Canadian Engineer

A WEEKLY JOURNAL

For CIVIL, MECHANICAL, ELECTRICAL and STRUCTURAL ENGINEERS and CONTRACTORS

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Vol. 16. Toronto, Canada, March 19th, 1909. No. 12.

BUYER'S REFERENCE—PAGE 2.

WHERE TO BUY

An Engineering Trades Directory

For the Assistance of Engineers, Contractors and Purchasing Agents

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

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

Automatic Railways
Babcock & Wilcox, Ltd., Montreal,

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

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McLaren Belting Co., J. C., Montreal,

Boilers, Marine, Stationary and Water Tube
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Senator Mill Mfg. Co., Ltd., Galt,

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

Coal Handling Machinery
Northern Engineering Works, Detroit, Mich.

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* Every Other Week

† Once a Month

CONSULTING ENGINEERS

NEW INCORPORATIONS.

New Toronto.—Davey Leather Co., $120,000; P. Davey, M. Hyde, N. J. Davey, Toronto.

Hamilton, Ont.—Canadian Tungsten Lamp Co., $300,000; P. D. Crerar, T. H. Crerar, S. E. Rusk.

Cap St. Ignace, Que.—Austin Lumber Co., $95,000; W. DeM. Marler, E. Cholette, J. E. Lemire.

Dawson, Yukon.—Dublin Hydraulics, $250,000; L. J. Thompson, A. W. H. Smith, R. S. Hildebrand.

Coderich, Ont.—United Heat, Light & Power Co., $100,000; A. W. Glass, W. G. Mackintosh, J. P. Gleadon.

Fort William. Ont.—Sturgeon Lake Gold Mining & Development Co., $200,000; M. Ferguson, R. S. Piper, M. J. Manion.

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The Canadian Engineer

WEEKLY

ESTABLISHED 1893

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The Canadian Engineer

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

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

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TORONTO, CANADA, MARCH 19, 1909.

CONTENTS OF THIS ISSUE.

If you do not file your copies of The Canadian Engineer kindly forward us the issue for February 19th, for which we will extend your subscription one month.

MAINTENANCE OF WAY ASSOCIATION.

Last week there met in Chicago, Ill., one of the strongest engineering societies of America. The American Railway Engineering and Maintenance of Way Association was organized ten years ago, having for its object "The advancement of knowledge pertaining to the scientific and economical location, construction, operation and maintenance of railways." And no single institution has done more than this organization to secure these results.

The reports of the committees of this Association are accepted as the standards of good practice, being the result of the labors of men especially informed on the questions considered. The membership is an individual one and purely voluntary, and the actual work performed is done for the love of the profession and the individual interest the membership takes in promoting research work and improving practice.

The work is divided into eighteen divisions, namely, Roadway, Ballasting, Ties, Rail, Track, Wooden Bridges and Trestles, Masonry, Buildings, Signs, Fences, Crossings, Cattle-guards, Records, Reports, Accounts, Signalling and Interlocking, Uniform Rules and Organization, Water Service Yards and Terminals, Iron and Steel Structures, Economics of Railway Location, the subject of Wood Preservation and Electricity.

In addition to the regular committees special committees are appointed from time to time to deal with matters not coming directly into the field of the standing committees.

In the preparation of committee reports the following general plan is adhered to, as far as practicable: Each committee ascertains the present practice relating to the particular subject in hand; the information is carefully analyzed and digested by the committee, and from the data before it and from its own personal knowledge of the subject it is expected to formulate its recommendations to the Association for adoption as recommended practice.

The reports are distributed first as bulletins, and after discussion, both written and verbal, are, as amended, distributed in the annual volume of proceedings.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.

President P. Gillespie and his Executive Committee are to be congratulated on the success of the first Cement Exhibition and Convention held in Canada.

So many interests and associations are exhibiting and convening that one wonders how a new organization can find room or secure membership, yet in less than one year the Canadian Cement and Concrete Association was organized and came before the public with a successful show, representing every phase of concrete work, and presented a convention programme equal in scope, originality and value to those presented by many of the older and stronger industrial associations and engineering societies.

Concrete as a material of construction is in greater demand. As the skill of the concrete worker increases the material will come more into use, and these conven-

tions and exhibitions will play a large part in perfecting the art and familiarizing the builder with the best methods and best materials.

THE GRAND TRUNK PACIFIC.

The Grand Trunk Pacific financing is just now a live question. The Canadian Government is expected to loan ten millions to the G.T.P.R. to assist them with the prairie section—a section which it was estimated would cost $18,000 per mile, but which cost over $30,000 per mile, making a difference of over $30,000,000 on the section from Winnipeg to Wolf Creek.

This demand coming, as it does, when Dominion revenue is shrinking may make financing difficult, yet the situation must be met, and met promptly. Such a national calamity as the discontinuation of construction work at this period in the country's growth must be averted. If the railway cannot finance the work, the country must.

What security shall be given for this loan is a matter for consideration. Although a separate organization, still the G.T.R. must lend aid to the G.T.P.R., for the success of the latter, in years to come, will be to the immense advantage of the former. Eventually the road will be a success, and Canada as a nation will reap great gain, but so also will the railway company, and it is not necessary to make them a gift. To act as their bankers for a time may be necessary.

EDITORIAL NOTES.

An interesting time was spent by the Road Committee of Montreal when they opened tenders for pavements, flagstones and curbs for 1909. Over one hundred and fifty tenders were submitted, and prices were from fifteen to twenty-five per cent. lower than last year.

To handle the Intercolonial Railway without a deficit appears to be a Governmental impossibility. Mr. Graham's scheme of a board of management should be an improvement, provided this will eliminate political interference.

See Page 46 for Toronto Sewage Report.

THE BOARD OF RAILWAY COMMISSIONERS FOR CANADA.

Order Re Steel Tires.

Upon the report and recommendation of the Inspector of Railway Equipment and Safety Appliances have ordered that the tender trucks (weighing 100,000 pounds or over when loaded) of locomotive engines used in passenger service by companies operating railways by steam power, under the legislative authority of the Parliament of Canada, be equipped with steel-tire wheels on or before the first day of December, 1909; and that the use in such service, on or after the said first day of December next, of tender trucks (weighing 100,000 pounds or over when loaded) of locomotive engines equipped with cast-iron wheels be, and it is hereby prohibited, except in cases of emergency in which it may be necessary to use the same to take trains to divisional or terminal points. A penalty is attached for failure to comply with the regulation.

THE BOARD OF RAILWAY COMMISSIONERS AND THE OPEN SWITCH.

The Board have sent out the following circular to Canadian Railways:—For some time past, the destruction of life and property resulting from accidents caused by main line switches being left open, has been so great that the Board is of the opinion that some action must be taken to secure better protection of trains against danger from the cause.

The Board has been informed that it is possible to install, at moderate cost, an electro-mechanical device which would indicate by a signal, suitable for both day and night use, that a main line switch was open; the said device to be connected with the switch-lever and act so that the opening of the switch would automatically give the danger signal.

Such a device being installed, a rule could be issued prohibiting engineers from passing such a signal at danger, and requiring them to call for the closing of the switch before proceeding further towards the yard or siding.

The Board will be pleased to have from your company, as soon as possible, an expression of opinion as to what it regard as proper and practicable in the premises.

The decision of the Supreme Court of Alberta in the case of the Province against the Canadian Pacific Railway Company says that the Province had the right to tax the railway's land and the Edmonton Land Company for local improvement and school purposes. These taxes will include arrears running as far back as 1903 in cases of some subsidiary companies of the Canadian Pacific Railway. Thus the thin edge of the wedge has been entered in the contention of the Canadian Pacific that it must earn 10 per cent. net on all stock before its property can be taxed.

COMING MEETINGS OF ENGINEERING SOCIETIES.

Architectural Institute of Canada.—6th April, 1909, general special meeting at 94 King Street West, Toronto.

Canadian Railway Club.—April 6th, Windsor Hotel, Montreal, 8 p.m.

Canadian Society of Civil Engineers.—March 26th, mechanical section, Montreal.

Canadian Society of Civil Engineers.—(Toronto branch), March 25th.—Report of the Cement Committee.

Canadian Society of Civil Engineers.—(Manitoba branch), April 8th.

American Institute of Electrical Engineers.—(Toronto Section), March 26th, Toronto.

American Society of Civil Engineers.—April 7th, New York.

American Society of Mechanical Engineers.—March 24th, New York.

Nova Scotia Society of Engineers.—April 8th, Halifax.

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

Canadian Electrical Association.—Annual Convention at Quebec, June 16th, 17th, 18th, 1909.

American Water Works Association.—Annual convention, Milwaukee, Wisconsin, June 8th to 12th, 1909. Secretary, J. M. Diven, Charleston, S.C.

RAILWAY EARNINGS AND STOCK QUOTATIONS

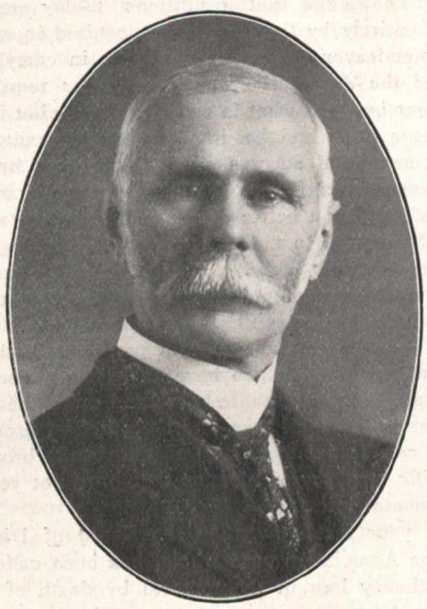
NAME OF COMPANY	Mileage Operated	Capital in Thousands	Par Value	EARNINGS Week ending Mar. 13		STOCK QUOTATIONS TORONTO				MONTREAL			
				1909	1908	Price Mar 12 '08	Price Mar. 4 '09	Price Mar. 11 '09	Sales Week End'd Mar 11	Price Mar 12 '08	Price Mar. 4 '09	Price Mar. 11 '09	Sales Week End'd Mar 11
Canadian Pacific Railway	8,920.6	$150,000	$100			146½ 145	167½ 166	166	78	146 145½	166¾ 166½	166	491
Canadian Northern Railway	2,986.9			148,900	132,700								
*Grand Trunk Railway	3,568.7	226,000	100	709,819	677 895		....*1st. pref.104, 3rd pref. 44½, ordinary 18½						
† T. & N. O.	305	(Gov. Road)		26,000	11,000								
Montreal Street Railway	138 3	18,000	100	66,142	64 657					182½ 181	207 205½	209 207	345
Toronto Street Railway	114	8,000	100	66,150	62,280	100 145¾	123 122½ 169	122 170 168	496 14	100 99¾ 147	123½ 123⅝ 169½	122½ 122 169	1285 40
Winnipeg Electric	70	6,000	100										

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

WILLIAM McNAB, PRESIDENT OF THE AMERICAN RAILWAY ENGINEERING AND MAINTENANCE OF WAY ASSOCIATION.

Mr. William McNab, President of the American Railway Engineering and Maintenance of Way Association, was born in Scotland fifty-four years ago. He is a son of the late Thomas McNab and grandson on his father's side of the late William McNab, Curator and General Superintendent of the Royal Botanic Gardens, Edinburgh, Scotland, and on his mother's side of the late James Haig Cobban, collector of Her Majesty's Customs, Alloa, Scotland. Coming to Montreal with his parents at an early age, he was educated at the McGill Model School and at the Montreal Collegiate School, and on graduating from the latter in 1870 entered the service of the Grand Trunk Railway Company as an indentured pupil in the Engineering Department, and has since been continually connected with that great corporation.

During this long period, Mr. McNab has had charge of the surveys for and construction of many of the new lines which eventually became part of the system, as well as having been closely identified with the design and superintendence, both in new construction and maintenance of most of



William McNab, Principal Assistant and Engineer, G.T.R., and President American Railway Engineering and Maintenance of Way Association.

the important works that have been the means of transforming the then Grand Trunk Railway into the great modern system that it is at the present day. That these works were many and varied in character goes without saying, and the opportunities for gaining experience offered on a road which has grown from small things to a system of such magnitude and international importance as the Grand Trunk now is, were not few nor insignificant.

Previous to 1875 Mr. McNab was engaged with the then chief engineer upon detail matters connected with the works of the International Bridge, then in course of construction across the Niagara River between Buffalo, N.Y., and Fort Erie, Ont.; upon the location and construction of the Lewiston and Auburn Railroad, Maine, including its brdigework; the construction of the Union Station buildings and general terminal facilities, Toronto, and the then new erecting and machine shops, Stratford, Ont. He also superintended the various works connected with the renewal in iron of all the large Howe truss bridges on the railway, the construction of the new train ferry docks at Point Edward, Ont., and Fort Gratiot, Mich., and the methods adoptel for and practical work in narrowing the old broad gauge of 5½ feet to the present or standard gauge. Between 1875 and 1885, inclusive, after having passed an examination before the Province of Quebec Board of Examiners for the study of Land Surveying, he was engaged for several years almost exclusively upon Grand Trunk Railway surveys, acting during that period as engineer of surveys and levels on upwards of 400 miles of Grand Trunk Railway lines for projected revision work, engineer of construction of double-tracking between Scarborough, Ont., and Toronto, Ont., of York Yard terminals and engine houses, and engineer of location and construction of portions of lines in the State of Michigan and Province of Ontario and Quebec, now merged into the Grand Trunk Railway System. Between 1886 and 1896 inclusive, he had charge of general engineering work and maintenance of way, including control of construction of the Terminal Station at Montreal, the subway under the freight and terminal yards, Wellington Street, Montreal, back cove draw bridge and approaches, Portland, Me., and the design and construction of masonry and other general structures of the railway. From 1896 to 1907, superintended the drafting room and assisted the chief engineer generally on various new works, including the replacing of the single track Victoria iron tubular bridge across the River St. Lawrence at Montreal by the present double-track steel trusses. In 1907, Mr. McNab was appointed principal assistant engineer of the whole System, 4,645 miles.

The history of Mr. McNab's life is, therefore, a story of the development or evolution of the technical side of railway management that has made the present physical status of the Grand Trunk the admiration of those who have followed the trend of events in railway engineering. Mr. McNab had ample opportunities of extensive travel and the knowledge he acquired by such opportunities was used to advantage.

Mr. McNab is a member of the American Society of Civil Engineers, as well as of the Canadian Railway Club and the Canadian Society of Civil Engineers. He was a member of Council of the latter body in 1903 and in 1907, and is at present Chairman of its Committee on Transportation Routes. He is a charter member of the American Railway Engineering and Maintenance of Way Association, and in this connection was the first vice-chairman of the Committee on Graduation (afterwards Roadway), becoming Chairman in 1902. In 1904 he was appointed Chairman of a new committee, that on Economics of Railway Location and in 1905 was elected a director of the Association. In 1907 he was elected second vice-president and became first vice-president in 1908, and in the same year succeeded to the office of president, made vacant by the death of the Walter G. Berg.

PRESIDENT'S ADDRESS AT THE AMERICAN RAILWAY ENGINEERING AND MAINTENANCE OF WAY ASSOCIATION.

Our Association has just completed a decade of active work, and during that period has made an enviable record, and now occupies a prominent position in the front rank of railway organizations and engineering societies.

The advantage gained by this status turns on the beneficial influence it exerts in connection with the objects of the Association, the scientific and economical location, construction, operation and maintenance of railways, an influence which has been imparted to the railway world in a degree of usefulness, universal in its scope and almost unparalleled in its import. This feature should be especially gratifying to the members on this particular anniversary. More especially should this appeal to us, as few, if any, kindred bodies have, within the same period or similar length of time, acquired the growth, stability, practical usefulness and, in general, the high standing attained by this Association.

In modern days the science of railway engineering occupies a wide range in the domain of civil engineering in the generic sense. This fact was appreciated even in the early days of railway construction by the compilers of the lexicons of that period, the term "civil engineer" being defined by them as "one who plans railways, harbors, docks, etc.", railways apparently being given first place in importance.

From these early days down to the time when the present classification of expenditure was introduced each railway was practically a law to itself in regard to physical standards, as well as to clerical and accounting methods considered necessary for its proper care.

In the course of time, however, the field covered by what is comprehended under the term railway engineering became so enlarged and so important that direct supervision in detail from one source was found inadequate, even though the authority enjoyed the broad title of civil engineer.

During that period there was in a more or less degree a lack of proper appreciation of the value of technical education and training as an adjunct to the practical working of the railway, and the results of experiments made from time to time by certain railways individually to establish a justification for proposed changes were, in regard to real value, not altogether satisfactory to the railway world in general. The experience gained from such investigations, desirable or undesirable as the case might be, was often acquired only after the expenditure of large sums of money, direct or indirect, and the ascertained facts were jealously guarded by the interests concerned.

To the railway world, however, the results of such investigations, even if known to be of benefit, did not meet all the requirements essential to a comprehension of what was expedient from an economic standpoint, and the lesson which should have been taught, viz., that as much, if not more, valuable experience is to be acquired through failures rather than from successes was not properly brought home.

The text books upon particular subjects connected with railway engineering in use in earlier days were produced under private or individual auspices. As a general rule they were ably edited, yet the perspective embraced was circumscribed by reason of existing circumstances, and the value of their use was necessarily limited on account of lack of systematic re-issue of such volumes with supplements to meet changing conditions. Special articles upon railroad technical matters which appeared from time to time lacked the value of full discussion, and information thus imparted did not meet requirements; therefore, the interest created could only be looked upon as more or less temporary and superficial.

Railway engineering, as a great department of knowledge, eventually came to be so sub-divided in order to meet the conditions of the times that each subdivision practically developed into a distinct science, yet each department retained possession of all the elements tending to form a harmonious whole. Evolution in this respect, however, progressed slowly, and the methods and standards in use were in many instances adhered to too long, partly because their chief recommendation lay in the fact that they were time-honored or that there was a lack of knowledge of better substitutes.

Nowadays, fewer text books on details of railway construction and maintenance are produced from private sources for the output of your Association, viz., the conclusions and principles of practice emanating from its various committees, which eventually find their way into the Manual of Recommended Practice have become the source of appeal in their respective spheres. If reference be made to the discussions preceding the adoption of such conclusions and principles of practice to be found in our Proceedings, it will be noted that every detail has been thoroughly covered.

The bibliography of the Association is, in consequence, liberally made use of to advantage, not only by the members, but by the executive officers of our railways, as being practically authoritative on railway technical details. In this general connection we are amply justified in stating that there need be no hesitancy in accepting as good modern practice, based upon scientific methods, the general principles which are recommended therein. You are all aware that before any of the various recommendations are adopted and disseminated they have been thoroughly discussed and voted upon in open convention by the most competent and up-to-date body of railway engineers to be found anywhere, and in no other organization is there a greater degree of care exercised to guard against inconsistencies than is exhibited in our own. But while there is every reason to be proud of our achievements during these past ten years, we should not rest content, but endeavor to keep our work up-to-date by eliminating from our Recommended Practice what in course of time has become obsolete and perfecting that which is considered worthy of retention, in order that our recommendations may be safely relied upon as representing the best practice that can be devised for the time being.

In no quarter of the world do the diversities of nature, both physical and climatic, exist in a greater degree than on the North American continent, and for this reason the problems confronting railway engineers afford ample opportunity for the exercise of that particular knowledge which your Association was formed to advance, namely, that pertaining to the scientific location, construction, operation and maintenance of railways.

Great progress has been made in that respect since the formation of the Association ten years ago, as will be noted by reference to the historical sketch prepared by the secretary. It is realized more fully that the railway problems coming under our immediate purview are being brought under the influence of common conditions and tendencies.

We meet the propositions which ever present themselves with the knowledge that conditions to-day are not to be governed entirely by the experience acquired in earlier days. It is our endeavor also to realize how, in carrying out the objects of the Association, true economics requires proper discernment between what is expedient and what is essential, as well as a clear insight into what will tend to the permanent commercial success of the companies by whom we are respectively employed. We are also striving, and not unsuccessfully, for a better understanding of the relationship of capital invested to maintenance and operating expenses. In this respect it is borne in mind that as the ratio of progress of all kinds is ever increasing, and that as railways are commercial undertakings, the various factors which produce the greatest permanent profit per cent. of the expenditure, as well as those which have an adverse effect, must be carefully studied. We realize more and more the value of a free exchange of experiences and the practical uses that such exchange can be put to as well as the results brought about by scientific analyses of theories that have not yet been put to experimental tests.

Since your last convention the Board of Direction, as well as the Association as a whole, has been called upon to sustain a heavy loss in the removal by death of two of its most valued members, namely, your late president, Mr. Walter G. Berg, and Mr. D. D. Carothers, member of the Board of Direction. In every department of the Association's interests, with which these gentlemen were respectively connected, their work was accomplished with a thoroughness that left a deep and lasting impress upon the minds of their colleagues and fellow-members, while the genial personality of each endeared them socially to the membership generally. Opportunity will be afforded during this convention for remarks from members eulogistic of the life and character of both the deceased officers.

Your president having been actively connected with the Association since its inception, desires now to bear testimony to the zeal shown by the officers and directors in shaping the destiny of the Association and guarding its best interests during their respective terms of office and since. Acknowledgment is also made of the earnest devotion of the chairmen, vice-chairmen and members of the committees, and of the members of the Association individually in the work, and it may be accepted as entirely within the limits of modesty if it be said that by reason of the elements just mentioned the work has been carried on with a degree of perfection that otherwise would have been impossible.

It may also be said that during the past decade railway construction could not have progressed to the extent and in the manner it has, nor the railways themselves been as efficiently maintained as they have been and are being maintained if it had not been for the organization and co-operation shoulder to shoulder, individually and collectively, of the members of the American Railway Engineering and Maintenance of Way Association.

THE

Sanitary Review

SEWERAGE, SEWAGE DISPOSAL, WATER SUPPLY AND WATER PURIFICATION

TORONTO SEWAGE DISPOSAL.

We confess to surprise and disappointment as the result of the experts' report on Toronto's sewage disposal question.

For over twenty years this question has received intermittent attention. It has been appreciated that to discharge raw sewage direct into Lake Ontario is an improper method of disposal, in view of the fact that the lake forms the only practical source of domestic water supply, while the amount of sewage pollution is an increasing quantity in proportion to the city's growth.

Owing to topographical conditions, the solution of the problem is both difficult and costly. When last year, however, a by-law was passed for $2,500,000 for the construction of a trunk or intercepting sewer for the purpose of concentrating the sewage at one point for purification purposes, it was generally understood that a practical solution was in sight.

The scheme as set forth, after the passing of the by-law, was received unfavorably by residents in the vicinity of the proposed works. They objected to the location of the site. Further, doubts were raised as to the amount and character of the purification resulting from the septic tank process proposed, consequent upon certain findings of the British Royal Commission on Sewage Disposal. Generally, it was felt that the locality was not a favorable one for dealing with large quantities of sludge.

The corporation called in Messrs. J. D. Watson, of Birmingham, and Rudolph Hering, of New York, to report on the scheme.

In brief, their findings are: The site considered suitable. Septic action not advised. Solids to be removed daily from the tanks to a marsh (part of Ashbridge's Bay) situate about a mile west of the site. The sewage liquor to be discharged untreated at a point about two-thirds of a mile into the lake, and about four miles east of the water supply intake.

The effects of the recommendations appear to be: A minimum of nuisance at the site of the sedimentation tanks. The lake to continue as a means of sewage disposal, eventual purification being anticipated by dilution and oxidation. The marsh to take care of the solids, eventual purification being anticipated by putrefaction or nitrification.

We can only view this report as a compromise or amendment to the plans as prepared, otherwise we are at a difficulty to explain it.

No method of sewage purification is advised other than has been in vogue in the past. One part of the lake and Ashbridge's Bay, which is part of the lake, will take over the responsibility of sewage disposal in lieu of Toronto Bay and the lake generally.

It certainly appears that the city is to obtain no value for the expenditure of $2,500,000, and the purposes of the by-law are not to be carried out. Nothing will be added to the health conditions of the community. From the esthetic point of view, the environment conditions will remain practically the same, apart from a change of venue.

It is understood that Mr. Rust (City Engineer) does not altogether agree with the scheme. He has advised in the past, and is understood to still be of opinion, that less danger would be incurred to the water supply by discharging the sewage at a point nine miles east of the intake. Such a proposal presents better value to the city than the one now proposed.

What the terms of reference were to Messrs. Watson and Hering are not quite apparent, or how far they were asked to carry their report, but the city is certainly being badly advised in the matter. The proposal to fill in Ashbridge's Bay with excremental sludge at the rate of two hundred tons per day, so providing a fever-breeding area in close proximity to the city, is one which cannot be faced with indifference. The excuse that the marsh is already a dumping ground for all manner of garbage provides no reason that such should continue, or that extra filth of an objectionable character be added. The time is approaching when the elimination of the unsanitary conditions in that neighborhood must be considered by the introduction of garbage furnace destructors. A sewage disposal system which depends on the destruction of the whole of the excremental filth of 300,000 people by a slow process of surface distribution, subject to rain and sun, in our very midst is unworthy of serious consideration.

Further, the proposal to discharge into the lake at a point opposite the eastern beach in the western current 30,000,000 gallons per day of untreated liquid sewage containing at least 40 per cent. of the solids, alive with intestinal bacteria, is a very poor solution to the sewage problem.

Reliance appears to be put entirely on the adoption of sand filtration of the domestic water supply; whereas, it is admitted by every expert that such a process is not infallible, the residual number of bacteria in the filtrate depending on the number in the raw water.

When action is to be taken, then Toronto should rise to a higher realization of its responsibilities and a better understanding of the principals of hygiene.

There are ways and means, methods which are not experimental, but certain in their action, economical in cost and maintenance, by which sewage can be changed into constituents which cease to have the offensive characteristics of sewage, and which would be perfectly harmless when turned into the lake.

BACILLUS COLI IN WATER.

Species—"Bacillus coli communis." This bacterium has come very much into the lime-light since 1891, when Theobald Smith recommended its use as an indication of the presence of faecal matter in water. It is found in the intestinal canal of man and animals, especially at the lower end. The organism occurs as thin rods; sometimes as ovoid or even rounded forms; rods are slightly curved, and may be motile.

As derived from warm-blooded animals it may be distinguished from the same species derived from cold-blooded. Those of human origin cannot, however, be distinguished from those derived from other warm-blooded animals. Hence its presence in river or lake water is not necessarily a sign of sewage excremental pollution, such bacteria may possibly be derived from the excreta of birds.

B. coli is found in sewage to the extent generally of not less than 100,000 per cubic centimeter (about a thimbleful). Its absence from a drinking water tends to show the non-existence of sewage contamination.

As a test of the sterilization or disinfection of sewage it is a valuable factor. Bacillus coli is very similar to the typhoid bacillus, but much more resistant to adverse conditions. Its presence is certain in cases of cholera, typhoid, dysentery, and other intestinal diseases. Hence any measures which lead to the destruction of bacillus coli may be safely assumed to dispose of the pathogenic germs possible in sewage. Infectious intestinal bacteria are generally enclosed in gelatinous masses and in suspended matter, and are not moving about in a free state in sewage. Processes which retain the suspended matter from sewage, also retain a large percentage of the pathogenic bacteria. This applies to both sedimentation and filtration.

The Hamburg experiments in sedimentation tanks showed that with the retention of 30 per cent. of suspended matter, bacteria were removed to the same extent.

It has been claimed that B. coli can be reduced 40 or 50 per cent. in passing sewage through septic tanks, this reduction, however, if it does take place, must be the result of simple sedimentation only. The British Royal Commission hold that in practice there is no diminution; but that a like number of bacteria are being constantly given off into the tank liquor, by the effervescence of the putrefactive air bubbles, as are settled by sedimentation, hence the number of bacteria in the inlet and outlet effluents is constant.

It has also been claimed that pathogenic germs are destroyed in septic tanks. This is by no means the case, as has been clearly demonstrated both by the Royal Commission and the Hamburg experiments. The Hamburg experiments showed that the cholera vibrio remained active for thirty-three days in a septic tank.

Land intermittent filtration has, apart from sterilization or disinfection, arrived at the nearest approach to the removal of pathogenic germs from sewage. When such are worked under favorable conditions, as in Massachusetts, it is possible to obtain effluents which give a negative coli test with 100 c.c. The English Royal Commission deductions as well as those of the Hamburg experiments, however, conclude that although pathogenic germs are only found in diminished numbers in land intermittent filter effluents, such effluents often present relatively large numbers of Bacillus enteritidis, sporogenes, streptococci, and also B. coli. At Hamburg such filters were charged with a million vibrios per c.c., and 10,000 per c.c. were found in the effluents.

In the case of biological filters, pathogenic germs are passed more freely than through land. In fact, by many, the action of biological filters in removing bacteria is believed not to be worth serious consideration. There is no doubt that the reduction of pathogenic bacteria which is effected by land must be regarded as a great advantage, similarly the smaller reduction in the case of biological filters must also be regarded as an advantage. The retention of the suspended matter in either case makes more difficult the fight for existence on the part of organisms which do find their way into the stream or lake. A complete separation or destruction of pathogenic germs is not possible by any of the known practical methods of sewage purification, unless followed by some system of sterilization or disinfection.

Generally speaking up to the present date the complete disinfection of sewage has been only satisfactorily accomplished by chemical methods applied to the non-putrescible effluents from disposal works.

In the case of sand filtration of water for domestic purposes, the conditions are, of course, entirely different from those of sewage treatment. It would be impossible to treat sewage with its large proportion of suspended and colloidal matter by filters of fine grain sand suitable for ordinary river or lake water. With sewage, such filters would immediately choke. Consequently a larger per centage of pathogenic bacteria can be removed from water than from sewage by filtration methods. However, even fine sand filters are not to be depended on in practice for the complete removal of pathogenic germs. Then efficiency is always doubtful, it takes some time for such filters to mature, and they do not obtain their greatest efficiency till a scum is formed on the surface of the sand. This gelatinous scum has the effect of retaining a large per centage of bacteria, and efficiencies have been obtained up to 98 and 99 per cent., figures, however, seldom arrived at in general practice. The sand has only a minor effect as a strainer of suspended matter in keeping back germs. The formation of this scum soon prevents the passage of water through the filter, and has to be removed, the filter being again inefficient till another scum is formed. The water at times makes short-circuits through the filter, through breaking or disturbing the scum. Such filters require the most careful and conscientious working, and at their best cannot be trusted to remove all disease germs.

