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Contents of this issue on page 213

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THE WATERPROOFING OF SEWERS

The subject of ground water infiltration into sewers is an exceedingly important one where it is necessary to pump and purify a large part of the effluent. A topical discussion of the subject is published in the proceedings of the National Association of Cement Users, for 1911, from which the following is abstracted.

Mr. George T. Hammond, designing engineer of the Brooklyn Bureau of Sewers, presented the following data:

New Orleans, La.—The plan provided for the removal of 0.003 cu. ft. per sec. per acre of ground water, or 1,250,000 gals. per sq. mile per day. In 1909 one sewage pumping station had an average dry weather discharge of 20,000,000 gals per day, of which "probably 15,000,000 gals. is ground water, which is being absorbed continuously from the soil of the city, lowering its moisture line in the soil and vastly improving its sanitary condition."

The sewers of New Orleans were constructed with great care, on the separate system, and Mr. Hammond considers the system one of the finest in the world. It is so located that the pumping of ground water is a distinct advantage to the city. Therefore, no waterproofing was undertaken, but the joints were all made as tight, and the work was constructed as water-tight, as such work can be made without special provision for waterproofing. The surface of the city is lower than the surface of the Mississippi River, except along the levees. However, the result well illustrates the freedom with which ground water enters well constructed sewers that have not been specially waterproofed.

The pipe sewers, from the smallest size up to 36 ins. in diameter, are of the very best quality of vitrified stoneware pipe. The main sewers are principally of brick, although there are also several miles of concrete sewer of sizes from 3 ft. 9 in. to 5 ft. 9 in. in diameter.

Brooklyn, N.Y.—The portions of the system in low ground admit considerable ground water. In one section of the city which contains about 200,000 population, and in which the dry weather flow is pumped and treated, from 5 to 20 per cent. of the flow, in accordance with the season, is estimated to be ground water. The total dry flow varies from 15,000,000 to 20,000,000 gals. per day. The system consists of brick main sewers, and of vitrified and concrete pipe collectors. The two kinds of pipe are used in about equal quantities. The maintenance cost per mile per year is about equal on each kind of pipe and is very low. Maintenance cost of brick sewers per mile is about four times as great. At Coney Island the leakage into sewers ranges from 20 to 50 per cent. of the flow, all of which has to be pumped. The Sewer Bureau is relaying much of this leaky system with sewers having carefully waterproofed joints.

Reading, Pa.—The water supply is 127 gals. per capita. The sewage is 163 gals. per capita. The infiltration of ground water amounts to 5,172 gals. per mile per day. The system is practically new and is constructed of vitrified pipe, and brick and concrete mains.

Providence, R.I.—The amount of sewage pumped in 1905 was as follows: Daily average for the year, 21,706,889 gals.; daily average for wet weather, 32,131,655 gals. This was an increase of about one-half in wet weather. The system is a separate system. The sewers, from 16 ins. in diameter up to the largest size, are brick. The pipe sewers range in size from 6 to 15 ins., and are partly iron and partly vitrified pipe.

Baltimore, Md.—In the new system being installed, notwithstanding careful waterproofing of interceptors, and the use of waterproofed joints, provision is being made in the size of the sewers for the entrance of some ground water. The Board of Consulting Engineers say, in their report to the sewerage commission (1906):

From our experience with this subject in other places, it is our opinion that in the earlier years of the new works, the total amount of the sewage would not exceed the water supply. In subsequent years, when the sewers are extended into less thickly populated portions of the city, and buildings are more generally connected with the sewers, the sewage increased by ground water will be materially in excess of the water supply.

The board advised providing for 150 gals. of flow per capita with sewers designed to flow half full with this quantity. The system is separate. Vitrified clay pipe is used for all pipe sewers.

Columbus, O.—Ground water entering sewers, when ground is wet after storms, is about 100 per cent. of the dry weather flow; during storms it ranges from 100 to 296 per cent. of the dry weather flow. System is built of brick, vitrified clay and concrete.

Kalamazoo, Mich.—Ground water entering sewers is about 20 per cent. of their capacity. System formed mainly of vitrified clay pipe.

Norfolk, Va.—Ground water forms 60 per cent. of the pumping. Sewers are brick, vitrified clay and iron pipe.

Canton, O.—Main sewer admits ground water at the rate of 70,000 gals. per mile per day.

Brockton, Mass.—The ground water flow is said by reports to have been 400,000 gals. per day from 16 miles of sewers, or 25,000 gals. per mile per day.

Red Bank, N.J.—Strictly separate system. No storm water is supposed to enter, but after a shower the flow quickly doubles in quantity. Vitrified clay and iron pipe are in use.

Vineland, N.J.—Strictly separate system of sewers constructed of vitrified pipe. The flow in wet weather is nearly double that in dry.

Westfield, N.J.—Strictly separate system of sewers constructed of vitrified clay pipe. There are about 15 miles of sewers 8 ins. to 24 ins. in size. The ground water entering the sewers increases the ordinary flow about 50 per cent.

Further interesting data on the amount of ground water infiltration are given by Mr. Kenneth Allen, chief engineer of the Metropolitan Sewerage Commission of New York. The following figures are from Mr. Allen's discussion.:

In Providence, R.I., the infiltration has been estimated at 47 gals. per capita per day.

In Waterbury the infiltration to a concrete sewer about 4 ft. 5 ins. square laid under a head of from 4 to 12 ft. amounted to one gallon per second for every 400,000 sq. ft. of interior surface, or 0.218 gal. per sq. ft. per day.

The infiltration of 140 miles of sewers in Massachusetts towns has been estimated at 40,000 gals. per mile daily. Taking the larger systems of the state it has been estimated at 70,000 gals per mile.

In the metropolitan system near Boston it has averaged 40,000 gals. per mile before making connections.

In their report on a system of sewerage for the city of Baltimore in 1897, Messrs. Hering and Gray recommended an allowance of 750,000 gals. per sq. mile in the low-lying districts near the harbor, and 100,000 gals. per sq. mile per day in other parts of the city. In 1906 Mr. F. P. Stearns proposed an allowance of from 30,000 to 80,000 gals. per mile of sewer daily. In later estimates 12 gals. per capita have been assumed.

Mr. C. E. Grunsky estimated for the sewerage of San Francisco a daily volume of 55,300 gals. per sq. mile for pipe sewers and 166,000 gals. per sq. mile for brick sewers.

In Peoria, Ill., the infiltration was estimated at from 50,000 to 100,000 gals. per mile for sewers in wet ground. In the case of brick sewers it was estimated at 15 gals. per sq. ft.

The above figures show the variation in the amount of ground water infiltration and indicate how serious the problem may become in some cases. Mr. Hammond considered it likely that his list could be extended to include nearly every sewer system installed in this country previous to 1900, and many since installed.

Methods of Waterproofing Sewers.—As Mr. Hering points out, waterproofing may be applied in three general ways. One way is to have the material of the structure and the joints impervious. This will prevent leakage in either direction. Another way is to coat the outside of the sewers if the object is to prevent infiltration of ground water into the sewer. The third way is to coat the inside of the sewer if a leakage of the sewage into the ground is to be prevented.

Mr. Hammond submits the following classification of the causes of failures and leaks in pipe sewers: 1. Pipe of improper material for sewers. 2. Defective or broken pipe. 3. Defective joints. 4 Defective house connections. 5. Improper foundations. 6. Careless or improper backfilling of trenches. 7. Improperly constructed brickwork and concrete. 8. Disintegration of pipe or masonry, caused by chemicals or impurities in solution in the sewage or in the ground matter, and from steam admitted to the sewers. 9. Failures from other causes not classified, as unexpected contraction and expansion, impact, etc.

Mr. Hammond discusses waterproofing methods as follows:—

"The waterproofing of sewers is perfectly practicable. The extent to which it should be employed, and the best method adaptable to a given case, are the problems to be met, as well as the probable length of time during which the waterproofing employed will continue effective, and the best should be selected for each special case.

"There are various methods here for producing the effect, as elsewhere. Coatings of bituminous materials may be applied to the external surface of the sewer, and gaskets dipped in tar or maltha or hot asphalt may be employed in the joints; or the whole interior of the sewer may, in the case of large masonry structures, be treated with a plaster. Again, the sewers may be designed to be built of concrete pipe rendered impervious by exterior coatings of asphalt paint or maltha; or by having an antihydrous waterproofing compound mixed with the cement used in the concrete. Recent experiments seem to show that even the admixture with the concrete of clay, or various other substances, will produce a dense and waterproofing material. Concrete rendered impervious by one of these methods may be used in forming the larger sewers in place, and in making the manholes and other appurtenances. Also, in the construction of pump wells and disposal works; and in various instances this method may be supplemented by the use of bituminous exterior coatings.

"In Baltimore, where the most elaborate and extensive system of sewers now under way in this country is being constructed, and no detail is being lost sight of or expense spared which could render the system more perfect, the intercepting sewers are being treated with a complete waterproof coating."

In addition to the data given by him on the amount of ground water infiltration, previously quoted in this abstract, Mr. Allen discussed the methods and cost of waterproofing sewers. We quote, as follows:

"In the case of vitrified pipe sewers, if these are sound and of good quality, it only remains to secure an impervious joint. This is not practicable with natural cement. With Portland cement mortar following a gasket saturated with grout and carefully calked there will be very little leakage. The difficulty lies in ensuring perfect work, especially in a wet trench, and the possibility of cracking the joint by settlement in a soft soil. To overcome these objections various substitutes for the cement mortar joint have been used with more or less success.

"With a firm bed or foundation a mixture of 1 part of fine sand with 1 part of flour of sulphur heated to about 230° F. poured in the joint over a well calked gasket is said to give a water-tight joint costing for an 8 in. pipe 12 cts., for a 15 in. pipe 19 cts. and a 30 in. pipe 30 cts. Possibly leadite, which is somewhat similar in character and which the writer has used successfully for cast iron pipe joints would answer equally well. Either of these materials will provide a strong and unyielding joint, so that in case of settlement an undue strain is brought to bear on the bell.

"For yielding soils the writer believes some form of bitumen may eventually be found that will be both elastic and impervious. For a number of years Mr. J. H. Decker has used a paste made by kneading cement and pine tar pitch by hand until of the consistency of dough in the sewers of Atlantic City with success, the material being pressed into the joint by hand. The writer employed this method in laying about ¼ mile of conduit of 8 in. to 20 in. vitrified pipe conveying water from a series of artesian wells to a reservoir. Testing under a head of 3 or 4 ft. after completion, the line was found to be almost absolutely water-tight. This joint, although setting quite hard, remains sufficiently pliable to conform to ordinary settlement without injury.

"In Baltimore, Mr. E. B. Whitman experimented with a joint which proved so satisfactory that a considerable amount of vitrified pipe has been laid in wet trenches in the sewerage of that city with bitumen joints. The specifications provide that the inside of the bell and at least 4 ins. of the spigot end shall first be painted with a thin paint consisting of a solution of bitumen and gasoline or turpentine. Two or three pipe lengths are usually joined together before lowering to the trench by first centreing and packing with a thin gasket of hemp or jute well calked and then filling the joint full of hot bitumen, heated sufficiently to expel bubbles but not so as to render it brittle. The bitumen may be the refined natural or artificial material or a mixture of both, but must not have a melting point lower than 170° F. or be brittle when cooled to 30° F. It must also be of such a consistency that a fragment will not materially alter in shape when kept in

ordinary temperatures and must have a moderate degree of resilience.

"As a test it is specified that 3 lengths of 8 in. pipe joined in this way and resting on supports 7 ft. apart shall carry a centre load of 200 lbs. without failure or excessive deflection, and that after such tests the joints shall show no leakage when subjected to a hydrostatic pressure of 5 lbs. per sq. in.

"Asphaltic joints have been used to a considerable extent in England and Germany, and the writer has long believed that a field would open for them in this country under conditions where cement work would be injured by washing or, later, by cracking.

"With larger sewers it is desirable to employ concrete in preference to brick if watertight work is desired. There is no question but that reasonably tight work can be secured by using correct proportions and a wet mixture, but additional safety may be had by the use of waterproofing compounds by the judicious admixture of lime or clay to the concrete or by the application of a layer of waterproofing material. The writer believes that the latter safeguards are rarely required in sewer work when good work can be relied on by contractor and inspector.

"In the construction of the west low level interceptor at Baltimore, waterproofing was applied to the interior surface of the concrete and a brick ring added inside to protect this. The diameter on sections 1 and 2, which lay along the waterfront with the invert from about 11 to 13 ft. below tide level, were from 74 to 84 ins. The invert was first swabbed with hot Trinidad asphalt upon which was placed a layer of 10 oz. burlap. This was then rubbed down and painted with hot asphalt, a second layer of burlap applied and this was then brushed down and saturated with a third coat of asphalt. The brick ring was then laid complete and the waterproofing carried over the brick arch. The concrete arch was finally laid on this.

"Some difficulty was experienced at first from the water which dripped on the tops of the side walls and found its way between the waterproofing and concrete of the invert, forming blisters 1 or 2 ins. in diameter. Where this occurred the blisters were pierced, emptied and patched. To prevent its recurrence channels were left in the tops of the side walls to cut the flow from outside and the lap of the burlap rolled up and covered with canvas to keep it as dry as possible.

"In forming the joint with the waterproofing of the arch the layers were lapped in pairs and an additional strip of burlap added outside, making the waterproofing at this most troublesome location 5-ply.

"To drain the channels left in the side walls 3 in. terra cotta drains were inserted, occasionally running down through the side walls to a quarter bend and thence to the gravel near the under drain.

"If the burlap got wet, as was sometimes inevitable, it was dried with a gasoline torch, although in extreme cases this was not practicable. To dry the invert before waterproofing, if too damp, gasoline was sprinkled on and lighted, but in sparing quantity to avoid injury to the concrete. At other times it was merely sprinkled with dry cement, which absorbed the moisture and was then brushed off.

"Estimates of the actual cost were made from time to time with the following results:—

	Per lin. ft.
Cost of waterproofing 84-in. sewer	$1.60
Cost of waterproofing 80-in. sewer	1.53
Cost of waterproofing 76-in. sewer	1.45
Cost of waterproofing 74-in. sewer	1.41

Cost per square yard:

Burlap at 6.9 cents per square yard	0.17
Asphalt at 25 cents per gallon	0.48
Labor	0.18
Total	$0.83

"The force employed usually consisted of a foreman, two laborers and two helpers.

"On section 3 the cost was reduced by the substitution of tar pitch for asphalt. Difficulty was experienced in securing a material that would neither be too soft at high temperature nor brittle at low temperature, but in other respects the results appeared satisfactory. The tar pitch cost $8 per 1,000 lbs., resulting in the cost for this material of but 15 cents per square yard of waterproofing.

"After the completion of the 3,590 lin. ft. of interceptor, about 100 ft. of which passed under the bed of a tidal stream, the leakage, including that from over 2,700 ft. of house connections and a considerable inflow around a bulkhead at the upper end of section 2, amounted to 11.16 gals. per min., or 0.223 gals. per sq. ft. of interior surface of interceptor (only) per day. The actual infiltration through the interceptor was practically nothing, as the water observed entered chiefly around the bulkhead mentioned, through the laterals or at the junctions with the interceptor. Probably 1/10 gal. of ground water per sq. ft. per day would be a liberal estimate in estimating on similar work. Considering the relative elevation of the ground water and the great difficulty in keeping the burlap at the spring-line dry while turning the brick arch, the final result was most satisfactory."

DRAFTING OF FORMS EFFECTS BIG SAVING EVEN ON SMALL, PLAIN JOB.

It is generally recognized that one of the prime reasons for the comparatively high first cost of reinforced concrete buildings is the cost of the material and labor put in the forms. Therefore continued efforts to reduce this item to a minimum are being made by many construction companies. A recent case of the Aberthaw Construction Company, of Boston, is illustrative of the possibilities of saving even on small jobs by designing the forms in the drafting room instead of putting the fitting up to the carpenter shop.

