods it should be explained that none of the plants which have their waterwheels equipped with heating outfits have at the present time any means of applying heat to their racks. This explanation is deemed necessary to offset the possibility of an unfavorable report being circulated against the whole scheme owing to a possible interruption of the services by the clogging of the racks which are unprotected.

The protection of the racks, penstocks and draft tubes from the action of the air, and the application of such an amount of energy as will keep the temperatures of the parts of the apparatus through which the water and the frazil flow a thousandth of a degree above the freezing point, will absolutely prevent frazil from interfering in any way with the operation of a hydraulic power plant.

In his book "Ice Formation," Dr. Barnes has generously praised the work that I have done in connection with frazil combating, and says:—"To my knowledge Mr. Murphy is the first to successfully apply such a method, and he deserves all the credit for demonstrating its applicability." At this summer's session of the British Association for the Advancement of Science, held at Leicester, England, Dr. Barnes delivered a lecture on the ice question, and he expressed the opinion that the operator of a hydraulic power plant in northern latitudes need now have no fear of frazil interrupting his services. He made use of some pictures and data supplied by myself, and these are included in the number herewith submitted for your information and consideration.

The following report of Dr. Barnes' lecture has been taken from the British Journal called "Engineering":—

The Ice Problem in Canada.

During the severe Canadian winter there is excellent opportunity for the physicist to study, on a grand scale, the operation of the natural laws governing the formation of ice in many forms with which it is met in large and often turbulent rivers. To the engineer the problem is more serious, for the development of the vast water powers of the country must include means of combating the ice troubles which arise each winter. Rivers are known to have been turned entirely out of their course into new channels during a winter of unusual severity, and in some instances the reversal of a rapid is of yearly occurrence. Nowhere can one witness a more wonderful sight of the delicate poising of the forces of Nature than in one of the Canadian rivers in winter. The steadiness of the temperature of the water throughout the ice season is a matter of great interest. It seldom varies more than a few thousandths of a degree from the freezing point, even in the severest weather. This is true for rivers flowing too swiftly for surface ice to form, as well as for the quieter streams protected by an ice covering. In general, three kinds of ice are distinguished, and present characteristics brought about by their method of production. Surface

*Can. Soc. C.E., Vol. XVIII., 1904, "Some Experiments on Loss of Heat from Iron Pipes, by R. W. Leonard, C.E., and discussion.

or sheet ice forms over the surface of quiet lakes or rivers, and is desirable or not, depending on the particular conditions. Specular ice—or as it is called in Canada, frazil ice—is formed by surface agitation in the more turbulent rivers and in waterfalls, and accumulates in great quantities in the quieter waters. It is this form of ice which gives the most trouble in hydraulic work. Anchor ice, or ground ice, is the most interesting; from the fact that it grows along the bed of a river not protected by surface ice, and often causes considerable inconvenience when it rises in great masses, carrying up with it boulders and stones of considerable size. Anchor ice is formed in the first instance, by radiation of heat during a cold clear night, but increases to great depths by entangling and freezing large quantities of the frazil ice carried down by the shifting currents. A study of the temperature conditions in the water during the production of these forms of ice shows that this is accompanied by a small temperature depression in the water amounting to a few thousandths of a degree Centigrade. During the severe weather the water is thus thrown into a slightly super-cooled state, during which time the ice crystals are growing rapidly by continued freezing, and give rise to the agglomerating stage, when they stick together in lumps and spongy mases, and adhere to the racks or to the machinery of the wheel gates or turbines. So firmly does the ice freeze that it will interfere in a short time with the operation of the machinery, and cause a temporary cessation of operations. The rack bars frequently become clogged with ice, and cut off entirely the supply of water. Fortunately it is only a small temperature depression which brings about these conditions, and methods of artificial heat, applied about the affected spots, are found to effectively relieve the situation. The sun is the most powerful agent in preventing the troubles, since the absorption of the heat rays prevents the state of super-cooling. At night, however, it has been found most important to have available a system of steam injection, or electric heating, which can be readily applied about the machinery, in order to prevent it from becoming super-cooled. It is not found necessary to warm the entire volume of water passing through, which would be very costly and difficult; but by applying the heat in the racks of wheel cases, or blowing steam about the affected parts, the ice is prevented from gaining a foothold. The ice is as effective as so much water in producing a head; hence the necessity of passing it through, and not allowing it to freeze to the metal surfaces of the machinery. In places where the steam injection system is installed no trouble is experienced, even in the most severe weather, thus completely demonstrating the feasibility of coping with a situation which, for many years, has been regarded as involving inevitable interruption to the continuous operation of the plant.