B. coli is then a very troublesome and awkward organism, and if with his attendant brethren he is to be kept back from returning into the human system, some more complete method than filtration must be relied on to remove it absolutely from our water supplies.

For complete and reliable methods of water purification, it certainly appears that we must fall back on disinfection or sterilization.

At the Paris water works of St. Maur, an apparatus has been installed capable of sterilizing about 40,000 gallons of water per hour by the ozone process, and it has given such satisfactory results to the chemists and authorities, that it has just been decided to sterilize 20,000,000 gallons per diem, including the whole of their St. Maur supply.

In the great epidemic of typhoid in Lincoln, 1904-1905, the whole of the water supply was sterilized during the epidemic with hypochlorite of sodium by Drs. Houston and McGowan, of the Local Government Board. The results were satisfactory.

The days of sand filtration are not necessarily by any means numbered, when it becomes a case of removing turbidity or matter in suspension likely to silt up water mains, and large settlement basins are not available, sand filtration will still have its place, but as an absolutely efficient means of rendering a water bacteriological harmless it stands condemned even by the admission of its own advocates.

THE SEPTIC TANK.

Chap II.

Recent Information as to Work Done.

In our last issue we traced the history of the septic tank process up to the recent decision of the United States Court, upholding the process patents of the company owning the American rights as against the defendants, the Saratoga Springs, N.Y.

Claims.

We have seen that certain definite claims were set up on behalf of septic treatment.

(a) "That it solved the sludge difficulty."

(b) "That it destroyed pathogenic germs in sewage."

(c) "That the liquor was more easily oxidized, than the liquor from ordinary tanks."

These claims being at first almost generally taken for granted the process experienced a boom.

Mr. Cameron, the patentee of the process, never claimed that the resultant liquor represented purified sewage, or that the effluent was non-putrescible. The company which took over the patent rights, also, we believe, never set up such a claim. The septic tank was advertised as a preliminary or preparatory process, preparing sewage for oxidation. The companies handling these tanks, advise that in cases where the tank liquor is not discharged into tidal waters, it be further dealt with by irrigation or filtration. It may, therefore, be difficult to understand the acceptance of the theory that a septic tank purifies sewage.

That irrigation, land intermittent filtration, or bioglogical filtration, will purify sewage and change its organic compounds into inorganic compounds is well established, but that the process which sewage undergoes in a septic tank will do this has never been established. It must be understood that we are now dealing with the septic tank action merely as a preliminary form of treatment, apart from the many methods of dealing with sewage by oxidation processes.

Referring to a pamphlet issued by the "Cameron Septic Tank Company," we find as follows:—"The process is to pass the sewage into a tank especially adapted to hasten natural decomposition, and to **liquefy all animal and vegetable solids.** These latter being thrown into solution, prevent the formation of sludge, and the heavy expense incurred in dealing with it is avoided." "A tank effluent in the **best possible condition** for either **irrigation** or **filtration.**" Again, "with the exception of two, or possibly three, all **pathogenic germs** are aerobic. The anaerobic conditions provided in the septic tank are calculated to **destroy them.**"

It is apparent that certain definite claims are here set up. Granting that these claims are good, it is not difficult to understand the reason for the process receiving the attention which it has.

The Royal Commission.

The fifth "Report of the Royal Commission on Sewage Disposal," issued about the end of 1908, deals with the above claims, and as a result of experiments, enquiries and evidence, the report concludes:—

"All the organic solids present in sewage are not digested by septic tanks. With a domestic sewage, and tanks worked at a 24 hours rate, the **digestion** is about **25 per cent.**"

"The liquor issuing from septic tank is **bacteriologically** almost as **impure** as the sewage entering the tanks."

"Domestic sewage which has been passed through a septic tank is not **more easily oxidized** in its passage through filters than domestic sewage which has been subjected to chemical precipitation or simple sedimentation."

Here we have definite answers to these claims. It at once becomes apparent that if we are to take the conclusions of the Royal Commission as stronger evidence than the statements of septic tank literature, then our preconceived views of septic action require modification. The Royal Commissioners do not stand alone in their conclusions, they have recently received support from Professor Dr. Dunbar, director of the Hamburg State hygienic experiments.

It must, however, be understood, that even if the above claims have not stood the test of experience, septic tank treatment is by no means condemned. As the Commission points out there are occasions and circumstances in which the adoption of the treatment as a preliminary process, is efficient and economical. There may have been a tendency lately not to give sufficient weight to the advantages appertaining to septic action under certain circumstances. These advantages, we will attempt to deal with in due course.

Sludge Digestion.

"If sewage be slowly passed through a tank of sufficient capacity, from which light and air are excluded, the organic matter will in time be totally eliminated." The reiteration of this phrase has almost made it an axiom. If a statement be only repeated sufficiently often, the mind will at last receive it as a proven fact.

The evidence produced before the Royal Commission as to the amount of sludge digested by septic tanks at the following towns is of interest. By digestion is meant the amount of solids which were converted into gases and liquid. Huddersfield, 38 per cent.; Leeds, about 30 per cent.; Manchester, not more than 25 per cent.; Sheffield, 32.9 per cent.; Birmingham, not more than 10 per cent. The Commissioners' own experiments were carried out at Exeter and Ilford. The digestion at the former works being 25 per cent., and at the latter 30 per cent. At both the latter places the sewage was domestic in character.

Professor Dunbar on "Principles of Sewage Treatment," states, "The question as to what value is to be attached to the diminution of sludge which takes place in the septic tank is still a matter of keen debate. At first it was maintained that the sludge was entirely liquefied and gasefied; then that its volume was reduced by 50 per cent.; and, as a result of the most recent investigations of which I am aware, it is stated that the amount of sludge is not reduced by more than 9 per cent."

Any estimation of the amount of sludge digestion is an extremely complicated one, and it is for this reason that errors have been made on which fallacious deductions have been formulated. The amount of sludge in a tank may have been measured, and then on remeasurement, say two months later, show no apparent increase in bulk, and the natural deduction be drawn that all or most of the solids carried into the tank during the intervening period have undergone digestion. The fallacy of the theory of total digestion or almost total digestion, can only be attributed to some such test as this, which does not take into account, viz., the amount and gradually increasing amount of solids which pass away in septic tank liquor, and the fact that the solids settling in the tanks become compressed and take up less bulk in proportion to the length of time they are allowed to remain.

Solids Issuing From Septic Tanks.

The settlement of solids is by no means thorough, although to the inexperienced this may not be apparent, as the solids which pass away are in fine particles. The reason for the increase in this quantity is found in the putrefactive action, the gas bubbles on rising to the surface are constantly bringing up fine particles of matter, which are carried off with the liquor. The liquor becoming stronger according to the length of time that putrefaction is allowed to continue. The following figures show the amounts of suspended solids left in septic tank liquors as compared with the original sewage at various works in England.

Places.	Suspended solids in original solids. Parts per 100,000.	Suspended solids in tank liquor. Parts per 100,000.	Percentage retained.
Accrington	38.93	19.40	49.8
Andover	15.80	11.10	29.8
Caterham	42.10	22.2	47.2
Exeter (Main)	37.2	12.50	66.4
Exeter (St. Leonards)	26.10	8.40	67.8
Hartley, Whitney	32.7	15.10	53.8
Guilford	42.1	15.9	62.2
Knowle	19.40	8.42	56.6
Prestolee	5.42	3.17	41.5
Rochdale	36.70	5.30	85.5
Slacthwaite	10.70	7.10	32.7
York	21.2	5.3	75.0

The above show an average percentage retention of solids of 55.7, or an average of 44.3 per cent. of solids which escape with the liquid.

Professor Dunbar estimates the amount of suspended matter leaving the tanks at from one-third to one-fourth the total amount.

As to the tendency for the amount of suspended matter to increase the following may be cited. At Burnley from 15 parts to 35 parts per 100,000 in six months; at Huddersfield, 6.6 parts to 23.3 parts in eleven months; at Leeds, 12.2 parts to 24.1 parts in twelve months.

Compression of Solids.

Fresh sludge contains about 90 per cent. of moisture, whilst sludge remaining in a tank for a considerable period of time (one to two years) contains only 80 per cent. This is accounted for by the settling together of the finely divided particles of septic sludge. The dry residue in the latter is therefore in the proportion of 20 per cent., as against 10 per cent. in the fresh sludge. One cubic yard of septic sludge containing as much solid matter as two cubic yards of fresh sludge.

It will from the above be readily seen that a great amount of the so-called sludge digestion can be accounted for by deposition and concentration.

(To be Continued).

THE QUESTION DEPARTMENT.

This portion of the Review is devoted to answering questions relating to data and facts. We cannot undertake to answer questions which call for the paid services of a consulting engineer. All questions must be accompanied by name and address, not necessarily for publication. The editor also asks for your opinions at all times upon subjects treated in this review.—(Ed.).

J. J., (Toronto), asks.—If Mr. Hazen had made the filtration plans in Toronto would the Corporation be still liable for the $1,800 duty, and if a duty on plans made out of Canada has ever been collected before?

If the plans had been made in Canada, there would certainly have been no duty to pay. Duty is collected on crossing the line. We do not know of any other case where such duty has been collected, although such may have taken place.

East Toronto, asks.—If it is possible to obtain any guarantee from Toronto Corporation that the Morley Avenue site may not at some future time be used for the treatment of sludge of a septic character, when the authorities get tired of emptying the sludge into the marsh.

We are afraid that this question is one which requires a legal answer. But the point is a good one, as any falling back on the originally proposed method of dealing with the solids in a septic state at Morley Avenue would cancel altogether any benefit the residents may have obtained by the experts advising that the most objectionable feature of the sewage treatment be removed from the site.

Medical Officer of Health, Ontario.

The various questions you ask us relating to your town could not well be answered without visiting the locality. They should be properly put before a consulting engineer by your council. Names of several engineers are advertized in this journal. We may say, however, that the biological system can be made to work throughout severe frost. It does not really matter whether sewerage precedes or follows water supply, but as a matter of fact the two should go together. A sewerage scheme is not much use without a water supply system, and vice versa.

Sewerage and Water Supply Engineer.—We thank you for your kind remarks re these columns, your MS will be made use of. The points are well made.

—Ed. Sanitary Review.

THE EVOLUTION TOWARDS THE USE OF CONCRETE IN MUNICIPAL WORKS.

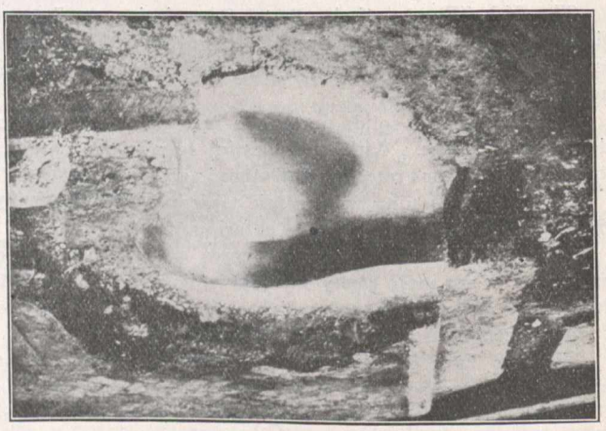
A. C. Blanchard, A.M. Can. Soc. C.E., Assistant Engineer, Toronto, Ont.

There is absolutely no question but that the stone age is again returning, and side by side with the age of iron is making for itself history that will be narrated to future generations by its own works.

When, with considerable diffidence, the writer undertook to prepare this paper to be read before your society he thought it would be an easy task to combine the usages of the age of stone and brick masonry and of the age of concrete masonry into the scope of this paper. Unfortunately, however, the outlining of the gradual evolution in municipal structures by substituting concrete as the outstanding building material is rendered all the more difficult by the multiplicity of examples and uses to which the newer material has been put, and the writer has been forced in seeking for illustrations to abstract examples at random with which he has been more or less personally familiar.

It is, of course, good business for the cement manufacturers, dealers and controllers of patented processes, to ingeniously point out the many uses to which concrete may now be put, in its own mass, and combined with steel. There have been some failures and many successes, and failures have always been accounted for by poor inspection at some point in the process of making. There are, of course, some things that concrete cannot be successfully used for. These have mostly been tried, and nothing more is heard of them. In the main, however, for engineering works the adaptability of concrete is simply astounding.

Perhaps the engineer most conservative in his ideas of newer materials, and especially, perhaps, of concrete, most conservative in his notions regarding its applicability, is the municipal engineer. Not that he is more difficult to convince or slower at grasping the truth than an engineer in any other branch of the profession, but principally because his works are subject to constant scrutiny of thousands, some who are capable of judging and others who are not, and comment made by these thousands in the newspapers, perhaps, or in deputations to municipal councils, act as a deterrent of greater or less force to the engineer to introduce any radical



Concrete Storm-water Inlet ready for Inlet Slabs.

change in his construction of the public works of the city or municipality.

Concrete, of course, is past its experimental stage. In many forms of construction it is the standard material. There are numerous examples in this country, built twenty-five and even fifty years ago.

In Saint John, New Brunswick, there is still in use a wrought iron water main encased in concrete and giving excellent service. This main goes across the river from St. John to Carleton, and was concreted nearly fifty years ago.

Thirty years ago Henry Reid, in an English treatise, refers to sewers made and used in England, and giving excellent satisfaction. He gave a design also of an egg-shaped sewer of large dimension, constructed of concrete blocks, forming, as he says, "a structure infinitely superior to anything reachable through the agency of brickwork or other means. Such a sewer would, indeed, prove itself competent to withstand every injurious influence of whatever kind."

It is most difficult to arrange in any sort of order the way in which the different branches of municipal work should be discussed. The importance of each stands by itself, and to each branch separate attention could be given, which would fill many volumes.

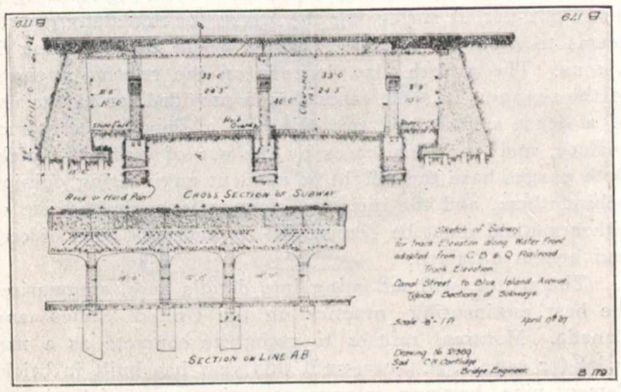
Since this paper was commenced the official programme of this society's annual meeting has been published, and the writer has noted that some of the papers in advance of this have covered fully a discussion of some of the ground intended to be covered by this paper. Therefore, to some of the audience this paper may seem more or less unbalanced by reason of its revision at a late date to omit some of the ground already covered and discussed; consequently, as the question of sewers does not appear to take a prominent part

* Read before the Canadian Cement and Concrete Association.

in any previous paper, that branch of municipal engineering has been enlarged upon to the exclusion to a greater or less extent of some other branches of the subject.

An exhibit of reinforced concrete was shown at Paris Exposition in 1855, and Coignet proposed several methods in 1861. In 1886 the city of Grenoble, France, laid a line of reinforced concrete pipe 330 feet long.

In reply to an official enquiry the following is condensed: The pipes have always resisted the normal pressure of 80 feet of head. The length of each section of pipe is 6 feet 3 inches; thickness, 1⅜ inches; internal diameter, 12 inches. Reinforcement was thirty longitudinal rods ¼-inch diameter, and 5-32 of an inch internal spiral wire and ¼-inch external



spiral wire. Pipe weighed 88 pounds, and were connected with concrete rings, reinforced. Two lengths were raised in 1901. They showed:—

1st. Irreproachable preservation.

2nd. No trace of oxidation of the metal.

3rd. The adherence of metal to concrete was such that it required heavy blows from a hammer to separate them.

4th. The line had required no repairs since it was placed in 1886.

The writer was interested last summer in discussing with a gentleman who had his office some thirty years ago on the south side of King Street, between Bay and York Streets. Concrete was suggested for the new sidewalk which was to be laid in front of the premises. A portion of the owners, however, were inclined to pin their faith to the trusted and tried stone slabs. Both sidewalks are there to this day, but the slabs have been taken up, chipped and reset three or four times since then, and the concrete walk, never repaired has the best part of its life yet to live.

In this city there are now upwards of 350 miles of concrete sidewalks built since that time, superseding overwhelmingly all other sidewalk materials, and the prophecy may safely be made that reinforced concrete will take a prominent place in sidewalk construction from standpoints of both durability and economy in the near future

As a base for street pavements, concrete stands preeminent. Its presence makes so easily possible the use of asphaltic and other waterproofing surfacings.

The use of concrete as a roadway surface pavement has not been adopted by this city, although it has been used more or less successfully in other cities, towns and in country districts.

As a road pavement for cities, however, which is constantly being cleaned, it suggests the possibility of becoming slippery under wear as well as an absence of elasticity.

We have, however, by no means ceased to learn the applications to which concrete may be put in municipal work, and possibly some day may see the concrete roadway complete being recommended to the exclusion of the bituminous surfacing so popular at present.

There is, of course, a considerable field for Portland cement as a binder for block pavements, and the writer had the good fortune to make comprehensive tests last summer to determine the efficiency of various pavements. Brick pavement stood foremost in this regard, and the asphalt pavement, which was very satisfactory in its results in the days when the sun was at all hot, gave poorer results than brick, even on rainy days, when the asphalt was thoroughly cool and solid. Owing to its absence cement pavement was not tested, but it is obvious that it would be as efficient as brick on level streets.

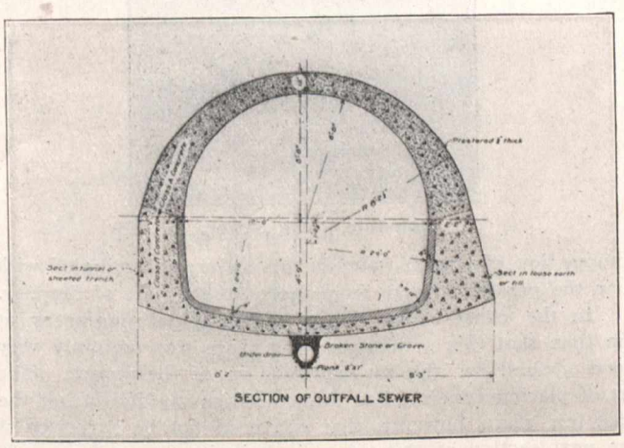
Turning now to bridges and subways, there appears to be no more vivid example of the forward march of concrete than the subway now being constructed at Lansdowne Avenue, in this city. The subways under the tracks at King and Queen Streets, built some time ago in stone masonry, are in no way superior to the concrete structure; on the contrary, the impression given by the concrete walls is much more pleasing.

It is to be hoped, however, that the railway companies will adopt the more rational bridge flooring when the next subway is to be built. The use of plate girders for street crossings is out of date for three reasons: first, expense; second, æsthetic appearance, and third, impossibility of deck flooring. The latter can only be obtained by the use of shallow beams embedded in concrete or by solid slabs, reinforced by rods. The Chicago, Burlington and Quincy Railroad have adopted a system of slab flooring whereby slabs 7 feet wide, 23 feet long, and 2 feet 9 inches thick are made in a central yard, loaded on cars by a wrecking crane, conveyed several miles and deposited on the abutments and piers waiting in readiness for receiving them. The heaviest slabs are 35 tons in weight, and the building of them in a central yard is considered not only more economical, but it also eliminates any possibility of vibration due to passing trains, which would have to be faced were the material deposited in in situ.

It occurs to the writer that Mr. Cartlidge, the bridge engineer of the Chicago, Burlington and Quincy Railroad, is responsible for one of the greatest forward movements yet met with in reinforced concrete construction.

In water supply work it is impossible to over-estimate the advantages of concrete. Its cheapness and absolutely durable qualities, the possibility of smooth finish and cleanliness recommends it for use wherever practicable.

The city of Toronto lately constructed a conduit in tunnel beneath the Bay. First designed circular in form and



nine feet in diameter. The section was changed to a horseshoe shape of equal cross-sectional area for convenience in building, and the invert up to the springing line of the arch is built in concrete. There could be no question whatever regarding the comparative cost of brick and concrete work for this portion.

The use of concrete in sewer work in Toronto has been chiefly in foundation work, in covering around pipes, in the Woodbine septic tanks, and in manholes; but the body of the larger sewers have almost been invariably constructed of brick. Until a sewer reaches a diameter of over three feet the close estimating between solid brick and solid concrete can hardly find any difference in the cost of the construction, with either material using the same thickness of walls.

Perhaps it is pertinent here to remark that the use of so-called cement pipe is still in its progressive state. The writer knows of several very excellent forms of reinforced concrete pipe, which are assembled above ground and placed like vitrified pipe. Such concrete pipe reach a maximum diameter of five to six feet. It is rather early to give judg-

ment on the efficacy of these pipes for ordinary sewage, but where they are properly made there should be no trouble with them afterward.

The selection of materials and proportions should both be most carefully looked after and governed by anticipated conditions. At the same time the principal failures in concrete sewers have occurred in reinforced concrete pipe work.

Above the dimension of three or four feet, however, a saving is at once evident in the use of concrete over brick, and engineers should balance well the advantages of the use of concrete before building in brick. In this city there is but one sewer which has been built within the present generation of a dimension exceeding the one above mentioned; that sewer drains the most of the northern part of the city. Doubtless it will be ultimately extended to drain those districts lately admitted to the city, known as Bracondale and Wychwood.

This sewer is 6 feet 6 inches in diameter, and follows down the valley known as the Rosedale Ravine to the Don River. On account of the very heavy grade numerous ramps had to be provided to reduce the velocity, and, although built in brickwork, it has been in a state of more or less repair through the wearing of the invert. The old invert bricks are being removed and vitrified pavers being inserted in their place, laid in Portland cement mortar, and the new invert is not giving any trouble. There is a con-

Concrete Block Sewer.

tinuous flow of stream water in this sewer, and mingled with it is the present sewage from the northern part of the city.

In the conservative minds of municipal engineers at the time that this sewer was built there was certainly very good ground for the recommendation of brickwork. The art of placing concrete has progressed so rapidly during the past few years, however, that one need not be surprised if the next section of this sewer is built in concrete masonry lined to the springing with vitrified brick.

During the past year the authorization of the people was obtained for a new sewer, to be constructed through the heart of the city, following its contour, and slightly dipping from west to east to intercept all the sewers now discharging in the harbor, and carrying the flow to be disposed of at the eastern part of the city.

In order to intercept all the sewage possible this sewer is located on a minimum grade, and the sewage, when running at its maximum velocity will travel at a rate of four feet per second. The minimum velocity which will occur, of course, during the first year of its usefulness will be just sufficient for self-cleansing, or about 2.3 feet per second. In the choosing of the materials for building the sewer such velocities as these were not considered harmful for either brick or concrete. Careful examination was made of cement mortar joints in the present brick sewers, and this examination failed to show any deterioration in the mortar attributable to action of acids. Then careful tests of the quantity of acids in the sewers were made. In no case was there a trace of free acid found in the eleven samples tested, representing 90 per cent. of the sewage.

The sewer is alternately specified to be built either in concrete or in brickwork. The concrete sewer was specified to be built in silicious sand and granite or trap aggregate. The velocity is such as to absolutely preclude wear, but the invert is reinforced as an additional precaution, with a more compact surfacing of 1:1:3, a granolithic surfacing of crushed trap.

In most sewers, and especially in sewers of relatively low velocities, a coating of slime and in some cases even a slight growth of low vegetable matter occurs below the flow line. The effect of the retardation of flow due to this cause is very important, and has to be dealt with by making a dense non-porous surface for the invert, for this slimy growth seems to occur to a greater extent where the surfacing is porous. The growth also depends on the relative strength of the sewage. In some cases this is provided for by the use of a dense mortar and trowelling to a smooth waterproof surface, and in other cases by the use of vitrified brick. Both usages have the weight of eminent engineering opinion behind them, and the question of expediency in the use of either method must be determined by considerations of cost and benefit obtained.

The writer, without going into details here, summarizes the best engineering practice in the United States and Canada. Montreal refuses to recognize concrete as a material for sewers. Ottawa until this year has built in brick. Cement pipe, however, is now competing successfully in the smaller sizes. Toronto exclusively brick. Winnipeg gave up the building of brick sewers a dozen years ago, and is now using nothing but concrete. Boston and the Metropolitan Board both use mass concrete, occasionally with vitrified brick inverts. They are claimed to be much tighter and less expensive than brick. Brooklyn has been unfortunate in some of its concrete sewers. These were all old sewers, 12 to 24 inches in diameter, and made and set in pipe lengths, and were poorly made. The Borough continues to place its confidence in concrete as a sewer material, and usually calls for alternative bids. In Cleveland it is a matter of price and expediency. They always use brick work in tunnel arches. Detroit is for brick.

The Twin Cities are famous advocates of reinforced concrete in large sewers, and claim complete satisfaction in its use; for steep grades they sometimes resort to vitrified invert pavers. Milwaukee's experience in concrete sewers is five years old. There, also, greater efficiency is claimed in large sewers. Duluth is exclusively for concrete in the larger sizes. Baltimore's new system is world renowned. Like Boston, they have adopted mass concrete, usually lined with hard burned common or semi-vitrified brick. Chicago, that city of advanced ideas in construction, is yet to gain her experience in concrete sewers. The sewer engineer told the writer last year that they preferred to be conservative because they knew brick to be good. It is not surprising, however, to hear that they are at present building a new large system in concrete, which has not yet been used.

The following are the principal features governing the selection of concrete for large sewers:—

1st. The cost is less.

2nd. The concrete fits exactly the irregularity of the excavation, giving more secure foundation.

3rd. It constitutes a solid structure without joints, and, therefore, is less liable to uneven settlement.

4th. There are no joints to be made watertight.

5th. Material may be saved by the readiness of concrete to be moulded into the exact theoretic shape required.

6th. Skilled labor is reduced to a minimum.

It is possible to enlarge very much on each of the points touched upon briefly in this paper, but, perhaps, the few points touched upon will stimulate discussion, which will be more instructive than the paper itself.

I cannot resume my place among the audience without thanking your Executive, and, indeed, your society for the honor I have received at your home being invited to prepare this paper, and to thank you also for your courtesy in extending to me a patient hearing.

SKEW CONNECTIONS IN COMPLICATED STEEL STRUCTURES.

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It has been well said that this is the age of steel, for today in almost every structure this important material is to be found as a framework giving greater stiffness and facility of erection, a saving in masonry, yet easily adapted to fireproof construction. It is but a short period, since this material became cheap enough to be largely used in ordinary structures, and the writer has noticed a lack of information along the line of detailing ordinary or extraordinary skewed connections. It is claimed by some that the mathematician can readily determine the angles required for all such cases, and then draw the details directly. While this may be true for simple joints, yet, for complicated ones, it is necessary to present on paper a picture of the whole, so that cuts and clearances may be readily determined. It may easily be understood that when a number of members come in together at a joint, and their shape an I or L section, that the easier way of fitting them one to another will be by plotting out in picture language.

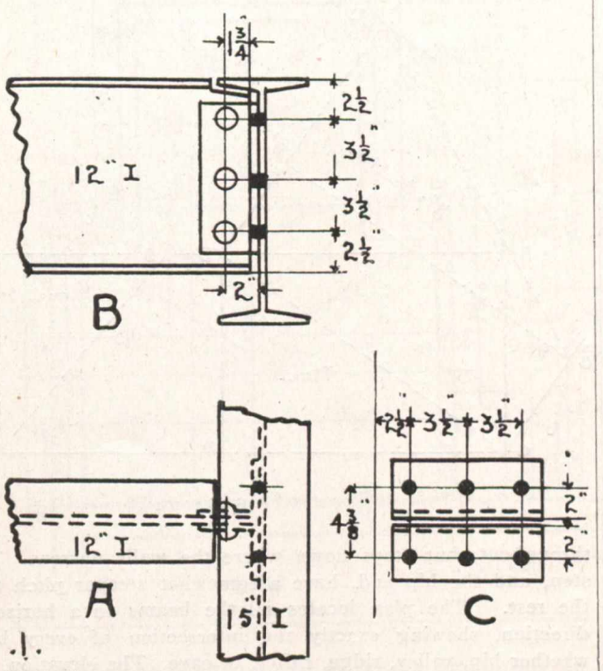


FIG. 1.

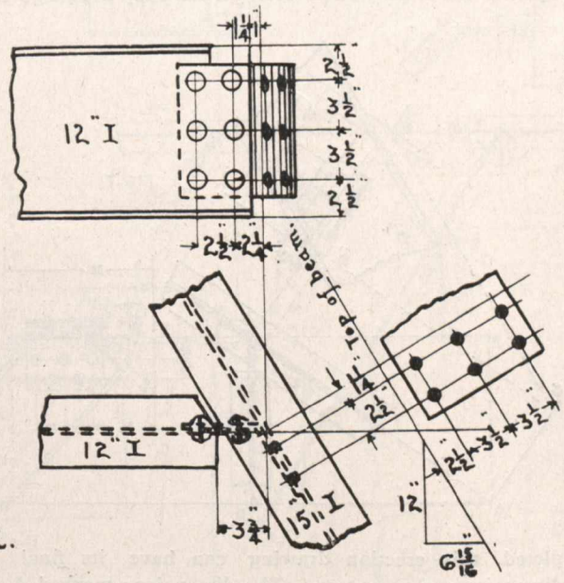


FIG. 2.

The purpose of this paper will be to present, if possible, in an easy progressive manner, the way to go about such skew detailing, and actual connections which have been used in structures already erected will be taken as illustrations. It will not be the purpose of this paper, however, to determine the size of the different members, nor attempt to use the language of descriptive geometry, although it is allied to this subject. The problems will be presented in as direct and simple a manner as is consistent with the subject.