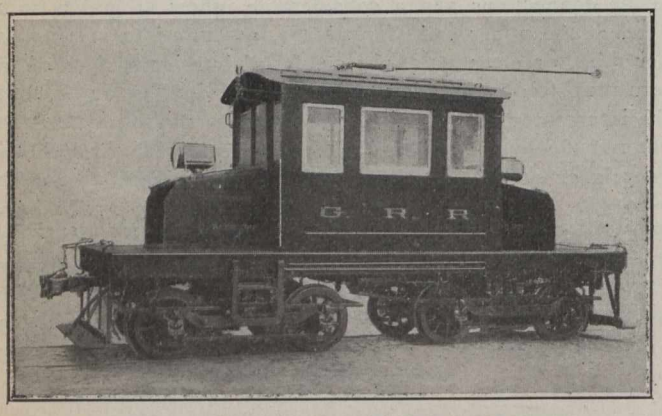
The job in question was a small structure costing about $26,000, and 50 ft. x 50 ft., four stories high. The design was of the beam and girder type, and was made as regular as possible in order to keep the cost down. In spite of this 115 different kinds of forms were required, making a total of about 500 forms in all, taking about 10,000 sq. ft. of stock. When it is considered that figures do not include any of the ledges, studs, or anything but the beam and column sides, it will be appreciated that 113 different kinds of forms is a large number for a plain, small job.

According to the company's former methods the carpenters not only made the beam sides but fitted them as they went along, and each one had to be sawed out. A large saving is therefore made by designing the forms for this small job in the drafting room, as the cost of drafting is very much less than the cost of making up the beams and fitting. It is very probable that the failure of new concrete contracting companies is often due to their ignorance of economical methods of handling form work, and the case above is an excellent illustration of how they might go astray on their estimate by not realizing the high cost of the many forms on such a small plain job.

27-TON LOCOMOTIVE FOR THE GUELPH RADIAL RAILWAY COMPANY.

The Guelph Radial Railway, Guelph, Ont., has recently purchased a 27-ton Baldwin-Westinghouse direct current locomotive. The cab, trucks and all mechanical parts were built by the Baldwin Locomotive Works, and the electrical equipment, including motor and control, was furnished by the Canadian Westinghouse Co., Limited, of Hamilton, Ontario, after the design of the Westinghouse Electric & Manufacturing Company, of East Pittsburg, Pa.

This locomotive is compactly built and may be used for freight and switching service. Interurban and city railways are using locomotives like this one and larger for various kinds of service, for a road's earning capacity can be materially increased by using locomotives to haul freight during the night or idle hours, thus improving the load factor. Many city roads also use similar locomotives for hauling construction material and refuse to dumping grounds.



New Locomotive for Guelph Radial Railway.

The Guelph Radial Railway locomotive is ruggedly built. The frame is of channel iron construction, and the cab is substantially built of clear ash fitted together with joint bolts and corner plates. The trucks are of the standard Baldwin electric M.C.B. equalizer-bar type with chilled cast iron wheels.

The electrical equipment consists of four type No. 101-B-2, 40-h.p., 500-volt Westinghouse railway motors and K-28-B control. It is also equipped with Westinghouse automatic and straight air brakes, with outside equalizing driver brakes.

The principal dimensions are:—

Length over end sills	23 ft. 0 in.
Width over all	8 ft. 0 in.
Truck centres	12 ft. 0 in.
Rigid wheel base	6 ft. 0 in.
Total wheel base	18 ft. 0 in.
Wheel diameter	33 in.

The hauling capacity of this locomotive is given in the table below:

Number of cars weighing 45 tons with load at 10.75 miles per hour at 500 volts.

Straight level road.	*Maximum Grade. ½%	1%	2%
17 cars.	7 cars.	4 cars.	2 cars

*On a fairly level and straight road, the load to be handled is determined by the maximum grade.

The figures given for "straight, level road" show the load which may be handled in switching service. The values given under "maximum grade" are safe when the grade requires a pull of but five or ten minutes' duration. In any particular case, the number of cars that can be handled may be greater or less than the values above tabulated, depending upon the profile curves and operating conditions.

HINTS FOR DRAINAGE SURVEYS.*

By I. W. Hoffman.

In many localities some drainage work has been done that proved to be no good. Usually it has been done without a survey, and it all had to be abandoned, and the work done over again.

In making preliminary surveys for county drains or drainage districts, I use stations 100 ft. apart, and only drive marker stakes. I take the levels simply on the ground, and when construction commences, put in the pluses and replace the markers, if any have been obliterated. On tile drains I put in plus stations every 50 ft. In that way the profile will be accurate and the exact depth of cut ascertained, or very nearly so. The profile should show the depth of the cut. It is well to put records of bench marks on the profile, as well as the length of drain that passes through the property of the different land owners; also the intersections with different subdivision lines and roads or highways.

The map should be made so as to show the surface conditions of the district (the points of the wet land, low land, or high land) and it should be as nearly accurate as it is possible to make it. The better the map is made, the more easily the board of supervisors can determine conditions in the district. The tracings of the map and profile should be kept by the engineer, and not allowed to be handled by the board of supervisors or other persons to any great extent. Blueprints can be made from these and filed in the reports. By the direct white-print process the map is made direct from the tracing and it shows everything plainly. It is made exactly as a blueprint. You do not have to make a negative; simply expose your tracing about seven minutes in bright sunlight, wash it, and you have a white print. You have a map then that can be taken by the commissioners and the classifications can be written on each 40-acre tract.

The engineer should make a complete and comprehensive report to the board of supervisors on every drainage district that he lays out. It is better to put in a little too much than not enough, so that the board will fully understand the conditions, the descriptions of the various drains, their approximate cost, and any recommendations the engineer sees fit to make. The engineer should keep a copy of everything that he does in his office. If some of the papers get lost in the auditor's office, which may happen, he then has copies to which he can always refer.

The engineer should try to attend all board meetings, but especially should he be present when the drain is to be established. These board meetings may sometimes be very animated, but he should face the music. It is particularly desirable for him to attend the meetings also when final action is taken on the assessment of benefits. There may be things that the engineer can explain to the satisfaction of the board and to the satisfaction of the land owner.

The engineer should try to accommodate the landowner in all things that can fairly be done. A landowner may wish a slight change sometimes, before the work is finally established or before the report is made. If he can be accommo-

*From the Proceedings of the Iowa Engineering Society, 1911.

dated without infringing on the capacity or use of the drain, this should be done.

The lines for the drains should be run as straight as possible, at the same time the line of the drain should follow the lowest depression. The engineer is one of the commission to appraise the damages in a drainage district. The damages asked for are sometimes a great deal more than will be allowed by this commission. The commission on damages should use judgment, and not allow any more than is fair and just.

The assessment of benefits is a very hard proposition. The drainage district should be examined very closely, each tract by itself, and all of the facts weighed and sifted until an equitable apportionment can be made by these commissioners. If this apportionment of taxes has been made in a just and fair manner, the board of supervisors should not change it. A great deal of trouble has resulted by boards changing the assessment.

The engineer and contractor should be on good terms always. The engineer should use judgment and have the contractor work to the line, but should not unnecessarily hamper the work of the contractor, who often has a very hard job before him. The drains should be laid out and constructed upon the best lines and no deviation made from them, and they should be constructed in such a manner as to do the most benefit to the land. The people are paying for it, and they expect the construction of these drains to be such as will be a benefit to them.

ACTION OF WATER ON LEAD PIPES, ETC.

Before the Chemical Section of the British Association, Dr. F. Clowes presented a paper on the action of distilled water on lead. When some years ago it was proposed to bring large volumes of soft water from Wales to London, the possibility of the action of this water on leaden pipes had to be investigated. Dr. Clowes had experimented with large sheets of very pure commercial lead. This lead was not acted upon by distilled water in a vacuum nor in an atmosphere of hydrogen; at any rate, the action, due probably to the last traces of oxygen, was infinitesimal. But supply waters always contain oxygen and also other gases. Of these gases, oxygen when alone present attacks the lead worst; carbon dioxide has a very slight effect; in equal mixtures of oxygen and carbonic acid the effect is quantitatively that of the oxygen, and when more CO_2 is present the action becomes less pronounced. The corrosion of the lead is hence primarily due to oxygen; the carbon dioxide acts in the second place by forming a carbonate with the oxide first produced. The action is rapid at first, and a white deposit is formed, while some lead passes in solution; the deposit in some hydroxycarbonate of variable composition. It has been suggested that the presence of bacteria was required to start the attack, or would hasten it; but heated lead corroded as quickly in water which had long been kept boiling as under ordinary conditions. These experiments demonstrated, however, the inhibitory influence of certain salts in the water. When water is distilled with the aid of a glass condenser tube, some silicate passes into the distillate, and this silicate protects the lead against corrosion. The water was therefore distilled from copper vessels and passed through copper coolers in some experiments. Sulphates also protect the lead, carbonates and carbonic acid are less efficient, lime is doubtful, and may even increase the corrosion if sufficiently concentrated. It is also due to this protective power of salts that distilled water does not acquire its full corrosive activity on subsequent aeration by exposure.

PROTECTION OF STEEL PIPES.*

By Alfred D. Flinn.

One of the siphons of the aqueduct under construction to supply New York City with water from the Catskill mountains was described in our issue of August 23. At that time the steel work of the siphon had not been completed, and consequently only a brief description was given of the protection, both inside and out, which was contemplated. In a paper before the New England Water Works Association, Alfred D. Flinn, Department Engineer of the Board of Water Supply of New York City, described the methods employed for furnishing inside and outside protection to this siphon and to the others along the line of the aqueduct. Of these siphons there are fourteen, ranging in length from 608 feet to 6,671 feet, the total length of all the siphons being 33,031 feet. About one-fourth of the total length has a finished inside diameter of 10 feet 11 inches, about one-fourth a diameter of 9 feet 5 inches and about one-half a diameter of 9 feet 2 inches.

While preparing the plans, investigations and experiments were conducted to determine the material and method which it would be best to adopt for protecting the steel. Apparently none of the pipe coatings commonly used possessed qualities giving it more than a few years' useful life when in contact with the water and soil which had to be considered in this case. One or two cases of the use of Portland cement mortar on a small scale and wide experience in reinforced concrete construction suggested the use of cement for this purpose; and after some study it was decided to jacket the siphons outside with rich concrete, with a minimum thickness of 6 inches and line them with Portland cement mortar 2 inches thick. An effort was then made to find the most economical and practical methods for the various steps in covering and lining the pipe, with a view also to obtaining intimate, complete and permanent adhesion in spite of the unavoidable changes in shape and the elastic distortions of the pipe.

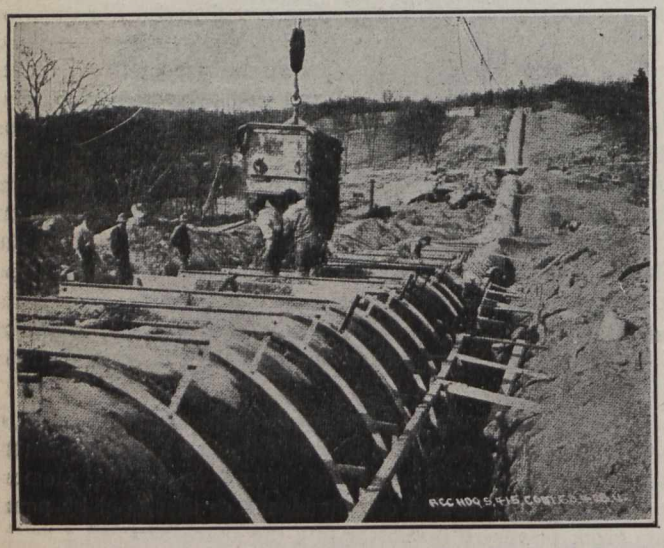
Mortar lining experiments were made on a steel pipe 9 feet in diameter and 12 feet long. This was lined by plastering with metal reinforcement of several styles, by plastering with terra cotta and cement blocks or tiles, and by pouring grout or very thin mortar into the space between a cylindrical steel form and the interior surface of the pipe. These experiments seemed to show that no combination of plasterer's skill with various kinds of cement mortar, reinforced or unreinforced, gave linings that were adequate; besides which this method was expensive. Bedding tiles of terra cotta or mortar, about ¾ or ⅞ inch thick and 6 by 8, 6 by 12, and 8 by 12, on mortar applied directly to the pipe surface, and, after setting, building up the lining to the required thickness with successive coats of mortar troweled on, was much more satisfactory, but also expensive. The grouting method proved by far the most satisfactory and least expensive and was made the basis of the specifications. It had the advantage of producing a monolithic lining, which was considered desirable, especially as it avoided layers or laminae, since it is well known to be difficult to cause one layer of Portland cement mortar or concrete to adhere absolutely and permanently to another without expensive and troublesome precautions. This method also gave promise of being feasible in actual construction, and was adopted for the work.

The specifications as adopted provided that the pipe should be tested by filling with water, should be made tight

*Abstract of paper before the New England Water Works Association.

while under pressure, and while still under the normal pressure should be surrounded with concrete, the pipe being kept under hydrostatic pressure until the concrete last placed had set for at least 48 hours. The water was then to be withdrawn from the pipe and the interior lined. It was provided that the lining should consist of Portland cement and sand mixed in such proportions as might be ordered, but probably one part of cement to two parts of sand. The lining was required to be of substantially uniform thickness throughout the entire circumference except for the unavoidable variations due to lap of the plates, butt straps and rivet heads.

The steel was required to be free from rust immediately before the application of either outer coating or inner lining. As a partial protection against rusting during transportation and construction, each pipe, after being pickled at the works, was given a coat of heavy lime whitewash, made as follows: To one barrel of whitewash (about 50 gallons), there were added 20 pounds of glue. After using this whitewash for a time, about one pound of Portland cement was added for each gallon of whitewash. The glue was dissolved in water before being added to the whitewash. The whitewash was applied with brushes, a machine for spraying by compressed air being found unsatisfactory. The whitewash did not adhere very well, some of it being removed almost as soon as applied. This temporary coating, however, did not suffer from abrasion or cracking off so much as from exposure to the weather; and even where the whitewash was not disturbed, light rusting occurred. In fact, the pipes arrived at the trench with more or less complete coats of light yellow rust; but there were no indications of any tendency to pitting, and the rust and the whitewash which remained were removed, before applying the concrete or mortar, by the use of wire brushes, although for some of the worst places steel scrapers were also employed. Inside some of the siphons the surfaces of the plates were rubbed with empty cement bags after the wire brushing.



Placing Concrete in Jacket, Showing One Type of Forms.

The methods employed for placing the concrete jacket were practically the same as those commonly used for concrete conduit construction, in which steel centres take the place of the steel pipe. On one siphon three methods were employed in different parts; monolithic; the invert first, then the remainder; invert and side walls to the horizontal diameter, then the arch. The best contact between jacket and pipe was obtained when the concrete was placed monolithically. Incidentally it was found that dropping concrete on to the pipe so as to cause shock should be avoided, a two-foot drop being too great. Earth covering was placed immediately after the completion of the concrete jacket, to protect it from accident and from temperature changes. For this reason there has been little chance to observe what tendency to crack there may be; but so far as has been observed, there have been very few cracks in the jackets of any of the siphons built so far.

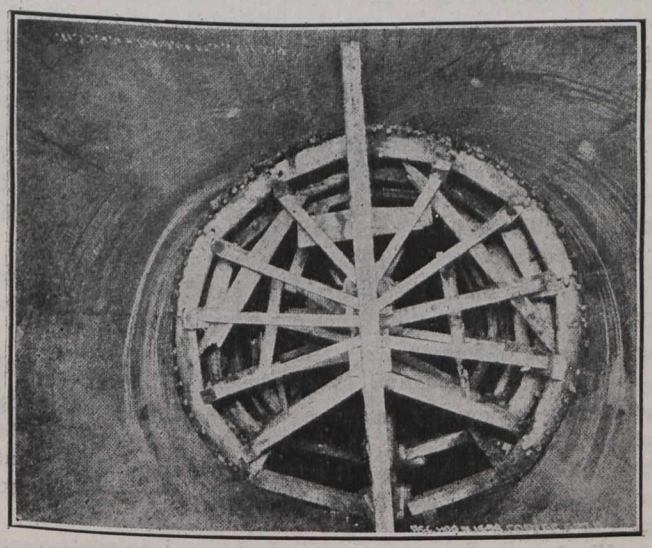
For lining the pipes two distinctly different methods were first adopted by the two contractors. On the northern half of the aqueduct, grouting with forms was employed, and on the southern half the mortar has been applied to the first siphon by the use of the cement gun. There were practical difficulties connected with the use of a complete cylindrical form, such as getting around curves, vertical or horizontal, collapsing one section of forms sufficiently to pass forward through another section which must remain in place while the grout is hardening; cleaning, lubricating and inspecting outside of form, etc. Consequently the invert for a width of about eight feet of arc has been placed first by methods similar to those of concrete sidewalk construction. These wide inverts have generally separated from the pipe along their edges, for one reason or another, so that a piece of steel tape could at places be pushed into the crack for several inches. To obviate this trouble trials have been made of inverts one foot to two feet wide.