To my former confreres of the Ottawa Electric Company, who erected the small frazil combating plant, and who so willingly helped to operate it at a time when the attempt was generally regarded as ridiculous or foolhardy, I beg to tender my best thanks.

ECLIPSE SYSTEM OF ROOF GLAZING.

A system of Messrs. Mellowes & Company's, Limited, Patent "Eclipse" Puttyless Roof Glazing is of special interest to railway engineers, engineering firms and architects.

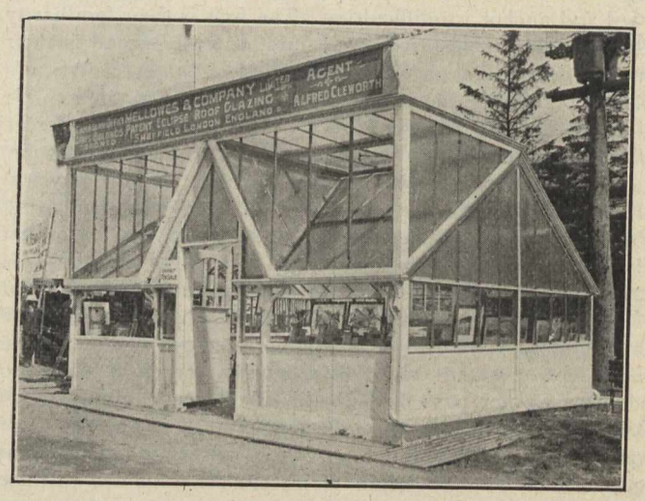
The feature of this steel bar is, that it is absolutely imperishable, being covered with a strong "Eclipse" metal cove which is soldered at both ends, thus preventing any rust or weather getting to it. Neither zinc, putty nor paint is required. Snow or rain cannot possibly drift in between the glass and the woodwork, owing to the existence of a lead windguard which is fixed underneath the bottom of the pane and between the bars.

Often for a few years a roof will give satisfaction, but afterwards trouble, owing mainly to the unsuitability and perishable nature of zinc, sheet iron and other bars.

The use of this bar for over 25 years on railway stations, engineering works, baths, dye works, and other buildings, subjected to the worst atmospheric conditions that could be selected, go to prove that it is imperishable, and entirely unaffected by atmospheric action.

The perfectly water-tight condition of this system of roof glazing, also the keeping out of dirt and dust is due to the existence of three webs, which (unlike either zinc or copper), are rubbed firmly against the glass, two webs above and one below.

The accompanying view is a photograph of Mellowes & Company's, Limited, exhibit just recently shown at the Toronto Exhibition, where practical demonstration of water flooding the roof, by means of sprinklers, were given daily.



Mellowes & Company's Exhibit at the Toronto Exhibition.

Estimates and fullest particulars will be freely given on application to their Head Office, 28 Victoria Street, Westminster, London, or to the Canadian Agent, Alfred Cleworth, Janes Buildings, Toronto.

THE PANAMA CANAL.

The Panama Canal cost the United States $84,449,000 up to December 31st, 1906, according to a statement of the audited expenditure just published. The bulk of this expenditure was the $50,000,000 to the French company and the Panama government for canal property, right of way and franchises. Just $3,949,033 went for material and supplies. For general administration there was expended $1,124,200; government and sanitation, $4,381,089, and construction and engineering, $9,972,552. Other expenses include $2,138,852 under the head of plant, which embraces rolling stock machinery, second main tracks, etc.

There is to be constructed at Southampton, England, the deepest open dock in the world. Exclusive of the quays and cargo sheds, the dock will cover an area of sixteen acres. The site chosen, admirably adapted for the purposes of a vast ocean trade, comprises the greater portion of the reclaimed land lying between the Empress dock and the Trafalgar Graving dock. Forming an oblong square, the water area to be created will be 1,700 ft. long, and a uniform width of 400 ft. is stipulated. The outer walls will be prolonged into the River Test, somewhat beyond the present boundaries, and the additional quay space secured will offer berths for eight of the largest vessels afloat. Alongside the existing deep-water quays in the Test—the scene of so much naval and military activity during the war in South Africa—there is already a depth of 32 ft. at low water of ordinary spring tides, but the dock designed will be capable of being dredged so as to give, under similar conditions, a depth of not less than 40 ft., increasing to 53 ft. at high water. Inside the dock will be berths for four vessels each about 800 ft. long, and these can enter or leave at any state of the tide. In respect of no existing dock at home or abroad can a like claim be sustained, and Southampton will, therefore, enjoy supremacy among British and foreign ports in its provision for the immense passenger and cargo steamers that form such an important element in the mercantile marine.