Fig. 1.—This figure is but an ordinary beam connection, framing in perpendicular to another beam. "A" is a plan looking down on the top flange of a 12″ and 15″ I. "B" is an elevation of the 12″ I web showing connection Ls shop rivetted to it. The 15″ I appears in section. "C" is an elevation of the connection angles legs which field rivet to the 15″ I. Notice that although this is a very simple case yet it requires three different views to portray the connection completely.

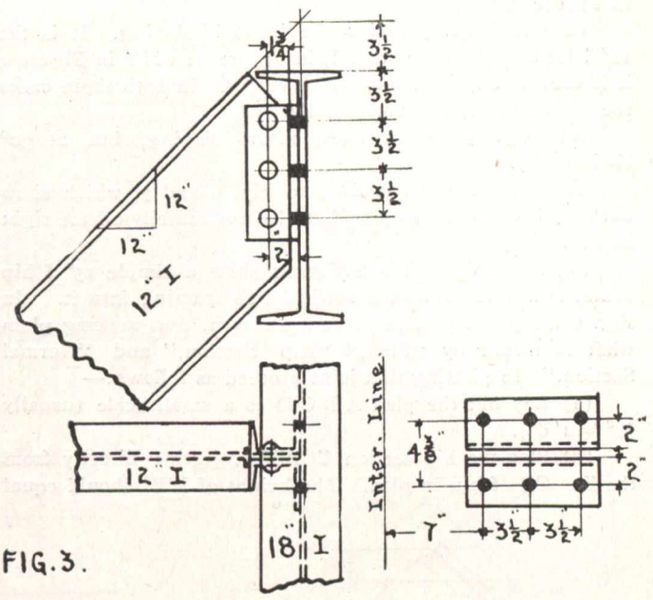


FIG. 3.

Fig. 2 shows a simple skew in the direction of flange, with both 12″ I and 15″ I webs vertical. The two elevations are projected at right angles to their respective parts in plan.

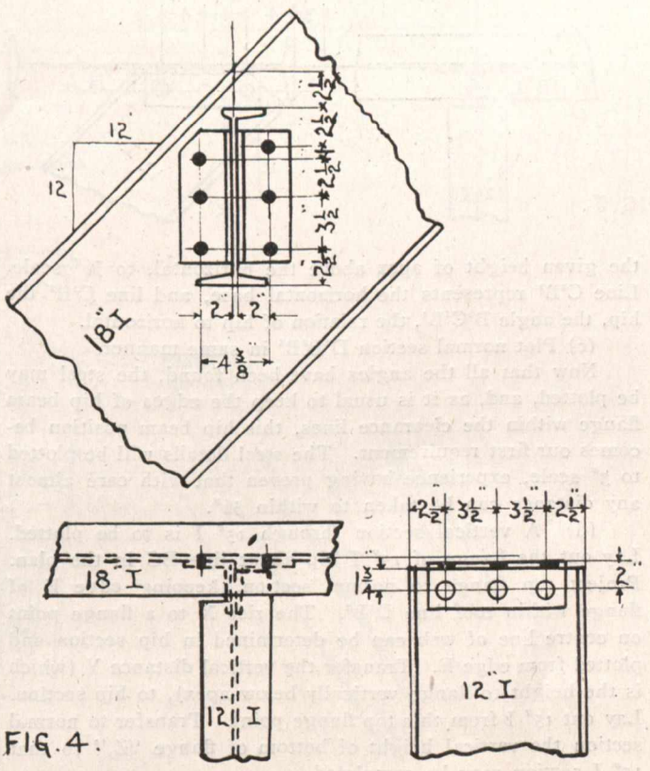


FIG. 4.

Fig. 3 illustrates a skew in the direction of the web of the 12″ I beam.

Fig. 4 shows a horizontal 12″ I framing into an 18″ I which slopes at 45° to the horizontal.

Fig. 5 shows a 12″ I framing into an 18″ I, and at right angles to it. Both beams slope at 45° to the horizontal.

Looking back in a general way at the five figures which have been given, three distinct steps can be seen.

(a) In Figs. 1 and 2 both beams are horizontal, the difference between them being the horizontal angle which one beam makes to the other beam. In Figure I this angle is 90°; in Figure 2, 60°.

(b) In Figs. 3 and 4 one beam is sloping. It is the 12″ I framing into the other I, in Figure 3; while in Figure 4 it is the 18″ I framed into which slopes. In both these cases the beams are at 90° horizontally.

(c) Fig. 5 shows both beams sloping, but at 90° horizontally.

These three steps lead up to Fig. 6 and 7, which show not only both beams sloping but also horizontally off the right angles.

Figs. 6 and 7.—These figures show a simple 15″ I hip beam, and a 12″ I with a vertical web framing into it. In Fig. 6 the primary steps alone are shown, thus making plain what is meant by "Plan," "Hip Section," and "Normal Section." In plotting this joint proceed as follows:—

(a) Lay out the plan A B C D to a small scale (usually ¼″ = 1′ 0″).

(b) Plot the hip section $C^1B^1B^2$ projecting directly from the line CB of hip in plan. The height of B^1B^2 should equal

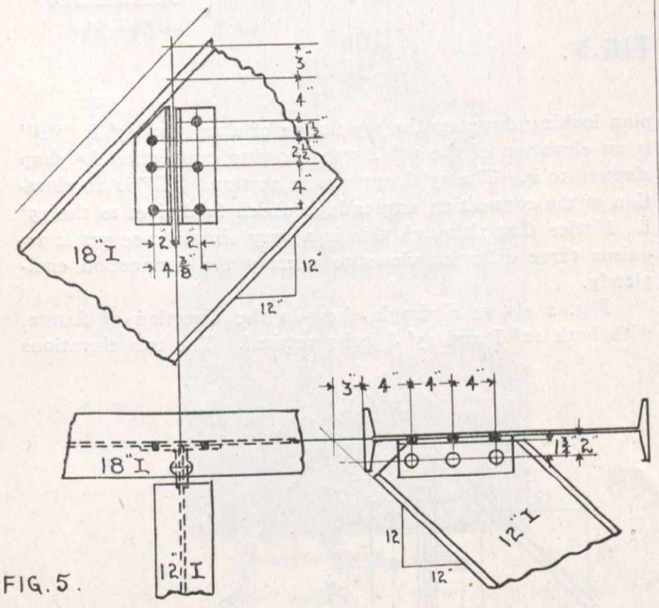


FIG. 5.

the given height of apex above the horizontal, to ¼″ scale. Line C^1B^1 represents the horizontal base, and line C^1B^2 the hip, the angle $B^2C^1B^1$, the relation of hip to horizontal.

(c) Plot normal section $D^1B^3B^4$ in same manner.

Now that all the angles have been found, the steel may be plotted, and, as it is usual to keep the edges of hip beam flange within the clearance lines, this hip beam position becomes our first requirement. The steel details will be plotted to 3″ scale, experience having proven that with care almost any distance can be taken to within ⅜″.

(d) A vertical section through 15″ I is to be plotted. Lay out the flange of 15″ I hip about line BC in the plan. Project top flange to normal section, keeping edge E of flange within roof line D^1B^3. The rise X to a flange point on centre line of web can be determined in hip section and plotted from edge E. Transfer the vertical distance Y (which is the height to flange vertically below apex), to hip section. Lay out 15″ I from this top flange point. Transfer to normal section the vertical height of bottom of flange "Z," so that 15″ I section may be completed.

(e) Plot 12″ I which frames into the 15″ I hip beam. Lay out 12″ I flange in plan, about line BD. In normal section lay out 12″ I having top flange flush with clearance line D^1B^3. Plot connection rivets, adjusting the elevations of same so that cuts on both beam and connection plate will be as neat and few as possible.

A Steel-framed Roof.—Beam Webs Vertical.

The object of these next four plates will be to present a complete set of drawings which will illustrate the office practice in working out a steel-framed roof, when the beam webs are vertical. Although there are no complicated trusses or girders, as is usual in a large roof, nor are the beams of big dimensions, yet this case will do very well in the problem at hand.

Fig. 8 is a complete erection drawing of a beam roof having a general slope of 7″ in 12″. The ridge is not horizontal

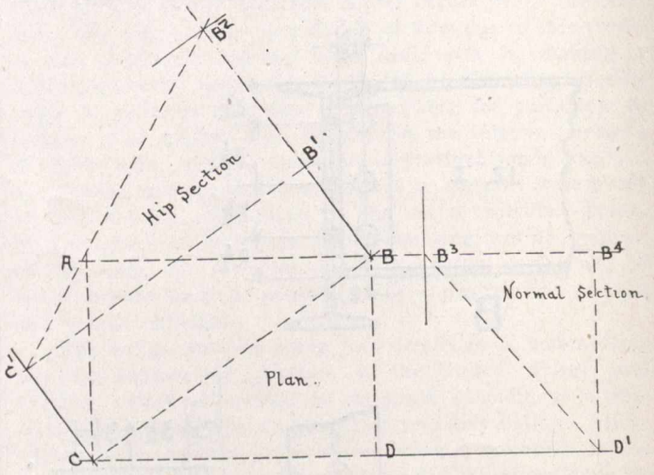


FIG. 6

throughout, but steps down where the walls narrow. This step, and the hip end, have a somewhat steeper pitch than the rest. The plan locates all the beams in a horizontal direction, showing exactly the intersection of every beam whether hip, valley, ridge, rafter, or eave. The elevation, and sections locate all the vertical distances; such as the height of ridge beam below apex, the column heights, etc.

In working up a roof of this sort, a careful plan like this needs to be made. First locate the finished roof lines; then, by finding out with what material it is to be covered, the clearances necessary can be determined. Dimensions locating every detail can only be found as sketches of the joints are worked up, but all the important ones must be decided upon at the start. Then, after all the shop drawings are com-

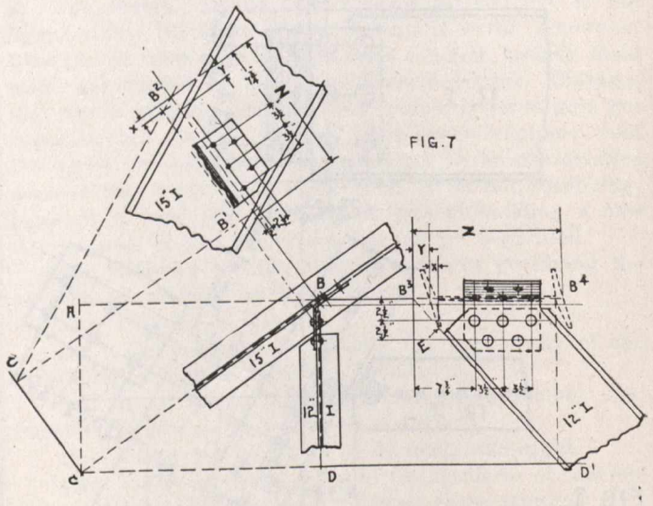


FIG. 7

pleted, this erection drawing can have its final marks, dimensions, etc., put on. The dimensions marked A in plan are not usually given in this kind of work, as the anchor bolts are set after the material is in place.

It is hardly probably that such a roof as this would be called for in ordinary work, on account of the cost. In a roof with the span of beam much larger, and the amount of material greater, there would be a better proportion of weight to work, binding down the cost. This particular roof was a wing to a very large structure and received attention on that

account. The actual cost of drawing alone was found to be 2¼c. per lb., and, if you add a proportionate amount for shop handling and the cost of raw material, this roof would require a very high price put upon it, or be out of the question.

Architects and structural engineers, as a rule, do not realize the importance of first measurements on a job of this kind; for, of course, in the old style wooden structure the carpenter only had to saw a piece off or nail a strip on, so as to make a good fit.

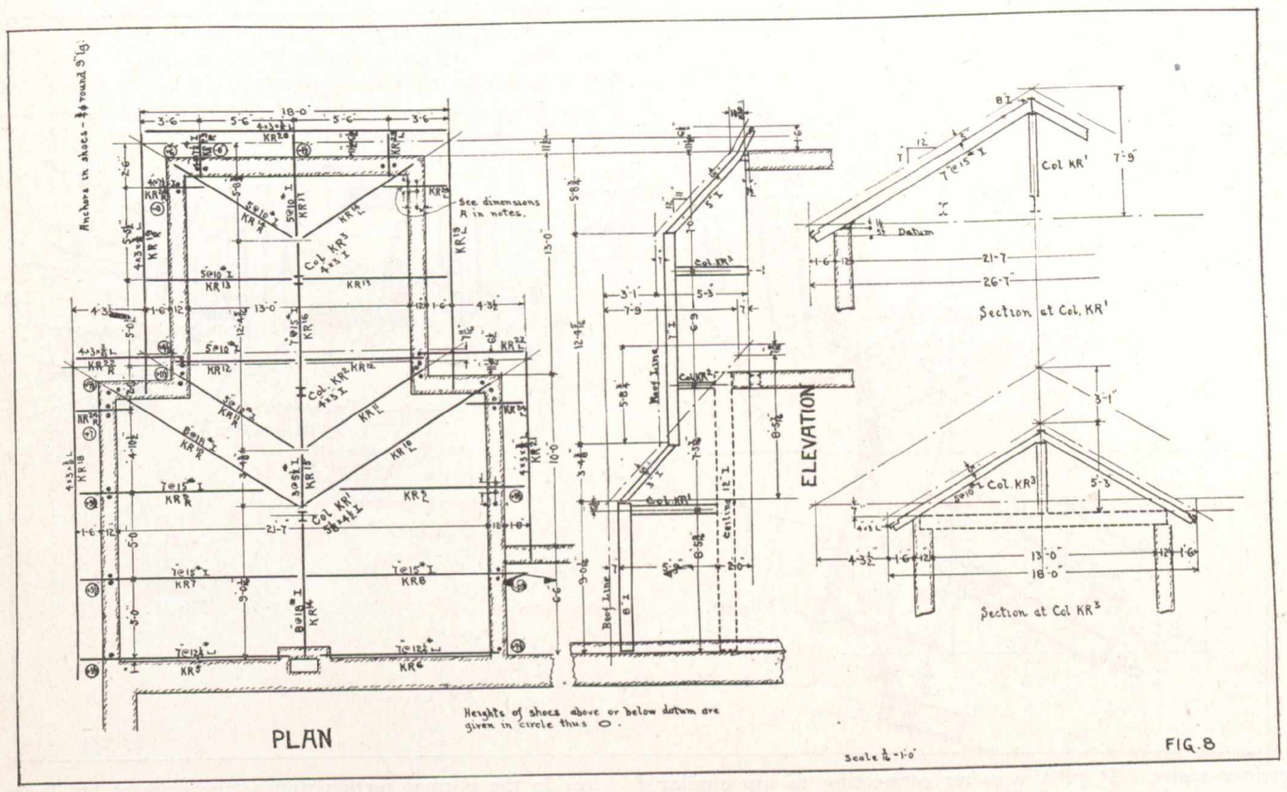


FIG. 8

Perhaps no one point can cost more to a draughting department than a change of only a single main dimension, after the sketches and drawings are completed; because it not only means the remaking of the joint sketches (to look

Fig. 9 shows how the joints are worked up on paper in the drawing office as a preliminary move towards the finished shop drawings. The ordinary draughtsman who is accustomed to work up in a laborious manner, one joint at a time,

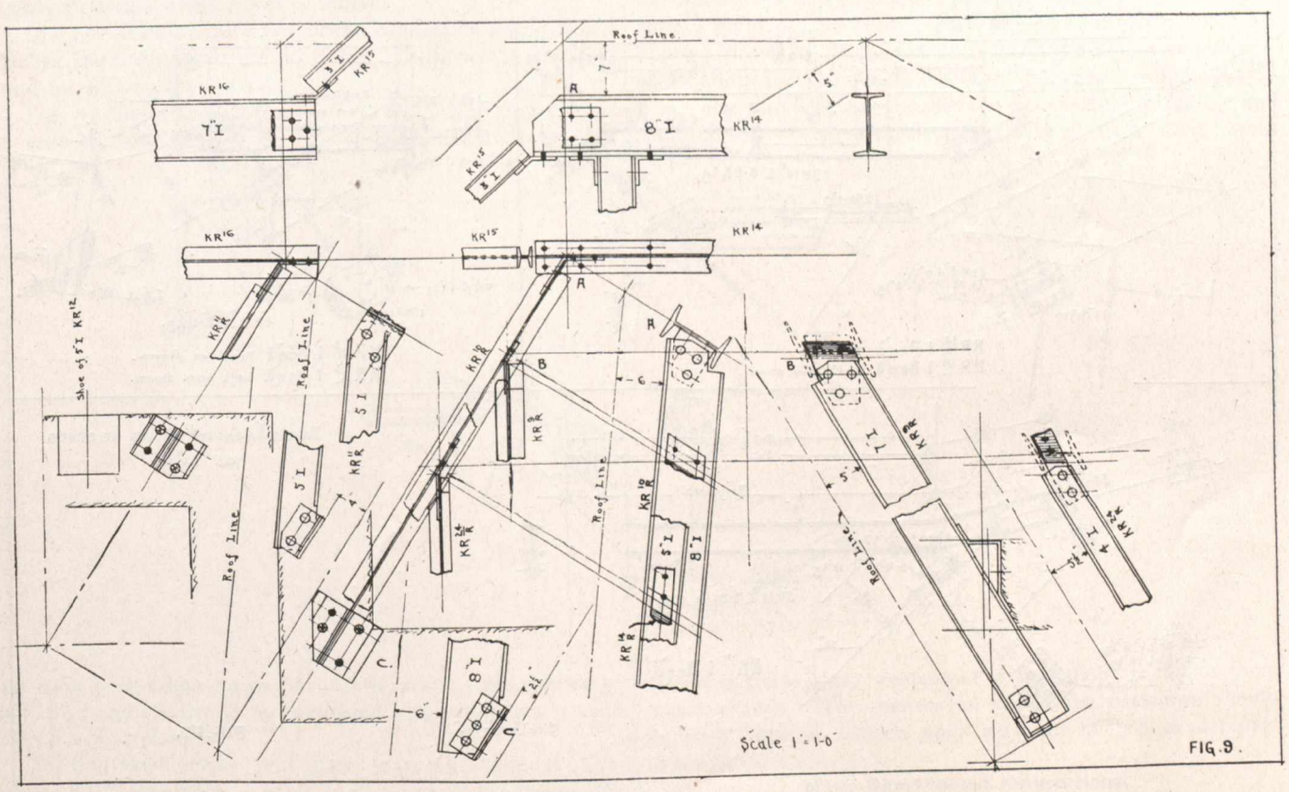


FIG. 9.

out for clearances, change in connections, etc.), but also the probable uselessness of the shop drawings upon which weeks of expert labor have been spent. If the material has been manufactured it is very difficult to make it fit elsewhere.

may find this sketch somewhat confusing, but, with just a little looking into, it will be found to become very simple and certainly a great saving in time and office material. When single joints are sketched, the laying out of the angles has

to be done each time, while by combining them, one plotting does the whole sketch. Another nice point to notice, is that the hip connections are worked up in order, thus facilitating the making of shop drawings.

At "A," the connection of hip to ridge is shown in its various views. At "B," a rafter connecting to hip similar to the one explained fully in Figs. 6 and 7; at "C," the hip shoe. The valley KR R[11], the ridge beams KR [14], [15], [16], and rafters KR R[9], KR R[24] are also shown.

The sketches show, throughout, a clearance of beam below roof line.

(a) Starting with the plan, plot AB which is the centre line of the hip web, and CD the centre line of 4″ I rafter web.

(b) Plot next the normal section with its double slope, and then the hip section.

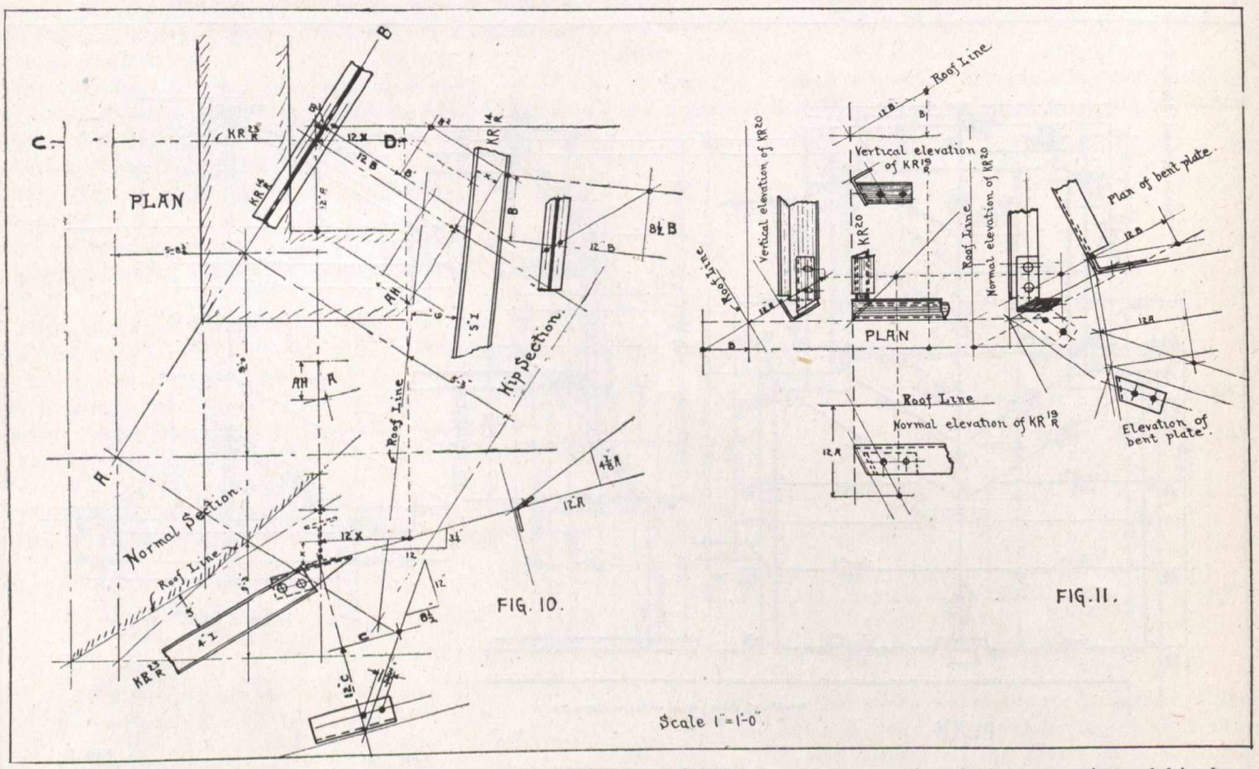


FIG. 10. FIG. 11.

(c) In the normal section find a true view of hip beam (shown dotted) by the method explained in Fig. 7.

(d) To find the bevel "x" of the connecting angle in relation to the 4″ I rafter. —— Plot in plan any horizontal distance (12 x) on centre line of 4″ I and find height x which is the vertical rise of the point at one end, above a point on

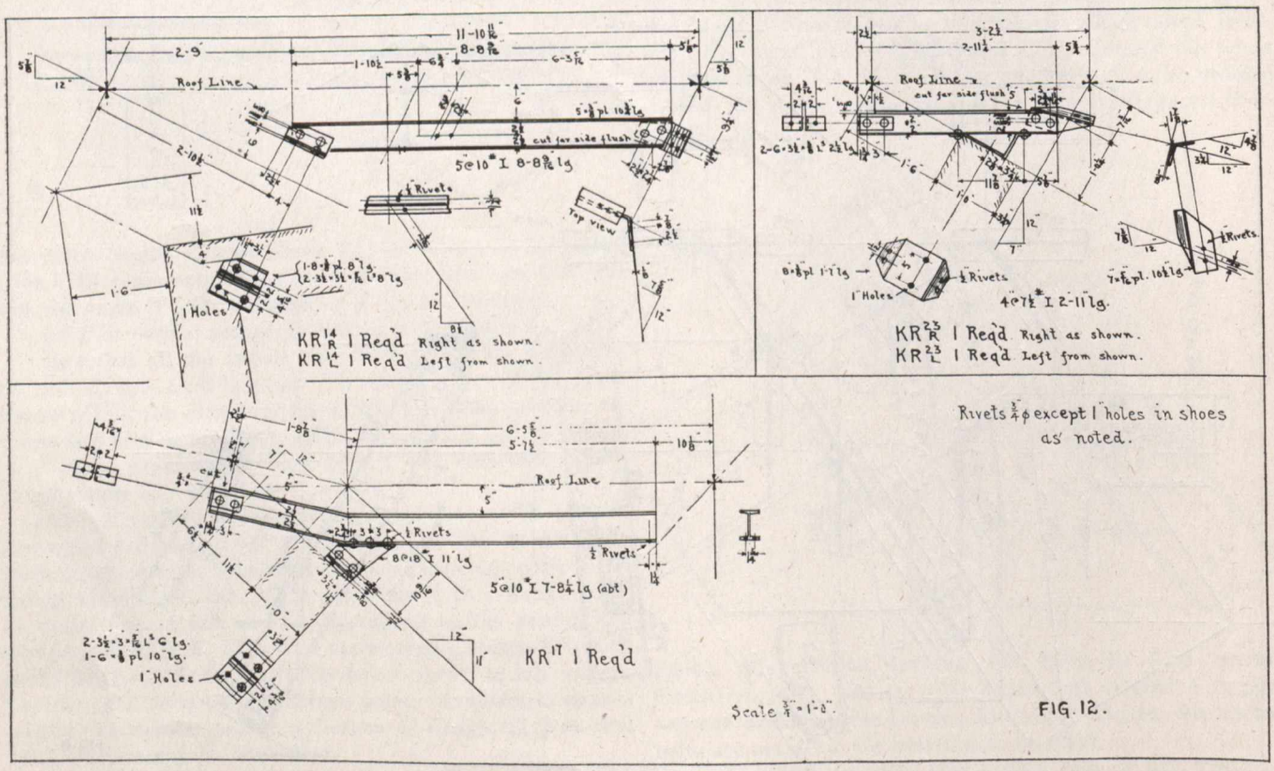


FIG. 12.

Fig. 10 shows a rather complicated connection to the hip beam, marked KR R[14] in erection plan, (Fig. 8). The secondary slope which the eave takes at this end, causes the 4″ I KR R[23] to frame into the hip at such a low level that the only means of connection will be to the bottom flange.

normal roof at the other end. Transfer this horizontal distance, and the vertical rise, to normal section where the bevel is obtained.

(e) To find the bevel "A" square across this angle. —— Plot a horizontal distance 12 A in plan. Find in the hip sec-

tion the vertical rise AH, between the extreme end points. Now AH is the vertical rise, but what is wanted is a rise square with angle. So plot AH and a line square with angle and we find the required distance A. It remains to transfer 12″ A and A to section, which is taken through angle, and bevel is obtained.

(f) To find the skew of holes in bottom flange of 5″ I hip. —— In plan draw a line B^1B^2 at a distance 12 B from, and parallel to, 5″ I. Draw a line B^3B^2 parallel to 4″ I. B^2 is the intersection of these two lines and B^1 is a point square

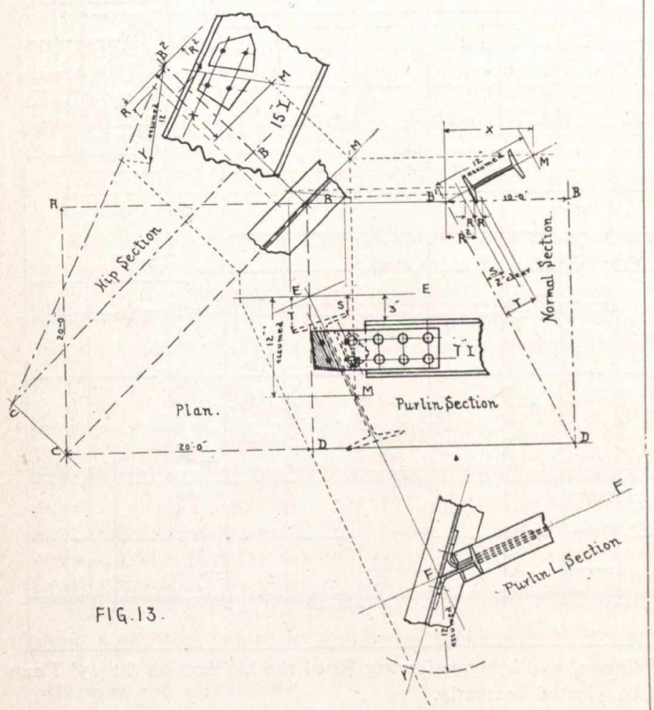


FIG. 13.

from intersection B^3. It can be seen that the line B^1B^2 is the horizontal trace of B, which is one side of bevel, and all that remains to be done is to transfer the assumed distance 12 B to plan of flange where bevel is found.

(g) The skew of the holes in the connection angle which matches the holes in flange of 5″ hip I, will be the same as found for B, i.e., 8½″ in 12.

Fig. 11 shows the connection between the eave angles at the corners, and is quite a different proposition from any

The skew across other leg of plate should be the same as that found for the first leg.