In both contracts wooden forms in panels 2 feet wide and 15 feet long, adjusted on modern rings and firmly braced, were used for pouring the remainder of the lining in 15-foot sections at one operation. The grout is poured from outside the pipe through a 2½-inch wrought iron pipe secured into a rivet-passing hole. In the southern department this pouring pipe is at the downhill end of the section and is long enough to give a head of about four feet at the top of the uphill end. A vent pipe is fastened in the uphill rivet-passing hole of the section, the bulkhead forming the end of the lining being placed just beyond it. The contractor for the northern siphons used, for pouring grout, two mortar boxes set on a temporary staging over the upper end of the section to be grouted. The mortar was mixed to the proper consistency in alternate boxes and allowed to flow into the pipe through a hole controlled by a sliding wooden gate. All mixing was done by hand and materials were carefully graded. It generally took about two hours to fill a section, after which a man was kept on for another hour or two in order to feed in sufficient grout to get the desired consistency. There was a noticeable tendency to get a porous or thin condition at the upper end of the section near the grouting hole. To avoid this the riser was removed two or three times during the pouring and the thin material which collected at the top was allowed to escape; when the riser was put back and grout added as necessary. In some cases it took nearly two hours after the main operation to get grout of proper consistency at the foot of the riser. At the finish of the pouring a small pipe was inserted through the large pipe, to permit the escape of the last air while grout was being poured through the larger pipe, and was churned into the small remaining space to insure complete filling. For the first batches, or nearly up to the horizontal diameter of the pipe, the grout was mixed one part cement to one part sand; the upper part was mixed about one to two. The rate of pouring the lining depended upon the number of forms and men available. In lining the Foundry Brook siphon about two moves per week were made with each of twelve sets of 15-foot forms, the rate being about 400 feet per week.

The cement gun builds up the lining in layers, but these are applied in such rapid succession and each layer has such a rough surface that there is little or no lamination. It was impossible, however, to secure a satisfactory smooth finish in this way, and a final layer was applied and floated and

troweled before it hardened. In using this gun charges of dry sand and cement are placed in the chamber of the machine and then rapidly discharged by air under 50 to 60 pounds pressure through a rubber hose; water under pressure being brought by a parallel hose and combining with the cement and sand in a special nozzle. The nozzle pressure is about 30 pounds and the resulting velocity causes an excellent union between the layers; but it also results that a measurable proportion of the sand bounds off the surface of the pipe and falls to the invert, especially when beginning the first layer on the bare steel. This dry material, which averages one part cement to 3¾ parts sand, is collected and used in making the invert. The use of the gun causes the atmosphere within the pipe to be very dusty, and artificial ventilation is consequently necessary. The grout applied by the gun is considerably less moist than that poured within the forms, and consequently more attention is required to keep the lining moist in order to minimize shrinkage cracks, a considerable number of fine cracks having formed in the lining first placed in this way. In spite of these difficulties a satisfactory lining has been secured; but the contractor discontinued its use after completing one siphon, the reason given being excessive cost.

Absolute adhesion of concrete or mortar to the steel has



Wooden Form for Mortar Lining. Completed Lining in Foreground.

not been secured at all points, as has been proved by careful sounding with a hammer; but on cutting out hollow-sounding spots, the space between the mortar or concrete and the steel has usually been found almost infinitesimal in width. What effect this would have on the protective action of the lining was investigated by the Board's laboratory. One of these tests consisted in placing horizontally in a galvanized iron tank six steel plates 8 x 16 inches, separated from the bottom by two 1¼-inch bars of alberene stone and from each other by ½-inch wood dowels. The first pair of plates had no protective covering; the second pair had their upper surfaces protected by a slab of cement mortar 2½ inches thick, held from contact with the steel by two metal strips about .04 inch thick; the third pair of plates was protected by cement mortar slabs 2 inches thick, cast directly on the steel, and apparently adhering to it firmly. The tank was filled with Croton water to four inches above the uppermost mortar slab, the water being renewed twice monthly, and the slabs being immersed for two years. Each slab had been cleaned by pickling and rubbing with emery cloth before treatment. At the end of the two years the first plates showed heavy corrosion. The second pair of plates showed a very slight corrosion, most of which washed off, thus indicating a considerable protective influence under the conditions described. When the mortar was removed from the third pair of plates it was found that a part of the surface of the steel had a distinctly different appearance from the other part. One part was clean and wet; the other was covered by strongly adhering particles of mortar and was dry, thus indicating that there had been actual adhesion of the mortar over the latter part of the surface only, and that the former had been separated by a space large enough for the water to enter. There had, however, been no rusting except at some places near the edges of the wet part of the surface, where apparently the space had been sufficient to allow circulation of the water. The water in the rest of the space had evidently been so highly charged with lime that no corrosion could take place.

Another experiment was made by immersing ¾-inch round soft steel rods in slabs made of rather lean concrete which, after about two years, were broken and found to be thoroughly saturated, but the rods showed no sign of corrosion whatever. It is hoped that the pipes will last one hundred years and even longer, because of the cement lining. In addition, because of the gain in smoothness of the interior surface obtained by covering the rivet heads and plate laps, it is computed that the hydraulic capacity of the three pipes would be as great as that of four unlined ones.

The contract prices of the several siphons, all of which were let in two contracts, were as follows:

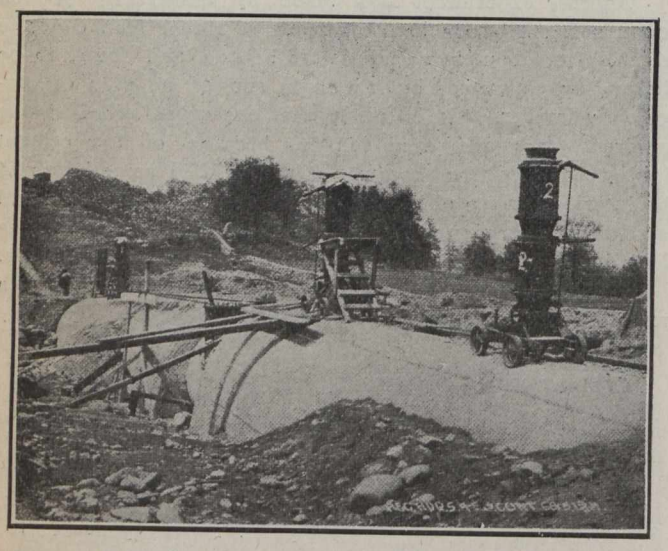
Contract Prices for Steel Pipes, Concrete Jacket and Mortar Lining.

Description.	CONTRACT 68. Contract price.	Average of all bids. (5 bidders.)
9 ft. 6 in. steel pipe, 7/16-in. plate, lap-jointed	$31.00 lin. ft.	$35.50 lin. ft.
9 ft. 6 in. steel pipe, ½-in. plate, lap-jointed	35.00 " "	41.20 " "
9 ft. 6 in. steel pipe, ½-in. plate, longitudinal seams, butt-jointed	40.00 " "	44.80 " "
9 ft. 6 in. steel pipe, 9/16-in. plate, longitudinal seams, butt-jointed	43.00 " "	48.80 " "
9 ft. 6 in. steel pipe, 11/16-in. plate, longitudinal seams, butt-jointed	47.00 " "	55.80 " "
9 ft. 6 in. steel pipe, ¾-in. plate, longitudinal seams, butt-jointed	50.00 " "	50.60 " "
Mortar lining for steel pipes	2.50 " "	4.90 " "
Reinforcement of mortar lining for steel pipes	.02 sq. ft.	.03 sq. ft.
Concrete masonry around steel pipes	6.00 cu. yd.	5.85 cu. yd.
Portland cement	1.75 bbl.	1.74 bbl.

	CONTRACT 68.	(8 bidders.)
9 ft. 9 in. steel pipe, 7/16-in. plate, lap-jointed	$29.00 lin. ft.	$33.25 lin. ft.
11 ft. 3 in. steel pipe, 7/16-in. plate, lap-jointed	33.00 " "	37.37½ " "
11 ft. 3 in. steel pipe, ½-in. plate, lap-jointed	38.00 " "	42.75 " "
11 ft. 3 in. steel pipe, ½-in. plate, longitudinal seams, butt-jointed	46.00 " "	48.75 " "

11 ft. 3 in. steel pipe, 9/16-in plate, longitudinal seams, butt-jointed	50.00 " "	53.62½ " "
Mortar lining for 9 ft. 9 in. steel pipe	3.00 " "	3.56¼ " "
Mortar lining for 11 ft. 3 in. steel pipe	3.50 " "	4.04½ " "
Reinforcement of mortar lining for steel pipe	.02 sq. ft.	.02¾ sq. ft.
Concrete masonry around steel pipe	5.25 cu. yd.	5.78 cu. yd.
Portland cement	1.60 bbl.	1.72½ bbl.

In immediate charge of the construction of the siphons are Division Engineers John P. Hogan, Alexander Thomson, Jr., and George P. Wood on the northern; and George



Cement Guns Resting on Concrete Jacket.

G. Honness, Ernest W. Clarke and Charles E. Wells on the southern department. J. Waldo Smith is the chief engineer of the Catskill water works, Merritt H. Smith is deputy chief. Many of the investigations of existing pipe lines were made by the assistant to the chief, Department Engineer Thaddeus Merriman.

In discussing the matter of preparation of the steel, F. N. Speller, metallurgical engineer for a Pittsburg firm, highly approved of the careful removal of the mill scale. He stated that experiments in which two parts of the same plate, one with and the other without the scale removed, had been exposed to corrosion showed about the same loss of weight per unit area in both cases, but this corrosion was in the form of deep pitting in the uncleaned surface, but uniformly distributed and with little damage in the other. A 5 per cent. solution of sulphuric acid, heated to about 180 deg. Fahr. when used, he thought the most effective conditions for removing scale by pickling.

BROKEN RAILS AND DEFECTIVE WHEELS.

In a recent report of the Interstate Commerce Commission of the United States, note is made of the number of broken rails and defective wheels. The Commission state that their attention has been called in numerous and in some instances startling ways, to the increased number of railroad accidents due to broken rails. The reports of accidents made to the Commission by carriers show that in the year ended June 30, 1902, 78 derailments were caused by broken rails, while in the year ended June 30, 1911, 249 derailments were due to the same cause. In the past decade 2,059 derailments have been caused by broken rails and have resulted in the death of 106 persons and injuries to 4,112 persons.

Exhaustive investigation was made of a wreck on the Lehigh Valley Railroad on August 25, 1911, in which 62 persons were injured and 29 persons lost their lives. There was and is no room for doubt that this wreck was caused by a broken rail. The Commission requested the co-operation of the Department of Commerce and Labor by its Bureau of Standards in examination of pieces of this rail. Inspection and careful analysis of same disclosed that the rail contained defect in manufacture and several other defects in the form of transverse fissures. This rail was manufactured in December, 1909, and was laid in the track in October, 1910. It had, therefore, been in use less than one year when the accident occurred. The reports of this accident suggest that the defects from use indicate that possibly the maximum weight of power and rolling stock that can safely be used on rails of present-day manufacture has been reached, if, indeed, it has not been passed.

Officials of railroad companies and of steel manufacturing plants are energetically pursuing careful investigations on this subject and apparently are determined to locate the difficulty and to correct it.

We deem it proper to call this situation to the attention of Congress, although we do not recommend that this Commission be authorized or directed to conduct an investigation in the premises. Any such investigation, whether conducted by carriers, steel manufacturers, or others, must of necessity be made on purely scientific lines, and if undertaken by the government there are doubtless bureaus in other departments that are equipped to do such work with competent men in the government service.

The attention of the Commission has been called to dangers in railroad operation from car wheels that are defective or composed of improper material.

The wide interchange of equipment between railroads necessarily frequently requires that broken or worn-out wheels shall be replaced on the lines of some carrier other than the owner of the car. It appears that such replacements are made under an agreed and standard price to be charged for the wheels.

We know of no existing statistics or information upon which statements as to the number of defective wheels discovered in service can be verified. No reports are made to the Commission of such instances unless a wreck or derailment is thereby caused. For the years ended June 30, 1902, 1906 and 1911, reports of accidents made to the Commission show for the respective years 538, 1,007, and 986 derailments caused by broken or defective wheels.

This suggests the possible desirability of requiring comprehensive reports from carriers as to the number of car wheels in use on their equipment and the number of same that have proven defective, by years, for the last decade. It is well known by all practical men that car wheels will crack from overheating by too long continued application of the brakes, and while presumably a wheel of poor material and workmanship would crack from this cause somewhat more readily than a wheel of good material and workmanship, it would seem proper in requiring such reports and analyzing same to differentiate wheels which are known to have been cracked or broken in this manner from those which have proven defective from other causes.

The suggestions already made as to an investigation of the quality of rails apply to any investigation undertaken as to the character and quality of material used in manufacturing car wheels.

METHODS OF REFUSE DISPOSAL FOR TORONTO.

In a report to the City Council, submitted on October 25th, 1911, Messrs. Rudolph Hering and John H. Gregory, consulting engineers, of New York, gave the results of their investigation into the refuse disposal question of Toronto. A digest of this report follows:

Four separate projects were considered: Two contemplated the incineration of the garbage, rubbish, and a portion of the ashes, (A) without and (B) with the utilization of the salable part of the rubbish. The other two projects provided for the reduction of the garbage and the incineration of the rubbish. (C) without and (D) with the utilization of the salable part of the rubbish. Street sweepings, dead animals, etc., are satisfactorily disposed of by the city's present methods and are not considered in the report.

The comparison of the four projects is based upon plant capacities sufficient to dispose of the refuse from a population of 600,000, which, it is thought, will be reached in 10 years; Toronto's population by the 1911 census is 376,240. The total weight of garbage, rubbish and ashes collected in Toronto amounts to about 0.55 ton per capita per year; the relative amounts per capita per year are, garbage 0.1 ton, rubbish 0.05 ton, and ashes 0.4 ton. On this basis the total estimated weight collected from a population of 600,000 would be 60,000 tons of garbage, 30,000 tons of rubbish, and 240,000 tons of ashes per year, a total of 330,000 tons.

Project A.—In this project it is proposed that all of the garbage and rubbish, together with ashes amounting to 20 per cent. of the mixture, be incinerated, the remainder of the ashes to be used for fill. With a population of 600,000 the average daily amounts to be incinerated would be: Garbage, 200 tons; rubbish, 100 tons; ashes, 75 tons; total, 375 tons. Studies of the cost of construction and cost of hauling led to the conclusion that two incinerator plants, each of a daily capacity of 215 tons of mixed refuse, would be sufficient. In project A it was assumed that the garbage and refuse would be collected together and the ashes separately. No boilers or equipment to produce power are considered in this project on account of the cheapness of electric power from Niagara Falls. As there is believed to be no market for clinker at present in Toronto no clinker mills are included in the cost of construction.

The cost of constructing the two incinerators is estimated at $478,400. The operating expenses, including interest and sinking fund charges, are given as $124,940 per year for the two units, or at a rate of $1.11 per ton of refuse handled.

Project B.—Project B, for two 195-ton incinerators, is similar to project A, except that the garbage and rubbish are to be collected separately and sorted over to recover salable material. Only a portion of the ashes would be delivered at the incinerators, the remainder being used for filling. The estimated average daily weights to be handled in project B are somewhat less than in project A. For 600,000 population there would be 200 tons of garbage, 67 tons of rubbish, and 68 tons of ashes daily, a total of 335 tons. It is assumed that two-thirds of the total rubbish collected would be burned, the other one-third being picked out and sold.

The estimated cost of constructing the two 195-ton incinerators, including means for picking out and handling the salable portions of the rubbish, is estimated at $489,300, with annual gross operating expenses of $166,570. In Buffalo, N.Y., the average receipts from the sale of material picked out from the rubbish for a period of over 4 years were $2.34 per ton of rubbish handled; on the basis of $2.25 per ton for Toronto the sale of the picked material will yield an income of $67,300 per year, thus giving a net annual cost of operation of $99,070, or 89.9 cents per ton of refuse handled. By comparing the operating costs of projects A and B it is seen that the picking out of the salable parts of the rubbish will result in an estimated annual saving of $25,870.

Project C.—In this project it is proposed that the garbage, rubbish, and ashes be collected separately; that the garbage be disposed of by the reduction process (grease and tankage being recovered); that all of the rubbish be incinerated; and that all of the ashes be removed to dumps and used for reclaiming low land. The average daily amounts to be disposed of, under this project, with a population of $600,000 are: Garbage, 200 tons; rubbish, 100 tons; ashes, 800 tons; total, 1,100 tons.

Project C provides for two 60-ton rubbish incinerators within the city limits and a garbage reduction works located about 10 miles east of the city near the shore of Lake Ontario. At each incinerator site it is proposed to install a loading-station with a railroad siding extending through it. Garbage wagons would be driven into the building and their loads dumped into special steel railroad cars of 40 tons capacity each, the car-body to be semi-circular and set on trunnions to facilitate the discharge of its load at the reduction works.

The reduction works would have a capacity of 240 tons per 24 hours and would comprise an unloading building, conveyor, digester building, containing digesters and presses for the cooked material, a dryer building where the moisture from the pressed tankage would be driven off, and a percolating building in which grease would be extracted from the dry tankage by means of the naphtha process. The liquids removed from the digester building would go to a grease separating and evaporating building. The syrup resulting from the evaporation of the liquids remaining after the grease had been drawn off would be mixed with the percolated tankage and dried, after which the tankage would be ready for shipment. It is proposed to operate all of the equipment at the reduction works power-plant by electricity, purchased from the Hydro-Electric Commission.

The estimated cost of constructing the two 60-ton rubbish incinerators, without means for picking out the salable material, is $227,700, including land. The operating charges for the two units, based on a population of 600,000, is $47,180, or at the rate of $1.573 per ton of rubbish handled.

The garbage reduction works, including loading stations, railroad sidings, power-line, etc., will cost $538,200 and the gross annual cost of operation of 600,000, will be $169,970.

In estimating the receipts from the reduction works at Toronto it is assumed that, with the naphtha process, the amount of grease recovered would be 3.5 per cent. and the dry tankage 15 per cent. of the weight of the garbage reduced and that grease would bring 3.5 cents per pound and tankage $7 per ton. On this basis the receipts from the sale of grease and tankage would be $210,000 per year giving a total net income of $40,030 annually, or 66.6 cents per ton of garbage.

Combining the estimates for the two incinerators and the reduction works, the construction costs for project C are $765,900 and the operating expenses $7,150 per year.

Project D.—This project is similar to project C except that the salable parts of the rubbish would be picked out and sold. The garbage, rubbish and ashes would be collected separately. The estimated daily average weights to be dealt with are garbage 200 tons, rubbish 100 tons, ashes 800 tons, the latter to be used entirely for fill. Of the total weight of rubbish only 67 tons would be burned in incinerators each day, the remainder being picked out and sold. Two 40-ton rubbish incinerators and one 240-ton reduction plant are recommended. The works are all practically a duplication of those described under project C.

The estimated cost of constructing the two 40-ton rubbish incinerators, including means for sorting out and handling

the salable part of the rubbish and including land, railroad sidings and paving is $2,555,300. The gross annual operating costs, including fixed charges and the cost of picking over the rubbish, is estimated at $92,510. The receipts from the salable material recovered, based on a value of $2.25 per ton of rubbish handled, would be $67,500 yearly, reducing the net cost of operation to $25,010 per year, or 83.4 cents per ton of rubbish handled.

The garbage reduction works and accessories are estimated at $538,200 for construction, and $169,970 gross for operation, the same as in project C. The estimated annual income from the sale of grease and tankage, however, is $210,000, leaving a net annual income of $40,030 for the reduction works.

Combining these estimates for the incinerators and reduction works the total cost for project C is $793,500 for construction, and with a population of 600,000 it is believed that there will be a net annual income of $15,020.

Summary.—After a discussion of the relative merits of the four projects Messrs. Hering & Gregory recommended that the refuse be separated into three parts, to be collected separately, that the garbage be taken to a reduction plant, located east of the city and converted into salable products, the rubbish to be taken to incinerators within the city and there burned, either without or with picking. It is also recommended that the ashes be taken to points within the city where land-making or road foundations are desired.

The report enumerates the important factors which lead to the final recommendations regarding the refuse disposal problem at Toronto. The first point has to do with the low-cost electric power from Niagara Falls. When the investigation was started it was the opinion, both of the local authorities and of Dr. Hering, that incineration of the city refuse would be the most probable solution and that works for this purpose would be required. With the advent of cheap hydro-electric power in Toronto the usual revenue to be expected from the sale of steam produced at incinerator plants can not be counted upon to reduce operating expenses. It would be cheaper at Toronto to allow the heat generated at incinerators to be wasted and to buy power from the hydro-electric company than to pay the cost of converting the heat into power. In view of these unusual local conditions the reduction process of garbage disposal comes prominently into the commercial foreground. The results obtained by the reduction process at Cleveland and Columbus are regarded as evidence of the satisfactory results obtainable from such works when properly operated.

The second important point bearing upon the recommendations is that the disposal of garbage, rubbish and ashes only is considered; other refuse, such as street sweepings, dead animals, etc., is disposed of satisfactorily by present methods.

The third consideration concerns the combined or mixed collection of refuse. The reduction process demands a separate collection of the several classes of refuse, and this is more costly than combined collection. The report advocates an investigation into the possible economies of collecting the refuse by electrically-propelled wagons receiving power from storage batteries.

The treatment of the refuse after delivery was the fourth important point. From the preceding figures of cost it is apparent that the projects for reducing the garbage and incinerating rubbish require a much greater outlay for construction than the projects for incineration of garbage, rubbish and ashes; the increase is $287,500 more without equipment for picking and $304,200 more with such equipment. The operating costs for the reduction projects, however, due to the return from the sale of products, is very much less, the difference being $117,790 per year without picking and $114,090 per year with pickings, assuming the population to be 600,000. Looking at the problem from the financial side, which it was the main object of the report to deal with, it appears that the reduction of the garbage is the most desirable means of disposal, although the necessity for separating the refuse is bound to cause inconvenience to the householder which a mixed collection would avoid.

WASTEFUL SYSTEMS OF SEWAGE PURIFICATION.

In a paper read before the Manchester Section of the Society of Chemical Industry, Dr. Grossmann stated that if all the valuable manurial constituents which are contained in sewage could be utilized on the land they would represent a value of somewhere about $200,000,000 a year. When the present system of sewage disposal by water carriage was adopted it was pointed out that it was the most wasteful system on economic grounds, but it was recognized that its advantages from a hygienic point of view should be such as to outweigh commercial considerations. The sewage, which is conducted by underground sewers to the sewage works to undergo further purification, consists of a liquid and a solid part, which are separated at the sewage works, and so far as the liquid part of the sewage (which ultimately finds its way into the rivers and the sea) is concerned, the present mode of purification, if properly carried out, will fulfil all anticipations with regard to public health; but as regards the solid part, the present mode of disposal is still a danger to the community. If that part which is generally termed "sludge" is carried out to sea there is a danger of infection to oysters, shell-fish, and fish; there is, moreover, a chance of this filthy material being washed back to places on the coast, as has been the case at several seaside places. If dumped on the ground it creates a nuisance, and if used on land for farming purposes there is the danger of infectious diseases being communicated to cattle and human beings from grass and crops grown on such land. Experiments carried out by the most eminent agriculturalists at the instigation of the Royal Commission on the treating of sewage and sewage sludge have conclusively proved that the value of sewage sludge, calculated on the dry substance which is contained in it, is no more than 10s. per ton at the outside, and as the sludge is produced at the sewage works in a state containing a large amount of water is cannot pay the farmers to use it unless the farms are in such close proximity to the sewage works that the cost of carriage and cartage is inconsiderable. Attempts have been made to reduce the cost of carriage by drying the sludge, but even after drying in the ordinary way it cannot be considered to be effectively sterilized, and is therefore still liable to carry infection. Moreover, it has been proved by the Royal Commission that it is worth even less after drying than before.

Dr. Grossmann gave calculations which showed the futility of attempting to dispose of the sludge by gasifying it in producers or of obtaining illuminating gas from it. The conclusions that he arrives at are that until the disposal of sludge is effected by sound hygienic methods there is still danger to the community; that no process for the disposal of sewage sludge can be considered satisfactory which does not enable us to return the manurial constituents contained in it to the soil in a thoroughly sterilized condition, and that sludge can never become a valuable manure unless it is previously freed from the greasy matters arising from soap suds and other fatty substances which in the sewers become mixed with the sludge, and which prevent its manurial constituents from being assimilated by the plants.

THE ECONOMIC ORGANIZATION AND MAINTENANCE OF THE FREIGHT CAR REPAIR YARD AT A TERMINAL POINT.*

By J. Thos. Warde.†

The question of the proper maintaining of a repair plant of where there is from two hundred to two hundred and fifty cars repaired daily, is a very serious one, and calls for careful consideration, to not only handle the work expeditiously but also to handle it in an economic manner.

To take the yard itself: Its location must be carefully selected; when possible, select a position where you can have twelve tracks of a capacity of twenty-five to thirty cars; tracks must be at least sixteen feet apart, alternate tracks, have a supply track of standard gauge and a third rail to form narrow gauge, and each end of yard should be connected by a lead. Yard must be well drained and, if possible, equipped with sewer and water system, compressed air system, electric power and light, and yard should also be in the near vicinity of shops as possible.

For buildings would recommend a central building under one roof, accessable from all parts of the yard, consisting of the foreman's office, general office, time office, stores, carpenters' shop, paint shop, oil house, triple rack, blacksmith and machine shop, men's lunch room and toilet, also lumber racks, material platforms and racks, and wheel tracks for B.O. and serviceable wheels. The advantage of one building lays in the fact of one heating; this can be very economically arranged for by an old boiler, and fed by the scrap wood, etc., this overcoming to a great extent the danger of fire, account of having stoves.

By having a drive-over about the centre of the yard and a standard gauge track, with a third rail making a narrow gauge track with turn-tables at intersects, you can connect all supply tracks—this can be used for handling wheels as well as other material, and also as a means of keeping yard clean of scrap, etc.

The fact of supplying a repair yard with a sufficient supply of necessary tools, quick lifting jacks, etc., and machinery should not be lost sight of, as (supposing yard is equipped and wired for electricity) individual electric motor power is not only economical, but desirable for the running of machinery. It will be found economy to install cut-off and rip saw, band saw, buzz planer, little giant borers, drills, portable forges and riveting hammers for steel car repairs, with a capable man in charge and helpers, blacksmith's forges with electric power fans.

Oil house should have (underground if possible) tanks. This point should have air device for emptying of oil barrels; should contain waste bin, oil tanks for soaking and proper treatment of, and making of dope.

Paint room should have a galvanized-iron covered table for cleaning of stencils, rack for storing stencils, iron tanks for paint, oil, etc.

The store room should be fitted with drawers, pigeonholes, racks, etc., for the proper storing of material and small supplies.

General office for use of assistant foreman, inspectors, clerks, etc., with a private office for foreman in charge. The efficiency of the organization depends on the executive and personal individuality of the foreman in charge; he should be a man of ability, an energetic nature and resourceful. His staff should average, for the number of cars mentioned: Six assistant foremen on a monthly salary, one inspector, four car oilers, thirty freight carpenters, one hundred and seventy car repairers, thirty laborers, two painters, two assistant painters, one clerk, two boys, one storeman, one leading laborer, two checkers, one leading air cleaner and tester, eight cleaners and two testers, and one pipe man and helper. The duties of the assistant foreman should be to oversee the work, under the general supervision of the foreman; these men should be taken from the rank and fyle, who have proved themselves adapted to the general overseeing of men and work; they should be practical and thoroughly conversant with the details of their work. The duties of the car inspector consists of inspecting all cars leaving yard; this man must be thoroughly conversant with the M.C.B. rules. Records of all foreign cars should be kept, re repairs. Repair and defect cards must be made and affixed according to M.C.B. rules. Duties of leading air brake tester: This man should have charge of air brake cleaner, testers and pipeman, and should be responsible, under the car inspector, for all air brake work. All triples should be cleaned and tested at the triple-rack, and a stock kept on hand for replacement. Duties of car oilers: It would be policy, although not recommended for a yard of this size, to have a leading car oiler; his duty would be to see that all dope is properly made, and a supply always on hand; he should inspect all boxes, and advise the oiler as to the re-packing. I recommend, in the matter of re-packing journal boxes, that a proper system be organized, and boxes re-packed and stenciled, and in the event of six months elapsing, pull box and renew packing, or, in other words, renew the packing every six months; packing removed to be treated and the oil and waste reclaimed. Two car checkers should be able to take record of repairs made to cars; same should be reported to foreman and fyled. Cars handled should be recorded by index system, and would recommend that a system be adopted to show time placed, time O.K., and dates; this can be handled by one of the boys. Carpenters and car repairers should be placed with assistant foreman as necessary, but recommend that any assistant foreman have not more than forty men. Painters should have well in hand the work of painting, etc.; all sheeting, roofing, etc., should be painted ready for use; the advantage in this is manifold, you have always something to keep your painters busy, your sheeting for patching is ready for the stencil, and finally your car is O.K.'d in one day instead of three. Laborers should be under charge of a leading-hand; his duties are manifold, from seeing that the scrap, etc., is gathered and placed in proper receptables to seeing material placed at stores, also heavy material placed in a convenient position to handle. The storeman should have charge of supplies, and be directly responsible for their up-keep. The foreman should furnish the general storekeeper every day a list of material supplied, attaching requisitions received and furnish a list of requirements. Foreman should be in close touch with stores and be in a position to anticipate requirements; this would be of mutual benefit both to storekeeper and himself. The clerk: I prefer training a man from the ranks of car repairers, as, being familiar with the work, he can handle the position to advantage. The foreman should insist on a careful record being kept of all work, supplies and general conditions, as the work of wrecking naturally falls to the repair yard, it is up to the foreman to insist on maintaining an efficient staff, and the wrecking crew should not be less than twenty men, taken from the car repairers; from these men selected at least two of them should be first aid men, holding certificates, and who have become conversant with the work; the men should be selected as required, according to nature of wreck; they should be under the charge of an assistant foreman, this man

*Paper delivered to Western Canada Railway Club, Winnipeg, Dec. 11th, 1911.

†Chief Clerk to General Car Foreman, Canadian Pacific Railway Co., Winnipeg.

should also be held directly responsible for everything in connection with wrecking work and the proper up-keep of the auxiliary equipment, and himself and crew be available day or night. One man should be assigned to the duty of factotum of the dining and sleeping car, and be able to satisfy the inner-man; his duties would also be that of commissary, which is no small part of the wrecking equipment.

The auxiliary equipment should consist of a serviceable dining and sleeping car (an old coach makes a good car) for this purpose, a tool car, heavy wrecking steam crane, block, tie and rail car, truck and wheel car. Tool car should be equipped with a first aid cabinet complete, with supplies and a modern equipment, quick lifting, traversing and other jacks, a plentiful supply of cables, tail ropes, chains and tools, and one man should be held responsible for their proper up-keep.

In arranging work for efficient handling on the repair tracks a set of rules governing proper marking of cars by inspectors in the traffic yards would aid repair yard men, and the rules of marking of cars should be respected by switchmen in placing cars on the repair tracks. Defects should be classed in A, B and C, or 1, 2 and 3 classes. Heavy work (three days) such as sills, roofs, etc., show A or "1" class; sill splices, ends, draught timbers, trucks, etc., medium work (two days) as class B or "2"; light, such as light patching, draught timber and gear bolts, brakes, side doors or any light work that can be handled in one day, show class C or "3." Tracks should be designated by the symbol or figure and cars placed as marked.

The foreman should place with yardmaster a switch list showing cars O.K. and location, listing cars he requires changed to other tracks to arrange his repairs, but the whole secret of success lies in co-operation with operating department in providing a proper and efficient system of switching.

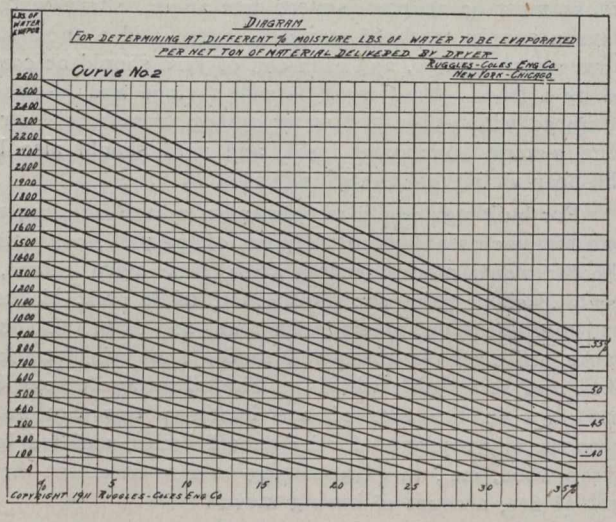
THE IMPORTANCE OF PERSONALLY STUDYING MIXER SPEED.