Fig. 12 is a shop drawing of three different pieces in the roof, and shows the method of locating rivets, etc. The roof line is first drawn in, and the beams located at their proper distance below same; then the shoe, connecting holes for

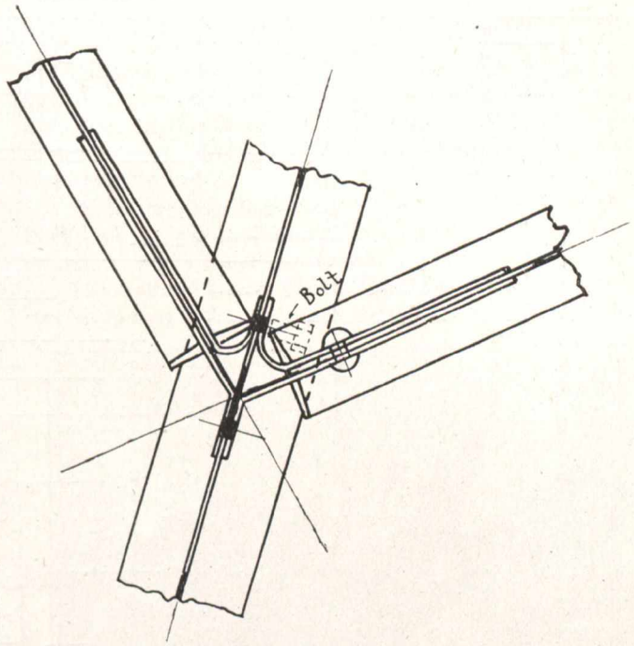
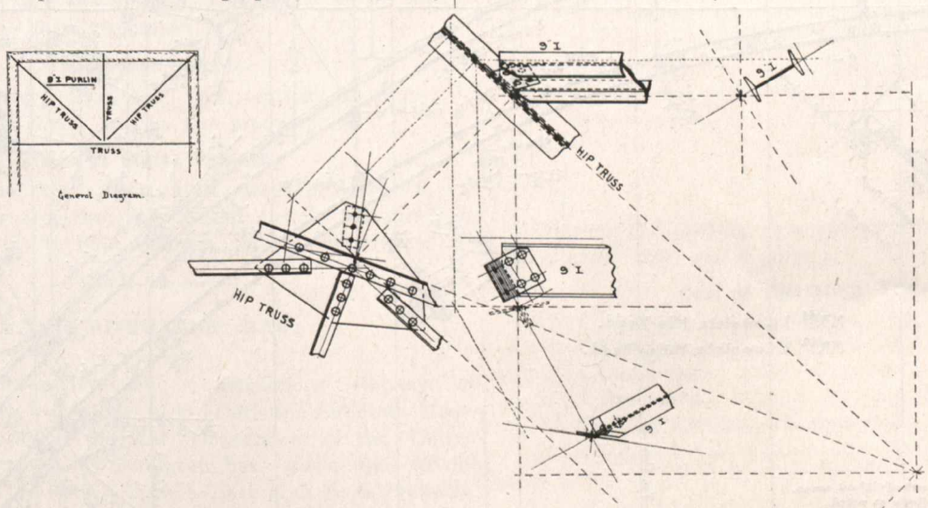


FIG. 14.

rafters, and the bent plates can be scaled directly from the large sketches.

The rivets are only located in two directions, and these are not always spaced along the beam nor even do they start from a point on the beam. The method shown would not be allowed in some shops, yet it is certainly the best manner of location for the office, because the pieces which frame into one another have respective dimensions matching up. Another row of figures, locating rivet to rivet along web



that have been taken up so far. Both steel L^s are normal to roof slope and require to be connected with two rivets in each side of a bent plate.

To find skew across bent plate, start with vertical elevation of KR^{20} and make a point at distance 12 A. Trace this into plan and then into a normal elevation of KR^{20}, where skew is found in a similar way to previous examples.

To find bend in bent plate, start with a point at distance 12 B in vertical elevation of KR R^{19}, trace this into plan, elevation and plan of bent plate. Here the bevel is found.

causes a tremendous amount of extra labour to make them match exactly. The manner in which the drawings should be made depends entirely upon what the shop is accustomed to use.

More Complicated Connections.

The next figures introduce connections which are more difficult because another angle enters into the problem. Fig. 13 shows a rather peculiar connection which was used in a certain building to see if it would be cheaper to cut beams clear of all copes, cuts, etc., and allow bent plates to make

the connection. In a shop where beams can easily be sawn on the skew, and have copes and flanges cut; the cost would be much greater when this method is used. For to make the connection stiff enough, there will be required a greater number of rivets in web and two connection plates in each case. The manner of connecting the field bolts or rivets needs to be carefully looked into, and Fig. 14 shows a bolt being inserted into connection. The method of plotting this connection will now be explained in detail.

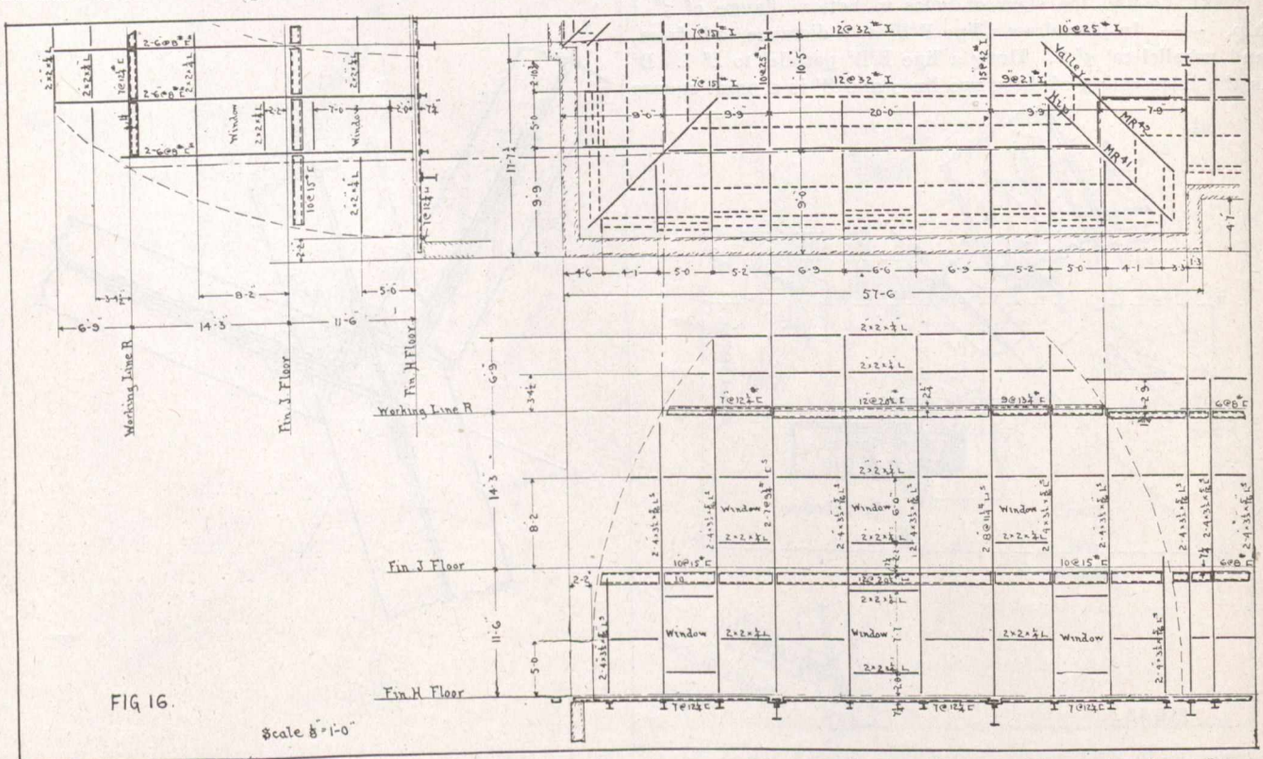


FIG 16.

Purlin Normal to Roof, Connecting to Hip With Vertical Web.

It is proposed to find the various skews required, and then to sketch a 7″ I purlin which heads into a 15″ I hip beam, when said hip beam is 2″ clear and said purlin 3″ of roof line.

(a) Lay out a plan ABCD showing hip CB.

(b) Erect a normal section of roof DBB¹.

(c) Erect a hip section, BB² being the same height as BB¹.

(d) It is required to plot 15″ I 2″ clear of roof, therefore in plan show flange, in normal section plot a line 2″ clear of roof (2″ is marked S). Now as 15″ I flange sticks up and down through normal roof, find this rise and fall in hip section. Half of flange has a vertical rise of R. Plot R in normal section thus finding required vertical height R² for 15″ I top flange, and by transferring R² to the hip section the 15″ I can be plotted correctly.

(e) It is required to find the line of "Intersection of 7″ beam hip," therefore draw a line B¹M perpendicular to normal slope through 7″ I, (say 12″ long), and find point M in hip section by projecting lines through plan and transferring vertical height X. Then B²M is required line.

(f) It is required to plot a "Purlin Section" through its centre line, so that purlin skew may be found. Draw a line EE parallel to BB, representing apex of section, and, by finding vertical trace of point M in purlin section, the required line EM which gives the proper skew may be drawn.

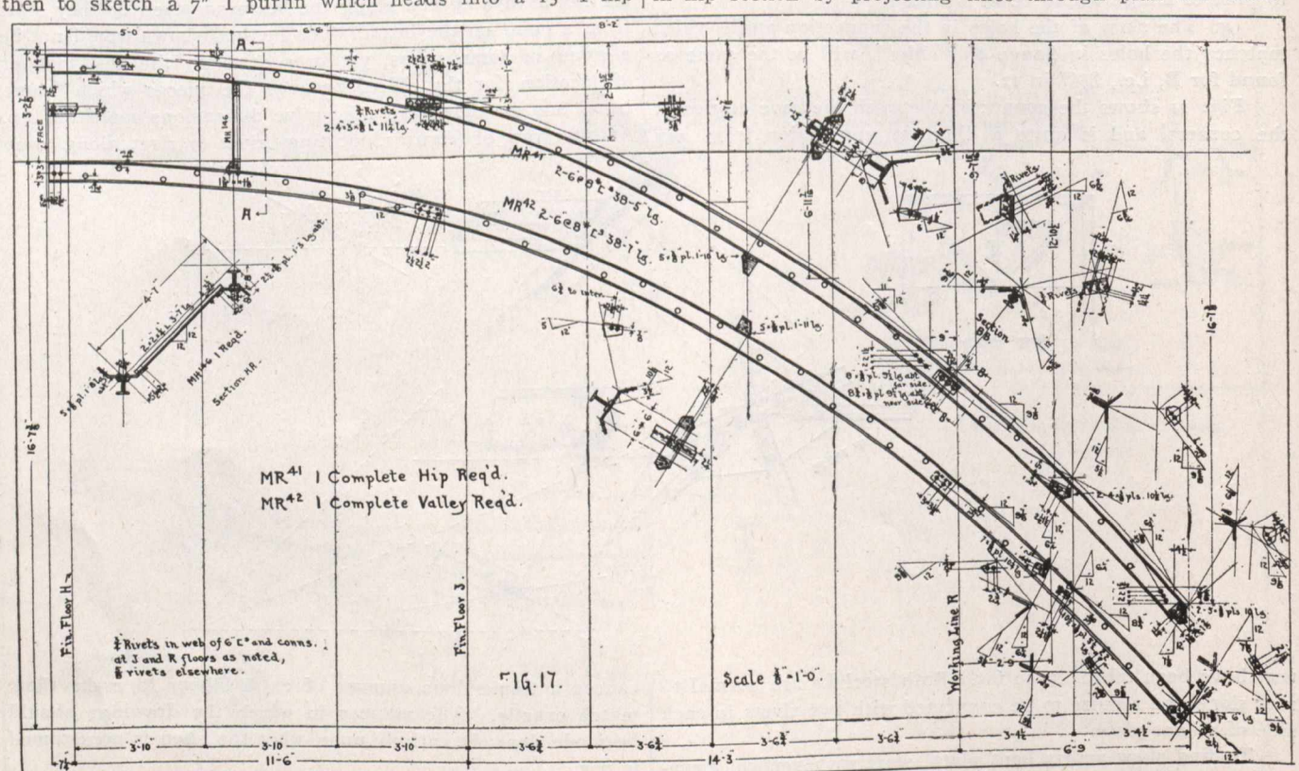


FIG. 17.

(g) It is required to plot a "Purlin angle section" to find skew at right angles to purlin skew. Draw any line FF at right angles to purlin skew representing centre line of 7″ I purlin in hip section. The angle that is wanted should give the relation of 7″ I purlin web with 15″ I hip web. Take a point in the 15″ I web at any distance from intersection B². Trace this point through the various views to the purlin angle section. The required point will be somewhere in this line, and at the assumed distance away from intersection. Using intersection point F as a centre and assumed distance as a radius, describe the circle. Join intersection point Y with F to find proper skew.

(h) Now, that all the angles are found, plot the section of 15″ I by projecting from plan the width of flange, and taking from normal section the drop below apex to outer edges S and T.

Remaining details of holes, cuts, etc., can be worked up in the usual manner.

Fig. 15 shows the second method of connection, which appears much neater and is more simple in every respect. In this case the truss chord to which it connects is dropped below the purlin, and the gusset plate extended to take the field rivets. A line along back of truss angle is used as the intersection line.

Figs. 16 and 17 illustrate a curved mansard roof. Fig. 16 shows a corner of the roof in plan and elevation, and Fig. 17 a detail drawing of the hip and valley marked on plan. On this large structure the only dimensions figured, were the centre to centre distances. All the other distances, bevels, cuts, etc., were taken from the 3″ scale sketches, and as the erectors found that the material fitted together perfectly, no better proof could be given to defend this method of scaling.

Illustrations could be presented indefinitely which would show in each case an entirely different problem to be met and overcome, but enough have been given so that all the general principles are established.

PATENTS.

Below will be found a list of patents recently granted to Canadian inventors in Canada and United States which is furnished by Messrs. Fetherstonhaugh & Company, Barristers, Solicitors, etc. Head Office, Royal Bank Building, Toronto. Offices in Montreal, Ottawa, Winnipeg, and Vancouver, Canada, and Washington, D.C., from whom all information may be readily obtained.

Canadian Patents.

C. A. Kennedy, Coaticook, Que., furnace castings; J. Brewery, London, Ont., suction gas productions.

United States Patents.

J. Carpenter, Oak Lake, Man., wooden posts; S. O. Dougherty, Toronto, Ont., shade and curtain hangers; O. R. Durrant and C. E. Bale, Oshawa, Ont., cinder sifters.

THE AMBURSEN DAM.

The Ambursen Hydraulic Construction Company, of Canada, Limited, with offices at 519 Coristine Building, Montreal, inform us that the War Department of the United States Government at Washington have given their official approval of an Ambursen Dam 60 feet high in the rollway, 80 feet high in the bulkheads, and of a total length of about 1,000 feet. This dam is to be installed on the Savannah River, and is to support a flood of 300,000 second feet such as occurred last summer, (as great as the total flow over Niagara Falls), which will mean a depth on the rollway of about 16 feet. The United States Government has also approved of the Ambursen Dam for the United States Reclamation Service and built one situated on the Sheshone River, about eight miles below Cody, Wyoming. The foundations are on gravel and shale, and the dam proper is 400 feet long by about 50 feet high, supported by a floor 2 feet thick.

A Page of Costs

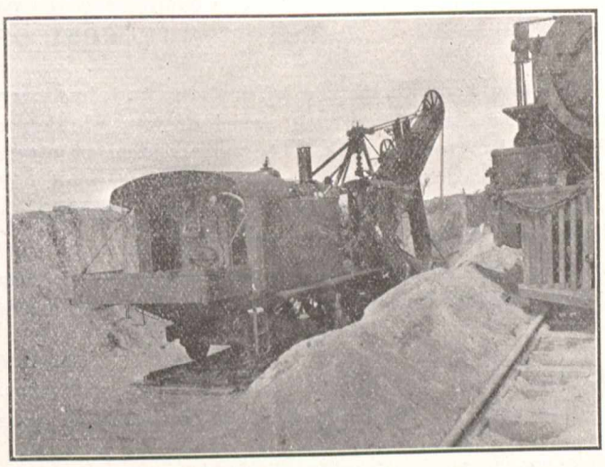
ACTUAL, ESTIMATED, AND CONTRACTED.

STEAM SHOVEL EXCAVATION.

The steam shovel is being used more each year on railway work and large excavations. At first, It was used in sand, then followed clay and gravel, and now the steam shovel is used largely in removing the rock after the blasts in certain work.

The costs given here are not the results of any one day's work, but are the averages of a number of "average days" extending over a couple of months.

The material excavated was fine sand, the face of the cut was some twenty feet high and the conditions for train hand-



Steam Shovel in Pit.

ling were good. It was a 70-ton shovel with a 2¼ yard dipper, run with wire cable, and operated in Parry Sound District, Ont., on the Toronto Sudbury division of the C.P.R. during 1908. The amount moved per day was 2,500 cubic yards, i.e., 100 cars at 25 cubic yards per car.

Cost of Operating Shovel, 10-Hour Day.

1 Engineer	$5.40
1 Craneman	4.00
1 Fireman	2.00
6 Trackmen at $1.75	10.50
1 Watchman	2.00
2 Tons coal at $5	10.00
Water per day	0.65
	$34.55

Digging and loading 2,500 cubic yards cost $34.55; or to load 1 cubic yard cost $0.013.

Cost of Operating Train.

1 Engineer	$4.10
1 Fireman	3.50
1 Conductor	3.50
2 Brakemen	4.20
Coal for spotting, 1¼ tons at $5	6.25
Water	.50
	$22.05

Train expense for 2,500 cubic yards, $22.05; or, for 1 cubic yard, $0.0087.

Making a total cost for digging and loading and hauling out to main line about ¾ of a mile, as follows:—

Digging and loading per cubic yard	$0.013
Spotting train and hauling to main line	0.0087
Total cost per cubic yard	$0.0217

These costs do not include the cost of clearing pit, nor of throwing track after each cut.

It will not be supposed that the shovel was operated to its maximum capacity for then it could have given almost double the output.

METHOD AND COST OF TRIMMING THE SIDE OF A ROCK EXCAVATION.

In open cut work where rock is encountered the rock sides of the cut seldom have to be dressed up with any nicety, but in foundation work it is often necessary to do so and also in canal construction. Where large areas of the sides of cuts are to be smooth and even, channeling machines are used, but on small jobs the work is generally done by hand. In New York City this character of hand work is often done on cellar excavation, to admit of machinery being installed and structural steel and brick walls being erected.

The following example was on such a piece of work in New York, the work being mica schist. After the excavation was made, one side for a distance of 64 feet had to be dressed up. From about 2 inches to 5 inches of the rock face had to be clipped off. The work was done by men working two together, one holding a heavy bull point, by an iron handle, and the other using a striking hammer. Ordinary laborers were used to do the work. For 32 feet the rock cutting was 8 feet high and for the other 32 feet it was only 6 feet high, making in all 448 square feet.

Labor, 340 hours at 15 cents, $51; or, 1 square foot cost 11.4 cents. Two men working together did on an average of 26½ square feet per day. These costs do not include any allowance for dressing the bull points.—Engineering-Contracting.

COST OF DREDGING.

We give herewith the cost of dredging both by Government dredges and by private owned dredges working on Dominion Government work. The various items of expense are proportioned and reduced to prices per cubic yard. The prices are given for various materials, and a description of the dredges doing the work is also given.

The Nipissing was 70.7 feet long with 25.0-foot beam, a dipper dredge capacity of buckets 3 cubic yards, and attended by a tug, two scows, and one coal tender. Greatest working depth, 20 feet.

The Ontario was a dipper dredge 75 feet long, 25-foot beam, and attended by a tug and two scows. Greatest working depth 22 feet.

The Sir Richard is 80 feet long, beam 20 feet. Greatest working depth, 22 feet. Capacity of buckets 3 cubic yards.

The International was a dipper dredge 109.6 feet long, beam 41 feet, greatest working depth 60 feet.

Dredge.	Wages.	Fuel.	Prov.	Stores and equipment.	Repairs.	Pilotage & tonnage.	Cont.	Totals	Cu. yds. excavation.	Materials.
"Nipissing"	$5,832.05	$1,769.66	$ 906.65	$ 399.22	$1,222.04	$.....	$ 93.50	$10,223.12	76,080	Sand & sawdust
Cost per cu. yd...	.0766	.0235	.0119	.0052	.0159	.....	.0012	0.1342		
"International" .	6,009.01	1,946.08	1,674.78	1,056.30	2,070.65	2,539.09	6,160.42	21,456.24	88,500	Sand.
Cost per cu. yd...	.0679	.0219	.0189	.0119	.0233	.0286	.0696	0.2424		
"Ontario"	5,021.44	1,322.76	1,071.18	1,032.06	2,343.41	.....	790.00	11,580.85	37,525	Clay.
Cost per cu. yd...	.1340	.0352	.0285	.0275	.0624	.....	.0210	0.3086		
"Sir Richard" ...	4,812.36	1,729.56	945.40	190.08	1,244.04	43.60	299.61	9,264.65	75,000	Clay.
Cost per cu. yd...	.0651	.0203	.0126	.0025	.0166	.0005	.0049	0.1235		
"Prince Louis" ..	395.55						31,999.75	32,395.28	320,016	Sand.
Cost per cu yd...	.0012						.0999	0.1012		
"Premier"	95.00						4,752.51	4,847.51	7,791	Clay.
Cost per cu. yd...	.0012						.061	.0622		
"Chief"	816.89						20,721.69	21,538.58	188,379	Clay.
Cost per cu. yd...	.0043						.11	0.1142		
"I.X.L."	612.00						29,523.71	30,135.71	306,933	Clay.
Cost per cu. yd...	.019						.08	.098		

THE COST OF CONCRETE BUILDINGS.

Leonard C. Wason, Boston, Mass.

It has been a common method to estimate the approximate cost of building by either the square foot of floor or the cubic foot of space enclosed. After comparing the results secured in the four accompanying tables I am convinced that neither method is accurate enough to put much reliance on, but that the square foot method is a little safer than the other.

In each case the total cost includes masonry and carpentry work without interior finish or decorating, plumbing and heating. The effort has been made to put the buildings upon a comparative basis as regards the amount of work done on each.

The first table consists of the total cost of actual contracts executed. The second table consists of bona fide bids on complete buildings on which Mr. Wason's company were not the lowest bidders, but where the difference was not as a rule very great. The third and fourth tables are bona fide bids on work by another contractor whose experience was similar. As a rule, cubic foot measurements are given in cents only, seldom being carried to any closer sub-division. In reference to Table 4 on second-class buildings, it will be noted that for the largest building a variation of one cent per cubic foot amounts to over twenty-eight thousand dollars, while the smallest one in the list amounts to only a little over fifty-four hundred dollars. Again, on the last three items, the cubic feet price is practically identical, while the square foot measurements corresponding vary by more than 100 per. cent. with no easily apparent reason in the design.

In Table 3 another discrepancy is noticed. In the first and the last items, the highest and the lowest per cubic foot as well as per square foot are on office buildings of similar type, which were within one mile of each other, where there is no apparent reason for such discrepancy in the design or difficulty of access in the erection of the building. It is recommended by Mr. Wason that very little reliance be placed upon this class of estimates.

Table No. 1—Cost of Fireproof Completed Contracts.

Kind of Building.	Job Cost.	Volume. in cu. ft.	Floor area. in sq. ft.	Unit Cost. per cu. ft.	Unit Cost. per sq. ft.
Offices and stores	$181,194	1,365,830	90,474	$.133	$2.00
" " "	61,646	496,780	39,840	.124	1.545
Factory	12,774	112,440	7,519	.114	1.70
"	44,652	746,674	49,546	.060	.902
"	39,830	312,000	24,960	.127	1.60
Garage	10,436	156,198	10,806	.085	1.23
Filter	19,993	149,250	19,208	.134	1.04
Fire station	6,757	44,265	2,982	.153	2.26
Observatory	3,625	9,734	657	.373	5.45
Filter	20,076	59,991	5,243	.333	3.82
Highest	.....	.....	.....	.333	3.82
Lowest	.....	.....	.....	.06	.90
Average	.....	.....	.....	.138	1.72

Table No. 2—Cost of Fireproof Complete Buildings.

Kind of Building.	Job Cost.	Volume. in cu. ft.	Floor area. in sq. ft.	Unit Cost. per cu. ft.	Unit Cost. per sq. ft.
Storehouse	$141,755	1,714,448	168,696	$.0827	$ .84
Hospital	60,800	703,692	57,654	.0865	1.05
Office buildings	61,646	496,780	39,840	.124	1.545
Cold Storage	200,051	1,535,000	154,000	.13	1.30
Factory	19,292	212,400	15,000	.091	1.28
"	141,529	1,327,868	106,022	.107	1.335
Storehouse	76,796	1,140,000	146,000	.0685	.575
Manufacturing building	91,377	1,380,500	90,240	.067	1.01
Office	136,880	693,840	56,552	.197	2.42
Factory	13,064	105,600	8,800	.124	1.485
"	75,604	1,211,364	74,604	.0625	1.01
"	23,332	180,000	16,394	.129	1.42
Highest	.....	.....	.....	.197	2.42
Lowest	.....	.....	.....	.0625	.575
Average	.....	.....	.....	.1088	1.27

Table No. 3—Cost of Fireproof Buildings.

Kind of Building.	Job Cost.	Volume. in cu. ft.	Floor area. in sq. ft.	Unit Cost. per cu. ft.	Unit Cost. per sq. ft.
Office building	$ 70,690	441,000	35,854	$.159	$1.97
Cold storage	132,365	1,016,400	101,640	.13	1.30
Hospital	44,451	348,320	34,832	.127	1.27
"	51,574	414,732	29,838	.124	1.73
Bank	65,580	533,750	.....	.123	....
Masonic	180,197	1,479,456	.....	.122	....
Warehouse	31,280	259,700	24,500	.120	1.28
Garage	59,105	497,420	.....	.118	....
Warehouse	275,723	2,597,000	212,000	.106	1.30
Hotel	220,646	2,116,106	.....	.104	....
Hospital	49,724	485,789	38,247	.100	1.30
Office	25,151	264,687	.....	.095	....
Cold storage	82,711	909,240	66,745	.091	1.24
Club	43,586	513,808	.....	.085	....
Office	60,003	501,575	67,400	.084	1.12
Highest	.....	.....	.....	.159	1.97
Lowest	.....	.....	.....	.084	1.12
Average	.....	.....	.....	.113	1.39
Five variation high and low	.....	.....	.....	53.8%	57.0%

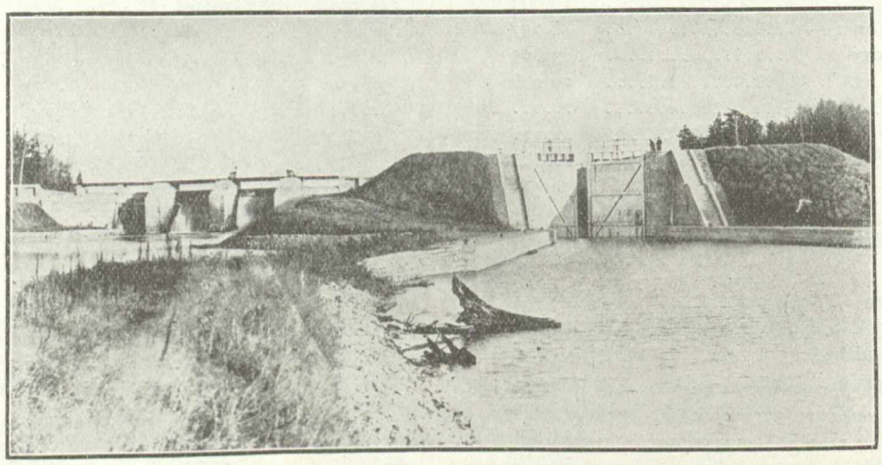
Table No. 4—Cost of Mill Construction or Second-Class Building.

Kind of Building.	Job Cost.	Volume. in cu. ft.	Floor area. in sq. ft.	Unit Cost. per cu. ft.	Unit Cost. per sq. ft.
Mill	$ 66,516	544,788	44,172	$.122	$1.51
Warehouse	337,000	2,808,850	.....	.12	....
Mill	113,288	1,271,300	129,920	.0891	.875
Storehouse	101,098	1,714,448	168,696	.059	.60
Mill	90,703	1,622,128	152,200	.056	.60
"	72,048	1,331,200	83,200	.054	.865
"	85,754	1,752,609	81,500	.048	1.05
"	122,128	2,641,000	98,059	.046	1.25
"	94,341	2,036,731	174,000	.046	.542
"	129,405	2,867,535	157,730	.045	.82
Highest	.....	.....	.....	.122	1.51
Lowest	.....	.....	.....	.069	.542
Average	.....	.....	.....	.069	.90

A DISCUSSION ON FIELD-MADE CONCRETE.*

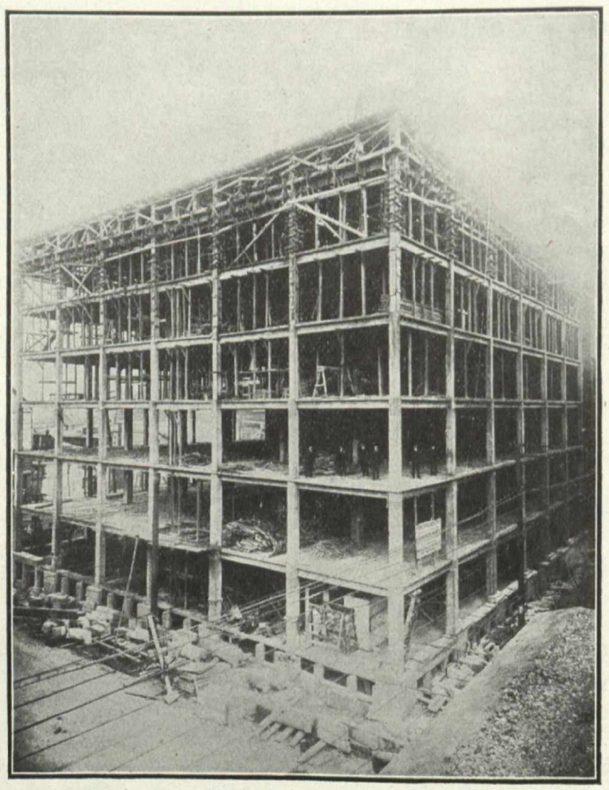
By Walter J. Francis, C.E.†

Such matters as calculations and general principles or let us say concrete in the abstract are dealt with in books, the making of which there seems to be no end. There are some points, however, with which the standard author seldom deals, and it is to these points which we may call concrete in the concerte that we wish more particularly to refer.



Balsover Lock and Dam.

The old college song in referring to certain high dignitaries says, "There are some of them good, and some of them not." This saying certainly applies to concrete structures. And just here I would not wish to be understood as saying that no other type of construction is unsatisfactory. We must recognize that every system of construction has



Skeleton of Lyman Building, Montreal.

its place. There are places where no one would dream of using anything but wood. Other conditions might demand stone or brick, while still others could best be carried out in concrete. A judicious builder will find that at many times combinations of the various systems will produce the best and most economical results. As a financially disinterested engineer, one must seek to know the virtues of every type of construction and to apply each one in the place where it is best suited. Concrete construction and its latest development, reinforced concrete, has in a very few years proven its claim to a place amongst the highest class of permanent and fireproof construction. It has passed through all the stages of development inevitable in every system destined to survive, and in its short life has passed through those changes with amazing rapidity. A few decades ago concrete was considered only good enough to be put out of sight in foundations, or into utilitarian structures usually cheap and nasty. Rapid development caused its most ardent friends to try to use it for everything, an effort which resulted in finding what it is not adapted for and in placing it where it stands to-day and where it apparently quite properly belongs. But we are learning, and I take it that while one of the objects of this Association is to advance the use of cement throughout Canada it is no less its duty to see that it is not improperly used. To the mind of the writer two important advances are necessary before concrete can be successfully used for purposes for which it has been tried with varying success within the past few years in the architectural field. One of these is the development of lines of architectural design to suit the material, and the other is the production of a cement which will give a pleasing color effect.

A Definition of Concrete.

Concrete as we understand the term to-day refers to a combination of Portland cement, sand, stone and water. As a system of construction it is comparatively new and many of our engineers who have not yet passed the prime of life recall the time when Portland cement was first introduced. Its introduction meant the passing of the older hydraulic limes and natural cements, and the entrance of a new and scientific method of construction. The structures which for centuries had been built of masonry were to be replaced by a new material differing in every point for the constructor. The old standard methods of building meant the adding of element to element already prepared off the site of the building, each bearing in itself some definite relation to the building, whether wood, brick or stone. Concrete meant the application of the atom, so to speak, the employment of the particle of cement, the grain of sand and the bit of broken stone, all of which were delivered to the building in the crude form without having passed the hand of any artificer. It is perhaps to be wondered at that more failures and unsatisfactory examples of the new construction have not occurred, for even to-day we hear of structures of wood, brick and stone failing the requirements of the builder notwithstanding the fact that these types are as old as the hills themselves. Even steel with its inherent and tremendous strength, handled by the bright minds of the engineering

* Read before the Canadian Cement and Concrete Association.

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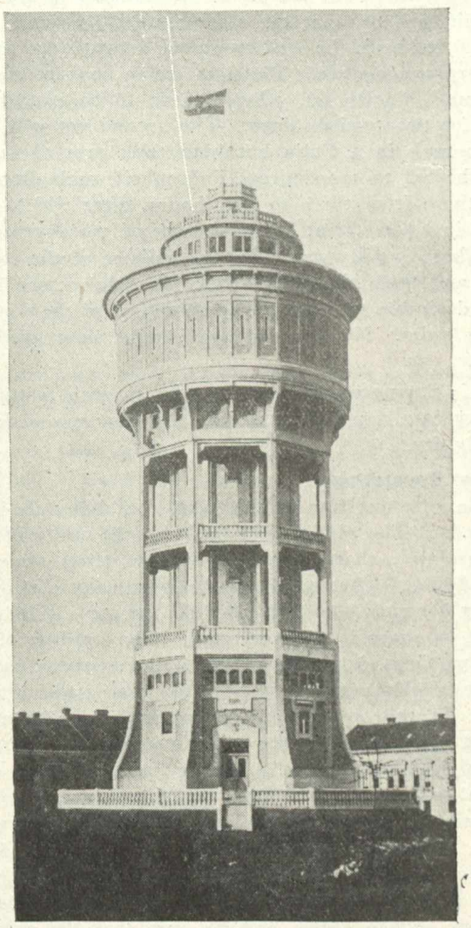
world does not always accomplish the aim of the designer. The great weakness of human nature is to remember the evil and forget the good. One chafes at missing a street car, not recalling that he has successfully boarded the preceding twenty cars he desired. Because Quebec bridge fell or a load of hay went through a fifty-foot steel span over a township creek the whole system of steel bridges is not to be condemned. If someone has erred in prematurely removing the forms in a concrete building surely that is not the fault of the concrete building. In case a brick wall



Concrete Water Tower.

capable of sustaining great loads when properly braced is loaded before the bracing is placed and as a consequence falls it cannot be said that brick construction is to be condemned. It is to be deplored that bad news travels faster than good. Let a trifling accident happen in a building and immediately the news is flashed far and wide, but no reference is made to the thousands of structures that are being safely erected throughout the land.

Wherever concrete has failed the writer believes that in many cases the failures have been the result of overzealousness on the part of its friends. Concrete construction, just like every other construction, requires a reasonable amount of care. The cry of cheap labour for concrete has been overdone. It is true that cheap labour can be used and should be used in the making of concrete, but it must be recognized that even the employment of cheap labour has a limit. Wood is probably more easy of manipulation than any other construction material, but no one would think of erecting even the simplest wooden structure without a certain number of carpenters. Bricklayers require considerable training before they can lay bricks passably well. Stonemasons and steelworkers require long training in their trades. Concrete construction does not need the same proportion of skilled labour as some of the other systems, but for satisfactory work it certainly requires the employment of men who understand something about what they are doing.

Of the highest types of permanent construction at the present time both for engineering and architectural purposes concrete is one. For many purposes its economy in cost renders it superior to any other form of construction. Its almost universal application to the construction of culvert and bridge abutments, in foundations of all kinds, in sewers and conduits, and for architectural purposes is ample proof of its general excellence and durability as judged by the best builders of the day. Good honest concrete need not make apology for its appearance wherever it is properly used. That there are some unsatisfactory examples cannot be denied. Even although the art is a new one it is the firm conviction of the writer that in the majority of cases these unsatisfactory examples are absolutely inexcusable. It is in the interest of the art and in the interest of every member of this Association that these matters should be frankly and carefully discussed.

The question may be asked, In what sense can concrete structure be unsatisfactory? The answer is from design, quality, surface finish, or colour, or a combination of all these points.

In the eye of the architect and artist the engineer's design is probably classed amongst the crudest of all things here below, and while it is not conceded that the productions of the architect are always things of beauty and a joy for ever, still it cannot be denied that many of our engineering structures are an offence to the eye. The most utilitarian bridge abutment can by the introduction of a base course, a coping and a pilaster or two be made a structure which is pleasing in its effect and which in the end may be more economical to build. It is a well known fact that very large planes show up the little inaccuracies of workmanship very glaringly, and the effort to get a perfect plane is very costly. The introduction of the pilaster or a break of some sort obviates this difficulty entirely, gives the builder a reasonable chance to make satisfactory lines and saves him expense in endeavouring to get unreasonable accuracy.

Another element seems to be creeping into design in the present day which is not calculated to be to the advantage of the structure. It is the effort of designers to save material by the introduction of counterforts and angles of all kinds in order to save concrete. To obtain the best results the builder should be given a fair chance with his form work and in the end it will be found more economical not to use

Ames-Holden Building during construction. Showing the various stages of erection.

unduly thin walls. Labor costs must be considered along with material costs.

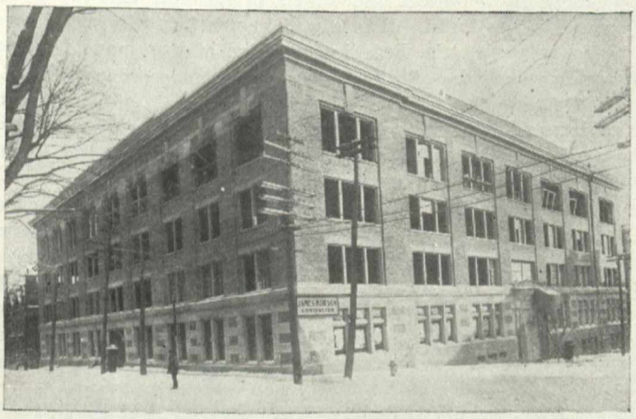
But of greatest interest to the engineer is the element of quality of the concrete. This matter of quality may affect the strength or the watertightness, or both, and in many instances either of these defects may be serious. The defect in quality may be the result of inferior materials, improper formulae, imperfect manipulation, or all combined.

First let us consider the mixture. When a doctor writes a prescription there is always one unwritten element in that prescription for which he depends upon the dispenser. That element is common sense., sound judgment, experience, or call it what you will. Without it a satisfactory medicine will not be produced. The same reasoning applies no less to the

formulae for concrete. The best materials that were ever made can be put together in such a way as to form an absolutely useless building material, while with mature judgment a competent builder can with materials of a lower quality make a passably good concrete.

Many specifications do not define clearly what the concrete is to be composed of. They do not say whether the cement is to be measured by the packed barrel or by the loose measure. They do not say possibly what shall constitute "sand," although at the same time they may give a fairly clear definition of what the stone is to be like.

One of the great difficulties with which the careful builder has to contend at the present time is the commercial unit of cement. A "barrel" of cement may mean almost anything. The barrels themselves vary in size, and if with this variation you combine the fact that cement is being packed may be made to shrink over 25 per cent., it will be readily appreciated that some definite understanding should be arrived at. The writer sincerely hopes that at no distant day the commercial unit of cement will be the pound or the even hundredweight. There seems to be no good reason why bags containing one hundred pounds of cement should not be the commercial package. For all practical purposes one hundred pounds of cement can be considered as one cubic foot, and if such a package were in common use a very easy comparison could be made between various mixtures at any time. As it is it is almost impossible to compare the mix-



Ames-Holden Factory Exterior.

tures of any two jobs or to tell just how much cement has been used. As we find things to-day for practical purposes a bag is a bag or a barrel is a barrel no matter what the actual size or weight may be. This is further complicated by the fact that some measuring devices are in use which measure the cement loose. The adoption of the hundred pound bag would not increase the labour of handling and would not make the package too heavy to handle. The farmer and the miller handle regularly 120-pound bags of wheat. The adoption of the hundredweight unit would also facilitate accounting.

Testing the Cement.

The cement on every important job should be carefully and regularly tested. Do not use it without tests. Of all the standard tests the writer considers the boiling or constancy of volume test to be by far the most important to the field man. This test is designed more particularly to develop those qualities which tend to destroy the strength and durability of the cement. Failure is revealed by cracking, checking, swelling, or disintegration, or all of the phenomena. The constancy volume test should be made every time. Practically all the standard brands will always pass the tensile and fineness tests, but the writer has known many of them to fail at times in the boiling test. Failure to pass the boiling test may mean that it is only necessary, if nothing better can be done, to pile the cement with plenty of air space so that the free lime present may have an opportunity to air slake. This may take six weeks, but even at that it may be the only remedy. The writer has been forced at times to deal with thousands of barrels of cement in this way, cement which had passed all the other tests quite satisfactorily. Where possible, of course, such cement should be removed from the work and replaced by satisfactory material. The writer does not for a moment wish to belittle the standard tests; he only wishes to point out the advantage of one of the speediest and easiest of the tests on cement, and at the same time for construction purposes one of the most important. The boiling test is described in the latest Canadian Government Specification as follows: To test the soundness of cement at least two pats of neat cement mixed for five minutes with 20 per cent. water by weight shall be made on glass, each pat about three inches in diameter and one half inch thick at the centre, tapering thence to a thin edge. It should be well trowelled to work out air bubbles and surplus moisture. The pats are to be kept under a wet cloth until finally set, when one is to be placed in fresh water for twenty-eight days. The second pat will be placed on the rack in a Faija hot bath tank over the vapour of water heated to 170 degrees Fahrenheit, and allowed to remain there from three to four hours, after which it will be placed in hot water at a temperature of 170 degrees Fahrenheit, where it will remain for the balance of the twenty-four hours and then allowed to cool. In some cases it will be found desirable to raise the temperature of the water to the boiling point. Neither samples should show distortion or cracks.

It is not necessary here to refer to such matters as the ordinary care required in storing the cement and keeping it properly dry.

Sand for Concreting.

The next question in the quality of materials is that of the sand. The old idea of having sand uniform in grain and absolutely sharp and clean is now being somewhat departed from. The sand must be practically clean and contain say not more than three or four per cent. of loam. That it must be sharp is not necessary. The grading of the size of the particles, however, is one of the greatest importance, and the ideal concrete may be said to be made of materials graded all the way from the particles of cement to the coarsest aggregate. In the writer's judgment it is quite immaterial whether crushed stone or gravel is used, but it is material to have a dense mass, and the best and most economical way of obtaining this density is to have graded material. Before starting any work of importance determine with great care by any of the standard methods the proportion of voids in the sand and the proportion of voids in the gravel or broken stone, and be sure that the combination of the materials selected is such that the mass will be without voids. The ideal concrete is obtained when the cement fills all the voids in the sand and the resultant mortar fills all the voids in the aggregate. Keep in mind that the strongest concrete is obtained with the greatest proportion of coarse material that can be used. A surplus of sand is detrimental to making a strong concrete. After the proportions are determined from the tests make a number of samples of concrete to the adopted formula so as to check up the result. This is of very great importance both for economical and constructional reasons. Break the samples and examine the fracture closely. In his practice the writer likes to consider as "sand" all the material up to about one-eighth of an inch in size, and he has succeeded in some instances in making a very strong and dense concrete with a formula which might be stated as one of cement, two and a half of sand and eight of gravel. It is very rarely however that this can be done, as very few pits furnish such an even grading. In using pit run the voids must be determined regularly.

The references that have been made to the grading of the gravel as an aggregate also apply to the grading of broken stone. One uniform size of stone is not advisable or desirable for the resultant concrete will not be so economical as with graded sizes.

Let me repeat: Make some more samples of concrete and examine the fracture.

Mixture for Concrete.

In considering the quality of concrete the mixing is of vital importance. In the best works to-day the comparatively

wet mixture is used and the day of dry concrete is past. With dry mixtures perfect watertightness is very difficult to obtain and imperfect mixing is more likely to result than when more water is used. On general principles batch mixers are to be preferred. It is a well known fact that a lean mix may be increased in strength very materially by continued manipulation in the machine, and it is also well known that a rich mix insufficiently turned may result in a poor concrete. Wet concrete also insures density. It is practically impossible to make the workman ram a dry concrete and obtain a density equal to that resulting from a wet mixture. A wet mixture also facilitates the placing of "plums" or boulders in the mass. A wet concrete can safely be filled with clean boulders until no more can be forced into it, and this is the only way in which boulders can be perfectly embedded. So long as the stones can be forced into the wet mass the writer can see no object whatever in naming fixed distances to be required between the boulders or between the boulders and the face of the walls. Work the concrete after it is placed in the moulds. If you will use a dry mix pound it. Then pound it some more. And when the men object to do more pounding make them ram it. If you have a wet mix work it, agitate it, get all the air and water bubbles out.

To cleanliness high virtues have been ascribed. A builder cannot make a good job in concrete without cleanliness. Chips, dirt and disintegrated concrete dust will not make concrete although we regret to find that at many times it has helped to swell the yardage. The greatest cause of the difficulty in bonding new concrete to old is dirt. Keep a hose handy with plenty of water pressure and do not hesitate to use it freely for cleaning purposes.

And here a word about temperatures and weather conditions. Mass concrete can be safely carried on at zero weather. Care is required as well as additional money. The concrete must be kept from freezing until after it has acquired its initial set and commenced to harden well. It should not thaw out and freeze at intervals during the process of hardening. A blazing sun on a hot summer day may be quite as detrimental to concrete as the frost of winter. It is very desirable and at times quite necessary to have a supply of water on hand to prevent drying out and to assist the concrete to mature.

Wet concrete also enables the builder to produce a face better than that which can be obtained from any other method, a face better in durability as well as in appearance. The custom of using a faced mortar seems to be a needless expense and even a deriment; and expense since it does not obtain any better result nor even as good a result as that got by the wet mass, and since it adds difficulties in the way of having to use a mortar instead of an aggregate, and since it also adds cost in placing and keeping the mixtures separate; and a detriment since we are placing together two bodies having a different coefficient of expansion, two masses having essentially different structures. Pure mortar under variations of temperature does not act in the same way as mass concrete, and it is not surprising to find that when bonded together they will not act in unison under ordinary climatic conditions. In a concrete wall built with face mortar the mortar is exposed to all the variations of temperature. It acts as a protector to the coarser mass behind it which therefore does not receive the same temperature shocks. It is not surprising then to find that cracks develop in the mortar. The writer is aware of many cases where face mortar so good as to be crystalline in structure has developed hair cracks at about eight foot square all over its surface, the cracks extending through the mortar face to the body of the concrete behind.

The most satisfactory concrete finish that can be obtained for exposed surfaces is when the formwork has been so well put up and the concrete so well placed that no patching is required after the forms are removed. The slight variations in colour and texture of such a perfect surface give it a character which cannot be obtained in any other way. The use of the plasterer's towel and the various washes should be discouraged on all heavy engineering structures. These means give a pasty, unworkmanlike and characterless tone to the structure at the start and also give a surface which does not improve with age. The natural finish on the other hand rather improves with time.

An attempt has been made to improve the surface of concrete structures by imitating stonework. On general principles imitations should certainly be avoided. Concrete has enough virtues to require no apologies for its appearance. In the oldest structures of stone the idea was to hide the weakest parts, the joints. Appreciating the difficulty of this designers later adopted them as a feature. Attempts to make concrete look like stone by making marks to imitate joints is inexcusable. Good honest concrete need not stand as an imitation.

Concrete surfaces are also unsatisfactory at times on account of colour. In some instances this is immaterial but in others it should be considered. The colour of the surface may be the result of the cement itself, of the sand used, or even the staining by the wooden forms. It is usually not difficult to get a cement that is a good colour. Ordinary pine planking for the formwork will not stain unduly, and a little care in selection from the pit may obviate the difficulty arising from the sand. The question of colour however is one which more particularly concerns architectural constructions.

Reinforced Concrete.

While concrete may be considered a modern method of construction the combination of the use of steel and concrete is very recent. It is less than half a century since the first genuine reinforced concrete was made, and for a considerable period its use was confined to the manufacture of such unpretentious articles as flower pots and tubs. The first instance of the use of the combined material which we know in this country as reinforced concrete was about thirty years ago when in New York State Mr. Ward erected a small house, using rods in the lower sides of his beams much as we use them to-day. The French and the Germans at about the same time began to develop the new system, and its growth has been so rapid that it has probably outstripped all the new arts of modern times. From the building of a rowboat in 1856 to that of a sixteen-storey sky scraper in 1903 is a tremendous stride, and to-day the system of reinforced concrete is worthy to be considered with the highest types of permanent and fireproof architectural construction. The reinforced concrete engineer is invading even the domain of his brother who works with steel, and we find railway bridges and viaducts being constructed in various places. For railway bridge superstructures time alone can prove the suitability of reinforced concrete. That cracks may be developed by the vibrations from trains or locomotives there may be good reason to think, in which case the steel would be exposed to those elements which will seriously deteriorate it. The suitability of reinforced concrete for architectural purposes however is past the experimental stage. Certain well defined designs are now recognized as good practice. Formulae have been developed which enable the engineer to design in reinforced concrete as rationally as he can do so in structural steeel.

Well designed reinforced concrete buildings possess certain virtues in a very marked degree. Some of these qualities assert themselves quite forcibly—fire resistance, absence of vibration, increasing strength with age, rigidity, sound proofness and economy are very marked. In many cases reinforced concrete demands consideration side by side with structural steel skeletons, but there are cases where reinforced concrete cannot for practical purposes be considered, as for instance the construction of a building during the winter season.

It is not our purpose here to enter into a discussion of design with which the standard authors deal so fully, but rather to refer briefly to some points which must be carefully watched in the field after the outside man has received his designs from the office.

In the present state of the art these designs will probably not call for any concrete to be exposed in the exterior

of the building in any building at least where architectural effect is aimed at. The building will probably be composed of a reinforced concrete skeleton with an exterior of brick or stone.

Some reinforced concrete buildings having concrete exteriors have proven unsatisfactory from the fact that up to the present no distinctive design has been developed to suit the material, and until the architects succeed in developing suitable lines the use of concrete for exteriors is not recommended.

As well as lines the element of color enters strongly into the architectural objection. Portland cement and ordinary sand do not giving a pleasing colour effect, but it is probably only a matter of time before a cement will be put on the market which will get away from this difficulty.

The building superintendent requires to take care of all the points that have been mentioned in connection with the field work of ordinary concrete, and he has in addition to carefully watch the placing of his reinforcing. He must appreciate the fact that he has placed in his hands the crudest kinds of building material, with respect to which he is the chief workman and master builder. He has no shop work to fall back upon and blame for errors. He has been given the details of a highly scientific structure, and he is responsible for carrying them out. The steel must be properly and accurately fabricated and correctly placed and held in the moulds. The columns must be of the proper size and perfectly plumb, avoiding eccentric stresses. In short, the concrete building superintendent must realize that he combines in himself the shop superintendent and the foreman erector.

The necessity for a wet mix required by his brother superintendent working in the heavier classes of concrete is still greater for the buildings.. Without a wet mixture he cannot properly fill the forms. The building members are comparatively small and filled with reinforcing steel. Mechanical pounding is out of the question. Use the mixture wet, and work it well all around the forms and the steel. In columns use long rods or gaspipes for manipulating or puddling the concrete.

Again, without a wet mixture the steel cannot be properly and thoroughly embedded. Unless you can flush up the wet mortar of the concrete against the surface of the steel adhesion cannot be secured. The writer recalls an instance of the demolition of a portion of a concrete structure in which a very rich but dry mixture was used, and in many parts there was no adhesion.

This brings up the subject of the adhesion of concrete and steel. In the mind of the layman this property is a very vague and doubtful one. In reality it is a very positive and definite quality. Let any doubter go to a mixing machine that has not been thoroughly flushed out with water on stopping operations, and after it has stood a few days and give him a hammer and a chisel and let him try to clean that concrete off the bright smooth steel interior. There will be no further doubt on the question of adhesion. And then let him remember that the interior of that machine is very smooth compared with the surface of the rods usually embedded. There is absolutely no doubt about the adhesion of concrete to plain steel. Set up the requisite amount of agitation in the concrete by puddling it and it will adhere to the steel. The manipulation is necessary, and if it is not done no amount of mechanical bond will save the structure.

As far as the writer's observation has extended practically all the accidents in reinforced concrete buildings have resulted from the premature removal of the formwork. Give the concrete time to set up and there will be no trouble from this cause. The time necessary can only be judged by experience. Ten days in some cases is as good as three weeks in others. A bridgeman will not remove his falsework until the riveting is safely completed. A builder will retain the bracing until the building is complete in itself. No greater amount of good judgment is required for concrete.

Something has been said about cleanliness in concreting on heavy work. Let it be said again. Keep the work clean. Chips and shavings and snow are not good reinforcing materials. If the superintendent is good he will be clean, and if he is not clean he won't be happy if he thinks at all.

And don't put up light building work in reinforced concrete during freezing weather. If you are compelled to do so be careful. It can be done but it means money and eternal vigilance.

Don't let a blazing sun shine on your new concrete when the thermometer stands at 80. Give the cement a chance.

Throughout the discussion the element of cost has been carefully avoided in order that it might be emphasized at the end. The cost is sometimes an unsatisfactory element—why? Because, after all ordinary and economical methods have been used, there remains the desire to get something in concrete that would never be thought of for other types, a polish finish. An owner may demand his concrete beams and columns to be mathematically true, but he would not dream of exposing in his halls or factory it may be the corresponding members if the building were of steel. He would be satisfied possibly with the rough unevenesses of a brick wall with its dust-catching surfaces, but in concrete he wants it like a billiard table. Do not attempt to get mathematical planes in concrete building work. If a perfectly smooth surface is demanded use common plaster. In this way the work may be cheapened very much and be made more satisfactory all around.

Let me repeat the formula for concrete—Portland cement, sand, stone, water and brains. And let me say again, mix it thoroughly. When you have mixed it enough give it another turn. After it has been pounded pound it again. When you have puddled it well puddle it some more.

CANADIAN CONCRETE AND CEMENT ASSOCIATION.

(Continued from last week's issue—Page 379.)

Mr. Lucius E. Allen read a paper on "Modern Methods of Waterproofing Concrete."

The president called on Mr. Hassan, of Ottawa, to open the discussion on Mr. Allen's paper.

Mr. Hassan: Mr. Allen in his paper states that concrete is liable to take up water. I would like to ask him if he has made any tests as to the porosity of either monolithic structure or concrete structure in any shape or form; also as to the solubility of concrete in water. If portions of the concrete are soluble in water, and if the solubility extends from day to day in the same ratio as the paper says, and finally disintegrates, I would like to know what that material is in the concrete or in the cement. Before we apply the waterproofing we want to know whether it is really essential. For my own part I do not believe it is essential to waterproof concrete. We have installed, in factories and so on, hundreds of feet of troughs having a continued flow of water to keep the box cool, passing the hot clinker from the retort to the drier or cooler, and we have not had any difficulty in that direction with regard to hot wells and cold wells. In power house construction we have never found it necessary to waterproof any cement, any concrete.

Mr. Allen: I have made tests of concrete blocks, and I think it is generally admitted that they are not damp-proof, as ordinarily made, from the fact that so many houses have been built of concrete blocks, and that people after living in them for a time object that they are not damp-proof. The tests that I have made conclusively show that concrete to a certain extent is soluble. I have been connected with the manufacture of cement for eight or ten years, and I know that while, from the manufacturer's standpoint, we don't like to advertise the fact that concrete is more or less subjected to moisture, at the same time it is a fact that we cannot deny, and the sooner concrete workers adopt some waterproofing, I think, it will be to their advantage. I don't mean to say we should always use the waterproof coat on, or anything of the kind. If the concrete is properly mixed and you can face your blocks with 1 to 2 or 1 to 3 mixtures, that is suf-

ficient; but the trouble is that there are so many blocks made that are not properly mixed.

Mr. Cadwell: I would like to ask if concrete in a moderate state of dampness, such as it is used in blocks, can be used to good advantage to thoroughly prevent that moisture, unless it is made in a very soft mixture.

Mr. Allen: I don't think I quite catch that.

Mr. Cadwell: Suppose you had a block that is mixed as ordinary building, blocks are made—just the dampness that you can bring up here—like what you would call moulding sand; by putting that into the blocks can you make that in the ordinary way waterproof without anything else in it?

Mr. Hassan: That question is easily answered. Any body that is porous is capable of taking up moisture. We know that brick, or concrete block, or even glass is able to take up moisture.

Mr. Cadwell: Then can we get blocks as dense as glass without something in it to relieve that water? I don't think we can; and if we can't then we have to have something to resist the water—throw it off instead of absorbing it. As a duck puts a coating over its feathers to shield the rain, we can put a coating over a block which will keep the water out, and yet the greater part of block is porous and will, without that, absorb moisture.

Mr. Allen: That is just the point that I tried to bring out. If you let the moisture go through the block or get into the air-space, if it is a hollow block, and you are carrying the moisture-laden air, it is not only detrimental to health, but it also passes through the inner wall and gradually gets into your house. The only way to overcome that is to put your waterproofing on the outside, whatever it may be, and it will absolutely prevent the moisture from getting into your block or wall.

Mr. Cadwell: Mr. Hassan made the statement that it can be done; that they are doing it. What I want to know is, how they do it. I don't say that it can't be done, but I don't know how to do it.

Mr. Hassan: Possibly we work on a different basis. The gentleman in question buys his cement. We make it, and use it ourselves, and there is a possibility that we can make a much richer material. Not only that, but we are inclined to put more weight on tamping, and, therefore, making a denser mass than a contractor usually does. I would like to hear from Mr. Smith on this matter.

Mr. Smith: For the information of the Convention I may say that concrete blocks can be made absolutely non-porous by the proper selection of aggregates, the proper mixing of the aggregates and the cement, and the proper addition of water to those aggregates. It cannot be done haphazard; there must be some care taken. If you will use a good rich mixture for the face—1:2:3 if the sand is a good sharp coarse sand—well tamp your mass, put in from 8 to 10 per cent. of water, you will find your block is absolutely moisture-proof without the addition of any filler or compound. Finding, however, that we have to deal with all sorts and conditions of men in these days, we have devised a waterproofing compound or filler that we recommend, only to make assurance doubly sure. But I have seen any number of blocks made absolutely dense and non-porous without the addition of any waterproof compound or filler. It is unnecessary to say also that the harder the blocks are rammed the better and more dense the concrete. But it can be done, is done, and, therefore, what has been done can be done again.

Mr. Cadwell: I have been in the block business for 19 years, and I know that you can do it just as well as these gentlemen; but I say there are conditions when we don't do it, and that is what I want to get at. We put up houses 18 or 20 years ago with cement that you could not buy to-day for $10,000 or $12,000; but the only objection to them is that there seems to be moisture in them. I don't think it can be avoided by making the mixture 1:2:3, but I think it can by using the cement more freely.

Mr. Lewis: I can corroborate what Mr. Smith said with regard to cement blocks. I am pleased to say that we can make our blocks waterproof without any compound of any kind. Our experience has been that it is in the mixture of your face. We mix our facing two to one of sand and cement, but it is machine-mixed. We take particularly good care that our mixture on the face is thorough. We moisten our block as dense as we can moisten it, so that it don't adhere too close. We put water on the face, and it has been there twelve hours after we built it, and never can enter at all. Our building inspector has experimented with water on the face of the brick, and he has failed yet to see it penetrate and go through. I am building a little cottage now, and the other day the sleet and the ice were so dense that the east face of the building was covered with ice, but the block was as dry as could be. On the house next door the ice could not be seen because it had all been absorbed. I don't think you need a compound at all if you make your blocks the right way.