A great many contractors take the word of the operating engineer of the mixing plant as to results derived by increasing or decreasing the speed of the mixer drum, while for some unaccountable reason the latter seem unable to grasp the fundamental principles underlying the operation of a mixer for maximum capacity. A personal investigation by the contractor will often pay, as evidenced by the experience of Mr. A. W. Ransome, the well-known manufacturer of concrete mixers, who in a recent discussion stated that he visited a plant in which one of their 1-yd. mixers was being driven at eleven revolutions, and it required, at this speed, something over a minute and a half to discharge the bath. By speeding up to 19 r.p.m. the batch was discharged in less than 15 seconds.

Mr. Ransome stated that their machines are ordinarily sent out with the engine adjusted to give a mixer speed running from 16 to 20 r.p.m., depending on the size of the mixer involved. The speed for which the various machines are adjusted is that which will give the best results for the average material. The speed, however, is more or less subject to variation, according as the materials to be mixed vary and as the amount of water used in the mixing may vary. In other words, if the material flows very freely, the speed of the drum should be higher than if the material flows less readily, and, similarly, where a very wet mixture is used, the drum should be driven at higer speed than where the drier and more sticky mixture is handled. The real governing factor is to be found by looking in the drum opening and so adjusting the mixer speed as to get the maximum discharge into the discharge chute, instead of falling short thereof, or carrying over.

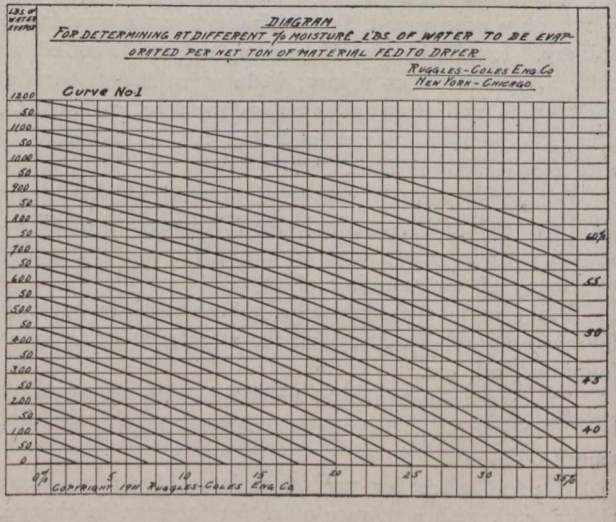
USEFUL CURVES IN DRYING CEMENT ROCK, CLAY, AND SIMILAR MATERIALS.

Cement companies use dryers for treating cement rock, clay, and other argillaceous materials as well as for drying the coal so that it may be pulverized and made ready for the kilns. The amount of water to be evaporated in reducing a given ton of material from one percentage of moisture to another is often desired to be known quickly. The curves



prepared by the engineering staff of the Ruggles-Coles Engineering Company fill this need and are reproduced here.

To make the use of these curves clear take a specific case of reducing cement rock from 6 per cent. moisture to 1 per cent. Referring to curve No. 2 follow the diagonal opposite to 6 per cent. at the bottom until it intersects the ordinate of 1 per cent. Then follow across to left and the figure 140 lbs. is the amount of water to be evaporated per



net ton of the cement rock delivered by dryer. Curve No. 1 is used in the same way and from it can be determined the lbs. of water to be evaporated per net ton of material fed to dryer.

A considerable saving of time can be effected by the use of these curves, and the Ruggles-Coles Engineering Co., 50 Church Street, New York, will send blue prints of them on request.

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CONTENTS OF THIS ISSUE.

THE TORONTO HYDRO-ELECTRIC COMMISSION.

The method of handling departments of municipal utilities by means of a commission has, during the past few years, received comment, both favorable and otherwise. There is little doubt that a commission composed of capable, energetic men is a most excellent instrument for directing and supervising the manifold items incidental to the carrying on of large undertakings. If a commission, however, is not well balanced and composed of individuals who have the time necessary to follow closely the daily routine, adjusting as occasion requires the small daily troubles that arise, and infusing into the work of the subordinates new vitality and enthusiasm, the work of such commission will not be the most efficient. Efficiency in these days of hurry is a prime requisite. The outlays of capital used in large constructional undertakings demand that work should be expedited as quickly as is consistent with a due regard for good construction, in order that interest charges may not accumulate, and that the period of income may quickly arrive.

The Toronto Hydro-Electric Commission was formed by act of the Ontario Provincial Legislature, and is composed of three men, one appointed by the Hydro-Electric Commission of Ontario, one by the city of Toronto, and the third the mayor of Toronto ex-officio. The work laid out for this commission is a large one, and it has only begun. Before it is finished there will have been a total expenditure of four and a half millions, of which only two millions have been already used. As we have noted in these columns before, the Toronto Hydro-Electric System has a strong competitor in the Toronto Electric Light Company. This company, with its affiliated interests, has the control of a large generating plant of its own at Niagara Falls, and it has its own transmission system. Its present heavy contracts with the Toronto Street Railway and other companies, place it in an enviable position for a strenuous fight. Every day the Toronto Electric Light Company is taking on new business which the Hydro-Electric, if it were in a better and more advanced position, could handle. Every contract the Hydro-Electric loses means a lengthening of the time before the system will be on a paying basis, which time must come before there is a lowering of rates.

The mayor is too busy a man to be saddled with the duties incidental to the work of the commission. Who would ask that the mayor be a member of the Harbor Commission or of the York County Good Roads Commission? Yet the duties of this body are far more onerous than either the Harbor or the Good Roads Commission. The mayor's duties are too many and too varied to force him to act on this body. Mayor Geary would be justified under the circumstances in withdrawing from the commission and appointing another who will devote his whole time to the work. By an amendment to the Act this could easily be done. Mayor Geary has proved himself in the past to be too broad and big a man to stand in the way of efficiency in the handling of the city's work, and we feel sure that sooner or later he will come to the conclusion that the interests of the city will be best served by an amendment to the Act as it now stands.

THE IMPORTANCE OF KNOWING COSTS.

The engineer of the present, to give the maximum of efficiency to his clients for expenditures on new work, must have a thorough knowledge, not only of the theoretic part of the design, but also of the methods of con-

struction necessary to give the minimum of cost. At the annual dinner of the Faculty of Applied Science and Engineering of the University of Toronto, on January 18th, Mr. W. F. Fye, the president-elect of the Canadian Society of Civil Engineers, laid special emphasis on the knowledge of costs in the experience of the engineer. Mr. Fye said that, to his mind, the most apt definition of engineering is "the art of doing well with one dollar what any person can do with two," and that it was impossible to do this without an intimate knowledge of costs and cost analysis. He would, therefore, advise the young engineer to keep records of the cost of the different works on which they are employed.

There is no question that this branch of the work of the engineer is exceedingly important, much more important than appears to be appreciated by many of the profession. Too often the question of costs is left entirely to the contractor who has the construction and installation of the work. But the engineer who superintends and lays out the work is negligent in his duty to his employer, and to his own best interests, if he does not keep in close touch with the costs of the different elements of the work. Much more necessary is it for him to have such knowledge if the consruction is being done by himself for his employer. For it is only by obtaining full information regarding costs that he can supervise intelligently. By a slight change in the method of arranging forms for concrete, by a different location for the concrete mixer, or in a hundred and one different ways he will find that he can save money and reduce the cost. There is another indirect effect which this study of costs has. The engineer who has constantly before him the aim of obtaining the most efficient results will not be led to needless outlay in the matter of design. He will study each element of the design in its relation to the purpose it must serve, and will choose the material which will do this as cheaply as possible.

The above statement is not intended as a plea for cheapess at the expense of efficiency or durability, but rather as a warning against the use of expensive and unnecessary details.

PER CAPITA ASSESSMENT.

The following table, which has been compiled by Mr. Samuel Baker, the city clerk of London, Ontario, presents in a clear manner the present standing of the ten largest cities in Ontario, as regards per capita assessment. It will be noted that the debenture debt per capita fluctuates within a wide range, from the figure of $45.93 for Windsor to the figure $182.98 for Fort William, although there is little difference in the population.

Per Capita Assessment.

City.	Population, 1911.	Municipal Taxes.	School Taxes.	Debenture Debt.
Toronto	341,991	$11.77	$4.59	$111.02
Ottawa	86,106	11.06	5.34	96.57
Hamilton	73,542	8.89	3.59	79.60
London	46,727	10.35	4.70	80.48
Brantford	21,964	10.05	3.73	90.17
Fort William .	19,858	12.44	5.75	182.98
Kingston	18,914	7.24	2.49	65.22
Windsor	17,534	10.16	4.63	45.93
Peterboro' ...	16,923	7.55	4.91	83.04
St. Thomas ...	15,240	7.77	3.52	61.78

One of the significant points of the table is the fact that Toronto, with the largest population, has also by far the largest debenture debt per capita, with the exception of Fort William. Evidently the citizens of Toronto showed good judgment in turning down the Tube by-law in the last municipal election.

Hamilton is to be congratulated on its showing as compared with the other cities of large population. When consideration is made of the large increase in population and area there in a comparatively short space of time, it reflects great credit on the city administration that they have been able to keep their debenture debt down.

EDITORIAL COMMENT.

In a recent newspaper report we note that Dr. McCullough, the Provincial Medical Health Officer for Ontario, has been on a tour of observation with Mr. N. J. Kerr, city engineer of Ottawa, looking over the different water filtration and sewage disposal plants of the United States preparatory to the installation of systems in Ottawa. If this is true it would appear that the Medical Health Officer is going afar afield of his duties. The plans which will be prepared for this work will, in the regular course of events, return to Dr. McCullough for acceptance before installation. He will then be put in the peculiar position of passing judgment on a scheme or design which he has already tacitly accepted while consulting with the city engineer. Ottawa may thus save the cost of paying for the services of a consulting engineer, but we do not believe that this means of doing so will meet with the approval of the engineering profession or of the public at large.

* * * *

Sir Hugh Allan, chairman of the Allan line, states that while he is very fearful of the practicability of a Canadian Lloyds, he would welcome it heartily. He believes, like many other Canadian shipowners, that the St. Lawrence route has been charged with many casualities which might fairly have been spread over other sections of the North Atlantic, and consequently the St. Lawrence vessels have been required to pay more than their full share. At the same time the rates of the English association has been on the whole both carefully and fairly made up. Mr. F. W. Cowie, the chief engineer of the Montreal harbor, states in an article published last week in The Canadian Engineer that during the season just closed only one marine accident of any importance happened in the St. Lawrence ship channel, when a large freight ship grounded and was released by tugs after lightening part of the cargo. This is certainly an enviable record.

LETTERS TO THE EDITOR.

The Editor:

Sir,—On about the fifteenth of October of last year, the building inspector of the city of Saskatoon ordered work stopped on two buildings known as the Willoughby and the Willoughby-Sumner blocks, on the grounds that the reinforced concrete structure was not sufficiently strong, for some unstated reason, either workmanship, materials or design. Work was suspended for about three weeks and then resumed on account of the building inspector having withdrawn his objection. In the meantime the report spread that the buildings were unsafe, and the writer, who happened to be away at the time,

heard of it in Winnipeg and St. Paul. The work was in charge of the Forest City Paving & Construction Co., and the architect W. W. LaChance, Esq., of Saskatoon. The reinforced concrete was designed by the writer, using twisted and round bars and following the specifications of the American Society of Civil Engineers. When the writer returned to Saskatoon he found that B. V. Hole, Esq., general manager of our company, had secured the services of W. R. Harris, C.E., M. Am. Soc. C.E , to superintend the making of tests on the buildings and that tests had already been made on the Willoughby building, and that same had proved satisfactory. Soon after, tests were also made on the Willoughby-Sumner building, which also proved satisfactory, and we enclose herewith a copy of the report by W. R. Harris, C.E., on these tests.

I might say that I am sending this letter to you at the suggestion of Geo. H. Archibald, Esq., contractor, Winnipeg, he having called the writer's attention to the fact that the reports circulated regarding these buildings had injured the standing of reinforced concrete construction in Western Canada, and that it was in the interest of the trade in general that a satisfactory explanation be made. The writer agrees with Mr. Archibald in this, and hopes you may see fiit to give this letter the publicity it may deserve. Yours very truly,

E. W. HYDE, JR.,

Manager Saskatoon Branch Forest City Paving & Construction Co.

Forest City Paving & Construction Co., Saskatoon, Sask.

Gentlemen,—I desire to report as follows, regarding examination and tests of two concrete buildings being constructed by you in this city:

On October 31st I examined the concrete and supervised the test loading of beams and floor slabs in the Willoughby building and found the concrete hard and sound.

Floor slabs and beams were subjected to a test load equal to 2½ times the estimated safe live load of 70 pounds per square foot, with a maximum deflection of ⅛ inch.

The deflection was normal and the examination and tests indicate that the structure is fully capable of serving the pupose for which it was designed and constructed.

On November 3rd the Willoughby-Sumner building was examined and tested, and in general the concrete was found to be hard and sound.

It was apparent that the concrete in this building was gaining additional strength with age, as is to be expected of concrete properly made.

All floor slabs and beams tested, except one, showed a normal deflection of ⅛ inch.

The one exception was a beam through which four electric conduits passed, the deflection on this beam was ¼ inch with a development of small cracks in tension side of beam.

This beam was not tested to destruction nor was permanent injury caused same by the test.

This building is capable of carrying the loads for which it was designed.

The first, second and third floors of the Willoughby building and the first and second floors of the Willoughby-Sumner building were tested; the remainder of the floors were not tested because a sufficient time had not elapsed since the floors were poured to justify such a severe test loading. Yours very truly,

(Sgd.) W. R. HARRIS, Saskatoon, Sask.

CANADA'S TRANSPORTATION PROBLEM.

BY E. B. BIGGAR.

Re-examining our economic relations to our fellow men and to the state, we find that out of what we produce —whether we are farmers, artisans, merchants or manufacturers—we pay toll or taxes mainly in two forms; first, on what we send out or take in from one place to another within our own country, and second, on what we import from other countries. The first we speak of as transportation charges, the second as customs duties. If we were born and educated in the planet Mars and dropped down upon the earth to investigate things anew, we would wonder why the second class of tolls upon our labor and income, though of minor consequence, is regarded as of the greatest political importance, while that which concerns each one of us most nearly, since it is an impost on everything we sell as well as everything we buy, is considered by many to be a matter almost outside the domain of politics. The readjustment of the customs tariff on an item that may add one dollar to the cost of a suit of clothes is a subject of such contention as may decide the fate of a government, but a railway official may, by a whim, or to meet an exigency, revise a schedule of rates which will add hundreds or thousands of dollars to the cost of our business, and the change seems to be accepted as a decree of fate.

Years before confederation became a practical issue in British America, a transcontinental railway under state control or ownership was advocated as a means of welding together the scattered groups of British colonies throughout the world, and so long ago as 1847 the prophetic vision of Major Carmichael Smyth saw in such a continental railway "a great link required to unite in one powerful chain the whole English race." There is the clearest proof that the need of a government owned transcontinental railway, both for imperial political purposes and for economic reasons, was felt long before there was a conviction in all the provinces that confederation itself was required. Antagonism to the confederation on political grounds lingered in some quarters long after the Act of Union came into force; while the warmest advocates of the measure found it necessary to acknowledge in a formal way in the terms of the union that, "the construction of the Intercolonial Railway is essential to the consolidation of the union of British North America and to the assent thereto of Nova Scotia and New Brunswick."

The Intercolonial Railway, however serviceable for local purposes, has always stopped short of that point where it could give to all the provinces the benefit of the lowest rates and best service from prairie to Canadian seaboard. For a time it ended at Riviere du Loup, then after a long delay at Quebec, and a still longer time elapsed before it reached Montreal; and all this time the railway traffic of Quebec and Ontario, and later on that of the new prairie regions, found its way to the sea, largely by way of Portland, Boston and other United States ports, instead of through the ports of the Maritime Provinces, which had paid for it by their assent to the union.

The high rates charged under the private ownership and control of the Canadian Pacific Railway have operated as a handicap alike upon the people of the West, and upon the fishermen, farmers, manufacturers and merchants of the Maritime Provinces—the former because prices have been depressed and the latter because the excessive tax of transportation cuts them off in competition with the producers and manufacturers of the middle western states, who ship to Canada at a cheaper rate. The same handicap operates against Ontario and Quebec.