Mr. Smith: My experience leads me to believe that where water has penetrated and complaint has been made, the greatest failure is due to improper laying of the blocks. It is not patted enough with mortar; sufficiently good mortar is not used; and I have found on investigation that the complaint has generally been because of the water penetrating between the blocks, and not through the block itself. Another thing: a great many people, when they get a non-porous block, insist on plastering on the inner surface of the wall, and when extremes of heat and cold come, and condensation ensues, they are led to believe that that water has come through the wall. It has not at all. It is condensation from the inside. We, therefore, recommend in every case to lath and plaster on the inside instead of plastering on the block itself, irrespective of the non-porosity of the block. Since we have recommended that so strongly we find that complaints have fallen away.

Mr. Smithson: I would like to ask Mr. Allen whether the houses he referred to were strictly lath and plaster, or plastered on the block?

Mr. Allen: They were not plastered on the block. They were simply lath and plaster. Those houses I referred to were made about five years ago with a hollow block.

Mr. Smithson: And then strapped, and then lathed and plastered inside of that?

Mr. Allen: Yes, and there was considerable dampness came through. We had a damp wall.

Mr. Smithson: More so than a stone house?

Mr. Allen: Oh yes, much more so.

The President: The remarks seem to confirm the findings of Mr. Humphrey, of St. Louis, that a great deal may be done in the matter of waterproofing by a judicious selection of materials. I think that is his dictum after a good deal of experimenting on those lines in the Government laboratory at St. Louis. The next item is a paper on "Reinforced Concrete Design from the Standpoint of Practical Engineering."

A. W. Burge, Trussed Concrete Steel Company, Toronto, read a paper, which will be given later.

After the reading of Mr. Burge's paper, there being no discussion, the meeting adjourned at 6 p.m. till 8 p.m.

THIRD DAY—EVENING SESSION.

Wednesday, March 3rd, 1909.

Convention resumed at 8 p.m.

The President: The next item is an address by Mr. Campbell, Deputy Minister of Public Works of the Province of Ontario, on "The Use of Concrete in Municipal Work."

The President: It was with a great deal of satisfaction that the Programme Committee announced that we were to be assisted by some gentlemen from across the line. Mr. Emile G. Perrott is with us this evening, and is to give us a paper on "Reinforced Concrete in Building Construction."

Mr. Perrott read a paper, which will appear later.

The President: We will now have a paper by Mr. Fred. A. Norris, consulting engineer, Boston, Mass., on "Ornamental Concrete Stone."

FOURTH DAY—AFTERNOON SESSION.

Thursday, March 4th, 1909.

Convention resumed at 2.30 p.m.—The President: We are to be favored with an address by Mr. C. R. Young, Lecturer in Applied Mechanics, University of Toronto. To some of you he needs no introduction. He has given attention to the artistic side of concrete bridge construction, and is ready to say something to us on that subject.

Artistic Concrete Bridges.

Mr. Young then gave a paper, which was beautifully illustrated with lantern-slides, but which cannot be easily reproduced.

Mr. Kahn (chairman): I believe you will agree with me that Mr. Young's paper is exceedingly timely; for, whereas, the reinforced concrete bridges are being built quite satisfactorily from an engineering standpoint, very much is still to be desired, except in a few cases, from an artistic standpoint. (Hear, hear.) According to the programme we are to have an address from a representative of the Architectural Institute of Canada, and I will call upon Mr. Burke.

Edmund Burke: In the absence of the Vice-President, Mr. Baker, I was requested to meet with you and represent our Institute. I have been very much interested in the papers and discussions, and, I think, I have learned a good deal. I am really from the youngest architectural organization—the Dominion Institute of Architects, incorporated last year. I have been very much interested in Mr. Young's paper on artistic bridges. I think he has struck the right note in a great many instances. I cannot say that from an architectural standpoint we can admire the parabolic curves; there is an awkwardness about them that does not satisfy the artistic eye. With regard to reinforced concrete architects, we have some complaints to make. We find that as a rule we require a good deal more supervision on our buildings where concrete is introduced. Where bricklayers or masons are employed we can drop around once a day or two or three times a week and see what is being done; but with reinforced concrete that is not possible, especially where your contractor is an irresponsible man and does not care much about the character of his work. We have been troubled by sometimes finding three truss-rods all bunched together, and the contractor not thinking that it amounted to anything. We, therefore, feel that we require to have constant supervision of that class of work. I suppose that as contractors become more responsible, and more seized of the serious nature of the problem, they will be more careful in construction. I was struck last night by the proportions of some of the columns shown in the slides. In Toronto it would be impossible to erect some of those buildings so high and conform to our by-laws. There is an instance now in Toronto where a seven-storey warehouse building has columns which are almost prohibitive in size, but they had to be built that way to conform to the city by-laws; and that also has quite an effect on the cost of the buildings. I was reading the other day of a concrete factory in a country town near Toronto which cost sixty cents per square foot. The same building in Toronto would cost double that amount in order to comply with our by-laws. In that way concrete construction is somewhat hampered with us. I have enjoyed your papers very much. (Applause.)

Beaumont Jarvis: I would like to say a word in regard to Mr. Burke's little talk. I think the architects have not studied the subject enough. I agree with Mr. Burke that rods approximately should not be allowed; a real truss should be insisted upon, and would come cheaper in the end, while per pound it may be a little more expensive. I would not allow rods to be put in a building of mine, after having gone through the same experience as Mr. Burke; I would have a real truss. So far as taking chances on work is concerned, if a man wants to get an irresponsible contractor, then an architect should not get an irresponsible contractor; he should get a man who is responsible, and make the owner pay for it; if he gives work to a cheap skate, of course, you are going to get into trouble.

Mr. Kahn: I am sure we are glad to receive the words from the Architectural Institute. I may say that one of the main objects of the formation of this Association is the advancement of the educational features of concrete, and the more we have of this the less objection will be found. Reinforced concrete has undoubtedly been carried on very satisfactorily in many section of the country. We are somewhat handicapped here in Toronto. We hope, however, in time to wear away the prejudices of the local authorities.

Mr. Jarvis: There is no reason why the columns should not be of steel, the structure of steel, and the fans and floor heads of reinforced concrete.

Mr. Kahn: We would very much appreciate it if Mr. Jarvis would convince our city authorities of the unnecessary large columns that we are using here.

Mr. Jarvis: Yes, that is the trouble, of course. (Laughter.)

Mr. Kahn: The next paper is by one whose face and name are undoubtedly familiar to the great majority of you, he having been formerly a resident of Toronto, now of Cleveland. I have much pleasure in introducing Mr. Chas. D. Watson, consulting engineer, Cleveland, for his paper on "Factory-made Concrete Building Products."

Mr. Kahn: Mr. Watson's extremely interesting paper should be thoroughly discussed. Unfortunately our time is becoming quite limited and we still have some papers which should be read before evening. I am, therefore, afraid that time will not permit us to enter into the discussion that the paper deserves. The next subject on our programme differs considerably from any of its predecessors, as it deals with "Electrical Equipment for Cement Plants." Is Mr. McCargar here? (Not present.) The next speaker's name is undoubtedly familiar to everyone who has been in the concrete business for any length of time. He is head of one of the original reinforced concrete institutions of the United States—Mr. Merrill Watson, general sales manager of the Consolidated Expanded Metal Companies, New York.

Mr. Merrill Watson was received with applause, and said: Mr. Chairman, an address at this time in the evening after so much science as you have had ought to be labelled, as I once saw the word "Address" labelled—"A chance to talk without any intention of saying anything." (Laughter.) You have had a big technical subject by a little man, physically, by the name of Watson, and now you are going to have a little bit of a speech by a physically big Watson. (Laughter.) Let me say, for the benefit of his friends, that we are in no way related. (Laughter.) We were both born in the State of Ohio, but that is no fault of his or mine. Over there we can't help it. Neither are we ashamed of the fact that this little man Watson lived a while in Toronto. It improved him to come back and live in New York State as I do. (Laughter.) A great many Ohio men get either too big or ashamed to stay in their native State, and they either go to New York or Washington; we dropped one in Washington to-day, you know, and we are going to leave him there for a little while. When I got a letter from your president inviting me to read a paper on any subject I chose it was a great surprise to me, and I replied that I never read papers; then he said I might give an address, and as I have told you, that is an easy way of getting out of it. Before I had been in town an hour to-day a gentleman collared me and insisted that I should talk to-night on some subject—I have forgotten it now—so I must save some hot air for to-night. I have been in the concrete business so long that I begin to feel old. I am almost in the position of Mark Twain, who told some newspaper men about a dream he had in which an angel came to take him home, but who insisted on allowing Mark only an hour to get ready. Mark replied, "Why, I have got to look around and get somebody with a balloon." The angel replied, "No, you don't want a ballon; what you want is a parachute—you are going the other way." Now, I am just about that old this afternoon, and inasmuch as I will stand up to-night where the lights will be brighter and the people will see where I am, I want you to excuse me this afternoon. I want to bring you congratulations from the United States, and particularly from the National Associ-

ation of Cement Users, organized some four years ago. I have had the honor of being one of its officers during most of its existence, and we have been doing what you are setting out to do here—educating the public to concrete; first educating your architects to think and design in concrete, then educate your public to live in concrete, and how to build and use it. It is only a question of education, but that will come on gradually and profitably. I thank you. (Applause.)

The meeting adjourned at 5 pm.

FIFTH DAY—SPECIAL MORNING SESSION.

Friday, March 5th, 1909.

A special session of the Convention was called for 11 o'clock a.m. on account of the unexpected arrival of Mr. Humphreys, president of the National Association.

Mr. Kahn occupied the chair, and introduced President Humphreys as a man who had, more than any other, advanced the interests of the industry and of the National Association, not only as president of the latter but also as superintendent of the Government laboratory at St. Louis.

President Humphreys was received with applause. He congratulated the Canadian Association on the showing made at their initial opening, not only as regards the exhibits but as to the Convention itself. He recalled the birth of the National Cement Users' Association, which resulted from a number of men interested in cement getting together at the World's Fair in St. Louis, and that the first Convention which was held at Indianapolis surprised everyone's expectation. Where they had perhaps looked for a few men to come together, there was a registration of over 650, and there were many in attendance who did not register at all. When I consented to go there to talk to them I did so with a good deal of hesitation and only because I had promised to do so. The hardest period was passed during the first forty-eight hours, and then it was a battle between those having the best interests of the Association at heart and those representing commercial interests as to who should control the organization. It resulted in an agreement of the commercial interests to work for the best interests of the cause without regard to commercialism. There are already old organizations that are engaged in technical work, such as the Canadian Society of Civil Engineers, and if this Cement and Concrete Association has been organized simply as a purely technical body it has no right to exist, but in the field of educational work it occupies a very important position. The National Association is doing a valuable work in disseminating information as to the proper uses of cement, and the Canadian Association can help the cause very much in the same way. It has been a difficult matter to maintain the National Association on a broad plane and keep out undesirable commercialism. They had felt the benefit of the various local State organizations, and in turn the National Association had helped the latter by giving them such information as they were able, because the men most benefited were those who could not afford to travel long distances to attend the National Convention. It was for this reason that the dues of the Association were kept as low as $5 a year, so as to bring the membership within the reach of every one. There was a surprising lack of information on the elementary principles connected with the use of cement at the early conventions, but this ignorance has gradually disappeared until to-day men are able to discuss the subject on broad lines, so that the small cement users, such as sidewalk men and block-makers can sit in Convention and listen with interest to technical papers on reinforced cement, which would have been impossible five years ago. The Canadian Association has entered on a very important work, and it should have high standards and endeavor to develop them and try to disseminate the information as to the very best use of cement. We are burning up as much as we build in the United States. Cement is not fireproof, but it offers one of the best materials for fireproofing, and we can build houses of that material so that they are sanitary, durable and fire-resisting. I believe that therein is one of the best uses of cement, and therein lies the great interest of this industry. It is especially so since the lumber industry, on which we have relied in the past, will become exhausted in less than 30 years, as far as the United States is concerned, though in a somewhat longer time, perhaps, in this country. So that we have a great future, but this future is going to be very much marred and the development is going to be very greatly retarded by improper uses. Now, it is all right for the engineer and the architect to know how to use these materials, but it is infinitely more necessary for the man who is working under the instruction of the architect and the engineer to know how to use them and to have an intelligent use of the material so that it will not be abused. It is on these lines that this Association must look for its greatest success. Your president this morning expressed to me the regret that perhaps the number of members of this Association was not as large as he had expected. That is not a matter that should discourage the Canadian Cement and Concrete Association. In the early days of our national organization, after the first year, notwithstanding the fact that over 650 men registered—and there were many in attendance who did not register—there were only 189 members who paid their dues. But that did not discourage us. We have grown every year until now our membership is very nearly 1,000, and we expect in the succeeding years to develop at an extremely rapid rate. We are daily getting applications for membership from all over the world. The reason for this is the fact that those who become affiliated with this organization realize the great importance of it on broad lines, and far more they appreciate the papers and discussions that come from these conventions. Now a word on the conventions themselves. It is a great thing to have a learned person come before you and give you a long paper that sets forth the very best thought, but it is infinitely better to have experience meetings at which there may be no prepared paper, but in which men representing all lines of users of cement will get up and exchange views. A man may have a difficulty some place in his work that he is not able to understand or explain, and he can get that solution at these conventions, and, I believe, the greatest good is done at our experience meetings. I know that at our National meeting at Cleveland we had a great wealth of papers, and it was under pressure that we were able to carry out our programme, forcing us to take up afternoons that had been set aside for the exhibits, and our morning sessions for the experience meetings were almost insufficient to meet the demands for that character of session. It is a problem how we are going to take care of the experience meetings next year. It looks to us as though we will have to extend the hour of assembling from 9 o'clock to an earlier hour, and that we shall have to have the afternoon meetings and allow experiences there. Our objects should be first to gain a knowledge of the proper use of cement, and second, which is more important, to my mind, a dissemination of that information. Strange to say, the very men whom you wish to reach are not men that care very much for the conventions, so the mere use of the proceedings will not attain the end, and it, therefore, becomes necessary—and, I believe, you will find it very desirable here in Canada—to form local organizations for the discussion of the various topics under the auspices of a national organization. Personally, I think to-day the cement industry is just about beginning. We have been through the experimental stage, and to-day we are beginning to realize more than ever before the necessity for standards of various kinds; so that I think that is one of the works in which this Association should engage—the formation of standard specifications covering the various uses of cement. That is one of the most important things, and, I think, that those who represent the architectural and artistic side of this Association must devote their attention to developing methods that apply to this plastic material, concrete, so as to make the material speak for what it is, and not resort to base imitations which have been the rule. The president of the local chapter of architects in Cleveland, in addressing the builders in that city expressed the thought that the reason for that was that the architects had been trained along certain lines to use certain materials, and that those styles of architecture did not readily lend themselves for concrete, and that, therefore, they did not

care to take the time to inaugurate a new system; but he believed it was up to the architects now to devise a new style of architecture adapted to concrete as a plastic material. Now, there is a great deal that we don't know about concrete, and our Joint Committee on concrete, composed of some thirty men, have been engaged in the work of trying to formulate rules governing the use of concrete. We have found that the data was not yet sufficient to enable us to reach any positive conclusions. It is for that reason that the experiments at St. Louis were undertaken under the auspices of the Government, appropriations have been made from year to year for those. Now, those appropriations look very large, and if the money was to be expended by a number of individuals perhaps a great deal more might be accomplished than is being done at present under the direction of the Government; but unfortunately the terms of the appropriation make it obligatory on the Government to make tests for the different departments, and the demands have been made of those laboratories for investigations and tests of material that enter into the various Federal buildings have made it impossible to set aside any very large amount of money for the investigation of concrete in itself. Last year there was only something like $10,000 available for investigations of cement and concrete, as investigations. Of course we have been buying equipment, and a large machine which has now been installed is part of that installation; but the importance of that work, and the field that opens up and the necessity for such work become more and more apparent. I have noted with a good deal of interest and satisfaction that there has been advocated in this country some appropriation of the Dominion Government looking to carrying on similar investigations; and I sincerely hope that they will appropriate money for investigations along similar lines, for there is an important field, and the amount of tests and investigations to be made is enormous. Not until we establish the properties of concrete more thoroughly can we get the great economy which is possible with this material. The main success of concrete as a building material has been due to the fact that structures can be put as economically, and generally more so, than with other materials; and for that reason there is a demand for it. It is strange to say that most of the demand comes, not from the architect and the engineer, but from the owner, who insists that a building shall be constructed of concrete. In connection with our committee on insurance we have collated the statistics of insurance rates on great structures over the country, and we have received some remarkable letters of a confidential character on the question of insurance. There are any number of owners of buildings who stated that they had cancelled their insurance on buildings because they believed that it was not necessary. In Minneapolis recently the contents of a building were entirely destroyed, but the damage to the building was so slight that on the strength of that the owners cancelled their insurance. I want to impress on the members of this Association the great work on which they have entered, and hope that they will always keep the educational features first as the main incentive, and prevent anything which would promote commercialism. While those who are interested in commercial lines should affiliate in every possible way, everything should remain subsidiary to the best interests of the Association, which is in the line of promoting the best knowledge of the proper use of cement. This will be, in the end, for the greatest good of the industry. I am very glad to welcome the Canadian Association into the field in its efforts in the campaign of education. I wish it every possible success, and you can rest assured that the National Association will ever be ready to lend its hand in co-operation. I thank you for the opportunity of addressing you.

Chairman Kahn: I am sure that Mr. Humphreys' remarks will bear weight with the gentlemen of the Convention, and I should very gladly hear some discussion from any of the members present, or any visitors.

Discussion.

Mr. Bowker: I would like to ask Mr. Humphreys if the United States Government has been making any investigations into cement drain tile?

Mr. Humphreys: One of the most active of our recent investigations has been that very problem. Last summer I was requested by the Department of Agriculture to prepare a bulletin for farmers on the subject of drain tile for their use. It seemed to be a very easy task, and I accepted it; but in order to satisfy myself on all the points I began an investigation into the question of tile and during the summer the effect of alkali on cement came up, and that led to perhaps a couple of months fuller investigation. As a result of that I concluded that the time was not opportune for writing a bulletin, and we began an investigation on the subject of cement tile. It opens a very broad field. We are gathering data. We examined drain tile that we know has been in existence for many years. We have tile 30 or 40 years old in a good state of preservation, and I am quite free to say that I believe cement has some of the most admirable qualities for drain tile. I know there have been a great many bad tile manufactured, just as there have been with other products. Recently I listened to an address by a gentleman from Iowa who was advocating clay for drain tile purposes in which he showed or inferred the solubility of the tile. He had put samples of hardened concrete into solutions of hydrochloric acid, which he put on the cement, and showed the bubbles, and said that was a question of solubility. It was an extremely interesting thing, because he had followed it up by taking a portion of the drain tile and by boiling it in water had determined the amount of solid material that was in the water after the boiling, and in that way inferred that the cement tile would in time lose its coherence, and he concluded that 15 years was the life of the tile. So I took some of his clay tile and boiled it in water and found that it lost a certain amount of soluble salts, and figuring inversely I thought that that might not last longer than the cement tile. I give that, not as an authority, but merely to show what can be done where people are looking for flaws. Recently we had a lot of bricks we were going to test for fire proofing, and the furnace was not ready at the time and they had to lie out the winter. I examined and found many of them simply a mass of clay,—they had gone to pieces in the weather. Now, I would not come to you with the statement that brick was not a good material. It is one of the best materials we have, and we know it, and it would be foolish for me to tell you that the brick would go to pieces in time. But in the case of the drain tile, especially in the north-west portions of this country, there is a lot of soil which must be drained which is heavily charged with alkalies, which do affect the cement qualities, especially if it is of the porous variety generally used. Unfortunately bulletins have come out in which that has been shown up, but the other side of the question has been forgotten; that is, that stone, iron, and clay and other materials are also disintegrated by alkali. I have seen two or three-ring brick sewers that would entirely give way at the end of six months as a result of the action of alkalies, when we investigated the subject of alkalies with the idea of finding out what protection can be afforded, because we find that raw materials are subject to such action. Unfortunately one of the troubles in making drain tiles is the fact that they make a very dry mixture, just as they do in a cement walk. It makes it very porous material, and the alkali will act on this porous material just as it will act on the poor sandstone or the poor quality of brick. But one of the things that I hope the Canadian Association will be most arduous in impressing on all its members is the necessity of using a quantity of water in making cement products. (Hear, hear.) The tile we make in this country to-day are very poor and porous, and even the best tile, that have a fairly metallic ring, are utterly inadequate for the purpose for which they are intended. Recently I addressed the Interstate Tile Association, and they showed me a sample and asked me what I thought of it. I said they were fair tile with the process that was now in vogue, but I ventured to add that in five years they would be classed as inferior material. The density is absolutely necessary to strength and durability, so that the tile of the future will be a tile that has a ring in it which, if properly made, will be not unlike that of cast-iron pipe. At the World's Fair we had pipe from Denmark, varying from six

inches up to the egg-shaped sewer of three feet through, and it had a ring in it that could not be equalled by cast-iron. It had the density, and the water could be poured on the surface of this pipe and it would run off just like cast-iron. That is the standard you have to reach. I remember when I first addressed the North-Western Cement Products Association in 1905, I inadvertently referred to wet mixtures, and I raised such a storm of indignation there that they thought I was the enemy of the cement industry—a man who would come there and advocate wet mixtures. At the recent Convention there was not a man who did not want to know how to make his mixture wetter. They could not get it wet enough. That was a change in five years from the dry porous material to the wet mixtures they are using to-day, many of which are perhaps about 25 per cent. wet enough. Unfortunately many men selling machinery have been advocating such proportions as one to eight and one to nine, and the result has been most disastrous. I think there is a great field for reason and common sense in the manufacture of cement products, the knowledge of the materials and the sands. Some sands have been submitted to us for investigation which were so dirty, the particles were so coated with clay, that it would be impossible to make any good material out of it; and the question of the proper gradation of sand and the density which is productive of thorough mixing is one of the things that must be continually dwelt on and hammered into the manufacturer of cement products. I believe most thoroughly that a large part of our troubles in the manufacture of cement products is due to poor sand, to a lack of water, and above all to insufficient mixing. There are many types of mixers in which the materials pass through the machine, and actually the beginning or first portion of the material has not a chance to get acquainted with the last. The result is that you get mixtures where the proportions, namely, one to three, will run from one to one to one to eight, and vary with every hour in the day. Now, it is absolutely essential that all materials that go into the mortar and concrete shall be kept in an intimate relation for a period of at least one minute; that is the minimum. It is not hard to understand why that is necessary, because you can only obtain density by getting out the air that is in the sand or crushed stone or gravel; and if you use a dry mixture it is still harder to get that out. You cannot get it out by compression, because by tamping you simply compress the air in a little closer place, but it is still there. You can get it out, however, by working the materials together into intimate relation so that the sand coats every particle, and you can work the air out. That takes some little time, and I think the time limit is one of the important phases of mixing, and above all, getting a good sand. (Applause.)

Beaumont Jarvis: Mr. Humphreys touched on the subject of standardization of concrete. The manufacturer of concrete, who has money and organization and business ability, is in the same position to-day as Carnegie was when he started with steel. I want Mr. Humphreys to give us a thought on standardizing concrete. Instead of our city architect making us put in a column or beam four times bigger than it need to be, let us get down to standardizing concrete.

Mr. Humphreys: I believe standardization is one of the essentials of this Association. The man that is making a cement product makes it the best he knows how, and perhaps the standard he has in mind is some product that he has seen, and he tries to carry an eye-impression of about what it ought to be, and he makes it as near as he can. To my mind that is a very poor standard. The standard that I hope this Association will attempt to establish is one that will tell that man his cement tile, for instance, shall have not more than a certain amount of absorption; it will have so much strength when tested in certain ways; and when submitted to certain corrosive actions it will have so much resistance. Make those tests so simple that it does not require a technical man or laboratory to make them, but simple rules that can be used in the field. I believe the simpler the rule is the more effective it will be. I believe that those standards are of the utmost importance to the success of the cement product. I think there is no doubt that our beams and columns and other parts of concrete structure are designed perhaps to the best of knowledge, but without an adequate idea of just how strong they are. I recall a remark of Captain Hunt not long ago in which he said he expostulated with an engineer in Chicago because he said the steel structure was too big and there was entirely too much material in it. The engineer replied, "It may be, but if it is so you will never find it out." I think a great many of our concrete structures going up to-day are made so strong that we will never find out how strong they are; but they are unnecessarily strong. Now, the question of standards is a very hard one to determine, but I believe there are many points in the use of concrete that should be insisted on. For instance, we specify that the cement shall be of an exceptionally good quality, and we provide a great many tests to ensure that it will be of that quality, and whenever we have a failure we all say, "Well, it must be the cement;" yet I believe that fully nine-tenths of the time the cement is not at fault; it is either bad work or materials other than the cement itself. The Joint Committee on concrete have provided a standard for the sand, and they have stipulated that the mortar taken from the mortar box shall give at least seventy per cent. of the strength that you would get in the laboratory. That is only a start. I think we should insist on a standard for the concrete itself. It is more necessary to make tests of concrete when you are doing the computation. An engineer's opinion based on what he sees is very misleading, and I have only to cite to you an illustration. The Isthmian Canal Commission sent us a lot of stone and a number of samples of sand, and they had a sand that was beautiful, very sharp and clean looking, which they thought was the best sand they could use in the construction of some of their locks. The sand had to be hauled for a great distance, and was, therefore, expensive. When we had finished our report it showed conclusively that the sand right on the side of the lock, which they did not think was of value, gave very materially higher results than the sand which they proposed using. That shows conclusively how very necessary it is to test the materials on the spot, and not to depend on your own judgment. We don't erect steel structures to-day without making tests at the mill, and the inspection of the work up there; why should we go into the field and fabricate the material and not use the same methods which are used in the steel structure? One of the greatest curses of the business is the men who say, "All you have to do is to have cement mixed up in any old way, and it will stand through all eternity." That is where we can trace our failures. You have to use the same care in the construction as you do in the construction of any other material, and if you don't have standards you cannot have real success. A standard, or something we may work to, is very essential. They may be low at first, but let us raise the bars as we proceed and we will bring the standard to the height to which it is destined. (Applause.)

Mr. Jarvis: What I would like to see is a number of men get together and in a scientific way bring this subject to a standard. It is a scientific proposition. I would rather build a cathedral than make a washtub—it would be an easier proposition to me, to build a cathedral than to build a washtub properly. There is now no standard for concrete; that is the reason we have to put so much in it—about four times more than is necessary in many cases.

Mr. Kahn: If Mr. Jarvis would familiarize himself with the work that has already been done by the National Association, and with the work that this Association hopes to do, he will find that one of the main objects is to bring these gentlemen together for that purpose. The work is being carried on in the States, and we hope it will be carried on in Canada. I am sure that President Humphrey's remarks are not only gratifying, but also encouraging to us, in the sense that the great success the National Association has made from a small beginning encourages us in the hope that our humble beginning will also ultimately reach such a success. Beyond question the institution is absolutely needed. The work has been carried on with great benefit in the United States, but until now we have not had any of it. We trust,

however, that with the encouragement we will get from the Associations in the United States, and also the encouragement and cooperation for which we hope from tthe allied industries in Canada, the results which are being accomplished elsewhere will come to us. I may say for Mr. Humphrey's information that the first thing decided upon as being absolutely necessary in the organization of our Association was the leaving out of commercialism. I am glad to be able to say that in this Convention there have been no remarks of any sort made which could in any way be construed as commercial remarks; the discussions and papers have been purely and simply on the subject of cement and concrete, its uses and its benefits, and proper methods of handling. I wish to impress upon every gentleman present our need of his cooperation, whether he be an architect, an engineer, a contractor, or a manufacturer.

Meeting closed at 12 o'clock, noon.

ENGINEERING SOCIETIES.

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

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

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

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE OF WAY ASSOCIATION.—President, William McNab, Montreal, Canada; Secretary, E. H. Fritch, 962 Monadnock, Chicago.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

SOCIETY NOTES.

McGill Engineering Society.

The annual meeting of the Undergraduate Society of Applied Science was held on Tuesday evening, the 9th inst., in the Chemistry Building. Reports of the various committees of the Executive were presented and approved. The treasurer's report showed a balance of $350, and altogether the statements gave evidence that the Society was in a most flourishing condition. The report of the year was reviewed and hearty expressions of appreciation of the efforts of the Executive were given and recorded in the minutes of the Society. The Election Committee reported the election of the following officers for next year:—President, A. N. Brown; vice-president, J. N. Limberlake; secretary, P. H. Skelton; treasurer, G. H. Walker; reporter, A. W. G. Clark.

The previous addresses before the Society had been delivered by engineers outside the University, but on this occassion, Dr. Adams, the Hon. President of the Society was called on to give the closing address, and chose as his subjects those which he termed his favorites, namely, The Faculty of Applied Science, McGill University, and Notes on a Geological Riddle.

In connection with his remarks concerning the Faculty of Applied Science he outlined the work done by a committee composed of Dr. Adams, Prof. McKay, and Prof. Evans, who had assumed responsibility in the formation of an Alumni Association in the Science Department. Formerly there has been no direct effort to keep track of graduates, but the committee was endeavoring to bring them into more intimate touch, and a Graduates Bulletin was being prepared. This Bulletin is to contain names and addresses of graduates, together with a history of the Faculty up to date.

Dr. Adams remarked on the area covered by the fame of McGill, drawing, as it does, students from all parts of the world, and intimated that at the end of the present session there would be a Grand Reunion of Graduates, and the formal opening of the new Engineering Building, which is described by visitors as the finest engineering building on the continent, and which had been designed, constructed and occupied by McGill men, and all within a space of a few months.

The latter part of his address treated of some geological phenomena, and was presented in Dr. Adams own inimitable style.

After the address the members of the Society were the guests of Dr. Adams for a half hour during which refreshments were served.

The Canadian Society of Forest Engineers.—The Canadian Society of Forest Engineers, with Dr. Fernow, president, Toronto, in the chair, heid their annual business meet-

ing in Ottawa on Thursday last. The report of the secretary showed the Society to have twenty active, one honorary, and two associate members. The election of officers resulted as follows:—President, Dr. Fernow, Toronto; vice-president, R. H. Campbell, Ottawa; secretary, F. W. H. Jacombe, Ottawa; executive committee, Elwood Wilson, Grand'mere, Que., and H. R. McMillan, Ottawa.