Recent investigations of freight rates, passenger rates, express rates and telegraph rates, show that the cost of

transportation in the Canadian West is in excess of rates for corresponding distances in the United States by proportions ranging from ten per cent. to over one hundred per cent. This being the case, of what avail is it to the people of Canada to assist in building a second and a third transcontinental railway when there is no reduction of rates?

The Conservative government, which created the Canadian Pacific Railway, may have thought it provided a safeguard for the return of some of the enormous assets which it threw into the company's lap in money and lands when it stipulated that all profits in excess of ten per cent. should be returned to the people. But the company has found a way to mop up these extra profits by the creation of subsidiary companies, such as hotel companies, catering companies, land irrigation companies, etc.

To make a bad situation worse for the people who pay without control, the late Liberal government in subsidizing the second transcontinental system committed the people to an expenditure which it is said will reach $250,000,000, and has designed as far as it could, that that portion of the new system, which is owned by the private corporation and comprises the only profitable part of the road, should be exempt from the control of the government railway commission, while the portion in which there is no present possibility of profit is owned by the government and controlled by the commission.

It is true that there is a proviso in the Grand Trunk Pacific Act that the company shall not charge any higher rates to a Canadian sea port terminal than to a terminal in the United States. But to those who know the methods by which the Grand Trunk secures its present traffic from the West to its own terminal at Portland, and who know the plans now being matured at great expense for a second United States terminal at Providence, R.I., this provision will only give a light touch of comedy to the administrative tragedy of the late government. The appropriation of $30,000,000 to the Canadian Northern for its transcontinental road passed in the late Parliament almost without comment from either side, as the cold potato was handed to Rip Van Winkle.

Here we have government railways built at a cost to date of over $237,000,000, carefully held back from reaching the only regions of the country where promising traffic exists destined for the sea; while privately-owned railway corporations to which the Dominion and provincial governments and municipalities have given cash bonuses amounting to over $301,000,000, besides vastly more valuable lands, are levying upon the producers of the West a form of internal revenue tax which no people could possibly pay if it were not for the miraculous fertility of a virgin soil. Remembering that the Canadian railway companies are also the owners or controllers of the express and telegraph companies of the country, it is within the bounds of truth to say that these imposts when combined make a system of taxation upon the people unparalleled in any country pretending to modern civilization.

Seeing that the world's market prices are not fixed in Canada, foreign trade can only be gained by reducing the cost of transporting the products of the mid-continent to the Atlantic and Pacific. The control of rates, and ultimately the ownership of the transcontinental lines of communication, is the only means to this end, because the purpose of private ownership is to make profits out of its transport system, while government ownership, with the object of international trade would seek to render an efficient service at the lowest possible cost consistent with the payment of good wages. The excessive rates are undoubtedly the prime cause of the apparent difference in prices in favor of United States goods as compared with Canadian goods when laid down in the Canadian West.

Essentially the transportation of human beings and the materials of their sustenance and employment is of the same nature as the transmission of intelligence through the post, and as no statesman would now propose to hand back the postal service of a nation to private operators as once was the case, so the day is fast coming when the railway service of Canada must be under state operation.

The solution of the problem therefore is to prepare for the acquisition of the railway, express, telegraph, and long-distance telephone services, and as a preparatory step, to bring these present public service corporations under the authority of the railway commission which can be reorganized into branches to cope with its increased work. It may be that the railway companies will have the foresight to see that these changes must come, and the wisdom to accede in advance to a change to which they must otherwise yield under pressure of public opinion. Such a yielding is in fact now advocated by some of the ablest railway managers in the United States who recognize that the logic of the increasing control now exercised by the government over railway corporations is early government ownership.

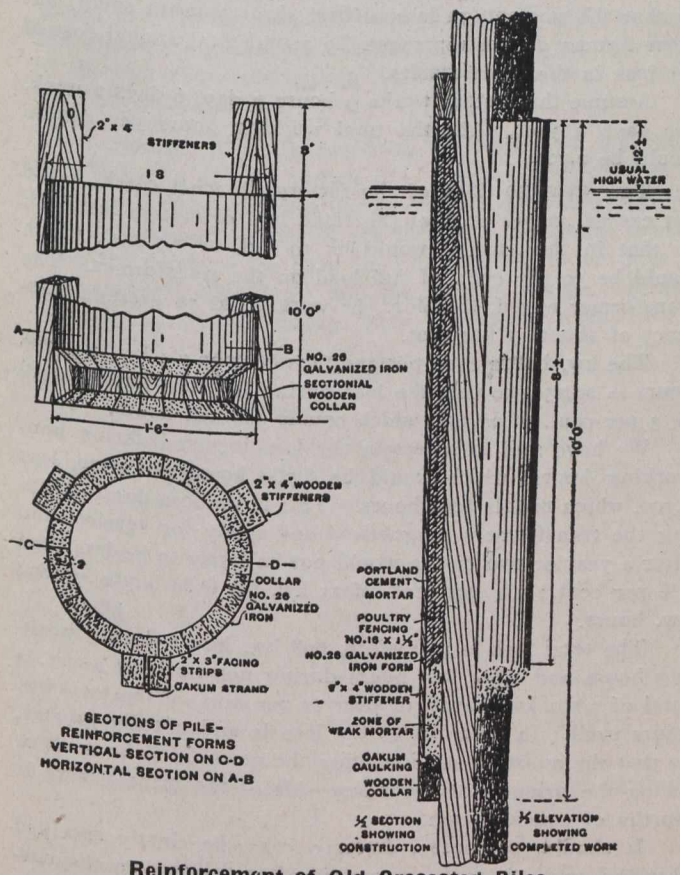
The Grand Trunk Pacific Railway should be expropriated by the Dominion government, and joined to the Intercolonial Railway, so as at once to afford an automatic regulator of rates from prairie to sea. That or the extension of the Intercolonial Railway to the Pacific. Some such method seems the only practical way of rendering long deferred justice to the people of the Maritime Provinces, the Western Provinces and British Columbia, and of securing to the nation what will inevitably be lost under the present scheme—the shipment by Canadian vessels and from Canadian sea ports of the produce of Canadian soil.

But where Canada has suffered and will suffer yet more in yielding up the principle of railway development on which our confederation was founded, is in the enormous and unreasoning waste of money, labor and land in the triplication of lines where communications already exist, to the starvation of those parts of the country that are without railway facilities. There is not even the consolation that a second or third line effects a material reduction in rates. For example, three competing lines of the three great corporations are now being finished between Toronto and Montreal, where one with new tracks to cope with increasing traffic would serve the public. The city terminal costs alone run into millions of dollars, not to consider the permanent waste of land by the extra right-of-way and the waste of labor by the triplication of the staffs. In the end the people, whose produce, labor and earnings provide this traffic—and who consequently suffer for this waste—are not benefited in the slightest by this illusory competition. What does the word "competition" signify when there is no reduction of rates?

But this is not the worst aspect of this senseless waste of a nation's resources. What was the purpose of the great sacrifices made by the people in subsidizing the private corporations to build these chains of communication? Was it not to colonize our vacant lands and utilize to the utmost benefit of all the provinces the resources of the country? Without doubt. And yet the primary purpose of each of our private railway corporations is to string their lines where traffic already exists, and new territory is now opened up only where profits are immediately visible. If colonization and the utmost public service were the actual, as well as the theoretical motive of railway building in this country, we should have in the older provinces lines to thousands of villages that are yet without access to railways, and still paying the oppressive cost of wagon haulage; while in the great West we should have had twice the area of land under cultivation with a doubling of the productive capacity of the country.

PILE PROTECTION.

In a paper read before the Boston Society of Civil Engineers, which is printed in the Journal of the Association of Engineering Societies, T. Howard Barnes described some wharf construction for the Guatemala Railway Company in Puerto Barrios, Guatemala, in which it became necessary to deal with some creosoted southern United States piles which had been in place for about seventeen years. These piles were nearly all of them in fair condition, excepting at and near the water line, but at this belt for, say, 5 ft. in width, most of them were badly eaten, many having cavities extending completely through them, resulting from the combined activity of the teredo and the limnoria. The expense of replacing these piles with new ones would approximate $50 each. The incentive for saving them by placing some reinforcement was so great that the writer gave much time to its consideration.



Reinforcement of Old Creosoted Piles.

The first idea was to place such reinforcement by using a chamber clam-shell like, each half of which should have a semi-circular opening in the parting line of the bottom for embracing the pile when clamped about it, and which would admit a workman after unwatering the chamber, the annual space about the pile being first calked. A test chamber was made, but trials in controlling it against the effect of even a wind-chopped sea of moderate force proved the futility of rapid and economical manipulation, and the idea of working in the dry was abandoned. Had the apparatus proved successful it was proposed to place a reinforcement of nails, poultry netting and cement mortar, similar to that hereinafter described for protecting some of the piles which were placed in the new construction.

Accordingly, forms were prepared for placing in the wet about the old piles a reinforced cement-mortar envelope which should have a width of about 8 ft. and a minimum thickness of 2 in. These forms were made of No. 26 gauge galvanized iron shaped into cylindrical shape with a slight taper and 10 ft. in length. A 2-in. x 3 in. strip of pine having a length of 8 in. greater than the form was attached on each side of the parting line, which was up and down. The metal was folded about the strip 1 in. on to the 3-in. side, leaving 2 in. for attaching an oakum strand, which was needed to prevent egress of mortar. Two 2-in. x 4-in. stiffeners of same length as the facing strips were fastened to the form at one-third points as shown in the cut. A collar of 2-in. stock made from narrow blocks was provided at the foot to serve as a gauge for regulating the thickness of the mortar, as well as serving to calk against in closing the foot against the escape of the mortar.

The mortar envelope was reinforced by a wrapping of poultry fencing of No. 16 gauge with 1½-in. mesh. The procedure was, first to scrape off the mussel growth on the pile to be treated. This growth forms a complete mat, but is detached quite readily. The poultry fencing was then put in place. This was made up into a roll, 8 ft. long, with sufficient fullness to lap on to itself several inches when placed about the pile. The form, nearly buoyant with the stiffners, was then floated into place, first having been provided with a wreath of fluffy oakum affixed to the collar. The facing strips were closed tightly with carriage clamps hung from them by cords of such length that when the clamps were squared into horizontal position they were in the proper place for screwing up by the divers. The divers were naked, and their further duties were to close the bottom of the form effectually against the egress of the mortar, watching carefully that none escaped at the time of the filling. Steel bars 8 ft long of ½-in. stock were hung, one in each of the three sections of the form. They had a shepherd's crook for support on the top edge of the form, and were used for slushing the mortar into compact state as it fills.

The mortar was made, one part cement to about two parts sand, the latter being silica and selected as coarse as possible, say 0.18 mm. effective size. It was assured that there was a little overfill of cement. The operation of filling was carried on rapidly, the effect of the slushing rods being supplemented by tapping with clubs on the stiffners, resulting in securing a sound mass excepting in the lower zone of about 18 in.

It will be noted that the forms were made 2 ft. longer than the reinforcement cage. The separating of the sand from the cement in the lower portion could not be avoided under the limitation of having to drop the mortar through so great a depth of water; accordingly the reinforcement was made to occupy only the sound part of the envelope.

Fig. 2 shows the construction and the finished appearance of the work. At the time of writing, the work is still in progress, with a record showing no failures. It should, however, be added that at times much delay is caused by difficulty in sealing the foot of the form. It is useless to place the mortar when any is escaping at the bottom.

The expense of this treatment is—labor (contract price), $8; materials (cement, fencing, etc.), $4; a total of $12, to which should be added the expense of experimenting and overhead charges.

There seems good reason to expect a further life of the piles thus treated as great as that at present sustained.

URGENT DEMAND FROM THE ADMIRALTY.

A Birmingham, England, firm of engineers have received an urgent order from the Admiralty for 150 sets of torpedo firing gear. The Admiralty have decided in this instance to forego the usual electrical tests in order that the appliances may be delivered at once.

CONTRACTS FOR THE SUPPLY OF ELECTRIC POWER FROM THE USER'S POINT OF VIEW.

IV.

By H. E. M. Kensit, M.I.E.E.

Further important points that should be clearly defined are:—

At exactly what point the power is to be delivered, and, if any transformation is required, exactly where the power is to be measured.

The following are sample clauses on these points:—

(1). "The supply shall be delivered at the pole nearest the reducing station of the consumer, situated on the consumer's property at ..... All energy shall be deemed to have been furnished when the power company has maintained the supply at that point."

It will be seen that this defines the point at which the supply is to be given, and provides that the consumer is to supply, and, presumably, to equip, the reducing or transforming station. It also leaves the consumer to bear the loss in transformers for reducing the pressure.

(2). "The power company will construct a line to convey the agreed amount of power to the customer's premises ready for distribution at approximately the voltage and periodicity set forth above."

(3). "The electric energy to be supplied under this contract shall be delivered to the customer at the terminals of the main outgoing switches in the sub-station of the power company, and the electrical equipment in the said sub-station shall be daily inspected by the electrician of the customer, and he shall immediately notify the power company of any defect in the same or detail requiring attention. Such inspection by the customer's electrician shall be deemed to be a voluntary aid to the power company, involving no responsibility to the customer beyond the use of reasonable diligence in making the aforesaid inspection and reporting the condition."

Here the expression "main outgoing switches in the sub-station of the power company" defines that the power company are to provide sub-station and equipment and bear the loss in transportation.

(4). "The electric energy shall be 3 phase, 60 cycles, 2,200 volts, and shall be delivered by the power company at the customer's sub-station and measured at the primary 2,200-volt switchboard of the customer."

Here it is clear that the customer receives the power at 2,200 volts in his own sub-station with the intention of further reducing the pressure at his own expense.

In some cases the customers provide the sub-station building because this cannot be removed by the power company at the termination of the contract, and the power company provide all the equipment for the sub-station, this equipment remaining their property. This is a fair and usually satisfactory arrangement. It then remains for the contract to specify clearly whether the power to be paid for is to be measured on the primary or secondary side of the thansformers. If not clearly specified, the power company will certainly measure it on the primary side, and the customer will, therefore, pay for the loss in the transformers. Either way is equally fair, as long as it is understood beforehand. The "all-day" loss in transformers may be from 3 to 15 per cent., depending on the size, and on the proportion of time during which they are fully loaded, working light, or merely wasting magnetizing current in order to keep them alive and ready for service.

The transformer loss is not usually an important matter where they are large and efficient, and where power is taken on the h.p. year basis, but it may be quite appreciable where the transformers are small, the energy paid for by the kw. hour, and the working hours a comparatively small proportion of the total time the transformers are in circuit.

To illustrate this, assume a factory with a total of 25 h.p. of motors installed. Taking 83 per cent. as the average efficiency of the motors, this corresponds to an input of 22.5 kw. Probably two transformers of 20 kw. each would be put in to avoid total stoppage from breakdown of one transformer; then either transformer could take the average load and the two together would handle any possible peak. This would mean a very small average load on the transformers and, therefore, a high percentage loss, so we will assume the more favorable case of one 25 kw. transformer, for the purpose of this example.

The efficiency of the transformer would usually be given by the makers about as follows:—

Full load.	¾ load.	½ load	¼ load.
98%	98%	97.8%	96.7%

so that the percentage loss at first sight appears small, but these figures do not represent the actual total annual cost of the loss in the transformers.

Assume the factory works 9 hours a day, 6 days a week, 300 days a year, then the total working hours per annum would be 2,700.

The **average** load of the factory, in most cases, would not exceed 40 per cent. of the rated h.p. of motors installed, so that in this case it would be 10 h.p. or 7.5 kw., which would be 30 per cent. of full load on the transformer. The transformer would, therefore, be working at an average efficiency of about 97 per cent.

The kw. hours used per annum would be 7.5 kw. × 2,700 hours = 20,250, so that the loss during **working** hours would be 3 per cent. of 20,250, which equals 608 kw. hours.

We have still to ascertain the loss incurred during non-working hours, which would be 8,760 hours per year, less 2,700, which equals 6060 hours. This is the loss due to keeping the transformers magnetized and ready for service, and after a year or two of use would not be likely to be less than 1¼ per cent.; 1¼ per cent. of 25 kw. for 6060 hours is 1894 kw. hours.

The total loss is, therefore, 608 kw. hours during working hours and 1,894 kw. hours during non-working hours, a total of 2,502 kw. hours, or over 12 per cent. of the total kw. hours used. In many cases the loss is undoubtedly greater, so that the question as to whether the power is to be measured on the primary or secondary side of the transformers is worthy of consideration.

It should, of course, in any case, be clearly specified that the power is to be measured after delivery on the customer's premises, unless it is specially desired to do otherwise, as in cases where the customer provides or finances the transmission line.

In some cases where the power company has to build a transmission line especially for one customer it charges interest on the amount so invested, but reserves the right to supply other customers from that line if the opportunity occurs. In this case the customer should be protected by a clause to the effect that if the line is used to supply other customers he shall thereafter only pay a proportionate amount of the interest.

CANADIAN MINERALS.

The annual report of the Mines branch of the Dominion Government shows the total value of mineral production in 1910 to be $105,000,000, an increase of $13,209,517, or over 14 per cent. Copper amounted in value to $7,209,463; gold, $10,224,910; pig iron, $11,245,630; lead, $1,237,032; nickel, $11,181,310; and silver, $17,106,604.

Metallurgical Comment

T. R. LOUDON, B.A. Sc.

Correspondence and Discussion Invited

DESIGN OF OPEN-HEARTH FURNACES.

Prof. M. A. Pawloff, of St. Petersburgh, Russia, gives out the following data relative to open-hearth furnaces. The original paper appeared in the leading German paper, Stahlund Eisen.

1. Ordinary Gas Furnaces.—The dimensions are determined by: (1) the distance between the bulkheads = L, (2) the distance of the long sidewalls = E, and (3) the height of the roof above the bottom = ho. L × E may be called the bath surfaces.

1. Hearth.—Usually based on the weight of the charge T. The ratio of bath surface S to weight of charge T is not constant in the different furnaces, but decreases regularly with increasing capacity of the furnace. This ratio depends upon the depth of the bath (in Europe not over 300 mm., or 11⅜ in., and often less) and the furnace design. Table I. gives some ratios of modern basic open-hearth furnaces:

Table I.

Charge T Tons.	$\frac{S}{T}$ — in Square Feet per Ton.	Path surface S, Square Feet.
12.5	12.9	161.5
15.	12.1	181.7
17.5	11.3	191.8
20.	10.76	215.3
25.	10.22	258.3
30.	9.68	290.6
40.	8.87	355.1
50.	8.61	430.4
60.	8.07	484.2

Sometimes we find $\frac{S}{T}$ somewhat greater, but rarely below above values. If the ratio $\frac{S}{T}$ has been well chosen, the most favorable value for T can be found only by practical experience under running conditions.

2. Dimensions of the Furnace.—The dimensions of the furnace are derived from the hearth. The width of the furnace in Europe is not over 11.5 ft., but in America it is as high as 14.8 ft.; the greatest length is 43 ft. The length of the furnace L may be found from the ratio $m = \frac{L}{E}$ after S has been chosen from Table I. In general m is between 2 and 3; in Europe usually 2½ or 2¾. For larger furnaces m = 3 is recommended. Therefore,

$$E = \frac{L}{m} \text{ and } S = L \times E = L \times \frac{L}{m}$$

$$L = \sqrt{S\,m} \text{ and } E = \frac{S}{L}$$

Table II.

Relation Between Capacity, Length and Width of Open-Hearth Furnaces.

T in Tons.	$\frac{L}{E} = m$	L Feet.	E Feet.	S Square Feet.
30.....	2.66	27.9	10.5	290.5
	2.70	28.	10.3	
40.....	2.70	31.	11.5	355.
	2.75	31.3	11.3	
50.....	2.75	34.4	12.5	430.
	2.80	36.1	11.9	
60.....	2.80	36.8	13.1	4.84
	3.00	38.1	12.7	

3. The slope toward the tapping hole is greatest in the middle of the hearth, being 1/12 to 1/16 of the width, in average 0.07, which corresponds to the tangens of an angle of 4°.

4. Furnace Volume.—The heights ho above the bath for 40-50-ton furnaces should not exceed 83 in. It depends largely upon the gas quality and quantity and the process in use for making steel. Only local conditions and furnace practice will decide this question, but it can be said that oil-fired furnaces require a greater distance than gas-fired furnaces.

5. Bulkheads.—The air inlet area is usually 23.25-38.75 sq. in. per ton of charged material.

The gas inlet area is 1⅓-2½ times smaller than above values.

The furnaces of the same system the area of the gas inlet decreases regularly with increasing furnace capacity.

	10-Tons Square Inch.	20-Tons Square Inch.	30-Tons Square Inch.	45-Tons Square Inch.	150-Tons Mixer Square Inch.
Air inlet	47.4	38.1	30.2	27.9	12.9
Gas inlet	39.1	29.8	23.6	18.6	7.8
Ratio	1.214	1.281	1.283	1.5	1.66

The reason for this is that the drop in gas pressure, caused by friction, is inversely proportional to the ratio of circumference to area.

Since the ratio $\frac{S}{T}$ decreases with increasing capacity, we may also compute the area of inlets from the ratio of this inlet area to bath surface. The author found that this ratio had an almost constant value, being 3.24 sq. in. for air inlet per square foot (or 225 sq. cm. per square meter).

6. Assuming the width of the inlets, the height is found from above data. The dimensions of the gas inlets are derived from those of the air openings. The author suggests that the ratio of the cross-sections of the air inlets and gas inlets should be proportional to the quantities of heat necessary for heating air and gas or to the quantities of the respective checkers.

7. Gas and Air Flues.—The slope of the gas flues (inlets) varies between 12° and 18°, and that of the air flues between 30° and 40°, and depends largely upon the size of the furnace. In American furnaces the gas burns almost completely, although only a single broa opening forms the gas inlet.

8. Vertical Flues.—Vertical flues have 25 per cent. greater area than their respective inlets for the larger furnaces, and 50 per cent. greater for the smaller (20-25-ton) furnaces.

9. Length of Bulkheads.—The length of bulkheads depends upon the type of the different furnaces. The distance between vertical gas flues and gas inlets is between 9.8 ft. and 13.1 ft.; for air flues the distance is between 4.9 ft. and 8.2 ft.

Regenerators.

10. Volume.—Modern practice per ton charge is 176.6 cu. ft. checkers for small European furnaces and 123.6 cu. ft. for the largest American furnaces. In economically working furnaces, which have a low temperature drop (about 120° C. or 216° Fahr. per hour) between two reversals, the author finds that there are 90 to 110 lb. checkers per pound of coal consumed per hour.

The author recommends to base the design of the checkers on the bath surface. By using the above values of the ratio S ÷ T, the checker volume per unit of hearth surface is almost constant = 4.5 cu. m. per square meter = 14.76 cu. ft. per square foot.

11. Dimensions of Regenerators.—The checkers in large furnaces are 80 per cent.; in smaller furnaces, 70 per cent. of the entire chamber volume. The depth of the checkers should not be less than 13 ft., and if possible 16 ft. The ratio between air and gas chambers varies between 2 and 1 For cool producer gas it is 1.5 and for hot gas 2; 1¾ being a fair average ratio.

Chimney Flues and Reversal Apparatus.—These dimensions are often too small, because in the case of rebuilding a furnace these parts are usually left unchanged.

12. In satisfactorily working furnaces the smallest area of air flue per 100 sq. ft. bath surface is 2 to 3 sq. ft.; the area in the reversal valves should be at least 3 sq. ft. per 100 sq. ft. hearth surface.

13. Instead of giving air and gas valve the same dimensions it is better to make the ratio of their cross-sections equal to the ratio of the cross-sections of their flues or to the ratio of their respective checker volumes.

14. Flues Between Valves and Chambers.—Flues between valves and chambers are made with twice the cross-section of the valve flue cross-section. Thus, for the air flue a cross-section of about 6 sq. ft. is chosen per 100 sq. ft. hearth surface.

15. Flues Between Valves and Stack.—The cross-sections of the flues between valves and stack should equal the sum of the cross-sections of the two flues which run to the valves of one side.

16. The same area has to be given to the stack at its base. The opening at the top of the stack is $\frac{1}{20}S$ where S is the bath surface, making the diameter $d = \frac{\sqrt{S}}{4}$

The height of stacks should be 131 to 148 ft. for larger open-hearth furnaces.

II.—Oil-Fired Furnaces.—The ratio $\frac{T}{S}$ remains the same.

The distance between roof and bath has to be greater to give the oil time for complete combustion; for 20-25-ton furnaces this height should be 71-79 in. The air inlet should be 4 sq. ft. per 100 sq. ft. hearth surface.

The volume of the air checkers should be 11.5 cu. ft. per square foot hearth surface, and on account of the high heat value about 140 to 160 lb. of checker should be used per pound of coal gasified per hour.

The cross-section of the flue to stack should be about 8.5 sq. ft. per 100 sq. ft. hearth furnace. The valve area and the opening of the stack at the top should be 4.25 sq. ft. per 100 sq. ft. surface.

THE ENDURANCE OF METALS.*

Experiments on Rotating Beams at University College, London.

By E. M. Eden (Armstrong College, Newcastle-on-Tyne), W. N. Rose and F. L. Cunningham.

When a piece of metal is subjected to alternating or intermittent stress the metal may fracture after a large number of alternations or repetitions of stress, although the maximum stress applied is considerably less than would be required to fracture the material with a single application. As in the large majority of cases metals used by engineers are subjected to varying stresses, and as failure when it does occur usually happens after a large number of repetitions of stress, the importance of tests on alternating stresses is very great. It is doubtful if a direct tensile test of a piece of steel gives any very definite information of its capacity to resist alternating stresses. The hard brittle-looking fracture of steel broken under repeated repetitions of stress is entirely different from the fracture caused by the single application of a larger stress in a testing-machine, and the hard-looking fracture of a broken piston-rod or crank-shaft is often taken as a proof that the material is or has grown too brittle for such service. The appearance of the fracture in such cases is probably responsible for the common idea that a soft ductile material is most suitable for withstanding alternating stresses.

The classical researches of Wöhler included experiments on repeated tensions varying from o to a maximum, repeated torsion, and on revolving bars subjected to a bending-moment while revolving; in this last case the stress in the outside fibres varies from a maximum tension to a maximum compression, and the range of stress is twice the maximum imposed stress. In every case the number of repetitions to cause fracture increases as the stress diminishes.

If a number of experiments with different maximum stresses applied are considered, and the applied stress is plotted against the number of repetitions to cause fracture, the points are found to lie more or less on a curve which appears to become nearly horizontal afer a few million repetitions. The stress where the curve is horizontal is the limiting stress which can cause fracture after an indefinite number of repetitions.

Culture, friendship and inspiration, these three, and the greatest of these is inspiration. This is the one thing which all the others lead to, for this is the true vision.

Tests were undertaken with a view to finding, if possible, the form of the stress-repetitions curve for any one material and to determine the effect of speed, or rate of alternation of stress on the stress-repetitions curve and on the limiting resistance for an indefinite number of repetitions. The testing-machine was specially designed and built with these objects in view, but the tests deal also with the comparative endurance of various materials and with the effect of rests, vibration, surface and form of test-piece, and annealing on endurance.

The testing-machine was of the revolving-beam type, in which the test specimens are subjected to a uniform bending-moment while revolving on their own axes. With truly turned test-pieces and holders the machine runs quietly.

The results of tensile tests of test-pieces cut from some of the bars of metal used for the endurance tests are shown in Table I. All the tensile tests were made on the full-size bar, and extensometer readings were taken on a 10-in. length.

*Abstract of paper read, October 20, before the Institution of Mechanical Engineers.

It is generally assumed that the stress-revolutions curve becomes horizontal after a sufficiently large number of repetitions of stress, and the ordinate of the curve where it is horizontal is the limiting stress causing fracture after an indefinite number of alternations or repetitions of stress. An examination of the curves which the authors give shows that this limiting stress is not reached with one million revolutions; this is seen more clearly in the logarithmic curves, which are also plotted, where, as in the case of the other curves, the limiting stress is the ordinate of the curve when it becomes horizontal. In spite of the irregularities in the position of the points, it seems to be certain that the curves have not become horizontal after one million revolutions.

Table I.

Bar No.	Material.	Limit of elasticity. Tons per sq. inch.	Tenacity. Tons per sq. inch.
5	½-inch bright drawn mild steel rod, Quality B	28.8	40.0
8	½-inch bright drawn mild steel rod, Quality A	25.0	35.7
9	Vanadium steel Type A, oil-tempered	46.5	57.2
10	Vanadium steel Type A, annealed	26.8	38.4
23	½-inch blued rolled Bessemer steel, Quality D	35.7	49.3
25	3 per cent. nickel steel	44.6	57.0
26	25 per cent. special nickel steel	24.1	48.8
27	½-inch bright drawn wrought-iron rod	25.9	33.3
28	½-inch bright drawn wrought-iron rod	26.8	34.0
29	½-inch bright drawn wrought-iron rod	26.8	34.1

The limit of elasticity was obtained from extensometer readings, and is the limit of the straight portion of the stress-strain curve. Both the limit and tenacity are expressed in tons per square inch of original area.

TITANIUM IN RAILS.

A set of sections illustrating the wear of rails laid down on the Kessler's Curve in West Virginia, on the Baltimore and Ohio Railroad, have been issued by Messrs. T. Rowlands and Co., Stirling-chambers, Sheffield. The diagrams have been drawn out by Messrs. Robert W. Hunt and Co., New York, for the Titanium Alloy Manufacturing Company, Pittsburg, and deal with open-hearth and titanium-treated Bessemer rails. The curve on which these tests were made is one of 9 degrees, the superelevation of the outer rail being 6 in. 90-lb. rails were used. A previous test of ordinary Bessemer and titanium-Bessemer rails on this curve showed an improvement in favor of the latter of 294 per cent. In the present test, the difference in favor of the titanium rails is not so great. The test extended for 338 days, the loss being measured in square inches of sectional area. Of the rails on the inside of the track, the open-hearth rails averaged a loss of 0.250 sq. in., and the titanium rails as follows:—0.03 per cent. titanium, 0.273 sq. in.; 0.05 per cent. titanium, 0.169 sq. in.; 0.1 per cent. titanium, 0.155 sq. in.; 0.15 per cent. titanium, 0.147 sq. in. The wear was even all across the head, and the open-hearth rails thus showed 1.70 times the amount of loss of the 0.15 per cent. titanium rails. On the outer rails the wear was principally, of course, on the inside of the head, the wear being as follows:—Open-hearth, 0.36 sq. in.; 0.03 per cent. titanium, 0.428 sq. in.; 0.05 per cent. titanium, 0.39 sq. in.; 0.1 per cent. titanium, 0.389 sq. in.; 0.15 per cent. titanium, 0.273 sq. in. The ratio of wear of the open hearth to that of the 0.15 per cent. titanium rails is thus 1.32:1. The average ratio for the loss of all open-hearth rails to the 0.15 per cent. titanium rails, on both sides of the track, is 1.45:1. It may be added that the open-hearth rails were of 0.64 carbon steel, while the titanium Bessemer rails averaged 0.47 carbon. A test carried out some time ago on the Chicago, Burlington, and Quincy Railway, lasting for nine months and including nickel, maganese, plain open hearth, Bessemer, and two makes of titanium rails, showed that the titanium rails, of which the extra cost per ton is only about 2 dols., were equal to the nickel-steel rails, the extra cost of which per ton was no less than 40 dols., being, moreover, superior to the other makes covered by the test.

POWER REQUIRED FOR ROLLING MILLS.

Prof. M. Hermann (Stahl und Eisen) derives the following simple formulas from theoretical considerations and from a study of the recent investigations of Puppe. These formulas apply to the rolling of rectangular sections:

Let A = Reduction of sectional areas per pass, in sq. in.;
k = Limiting stress of lateral extension of metal, lb. per sq. in.;
t = Reduction of thickness of billet per pass, in inches.
D = Roll diameter, in inches;
v = Velocity of bar leaving rolls, ft. per sec.
a = Arc of contact of billet with the roll, in degrees.

Then,

$\cos a = 1-(t/D)$, from which sin a may be found from tables.

Force required to draw billet through the rolls: $F = 2k A$.

Roll pressure, in lb. $= P = k A [1+(1-\cos a)/2]/\sin a$.

H.P. (exclusive of power required to run rolls empty) $= F v [1.1+0.12 (P/F)]/550$.

The value of k is difficult to assign; it increases with the number of passes and decreases with increasing temperatures. Herr Hermann gives a table taken from Puppe's experiments in which k (average) for the 5th to 8th passes ranges from 6,940 lb. per sq. in at 2,237 deg. F. to 10,042 lb. per sq. in. at 2,091 deg. F.; and for the 9th to 17th passes from 7,965 lb. at 2,237 deg. F. to 11,547 lb. at 2,091 deg. F.; or mean values of k for the 12 passes ranging from 7,609 lb. at 2,237 deg. to 11,265 lb. at 2,091 deg.