Dominion Forestry Association.—At the annual business meeting of the Dominion Forestry Association, held in Ottawa last Thursday, Mr. Thomas Southworth, ex-Forestry Superintendent of Ontario, was elected president, and Senator Edwards was elected vice-president. The other officers of the Association were all re-elected. It was decided that as soon as a suitable man can be found a permanent salaried secretary of the Association will be named by the executive to conduct an educational campaign for the promotion of scientific forestry throughout the Dominion. The Association aims to take an active part in the popular movement now well under way for the conservation of Canada's forestry resources, and the decision to appoint a trained forester as permanent secretary, who will give forestry lectures in each Province, is one step in this direction.

ORDER OF THE RAILWAY COMMISSIONERS OF CANADA.

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

6389—February 16—Authorizing the city of Calgary to lay at its own expense, water main under the tracks of the Canadian Pacific Railway at Eleventh Street West, Calgary, Alberta.

6390—February 17—Authorizing the city of Calgary to lay at its own expense water main under the tracks of the Canadian Pacific Railway station grounds crossing at 13th Street East, Calgary, Alta.

6391—February 17—Dismissing application of the city of Calgary for agreement between the city of Calgary and the Canadian Pacific Railway, dated 13th December, 1906, and an Order of the Board bearing the same date with respect to subway at Osler Street and First Street East, Calgary, under the tracks of the C.P.R.

6392—February 17—Dismissing complaint of Thos. Fitzgerald, of Crossfield, Alta., that the train employees of the C.P.R. in that district are employed an excessive length of time on continuous duty.

6393—February 15—Granting leave to the city of Medicine Hat, Alberta, to construct a pedestrian subway from the intersection of Toronto Street with North Railway Street under the right-of-way of the Canadian Pacific Railway Co. to the intersection of Toronto Street with South Railway Street, Medicine Hat.

6394—February 15—Dismissing application of City of Medicine Hat, Alta., for an Order authorizing the construction of an overhead bridge from Ottawa Street on the south side of the C.P.R. right-of-way, to Ottawa Street on the north side of said right-of-way.

6395—February 15—Authorizing the City of Medicine Hat to extend Main Street across the lands and right-of-way of the C.P.R., forming a public highway; and also authorizing the said city to construct a public crossing under the C.P.R. bridge over the Saskatchewan River between the east pier and the east abutment, at the cost of the applicant.

6396—February 17—Authorizing Robert Lake, Blairmore, Alta., to lay, at his own expense, a water pipe under the C.P.R. at road allowance N.E. Quar., Sec. 34, Tp. 7, R. 4, W. 5 M., Tp. Blairmore.

6397—February 19—Dismissing complaint William Robinson, Hurry, Alta., that the G.T.P. Ry. has constructed its right-of-way across his homestead, made a deep cut through his property, and thrown waste material over his land.

6398—February 19—Dismissing complaint of Alberta Farmers' Association, respecting condition of the Edmonton, Yukon and Pacific Railway bridge, approved by Order of Board No. 5691, dated November 24th, 1908.

6399—February 17—Authorizing the City of Calgary, Alta., to cross the spur of the C.P.R. Company on Second Street East with the tracks of the Calgary Street Railway.

6400—February 19—Dismissing complaint of A. Landals, Strathcona, Alta., that the C.P.R. Company has constructed a wagon road across his property, cutting his place in three parts and shutting him off from the water.

6401—February 19—Dismissing application of town of Vegreville, Alta., for authority to construct a suitable highway crossing over the C.N.R. tracks at Main Street.

6402—February 19—Dismissing application of the Parkdale Coal Company of Edmonton, Alta., against the G.T.R. Railway Company continuing their right-of-way through portion of Lot No. 22, Edmonton Settlement Survey.

6403—February 17—Authorizing the City of Calgary, Alta., to lay a 16-inch water pipe under the C.P.R. tracks at Eighth Street West, Calgary, Alta.

6404—February 17—Authorizing the City of Calgary, Alta., to lay a sewer pipe under the C.P.R tracks at Fifth Street West, Calgary, Alta.

6405—February 17—Authorizing the Calgary Gas Company to lay a gas main under the C.P.R. tracks at Eighth Street West, Calgary, Alta.

6406—February 8—Dismissing application of the City of Winnipeg for authority to construct a bridge between Brown and Brant Streets, over the C.P.R. yards, Winnipeg, and directing the Railway Company to contribute towards the cost of construction of said bridge.

6407—February 8—Approving location line of C.P.R. across the road allowance on its Molson Branch, between Mile 99 and Mile 124.

6408—February 8—Authorizing the City of Winnipeg to construct crossings over the Louise Bridge Spur at Talbot, Chalmers, Poplar, and Gordon Streets, Winnipeg; also to construct crossings over the old main line or Selkirk Branch, C.P.R. at Talbot, Chalmers, and Nairn Streets, and further ordering that all expense in connection with necessary grading, etc., be borne by the City of Winnipeg.

6409—February 8—Dismissing application of D. A. Keizer, Engineer of the Mun. of St. Paul's, for authority to lay a culvert under C.P.R. tracks at Rossmore Avenue, Lot No. 3, St. Paul's Parish, Winnipeg.

6410—February 19—Authorizing the Edmonton Radial Railway Company to cross with its tracks the line of the Edmonton, Yukon & Pacific Railway, at the corner of Hardisty Avenue and Curry Street, Edmonton, Alta.

6411—February 19—Refusing application of members of East Clover Bar Branch of Alberta Farmers' Association, requiring railways to provide movable partitions in their cars to enable individual farmers to make individual shipments.

6412—February 19—Dismissing application of the C.N.R. Company, for authority to construct a spur from its main line to Cushing's Mills and Lumber Yard, Edmonton, Alta.

6413—February 19—Approving location of the C.P.R. Company's branch line from Peave Avenue to Sixteenth Street, Edmonton, Alta., along the south side of Mackenzie Avenue.

6414—February 19—Authorizing the City of Edmonton, Alta., to extend Sixteenth Street south across the lands and right-of-way of the C.N.R. Company to join Sixteenth Street north of the said railway lands; and ordering that all expense in connection with the necessary grading, etc., be borne by the City of Edmonton. Further, that the Railway Company shall receive no compensation for the use by the said city of lands covered by said extension.

6415—February 19—Dismissing application of J. C. Haddock, of Wabamun, Alta., that the G.T.P. Railway Company took possession of his lands on the east half of Section 8, Tp. 53, R. 4, W. 5 M., without full settlement.

6416—February 19—Dismissing application of J. Gainer & Company, Strathcona, Alta., for lower minimum weight on live hogs in double-decked cars; also for order authorizing C.P.R. to rebate to applicants excessive freight on two cars of live hogs shipped from Wetaskiwin and Strathcona to Victoria, B.C.

CONSTRUCTION NEWS SECTION

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

TENDERS.

Quebec.

MONTREAL.—Tenders will be received until the 29th of March, 1909, for supplies required on the canals of this division during the fiscal year 1909-10. Address—Ernest Marceau, Superintending Engineer, Canals, P.Q.

Ontario.

FORT WILLIAM.—Tenders will be received to March 29 for the supply of timber to be delivered as specified at the mouth of Mission River, Ont. Specifications and bills of timber can be obtained at the offices of W. R. Merrick, Fort William, Ont.; J. G. Sing, Confederation Life Building, Toronto; A. R. Decary, Post Office, Quebec; J. L. Michaud, Merchants Bank Building, Montreal, and at the Department of Public Works, Ottawa. Napoleon Tessier, Secretary, Department of Public Works, Ottawa.

OTTAWA. — Tenders for concrete superstructures for piers will be received until Monday, March, 29, 1909. Plans, etc., can be seen at the office of C. D. Sargent, Resident Engineer, Ontario-St. Lawrence Canals, Cornwall, Ont., at which place forms of tenders may be obtained. Address—L. K. Jones, Secretary, Department of Railways and Canals.

OTTAWA.—Tenders will be received at the office of the Commissioners of the Transcontinental Railway until the 8th of April, 1909, for the construction and erection of a steel and concrete bridge and approach spans over the Red River between Winnipeg and St. Boniface. Plans may be seen and full information obtained at the office of the Chief Engineer at Ottawa and also at the office of the district engineer at St. Boniface, Man.

OTTAWA.—Tenders for stone protection on summit level will be received until Thursday, the 23rd March, 1909. Specifications can be seen and forms of tender obtained at the office of the Superintending Engineer, Welland Canal, St. Catharines, Ont. L. K. Jones, Secretary, Department of Railways and Canals, Ottawa.

OTTAWA.—Tenders will be received until March 23, 1909, for the construction of three Ice Piers, for the Annapolis River at Annapolis Royal, Annapolis County, N.S. Address—Napoleon Tessier, Secretary Department of Public Works.

OTTAWA.—Tenders will be received until 25th March for the fiscal year 1909-1910 for coal, coal-oil, cordwood, forage, hardware, leather, oils and paints, Portland cement, sole leather and tinware. Address—Douglas Stewart, Geo. W. Dawson, Inspector of Penitentiaries, Department of Justice.

ST. CATHARINES.—Tenders will be received by the Whitman & Barnes Manufacturing Company up to March 22nd, for the erection of a forge shop. Plans and specifications may be had on application to the architect, Mr. A. E. Nicholson, 16 Queen Street.

TORONTO.—Tenders will be received until 24th March for the dredging required in the harbour of Toronto for this season. Address—C. W. Postlethwaite, Harbour Master, 508 Board of Trade Building.

TORONTO.—Tenders are invited for the erection of a timber bridge in North Toronto. W. Scott Brooke, Engineer, 24 Adelaide Street East. (Advertised in the Canadian Engineer.)

TORONTO.—Tenders will be received until Monday, March, 22nd, for all trades required in the erection of a building for the Faculty of Education, University of Toronto, corner of Bloor Street and Spadina Avenue. Address: Darling & Pearson, architects.

TORONTO.—Tenders will be received up to noon on March 16th, for the supply of cast iron water pipe for the year ending April 1st, 1910. Also for the laying and jointing of pipes, valves, hydrants, special castings, etc., up to 31st of December, 1909. Address: Joseph Oliver, Mayor, Chairman Board of Control, City Hall, Toronto.

Manitoba.

BRANDON.—Tenders for cement will be received until April 16th for the supply of one thousand to two thousand barrels of Portland cement. W. H. Shillinglaw, City Engineer; Harry Brown, City Clerk. (Advertised in the Canadian Engineer.)

CLEARWATER.—Tenders will be received up to March 30, 1909, for a supply of plank, bridge timber and lumber required by the municipality for the year 1909, to be delivered at the following places: Pilot Mound, Crystal City, and Purves. W. Cranston, Clerk, Clearwater, Manitoba.

WINNIPEG.—Tenders for supply of man air lock for well No. 7, delivered f.o.b. cars city yards, or delivered at well site, lot 19, Kildonan, corner McPhillips Street, will be received until March 24, 1909. Address—M. Peterson, Secretary, Board of Control Office.

WINNIPEG.—Tenders will be received up to Thursday, April 15th, 1909, for the manufacture and delivery at Winnipeg of two testing transformers, viz.: One 30 k.w. at 80,000 volts, and one 200 k.w. at 200,000 volts, also for control equipment therefor. Copies of the instructions to bidders, specifications and forms of tender may be obtained at the power engineer's office, Carnegie Library building, Winnipeg, Manitoba. These specifications may also be seen at the office of Smith, Kerry & Chace, Confederation Life Building, Toronto, Ontario. M. Peterson, secretary, office of the Board of Control, Winnipeg, Man.

Saskatchewan.

PRINCE ALBERT.—Tenders for road machinery will be received until Thursday, March 18th, for one stone crusher, one elevator and screens, one electric motor, one steam road roller. Information will be forwarded on application to F. A. Creighton, Esq., city engineer, Prince Albert, Sask. (Advertised in The Canadian Engineer.)

QU'APPELLE.—Tenders will be received up to 31st March for 500 sacks of cement; 60 slush scrapers, capacity 7 cubic feet; 4 wheel scrapers, capacity 13 cubic feet. Address—J. C. Starr, Secretary-Treasurer, Municipality of South Qu'Appelle.

WEYBURN.—Tenders will be received until April 7th, 1909, for pipe-laying, water tower, cast iron pipe, and fire hydrants and valves for the town of Weyburn. Geo. Ross, secretary-treasurer; Willis Chipman, chief engineer. (Advertised in The Canadian Engineer.

Alberta.

MEDICINE HAT.—Tenders for drilling a gas well will be received until April 30th. W. P. Morrison, City Engineer. (Advertised in the Canadian Engineer.)

British Columbia.

VICTORIA.—Tenders will be received by the Hon. the Minister of Public Works, at the Department of Public Works, Victoria, B.C., up to Monday, 22nd March next, for the erection and completion of a court house at Fernie, B.C. Address—F. C. Gamble, Public Works Engineer, Works Department.

Foreign.

ADELAIDE, AUSTRALIA.—Tenders addressed to the undersigned will be received until April 28th, for the supply of one bucket dredger, one tug, and two hopper barges.

Address, Engineer-in-Chief's Department, Adelaide, South Australia.

BRISBANE, AUSTRALIA.—Tenders will be received until May 31st for installing in the general post office a switchboard, consisting of one trunk line section, three subscribers sections, cable turning and string sections, frames, racks, power plant, etc. Address: Captain R. M. Collins, Australian Commonwealth Offices, 72 Victoria Street, Westminster, S.W., London, England.

SYDNEY (AUSTRALIA).—Tenders will be received until May 19th for two multitype magneto switchboards for Postmaster General's Department. Address—Captain R. M. Collins, Australian Commonwealth Office, 72 Victoria Street, Westminster, London, S.W., England.

SANTIAGO DE CHILE.—Tenders will be received until April 24th for supply of tyres for locomotives, wagons and coaches, springs, wheels, axles, buffers, safety valves, etc. Address—Director General de Obras Publicas.

TOULON (FRANCE).—Tenders will be received until April 22nd for 59 to 79 tons of mineral oil for engines. Address—Administration de la Marine.

CONTRACTS AWARDED.

Ontario.

CORNWALL.—The Vulcan Portland Cement Company has been awarded a contract to supply about 46,000 barrels of cement to the Department of Railways and Canals, for use on the Lachine and Cornwall Canals.

OTTAWA.—The Transcontinental Railway recently awarded contracts for steel rails as follows:—For 105,695 tons, to the Dominion Iron and Steel Company, Sydney, N.S., and 69,123 tons to the Algoma Steel Company. The contract for the inspection of the steel rails was awarded to the Standard Inspection Bureau, Toronto, at 5 cents per ton.

TORONTO.—The County of York have awarded the contract for a bridge superstructure over the Humber River, north of Lambton Mills, to the Ontario Bridge Company, of Toronto, whose tender for a single span of 200 feet was $9,404. Following is a list of the tenders submitted:—

	Single span of 200 ft.	Two spans of 98 ft. each
Dom. Bridge Company, Ltd., Montreal	$10,120	$7,823
Hamilton Bridge Company, Ltd.....	9,750	7,720
Can. Bridge Co., Ltd., Walkerville....	....	7,912
Ontario Bridge Company, Toronto....	9,404	7,540

Frank Barber, County Eng.

WELLAND.—The Page-Hershey Company, Ltd., recently awarded a contract to the Berlin Construction Company, of Berlin, Conn., for the erection of large mills at Welland for the manufacture of water and gas pipe. The work of construction will begin shortly. The plant will be operated by electricity.

British Columbia.

VICTORIA.—The lowest tenders received for the new school on Chambers Street for a flat roof and a pitched roof building were as follows:—

	Flat.	Pitched.
Brick and Stone Work—		
Parfitt Brothers	$42,387	$41,487
Carpenter—		
W. A. Gleason	7,659	8,698
Galvanized Iron Work—		
Pac. Sheet Metal W.....	1,865	2,746
Plumbing—		
J. Colbert	4,487	4,487
Wiring—		
Hawkins & Hayward	1,365	1,356
Plastering—		
J. Allen	2,506	2,506
Painting—		
Arman Lewis	3,323	3,323
Total	$63,583	$64,603

Manitoba.

WINNIPEG.—The tender of the H.D. Williamson Construction Company, of Toronto, in connection with the construction of transmission lines between Point du Bois and Winnipeg was accepted. It amounts to $118,424, which includes $83,424 for the steel, gravel and cement required for the tower. Other tenders accepted were R. & D. McLeod, $23,421, for a telephone line, and the Stuart Machinery Company, $1,544 for repair shop equipment.

WINNIPEG.—The Public Parks Board recently awarded the following contracts: For lining a water tank, capacity 16,000 gallons, with galvanized iron, J. W. Wright, $108.30; for 3,000 elm trees, H. J. Lomer, 35c. each.

RAILWAYS—STEAM AND ELECTRIC.

Ontario.

COBOURG.—The Cobourg, Port Hope and Havelock Electric Railway Company succeeded in convincing the Railway Committee of the Legislature that they are entitled to a charter for a line which will run from Port Hope to Cobourg, across Northumberland County to Warkworth and Campbellford and on to Havelock, with branches to Blairton and to the Marmora mining district, and other branches from a point near Warkworth to Roseneath and Hastings. The company includes Col. H. A. Ward, K.C., of Port Hope, secretary of the company; W. J. Crossen, car manufacturer, Cobourg; H. T. Bush, Port Hope, president Standard Ideal Sanitary Co.; E. S. Huycke, K.C., Port Hope, and Reeve Jos. Knox, of Havelock.

TORONTO.—According to an announcement at the annal meeting of the Crow's Nest Pass Ry. Co., held at Toronto last week, Mr. James J. Hill has obtained control of the Crow's Nest Pass Railway.

OTTAWA.—The St. Mary's and Western Ontario Railway Company were granted an extension of time on Tuesday by the Railway Committee of the House of Commons to construct lines from Woodstock to Brantford, St. Mary's to Stratford and St. Mary's to Exeter. A protest was entered on the ground that it was entirely of a Provincial character and should come within the jurisdiction of the Province. Mr. Henderson (Halton) said that as the Dominion Government had already granted a charter to the St. Mary's & Western Ontario Company it would be absurd to refuse them power to construct branches. The Provincial authorities were too late in entering their protest.

LIGHT, HEAT, AND POWER.

Quebec.

IBERVILLE.—The Northern Electric and Manufacturing Company, Ltd., have been awarded the contract for supplying and installing a Western Electric alternator, exciter and switchboard equipment for the town of Iberville, Que.

Ontario.

BRANTFORD.—The City Council have adopted the by-law ratifying the agreement with the Western Counties Power Company, now operating as a subsidiary of the Cataract Power Company. Under the new agreement the company gets a five years' contract, charging the city $48 per light per year for street lighting, and 7.65 cents per kilowatt for commercial and domestic lighting.

Saskatchewan.

PRINCE ALBERT.—The city is advertising for an engineer holding a second-class Saskatchewan certificate to operate the electric plant. Salary $80 a month.

SEWERAGE AND WATERWORKS.

Ontario.

ST. THOMAS.—City Engineer J. A. Bell visited Toronto last week to meet the Provincial Board of Health and seek their acceptance of septic tank plans.

Alberta.

CLARESHOLM.—Messrs. Arnott & Reid, who visited the foothill country to explore suitable sources of water supply for the town, have decided on a site, and suggest the installation of a 65 horse-power turbine pump. The cost of the proposed water system is estimated at $54,000.

TELEPHONY

Alberta.

LETHBRIDGE.—A two-storey building, to be used as a telephone exchange, will shortly be erected here.

FINANCING PUBLIC WORKS.

Ontario.

BRANTFORD.—Debentures for local improvements amounting to $65,477, bearing 4½ per cent., are offered by the City of Brantford.

THOROLD.—Tenders are invited by the town of Thorold for $15,000 5 per cent. waterworks extension debentures.

Manitoba.

HARTNEY.—The town of Hartney is offering, until May 3rd, $5,000 5 per cent. sidewalk improvement debentures.

MISCELLANEOUS

Quebec.

MONTREAL.—The Harbor Commissioners will commence in a short time to erect conveyors and conveyor galleries at the Jacques Cartier pier. A wharf will also be built at Longue Pointe.

CURRENT NEWS

Ontario.

OTTAWA.—The new Quebec Bridge will be 150 feet above the river at high tide, with 600 feet of centre span, according to a statement made recently by the Hon. G. P. Graham.

PERSONAL.

CAPT. A. G. MIDFORD, of Toronto, Ont., has been called to Regina, Sask., to act as arbitrator.

MR. W. G. ROBB, general foreman of motive power for the G.T.R., at Ottawa, has been appointed assistant master mechanic of the G.T.P., with headquarters at Rivers, Sask.

MARKET CONDITIONS.

Toronto, March 18th, 1909.

The metals trade has been looking anxiously for something to happen as a result of the declaration of $4 a ton reduction by the United States Steel Company in price of steel. But nothing startling has happened, and people are wondering why. Efforts to hasten spring, or at least to spur up spring trade, in the States, by artificial methods have not succeeded. Manufacturers cannot force business because buyers are disposed to hang back until they see what is to be effected by President's Taft's call of a special session of the American Congress, to discuss the tariff in particular.

On this side the Lakes, there appears to be no brisk demand for anything in metals. The weather has been boisterous, and the reverse of spring-like. In some directions building materials, such as roofing felts and building papers, have experienced occasional request, but this has been for patching-up work, until the weather became more settled. The market for bar-iron is well supplied, with no change in quotations in consequence of United States changes, Canadian makers of iron pipe are strongly of opinion that prices must go up, therefore, they decline to book orders ahead.

More steadiness is perceptible in tin, some American holders of which predict an advance in price before 1st April, as a result of the large consumption of tin plates which must come because of short supplies for vegetable and fruit canners. The copper market exhibits weakness, and but little activity exists here. Zinc holds its own. Not much doing in pig-iron.

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

Antimony.—Price lower, at 9½c. Movement quite limited.

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

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

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

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

Bricks.—Common structural, $9 per thousand, wholesale, and the demand moderately active. Red and buff pressed are worth, delivered, $18; at works, $17.

Cement.—Price in 1,000-barrel lots $1.70 per barrel, including bags, or $1.30 without bags. Smaller quantities, $1.55 to $1.60 per barrel, in load lots delivered in town, and bags extra. No marked activity.

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

Copper Ingot.—Market weak, with but little doing, price declined to 13¾ and 14c.

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

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

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

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

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

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

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

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

Iron Pipe.—Black, ¼-inch, $2.03; ⅜-inch, $2.26; ¾-inch, $2.63; ¾-inch, $3.16; 1-inch, $4.54; 1¼-inch, $6.19; 1½-inch, $7.43; 2-inch, $9.90; 2½-inch, $15.81; 3-inch, $20.76; 3½-inch, $26.13; 4-inch, $29.70; 4½-inch, $38; 5-inch, $43.50; 6-inch, $56. Galvanized, ¼-inch, $2.86; ⅜-inch, $3.08; ½-inch, $3.48; ¾-inch, $4.31; 1-inch, $6.19; 1¼-inch, $8.44; 1½-inch, $10.13; 2-inch, $13.50. Makers are holding prices stiff, and talk of an advance.

Lead.—Prices steady outside. Price here lower at $3.80 to $3.90.

Lime.—Retail price in city 35c. per 100 lbs. f.o.b., car; in large lots at kilns outside city 22c. per 100 lbs. f.o.b., car. Small but steady consumptive demand.

Lumber.—We quote dressing pine $32 to $35 per thousand; common stock boards higher at $26 to $30.00; cull stocks, $20; sidings, $17.50. Norway pine is neglected in favor of Southern, which is much stronger in fibre and the price well maintained. Hemlock continues to sell pretty freely, and in car lots brings $16.50 to $17.00. Spruce flooring is worth $22.00 in car lots with stiffer feeling. Shingles firmer, price for British Columbia, $3.20. Lath higher at $4.25 for No. 1 and $3.75 for No. 2 white pine 48-inch; the 32-inch are now in market and bring $1.30 per thousand. Spruce laths are scarcer in this market and prices keep up. More spruce and hemlock have moved than pine. Prices are maintained all over the list.

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

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

Pig Iron.—Business continues quiet; prices are fairly well maintained. Clarence quotes at $20.50 for No. 3; Cleveland, $20.50 to $21.00; in Canadian pig, Hamilton quotes $19.50 to $20.

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

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

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

Sewer Pipe.—

	4-in.	6-in.	9-in.	10-in.	12-in.	24-in.
Straight pipe per foot	$0.20	$0.30	$0.60	$0.75	$1.00	$3.25
Single junction, 1 or 2 feet long.	.90	1.35	2.70	3.40	4.50	14.63
Double junctions	1.50	2.50	5.00	....	8.50	.....
Increasers and reducers	....	1.50	2.50	....	4.00	.....
P. traps	2.00	3.50	7.50	....	15.00	.....
H. H. traps	2.50	4.00	8.00	....	15.00	.....

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

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

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

Sheet Steel.—Market steady, with fairly good demand; 10-gauge, $2.50; 12-gauge, $2.55; American Bessemer, 14-gauge, $2.35; 17, 18, and 20-gauge, $2.45; 22 and 24-gauge, $2.50; 26-gauge, $2.65; 28-gauge, $2.85.

Tank Plate.—3-16, $2.40 100 lbs.

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

Tin.—A little more steadiness characterizes the market. The price is maintained at 30½ and 31c.

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

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

* * * *

Montreal, March 17th, 1909.

Advices from Pittsburg are to the effect that foundry, malleable and and basic iron would sell at considerably lower prices if any attractive inquiries developed. Quotations now being given out at Valley furnaces are $15.50 for bessemer, $15 for basic and malleable, $14.75 for foundry, and $14 for forge, with a 90c. rate to Pittsburg. As for steel, leading makers are quoting $23, Pittsburg, $25 to $25.50 for steel bars. The feeling prevails throughout the market that it would not be difficult to make purchases of large lots at a considerable reduction on prices generally quoted. Buyers are not coming forward freely, thus indicating a belief on their part that the end of the declines has not yet been seen. It is only natural to look for reductions in wages at a time such as the present, and the probability is that these must take place and prices be placed on a yet lower level in order to bring about confidence in the situation. In fact, announcements of reduction are already being made, some of the reductions—such as at Eastern Pennsylvania and New Jersey blast furnaces—amounting to 10 per cent. Mining wages have not yet been touched, but the general expectation is that there will be a reduction all round. There has been a somewhat better trade, however, during the past week, and this is being put down to the credit of the lower prices. Railway companies are still buying in very limited quantities, but they are buying some and enquiring for more. Transactions of in pig-iron, for early delivery, show the market to be weak. Accumulations of stock are heaviest in the central west.

Advices from Great Britain are exceedingly uninteresting. Practically nothing new is forthcoming, and it would almost seem as though the situation there was dependent upon that in the United States. At any rate, all eyes there are turned towards the United States, and the principal point of interest is whether or not reductions are to be made in the tariff against foreign iron and steel, and the extent of such reductions. There seems to be an impression that very little news of importance will be forthcoming until these matters are settled.

In Canada, also, the entire trade is finding its principal interest in the situation in the United States. Awaiting further declines, there, trade here is dull. Up to the present, prices have been but little affected in Canada, owing to the fact that for a long time past importations from the United States to Canada were made at such figures that recent declines there do not disturb holders here. Further declines, however, in all probability would, and the belief exists here to no small extent that further declines are bound to occur in the United States. Meantime there is a fair demand from several quarters, here, and some business has been closed within the past week.

The very steadiness in the list of prices, lately, would indicate the dullness of the market, hardly a change having been made in months. Spikes are a little easier, this being the only alteration this week. It is thought, however, that practically the entire list would be shaded in order to induce business.

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

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

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

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

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

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

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

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

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

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

Iron.—Prices are rather higher, and the outlook is steady. The following prices are ex-store: Canadian pig, $18.50 to $19.50 per ton; No. 1 Summerlee, $21 to $22; No. 2 selected Summerlee, $20.50 to $21.50; Carron soft, $20.25 to $20.75; No. 3 Clarence, $19 to $20 per ton.

Laths.—See Lumber, etc.

Lead.—Trail lead is firmer, at $3.75 to $3.85 per 100 pounds, ex-store.

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

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

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

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

Pipe.—Wrought and Galvanized.—The market is steady, moderate-sized lots being: ¼-inch, $5.50 with 63 per cent. off for black, and 48 per cent. off for galvanized; ⅜-inch, $5.50, with 59 per cent. off for black and 44 per cent. off for galvanized. The discount on the following is 69 per cent. off for black and 59 per cent. off for galvanized; ½-inch, $8.50; ¾-inch, $11.50; 1-inch, $16.50; 1¼-inch, $22.50; 1½-nch, $27; 2-inch, $36; 2½-inch, $57.50; 3-inch, $75.50; 3½-inch, $95; 4-inch, $108.

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

Railway Ties.—See lumber, etc.

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

Rope.—Prices are steady, at 9½c. per lb. for sisal, and 12c. for Manila. Wire rope, crucible steel, six-strands, nineteen wires; ¼-in., $2.75; 5-16, $3.75; ⅜, $4.75; ½, $6; ⅝, $7.25; ¾, $8.50; ⅞, $10; 1-in., $12 per 100 feet.

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

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

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

Telegraph Poles.—See lumber, etc.

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

Tin.—Prices are 32c. to 32½c.
Zinc.—The market is steady at 5¾ to 5¾c.

* * * *

Winnipeg, March 15th, 1909.

Market quotations still remain the same but there is a strong likelihood that lumber will show an increase very shortly, especially in the West. In view of the prosperity in every line of trade, manufacturers of lumber and shingles, and all other wood products are curtailing their out-put now, thus starving the market. This is reported to be more in the shingle industry than in the lumber as practically all the shingle mills on the Coast are shut down.

Cement is spoken of as likely to take a rise. Dealers state that manufacturers are going to advance their prices so dealers will have to also.

Indications continue very bright for an immense building trade in the West this year, and a number of proposed structures have already been commenced.

Winnipeg quotations are as follows:—

Anvils.—Per pound, 10 to 12½c.; Buckworth anvils, 80 lbs., and up, 10¼c.; anvil and vise combined, each, $5.50.
Bar Iron.—$2.25 to $2.60.
Beams and Channels.—$3 to $3.25 per 100 up to 15-inch.
Building Paper.—4½ to 7c. per pound. No. 1 tarred, 84c. per roll; plain, 60c.; No. 2 tarred, 62½c.; plain, 56c.
Bricks.—$11, $12, $13 per ton, three grades.
Cement.—$2.65 to $2.75 per barrel.
Chain.—Coil, proof, ¼-inch, $7; 5-16-inch, $5.50; ⅜-inch, $4.90; 7-16-inch, $4.75; ½-inch, $4.40; ⅝-inch, $4.20; ¾-inch, $4.05; logging chain, 5-16-inch, $6.50; ⅜-inch, $6; ¼-inch, $8.50; jack iron, single, per dozen yards 15c. to 75c.; double, 25c. to $1; trace-chains, per dozen, $5.25 to $6.
Dynamite.—$11 to $13 per case.
Hair.—Plaster's, 80 to 90 cents per bale.
Hinges.—Heavy T and strap, per 100 lbs., $6 to $7.50; light, do., 65 per cent.; screw hook and hinge, 6 to 10 inches, 5¼c. per lb.; 12 inches up, per lb., 4¼c.
Iron.—Swedish iron, 100 lbs., $4.75 base; sheet, black, 14 to 22 gauge, $3.75; 24-gauge, $3.90; 26-gauge, $4; 28-gauge, $4.10. Galvanized—American, 18 to 20-gauge, $4.40; 22 to 24-gauge, $4.65; 26-gauge, $4.65; 28-gauge, $4.90; 30-gauge, $5.15 per 100 lbs. Queen's Head, 22 to 24-gauge, $4.65; 26-gauge English, or 30-gauge American, $4.90; 30-gauge American, $5.15; Fleur de Lis, 22 to 24-gauge, $4.50; 28-gauge American, $4.75; 30-gauge American, $5.
Lead Wool.—$10.50 per hundred, $200 per ton, f.o.b., Toronto.
Pipe.—Iron, black, per 100 feet, ¼-inch, $2.50; ⅜-inch, $2.80; ½-inch, $3.40; ¾-inch, $4.60; 1-inch, $6.60; 1¼-inch, $9; 1½-inch, $10.75; 2-inch, $14.40; aglvanized, ½-inch, $4.25; ¾-inch, $5.75; 1-inch, $8.35; 1¼-inch, $11.35; 1½-inch, $13.60; 2-inch, $18.10. Lead, 6½c. per lb.
Picks.—Clay, $5 dozen; pick mattocks, $6 per dozen; clevishes, 7c. per lb.
Pitch.—Pine, $6.50 per barrel; in less than barrel lots, 4c. per lb.; roofing pitch, $1 per cwt.

(Continued on Page 45.)

RAILWAY ORDERS.

(Continued from Page 411).

6417—Feb. 19—Dismissing complaint of Cyril Hind, Mannville, Alta., alleging excessive freight rates charged by the C.P.R. Co. on a horse shipped from St. John to Strathcona, Alta.

6418—Feb. 19—Dismissing complaint of Peter Reid, that the C.P.R. has removed gates and cut the posts and wires where the railway affects his property, causing loss by cattle getting on right-of-way and being killed.

6419—Feb. 19—Dismissing application of city of Edmonton, for an Order declaring that the plan, profile, and book of reference of the C.P.R. Co.'s location through Edmonton is not in accordance with the Railway Act, and that the same be cancelled and annulled.

6420—Feb. 19—Dismissing complaint of United Farmers of Alberta that railway companies had not fenced their right-of-way, that grain cars are not provided with proper grain doors, that freight rates are excessive, that serious losses are sustained by reason of stock cars not being promptly spotted for unloading; and that in districts where new railway lines are being built farmers are compelled to sustain heavy losses because the companies do not fence or protect their right-of-way while work is being done thereon.

6421—Feb. 19—Authorizing the G.T.P. Railway Co., on or before the 1st April, 1909, to construct a suitable and convenient temporary crossing for use of farmers desiring to cross the lines of their railway with farm implements between Sections 12 and 13, Township 53, Range 23, west 4th meridian, between mileage 77 and 112; and that the temporary crossing shall be discontinued when the permanent subway is constructed.

6422—Feb. 17—Authorizing the municipality of Didsbury, Alta., to open up a street across the right-of-way and tracks of the C. and E. Railway, in the town of Didsbury, Alta., in the line and of the width of Hespeler Street, in an easterly direction to the easterly boundary of the lands of the railway company; all expense in connection therewith to be borne by the municipality of Didsbury; any questions that may arise as to protection (if any) to be reserved for further consideration; and the crossing of the lands of the said railway company at Waterloo Street shall not be affected by this Order.

6423—Feb. 25—Directing that the crossings in the village of West Lorne, Ont., be protected by gates to be installed by the M.C.R.R.; the gates to be controlled from a tower between the M.C.R.R. and Pere Marquette line, detail plans to be submitted to engineer of Board; the gate operators to be appointed by the M.C.R.R., and the cost of installing gates and erecting tower to be borne equally by the M.C.R.R. and P.M. Companies, etc.

6424—Feb. 25—Directing that the crossings of the M.C.R.R. and Pere Marquette Railway Companies, in the village of Dutton, Ont., be protected by gates.

6425—March 1—Authorizing the city of Calgary, Alta., to place its electric light and power wires across the C.P.R. tracks at Eighth Street East, Calgary, Alta.

6426—Feb. 26—Authorizing the C.P.R. Co. to construct a branch line or spur from a point at chainage 141 + 77, on the Quebec section of its line, to and into the premises of Messrs. Leroux Bros., Lots 456 and 457, together with another spur commencing from a point on the first mentioned spur 431 feet in an easterly direction.

6427—Feb. 27—Authorizing the Esquimalt and Nanaimo Railway Co. to construct a spur into the premises of the Shawinigan Lake Lumber Co., on Lot No. 13, Malahat District, Vancouver Island, B.C.

6428—Feb. 27—Authorizing the C.P.R. Co. to construct two branch lines of railway, or spurs, on the south-east quarter Section 11, Township 24, Range 1, west 5th meridian, near Calgary Junction, Alta., for the Alberta Portland Cement Co.

COPPER PRODUCTION IN 1908.

The Mining World.—The copper industry of the United Sttates in 1908 enjoyed a period of gradual recovery from the severe depression suffered in the last period of 1907, according to a statement made by L. C. Graton of the United States Geological Survey.

(Continued on Page 48.)

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1 refitted 50" x 14', containing 64-3" tubes.
1 refitted 54" x 12', containing 64-3" tubes.
1 refitted 52" x 11', containing 68-3" tubes.
1 refitted 48" x 13' 6", containing 42-3" tubes.
1 refitted 44" x 11' 9", containing 42-3" tubes.
1 refitted 36" x 11' 6", containing 32-3" tubes.
1 refitted 44" x 10', containing 48-3" tubes.

HORIZONTAL ENGINES.

1 refitted 16" x 24", L.H. rocking valve.
1 refitted 11¼" x 14", L.H. slide valve.
1 new 12" x 15", C.C. slide valve.
1 nearly new 12" x 12", C.C. slide valve.
1 refitted 10½" x 14", C.C. slide valve.
1 refitted 10¾" x 16", R.H. slide valve.
1 new 10" x 15", C.C. slide valve.
1 refitted 11" x 11", C.C. rocking valve.
1 new 9" x 12", L.H. slide valve.
1 refitted 9" x 12", L.H. slide valve.

STEAM PUMPS.

1 refitted No. 6 pulsometer pump, 300 gals. per min.
1 new 8" x 5" x 12" duplex, 224 gals. per min.
2 refitted 7½" x 4½" x 10" duplex, 172 gals. per min.
1 refitted 7" x 4½" x 8" duplex, 150 gals. per min.
1 new 7½" x 4" x 8" duplex, 82 gals. per min.
3 new 6" x 4" x 7" duplex, 114 gals. per min.
2 refitted 6" x 4" x 7" duplex, 114 gals. per min.
1 refitted 5¼" x 3½" x 5" duplex, 100 gals. per min.
1 new 4½" x 2¾" x 6" duplex, 60 gals. per min.
6 new 4½" x 2¾" x 4" duplex, 40 gals. per min.
1 nearly new 3" x 2" x 4" duplex, 22 gals. per min.
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(Continued from Page 7)

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Toronto.—Powell Lumber &Door Co., $50,000; F. W. Powell, C. B. Dougherty, Ottawa; R. Locke, Toronto. Cobalt-

(Continued on Page 48.)

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(Continued from Page 43.)

Plaster.—Per barrel, $3.

Roofing Paper.—60 to 67½c. per roll.

Lumber.—No. 1 pine, sprce, tamarac, British Columbia fir and cedar—2 x 4, 2 x 6, 8 to 16 feet, $27.25, 2 x 20 up to 32 feet, $38.

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

Tool Steel.—8½ to 15c. per pound.

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

Boards.—Common pine, 8-inch to 12-inch wide, $38 to $45; siding, No. 2 white pine, 6-inch, $55; cull red or white pine or spruce, 6-inch, $24; No. 1 clear cedar, 6-inch, 8 to 16 ft., $60; Nos. 1 and 2 British Columbia spruce, 6-inch, $55; No. 3, $45.

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REPORT OF MESSRS. RUDOLPH HERING, C.E., OF NEW YORK CITY, AND JOHN D. WATSON, C.E., OF BIRMINGHAM, ENGLAND, IN REFERENCE TO SEWAGE DISPOSAL AND THE RELATION OF WATER FILTRATION THERETO.

Early in the year Rudolph Hering, of New York, and John D. Watson, of England, were called in by the Council of the city of Toronto to give expert advice on the question of sewage disposal. Mr. C. H. Rust, City Engineer, propounded eight questions to them and in addition volunteered the information that:—

"It has also been decided to filter the water supply of the city by slow sand filtration, and Mr. Allen Hazen, of New York, is now engaged in preparing plans for this work."

Their reply and report is as follows:—

In compliance with Report No. 1 of the Board of Control, adopted by your Council on the 25th of January, 1909, requesting us to report to your Council on the general question of sewage disposal, and on the relation of water filtration thereto, and further in compliance with a letter of instruction received from the City Engineer, a copy of which is appended, we beg to report as follows:—

We arrived in Toronto on Friday, February 26th, and on Saturday morning we met His Worship the Mayor, Mr. Controller Harrison, Mr. Alderman McGhie, Chairman of the Committee on Works, Dr. Charles Sheard, Medical Health Officer, and Mr. C. H. Rust, City Engineer, and at this meeting a general discussion took place in connection with the object of our visit.

On Saturday afternoon, accompanied by these gentlemen, we made an inspection of the site east of Morley Avenue, purchased by your Council for the erection of the Disposal Works, and also of the Leslie Street site and the marsh site at the foot of Cherry Street. We inspected the present small Sewage Disposal Works at the foot of Woodbine Avenue and the Lake Shore, and went east and north up Beech Avenue to East Toronto, and then returned to the city.

On Wednesday, March 3rd, we met the members of the Board of Control in the office of the Mayor, and discussed generally with that Board the entire situation.

On Friday, March 4th, we met a deputation from the Beeches' Association and the Riverdale Business Men's Association, and in the afternoon, at the request of these gentlemen, we visited the districts in which they are specially interested. The representatives of these Associations were rather alarmed at the prospect of having the Works located upon the site selected and feared that the discharge of the effluent sewage into the lake would not only have an injurious effect upon their property, but also pollute the shores and prevent the lake from being used for bathing and pleasure purposes. Without going into detail, it may suffice at this juncture to say that later in the report we suggest modifications to the plans that will remove every reasonable objection.

We have also been waited upon by ex-Alderman Davies and Mr. T. Aird Murray.

Mr. Davies explained to us his views regarding the currents in the lake and harbor, and the possible effects of discharging a sewage effluent into the lake opposite the Woodbine, as against its discharge after special treatment in tanks to be located east of the new fort.

We have satisfied ourselves that the currents in the lake are almost entirely due to wind, and that the observations which have been made by many official observers, and extending over many years, all establish the fact that there is no such persistent westerly current as Mr. Davies suggests.

We are of opinion that the float experiments made and published by the United States Department of Agriculture Weather Bureau in conjunction with observations made by Mr. Rust and his predecessors in office, unite in proving that, under favorable conditions, surface currents may be expected approximately to follow the direction of the wind.

Mr. T. Aird Murray submitted to us a clearly expressed opinion as to what should be done with the sewage of Toronto, before discharging it into the lake. Mr. Murray's views embody plans for obtaining a high grade purification at once. This course is possible from an engineering standpoint, but unnecessarily expensive.

We know that it is possible to purify a sewage so that it might be drunk with impunity, but the cost is uncalled for in face of the fact that nature has in Lake Ontario, provided Toronto with a great vehicle for oxidizing a well prepared sewage effluent.

The City Engineer and Medical Health Officer have supplied us with plans, specifications, estimates, analyses, reports and calculations too numerous to mention in detail and they with other officials of the city have most courteously, and sometimes at great trouble to themselves, obtained for us information for the elucidation of some point bearing on the subject under consideration.

After carefully considering the problem, which you have put before us, we believe that we can best present our report in the form of answers to the questions contained in the appended letter, addressed to us by Mr. C. H. Rust, and to follow same with our general recommendations.

Question 1.—"In your opinion, would any fouling of the shore in the neighborhood of the outfall works occur?"

With the design presented to us and with such modifications as are suggested hereafter, it is our opinion that the sewage of Toronto could be disposed of satisfactorily, not only without fouling the shore at any point, but in a manner that will be unnoticeable on the lake itself.

Question 2.—"Would it be possible, after careful screening of the sewage and making the provision for tank treatment, to use the resulting sludge with safety for filling purposes? If not, what method would you suggest for its disposal?"

We hold the opinion that the plans of the tanks proposed by the city engineer should be modified so as to ensure greater efficiency in the elimination of solids. Septic action is bound to take place in the sewage before it reaches the tanks and to that extent the proposed tanks will contain septicised sewage. But we suggest a provision for cleansing each pocket of the tank daily by utilizing electric current to pump the solids to the west end of the Ashbridge's Marsh.

If this course is followed, the sludge will not be exposed to the atmosphere until it reaches the western end of Ashbridge's Bay, where it will be mixed with the dry refuse and spoil which is being deposited there to fill up the marsh. This can be done, not only with safety but with advantage as in our experience city refuse is generally combustible, and when ignited on rubbish heaps frequently gives rise to nuisance. Admixture with wet sludge will obviate this, and if the admixture is not deposited in layers exceeding two feet in thickness at one time, nitrifying bacteria will very speedily reduce the whole to an inoffensive substance.

We are of opinion that if ordinary care is exercised no offensive odor will be perceptible more than a short distance from the site of the deposition.

Question 3.—"Provided proper ventilation is used with covered tanks, would there be any nuisance from odors?"

Even without special ventilation no nuisance will arise from the tanks, if they are properly constructed and operated, but, as an extra safeguard, provision will be made to ventilate them by means of an electrically driven fan fitted with a suitable exhaust pipe.

Question 4.—"Would those residents in the immediate neighborhood of the works, or persons using Queen Street as a highway, experience any nuisance from odors from the existence of tanks upon the site proposed?"

Residents in the neighborhood of the tanks will experience no odor from them, and if the tanks are covered with earth and planted with shrubs and flowers, the site would even be rendered pleasantly attractive.

If the sludge were removed from the tanks and deposited in proximity to them in the ordinary way, we think residents might have occasion to complain; but by making the only outlet for sludge at Ashbridge's Bay opposite Cherry Street, this possibility is entirely obviated. The tank will not be more noticeable to a person passing it than would be a flush tank or chamber in a large sewer under a leading thoroughfare.

In view of the results of additional trial holes, which we have had made, we advise that the tanks be located close to the shore line, south of Eastern Avenue, where we consider that there is sufficient area of suitable land for their construction.

We recognize the validity of the objections to having the tanks placed on a site that would entail an alteration of the line of a thoroughfare from the centre of the city to a beautiful undulating district.

The position of the outfall sewer meets with our entire approval, but we think the sewer should be extended at least another 1,500 feet further into the lake, so as to insure a discharge into deeper water.

Question 5.—"Having regard for the large body of water into which the effluent is to be discharged, do you think that the proposed method of disposal could be operated successfully and satisfactorily?"

Sewage is finally purified by oxidation, whether this be on land or in water; on land, by percolation through beds of sand, or beds of stone; and in water by oxidation accomplished by dissolved oxygen.

We are of the opinion that the large body of water into which the effluent is to be discharged will successfully and satisfactorily dilute and dispose of the sewage effluent.

It is imperative that no visible particles of suspended matter should be allowed to reach the lake. The effluent, therefore, will consist of a liquid, the polluting matter in which will be mostly in solution, and when issuing at the outfall will be discharged in about 30 feet of water, and at least 3,500 feet from the lake shore.

We recommend that the sewage be made to issue from a number of small openings in the outfall sewer, extending

over a length of several hundred feet, so that, instead of discharging the effluent at one point, it will be discharged through many openings to facilitate a high degree of dispersion and dilution.

We are entirely satisfied that the proposed location of the outfall will not injuriously affect the water supply, which fact will again be referred to below.

Question 6.—"In your opinion, do you advise the use of brick or concrete for the proposed intercepting sewers?"

We recommend the council to construct the intercepting sewers of Portland cement concrete, having the invert lined with a single course of hard, sharp-edged, vitrified brick. This method of construction will be equally durable and less costly than a sewer built entirely of brick.

Question 7.—"In your opinion, is the proposed adoption of water filtration advisable and necessary, and will it completely safeguard the water supply of the city of Toronto in connection with the proposed sewage disposal works?"

It is our opinion that the proposed adoption of water filtration is both advisable and necessary, and that it will completely safeguard the water supply of your city, not only with reference to any possible pollution from the proposed sewage disposal works, but also from any pollution in the neighborhood of the intake, due to excursion boats or other shipping. It will also prevent the water, made roily by the stirring up of the lake shore bottom by wave action during high winds, from reaching the city mains in a turbid condition.

Question 8.—"It has been considered by a great many of the residents of the east end that the disposal works should be situated upon the marsh in the vicinity of Cherry Street. Will you please advise upon this matter, and if this site is selected, would you advocate the discharge of the sewage into the lake in its immediate vicinity, or should it be carried eastwardly to the point of discharge, as mentioned in the site already selected?"

We have carefully considered the whole question of site, and have deliberately come to the conclusion that the Morley Avenue site is the best.

To construct the tanks at Cherry Street would not offer any advantages in the treatment of the sewage over the plan above referred to, and in view of the sludge disposal at the Cherry Street end of Ashbridge's Bay, no advantages, from a hygienic point of view, would be obtained. Moreover, constructing the tanks at Cherry Street would involve a much greater cost than constructing them at Morley Avenue.

Under any circumstances the outfall sewer should be located in the position shown on the plans, namely, about three thousand five hundred feet south of the shore opposite the Woodbine and upwards of four and a half miles from the waterworks intake.

After ten years consideration of the subject, the Royal Commission of Sewage Disposal came to the conclusion that the conditions of different cases vary to such an extent that each case should be considered on its own merits. In dealing, therefore, with the problem which you have placed before us, we have endeavored to give due weight to local circumstances. We are perfectly satisfied that the plans of the work as proposed, amended as we have suggested, will not only effectually dispose of the sewage of your city, but do it without danger to health, without nuisance at any point and for a reasonable outlay of money, therefore we recommend their adoption.

CUTLER-HAMMER CO. OPENS CLEVELAND OFFICE.

The Cutler-Hammer Manufacturing Company, of Milwaukee, makers of electric controlling devices, announce the opening of a district office in Cleveland, Ohio—1108 Schofield Building. The new office will be in charge of Mr. C. J. Kruse, who comes from the engineering department of the Cutler-Hammer Company, and who is well qualified to advise regarding the proper device to use in any case involving the control of electric motors.

CITY OF MEDICINE HAT.

TENDERS FOR GAS WELL.

TENDERS for the drilling of a well for the City will be received at the office of the undersigned up to April 30th, 1909.

Tenders to be given as follows:

The contractor to furnish all labor, pipe, machinery and material, anchor and shut in well in a practical manner, the City to pay for all pipe which it is necessary to leave in the well, or the contractor may tender to furnish labor only, anchor and shut in well in a practical manner.

Specifications may be obtained by applying to the undersigned.

W. P. MORRISON,
City Engineer and Commissioner.

(Continued from Page 45)

Wilber Mines, $40,000; Misses E. M. Wilson, S. A. Clyde, I. M. Clyde. Ryan (Gow Ganda) Mining Co., $1,000,900; C. W. Kerr, C. C. Robinson, E. B. Coleman. Gow Ganda and Montreal River Mines, $1,000,000; J. R. L. Starr, J. H. Spence, I. V. Williams. Standard Combination Motor Rim Co., $100,000; J. S. Lovell, W. Bain, R. Gowans. Welcome Silver Mines, $40,000; A. R. Bickerstaff, W. Freeman, W. D. Earngey. Esperanza Syndicate, $40,000; R. Pielsticker, J. D. Pringle, W. Kirkpatrick. O'Kelly Mines, $5,000,000; C. G. Locke, C. M. Bartram, W. R. Wadsworth.

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Many producers that had greatly curtailed, or even suspended, production in 1907 began again to increase output practically at the opening of 1908, and in spite of the low price of the metal nearly all the important producers of 1907 were in operation throughout most of 1908, and a few new companies began production during the year. The rate of production has been steadily increasing, and is now greater than at any other time in the history of the industry. . . . Stocks of refined copper are still undoubtedly very large. Domestic consumption of new copper will show a decline from the 485,000,000 pounds of 1907. The average quoted price of electrolytic copper at New York for 1908 was 13.20 cents. The price at the close of the year was 14.18 cents.

The prospect is bright at the present for a still larger copper production in the year 1909, but it is evident that the principal producers will, more than in recent years, gauge their operations by the consumption of the metal, which cannot at this time be safely forecasted.

WHERE TO BUY.

(Continued from page 2.)

Contractors
Cleveland Bridge & Engineering Co., Ltd., Darlington, England.
Metcalf Engineering Co., Ltd., Montreal, Que.

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

Conveyors
Babcock & Wilcox, Ltd., Montreal.

Cranes
Dominion Bridge Co., Ltd., Montreal.
Mussens Limited, Montreal, Que.
Northern Engineering Works, Detroit, Mich.
Pennsylvania Steel Co., Steelton, Pa.
Structural Steel Co., Ltd., Montreal, Que.

Damper, Regulators
Babcock & Wilcox, Ltd., Montreal.
D'Este Co., Julian, Boston, Mass.

Derricks
Dominion Bridge Co., Ltd., Montreal,
Mussens Limited, Montreal, Que.
Northern Engineering Works, Detroit, Mich.
Structural Steel Co., Ltd., Montreal, Que.

Draughting Supplies
Berger & Sons, C. L., Boston, Mass.,
Hart Co., John A., Winnipeg, Man.

Drawing Material.
Keuffel & Esser Co., Hoboken, N. J.

Drills
Canadian Buffalo Forge Co., Montreal and Toronto.
Mussens Limited, Montreal, Que.

Dust Separators.
Canadian Buffalo Forge Co., Montreal and Toronto.

Drying Apparatus.
Canadian Buffalo Forge Co., Montreal and Toronto.

Dynamos and Motors
Toronto & Hamilton Electric Co., Hamilton, Ont.

Economizers
Babcock & Wilcox, Ltd., Montreal.

Electric Apparatus
Hill Electric Mfg. Co., Montreal, Que.
Toronto and Hamilton Electric Co., Hamilton, Ont.

Electrical Supplies
Hill Electric Mfg. Co., Montreal, Que.
Phillips, Eugene F., Electrical Works, Ltd., Montreal, Canada.

Elevators
Northern Engineering Works, Detroit, Mich.

Engineers, Consulting
Beaubien, Gaspe de, Montreal.
Francis, W. J. Montreal, Que.
Fuce, Ed. O., Galt.
Metcalf Engineering Co., Ltd., Montreal, Que.
Mitchell, C. H., C.E., Toronto, Ont.
Nold, Henry N., Hamilton.
Richmond, J. Stanley, Toronto.
Standard Inspection Bureau, Limited, Toronto, Ont.

Engineering Instruments.
Keuffel & Esser Co., Hoboken, N. J

Engines
Canadian Buffalo Forge Co., Montreal and Toronto.
Mussens Limited, Montreal, Que.
Northern Engineering Works, Detroit, Mich.
Reavell & Co., Ltd., Ipswich, Eng.
Petrie, H. W., Ltd., Toronto, Montreal, Vancouver.

Fans and Blowing Apparatus
Canadian Buffalo Forge Co., Montreal and Toronto.

Feed Water Heaters and Purifiers
Babcock & Wilcox, Ltd., Montreal.

Fence, Fencing, Wire
Owen Sound Wire Fence Co.

Fire Brick and Clay
Leslie & Co., A. C., Montreal.

Forgings, Drop
Coghlin & Co., B. J. Montreal, Que.

Foundry Supplies
Mussens Limited, Montreal, Que.

Generators, Alternating and Direct Current
Toronto & Hamilton Electric Co., Hamilton, Ont.

Heating and Ventilating Machinery.
Canadian Buffalo Forge Co., Montreal and Toronto.

Hoists, Electric and Pneumatic
Northern Engineering Works, Detroit, Mich.

Hydraulic Machinery.
Canadian Buffalo Forge Co., Montreal and Toronto.

Iron Bar, etc.
Leslie & Co., A. C., Montreal

Inspections
Standard Inspection Bureau, Limited, Toronto, Ont.
Dominion Bureau, Montreal, Que.

Ladles
Northern Engineering Works, Detroit, Mich.

Mechanical Draft Motors.
Canadian Buffalo Forge Co., Montreal and Toronto.

Motors
Mussens Limited, Montreal, Que.
Toronto & Hamilton Electric Co., Hamilton, Ont.

Patent Attorneys
Budden, Hanbury A., Montreal, Que.
Ridout & Maybee, Toronto, Ont.

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

Poles, Telegraph and Telephone.
Lindsley Bros. Co., Spokane, Wash.
Sterling, W. C. & Son Co., Monroe, Mich.

Portland Cement
Hartranft Cement Co., Wm., Montreal, Que.

Posts
Lindsley Bros. Co., Spokane, Wash.

Presses, Hydraulic and Power
Mussens Limited, Montreal, Que.
Wood & Co., R. D., Philadelphia, Pa.

Pressure Regulators
D'Este Co., Julian, Boston, Mass.

Pulleys
Mussens Limited, Montreal, Que.

Pumps—Steam and Power.
Canadian Buffalo Forge Co., Montreal and Toronto.
Mussens Limited, Montreal, Que.
Petrie, H. W., Ltd., Toronto, Montreal, Vancouver.
Reavell & Co., Ltd., Ipswich, Eng.
Wood & Co., R. D., Philadelphia, Pa.

Purifiers
Babcock & Wilcox, Ltd., Montreal,
Wood & Co., R. D., Philadelphia, Pa.

Railway Supplies
Coghlin & Co., B. J. Montreal, Que.
Mussens Limited, Montreal, Que.
Koppel Co., Arthur, New York City.

Railways, Industrial and Portable
Koppel Co., Arthur, New York City.

Ratchet Drills, Universal
Armstrong Bros. Tool Co., Chicago, Ill., U.S.A.
Mussens Limited, Montreal, Que.

Rock Crushers
Mussens Limited, Montreal, Que.

Rope, Manilla and Wire
Mussens Limited, Montreal, Que.

Separators, Steam
Babcock & Wilcox, Ltd., Montreal,

Sewage Disposal
Cameron Septic Tank Co., Chicago, Ill., U.S.A.

Sewer Pipe
Hamilton & Toronto Sewer Pipe Co.

Sheet Metal Work.
Canadian Buffalo Forge Co., Montreal and Toronto.

Shovels, Steam
Mussens Limited, Montreal, Que.

Springs
Coghlin & Co., B. J., Montreal, Que.
Montreal Steel Works, Montreal, Que.

Steel, Speedicut High-speed
Montreal Steel Works, Montreal, Que.

Steel, Structural
Cleveland Bridge & Engineering Co., Ltd., Darlington, England.
Dominion Bridge Co., Ltd., Montreal,
Hamilton Bridge Works Co., Hamilton, Ont.
Pennsylvania Steel Co., Steelton, Pa.
Structural Steel Co., Ltd., Montreal,

Steel, Tool
Montreal Steel Works, Montreal, Que.
Mussens Limited, Montreal, Que.
Allen & Co., Edgar, Sheffield, Eng.

Stokers, Mechanical
Babcock & Wilcox, Ltd., Montreal,

Stone Crushers and Screens
Mussens Limited, Montreal, Que.

Surveying Instruments
Berger & Son, C. L., Boston, Mass.
Gurley & Co., W. & L. E., Troy, N.Y.
Hart Co., John A., Winnipeg, Man.

Tanks, Steel and Iron
Structural Steel Co., Ltd., Montreal,
Wood & Co., R. D., Philadelphia, Pa.

Ties, Railroad
Lindsley Bros. Co., Spokane, Wash.

Tool Grinders
Armstrong Bros. Tool Co., Chicago, Ill., U.S.A.

Track Jacks
Montreal Steel Works, Montreal, Que.
Mussens Limited, Montreal, Que.

Transformers
Toronto and Hamilton Electric Co., Hamilton, Ont.

Transmission Machinery
Mussens Limited, Montreal, Que.
Toronto and Hamilton Electric Co., Hamilton, Ont.

Trucks
Northern Engineering Works, Detroit, Mich.

Valves
Babcock & Wilcox, Ltd., Montreal,
Wood & Co., R. D., Philadelphia, Pa.

Waterworks Supplies
Wood & Co., R. D., Philadelphia, Pa.

Wire
Coghlin & Co., B. J., Montreal, Que.

Wire Rope
Coghlin & Co., B. J., Montreal, Que.
Mussens Limited, Montreal, Que.