Example.—Let A = 4 sq. in.; k = 8,000 lb. per sq. in.; t = 0.75 in.; D = 20 in.; v = 6 ft. per sec.

Then,

$\cos a = 1-(0.75/20) = 0.9625$. whence $\sin a = 0.2712$.

$F = 2 \times 8000 \times 4 = 64{,}000$ lb.

$P = 4 \times 8000 [1+(1-0.9625)/2] \div 0.2712 = 120{,}206$ lb.;

$P/F = 1.8782$.

H.P. $= 64000 \times [11.6+(0.12 \times 1.8728)] \div 550 = 925$.

HYDRO-ELECTRIC POWER IN CHILE.

It is proposed, in a report submitted to the Chilean Ministry of Industry and Public Works, to divide the hydraulic works department into sections—(1) hydraulic surveys (2) power stations (3) transmission of electric energy; to expropriate as soon as possible all the hydraulic undertakings which it may be thought desirable to be worked by the State; and to encourage the development of other hydraulic projects by private enterprise in the most efficient manner. It is also proposed to investigate the requirements of the State railways, and the possibility of employing hydro-electric power for military and naval arsenals. The first part of the programme will comprise inquiries to be made during a period of five years in connection with the rivers Aconcagua, Maipo, Cochapoal and Bio-Bio.

ENGINEERS' LIBRARY

Any book reviewed in these columns may be obtained through the Book Department of The Canadian Engineer.

BOOK REVIEWS.

The Theory and Practice of Technical Writing. By Samuel Chandler Earle, Professor of English in the Engineering School, Tufts College. The Macmillan Company, New York and Toronto, Canada. Cloth; 5x7½ ins.; pp. 301; many text illustrations. $1.25 net.

The present tendency in the engineering schools is to devote more time to the study of English. It is only recently, however, that such instruction has been given. This instruction has varied in different schools, and falls into two general classes. The first class is that in which English is taught as a purely cultural part of the curriculum. This teaching is often given with the other students taking a general arts course. Many of the schools in the United States, however, have given separate instruction to the engineering students, and as a result there has developed a course of lectures specially adapted to their needs. This has naturally led to a specialization of the teaching of English, which may be called technical English, and this is the second class. The command of good technical English is as essential to the engineer as the other elements of knowledge which go to make up the well balanced man. This is coming to be appreciated more and more. Few of the engineering schools do not now give instruction along these lines.. Therefore any book dealing with the subject of technical writing is of interest from this point of view.

However, this book by Professor Earle is of interest to more than the engineering student or the teacher. Professor Earle draws attention to the fact that the engineer makes use of a form of expression no less special than that of the lawyer, the novelist, or the poet; and the engineer no less than the members of the other professions, needs special training in writing, over and above all that he may get in general composition. In this volume a study of some of the fundamental problems of technical writing is given in an accurately, orderly and logical sequence.

The book will be of service to the student as an introduction to technical writing, and to the engineer of some years' standing, as a concise presentation of what he perhaps already appreciates in a general way.

Theory and Practice in Designing. By Henry Adams. Published by Constable & Company, London. Cloth; 5¾ x 8¾ in.; 240 pp., including index; 371 illustrations. Price $2 net.

The author has written many books on designing, but this one is quite distinct from the others. In this treatise the theory of structures is dealt with, from the most elementary examples of simple beams and columns, to the more involved cases of trusses, continuous girders, arches and suspension types. Elementary mathematics are used throughout, and graphic status are used wherever possible.

The subject matter taken up includes safe loads, stresses in different structures, bending moments, moments of inertia, foundations, riveting, designing of girders, trusses, roof trusses, columns, cantilevers, suspension bridges, arches and retaining walls. In fact, the subjects covered are too numerous to allow of very extensive treatment in the book; for this reason formulae are given without their theoretic analysis and basis. There are many valuable details given throughout the volume which will appeal to the young designer. The different elements of design are illustrated by examples which are worked out arithmetically.

The book appeals more to the draughtsman and designer who has not had the advantage of a course in a technical college, and who is without a knowledge of higher mathematics. To such a man the book will be valuable. It should also be useful to the architect and structural engineer. It, however, would have been better to have omitted on the other hand the inclusion of such matter as the elementary principles of trigonometry, and at the extreme, the treatment of arches and suspension bridges. This constitutes the objection to the book in that the attempt is made for too broad a treatment of the subject of design of structures.

Aside from the above mentioned objection, the book will be found to be a useful one.

Structural Engineering. By Joseph Husband and William Harby. Publishers: Longmans, Green & Co., London. Cloth; 6x9 in.; 396 pp.; 32 tables; 337 cuts. Price $2.50.

Books on structural engineering fall usually into two classes: those which treat the subject from a purely theoretical standpoint and those which deal mainly with regard to the practical arrangement of structural details. Between the theoretical analysis of stresses and loads and their application to a practical design there exists a gap which, in the literature existing at the present time on the subject, is not very well bridged. In this volume the endeavor is made to combine these two divisions, treating the theoretical side of the design first and leading up to the practical application to the actual incorporation in the structure of the different elements composing the finished work. The mistake so often made in volumes treating technical subjects, of endeavoring to cover too wide a field, has been avoided, by confining the consideration to simple structures and details of everyday occurrences. This principle could have been carried to advantage even further by omitting a chapter on the materials of construction. The book is well arranged, leading logically from loads and stresses, bending moments and sheering forces to the elements making up the structure, such as beams, columns and struts, plate girders and lattice girders; then follow chapters on deflections, roofs, miscellaneous applications and tall buildings and masonry and masonry structures.

The chapter on columns and struts is very good, covering the different formulae in use, noting their applications and restrictions, and giving many numerical examples when applied to actual design.

The book is a decide d addition to the literature of the subject and should prove of general utility to the student and draughtsman having occasion to make use of it.

Home Waterworks. By Carleton J. Lynde. Published by Sturgis & Walton Company, 31 East 27th Street, New York. Size, 5x7. Pages, 280; illustrated. Price 75c. net.

The obtaining and introduction of water into houses and outbuildings, and the domestic utilization of water-power are

the subjects treated in this volume. This thoroughly practical book meets a widely recognized need for information, and is written by a specialist.

Thousands of men living in rural parts of Canada, out of reach of a public water system, have equipped their homes with water supply conveniences equal to any found in the cities. Thousands more who could well afford to do so and who could do so advantageously, have not done so for various reasons—because the idea has not occurred to them, or because they did not know how to go about it, or because they mistakenly thought the expense too great. To all such this book should prove of the greatest practical help.

The author of the book is Professor C. J. Lynde, of Macdonald College, Quebec, and the book contains chapters on the value of water indoors; first steps in kitchen equipment; sources of water supply—underground water; sources of water supply—wells and their requirements; sources of water supply—springs, rivers, lakes, and cisterns; properties of air supplied in pumps; pumps and their action; standard types of pumps; running water—the pneumatic tank; the siphon—the hydrostatic paradox—the kinetic theory; methods of pumping—hand power, horse-power and windmills; methods of pumping—the hydraulic ram; methods of pumping—the hot-air engine; method of pumping—the gasoline engine and steam engine; method of pumping—the electric motor; water power; plumbing and sewage disposal; acknowledgment; firms dealing in water supply and plumbing materials.

In addition to a table of contents there is an index well arranged and complete.

The book is interestingly written, and is correct as to statements, and is not so technical that it confuses. Being a manual of water supply in country homes, it is written more for the general reader than the engineer, yet the engineer will find much of interest.

The Canadian Almanac. Published by Copp-Clark Company, Toronto. Paper; 6 × 8¾ in.; pp. 504. Price, 60c. net.

This volume is now in its sixty-fifth year of publication. Every editor has seen additions and improvements rendering it more convenient and complete and ready of reference. The result of this continuous attention is exhibited in the numerous lists and pages of information not found elsewhere and presented in a way that saves much expenditure of time and pains. The publishers justly claim that in no other volume can so much information about Canada be found in so small a space. Among the principal subjects covered are the astronomical and tide tables; the complete customs tariff; weights and measures and foreign exchange. The banks, branches and names of managers are given; patents in Canada receive attention, and a full Canadian militia list is included. Complete post and postal information and newspaper statistics; particulars regarding the Dominion and Provincial Governments, the clergy of all denominations, the legal profession, educational institutions, life assurance companies and other societies are all to be found within its boards. This edition also includes maps of Manitoba, Alberta and Saskatchewan, showing railways and principal towns. The volume is clearly printed and is in every way a credit to its publishers.

Mechanics of Materials. By Professor Louis A. Martin. Published by Wiley & Sons, New York. Renouf Company, Montreal, Canadian agents. No. of pages 210; size 7½ × 5½. Price, $1.50.

Professor John Perry, speaking of the use of the mathematics by students, somewhere asserts that although they may be able to pass difficult examinations in the calculus, and to differentiate any function of x and to integrate many, their mathematical knowledge seems to be of no use to them in practical engineering problems. Professor Martin, in his academic work has evidently realized the same difficulty, for in "Mechanics of Materials" his method of treatment has been manifestly designed to encourage the student to apply his mathematical tools.

The little volume bearing the above name is the third of a series in uniform size, type and binding, issued by Professor Louis Martin, of Stevens Institute. Like its predecessors, it claims to be a text-book rather than a treatise and in this instance covers the work usually taught in schools of engineering as an introduction to structural and mechanical design. The work presupposes a knowledge of the conics and of the infinitesimal calculus as a preparation on the part of the student, and as stated above, the use of the latter in the derivation of formulae and the solution of problems is frequently made.

The volume devotes a chapter to stress and strain, and Hooke's law and proceeds at once to the theory of the beam. Of its two hundred pages over eighty are devoted to this element, and in consequence the treatment is quite as full as one would expect in a volume of its scope. The author in this connection develops in conjunction with, and by the aid of, graphics, the principle that the Moment, Shear and Load diagrams are derivative curves; that is, that the shear is the first derivative of moment, and method of loading the second, with respect to axial distance. This view will be instructive to students who have been previously trained to regard, for example, velocity and acceleration as the first and second derivatives of space with respect to time, and the one will undoubtedly elucidate the other.

Subsequent chapters are devoted to columns and struts, torsion in shafts, thin and thick cylinders under internal pressure, an introduction to the mathematical theory of elasticity and what in the texts is commonly known as compound stress. The writer is not quite clear why no reference is made to riveted joints.

The volume has much to commend it. The graphics are good, as is also the selection of problems, 276 in all, illustrating applications of the theories discussed. For these, the answers are appended, providing a source of much satisfaction to the conscientious students. A perusal of them shows, also, that the author is not merely an academician. The book will be read with profit by both teachers and students of the subject.—P. G.

Analytical Mechanics. By Professor Edwin Barton, University College, Nottingham. Published by Longmans, Green & Company; 525 pp.; 6 × 8¾. Price, $3.

This book differs from many recent texts for the use of students of mechanics in the extent of the field it covers. The tendency toward extreme differentiation in the teaching of science and the compilation of texts is evidently not regarded sympathetically by Professor Barton, for the excellently thorough work at hand discusses in turn Kinematics, Dynamics, Statics, Hydromechanics and Elasticity—subjects to each of which the modern tendency is to denote an entire volume. To read it intelligently, the student should possess a working knowledge of the differential and integral calculus and of differential equations, so that the text can scarcely be described as elementary. In fact the volume is manifestly intended more for the student of Pure than of Applied Mechanics, in that the exemplification of principles is rather more academic than practical, yet, notwithstanding this, it will be generally conceded that a knowledge of its contents would be of inestimable value to the student contemplating the study of engineering science. Occasional reference, his-

torical and otherwise, is made to the classics of Galileo, Newton, Thomson and Tait, Gauss, Lodge and others, but as to the controversial questions concerning the philosophical basis of the science, the author displays a commendable toleration. The large collection of selected problems is an excellent feature of the book, whose usefulness would undoubtedly have been somewhat increased had the answers to these been appended. In contrast with some of the texts that have appeared during recent years, especially from the American press, this volume displays discrimination in the compilation of matter, system in its arrangement, and care in its editiing, and on the part of the author, capacity and thoroughness. The book will constitute a real addition to the literature of this subject.—P. G.

Practical Cement Work. By W. B. Henry. Published by The Concrete Age Publishing Company, Atlanta, Ga. Size, 4 × 6½ in.; pp. 110. Price, 50c.

A practical little book on cement construction, which will be of interest to any one identified with the cement or building industry. The book contains short chapters on the materials of concrete and its use in construction.

Modern American Telephony. By Arthur Beasey Smith. Published by Frederick J. Drake & Company, Chicago, Ill. Size, 4½ × 7; leather bound; 790 pages, including index; 470 illustrations. Price $2.

This book is a treatise on Telephony in all its branches, compiled and edited by Mr. Smith. It includes descriptions of the installation, operation and maintenance of telephones, with a description of the different systems, chapters on power plants, different types of switchboards, protective devices, measuring instruments, line construction, etc. This is a book for the telephone engineer and the workers on telephone switchboards.

Ship Wiring and Fitting. By T. M. Johnston. Published by Constable & Co., Ltd., London. Cloth; size, 4¼ × 6½; 77 pages; illustrated. Price, 50c.

This book is intended to treat in a simple manner the systems of wiring most commonly used in the fitting of electrical apparatus on vessels of the mercantile class. The different adverse conditions which have to be contended with in installing electrical apparatus and the precautions necessary for safeguarding the efficiency of the work are discussed. The book is a concise treatise on the subject, and forms one of the electrical installation manuals issued by the publishers.

The Waterpowers of Canada. Issued by the Commission of Conservation, Canada, James White, Secretary. Authors, Leo. G. Denis and Arthur V. White. Cloth, 7 x 10 in., 397 pp.; well illustrated.

The first inventory ever taken of the water-powers of Canada has been completed by the Commission of Conservation and the results embodied in a large and profusely illustrated report just issued. The investigation made by the Commission, which has extended over a period of two years shows that there are 1,016,521 horse-power developed from water-power in Canada. Every phase of the subject from the laws governing the disposition of water-powers in the various provinces, to the actual physical data regarding each individual water-power concerning which information was obtainable, is treated in the report. In addition, there is a very full bibliography of 30 pages, and the appendices giving, among other things, the text of the laws concerning the export of power and also of the treaty recently concluded with the United States regarding the establishment of an International Joint Commission.

The volume opens with two chapters of an introductory nature that are concerned mainly with the general economic bearing of water-powers on national development. The relation of water to agriculture, mining, navigation, domestic supply and so forth, is dealt with, and the principles to be used in the interpretation of water-powers data are stated and discussed critically. The broad and optimistic statements very often made on the platform and in the press regarding our vast water-power resources are deprecated. To quote from the Report, "General statements implying that the aggregate amount of water-power must be great because the total water area, or watershed area is so great, or because there are so many lakes and rivers, are generalities to be considered of very little definite value . . . One of the chief dangers of such generalities is to create in the popular mind a feeling of unwarranted assurance that, even though desirable water-rights are being granted by a government, yet there is so much left that no apprehension may be entertained regarding the amount of power rights being parted with."

A chapter is devoted to the water-powers of each province in which the general features of the province as regards water-power development are discussed and an outline given of the law whereby powers are granted or leased to private individuals or corporations. The larger developments are also described. The statistical data given in tabular form includes the height of the fall, the horse-power that may be developed, the present development and the main uses to which the power is applied such as lighting, pulp and paper making, etc. Reference is also made to the possibility of increasing the amount of power developed by storage reservoirs and dams where such are feasible.

The power situation in Ontario is treated very fully, special attention being given to the power possibilities at Niagara and the conditions affecting development there. Each of the power companies operating there, whether on the Canadian or American side, is described in detail. A significant reference is made to the granting of franchises to develop power at Niagara Falls. The report states that the low-water flow of the Niagara river would yield at the Falls, about 2,250,000 H.P., of which Canada's share (one-half), would be 1,125,000 H.P. "Franchises have already been granted," it goes on to say, "and plants partially completed, for the development on the Canadian side of the river, of about 450,000 H.P. In other words, instead of 'millions' of horse-power being available, as has been sometimes stated, it appears that about half, and by all odds the better half, of Canada's usable share of Niagara Falls power has already been placed under private control."

The volume embodies all the useful information regarding the water-powers of Canada that has heretofore been collected and this has been supplemented and, in many cases, verified, by field surveys, conducted by the engineers of the Commission. In fact, all the information regarding the Maritime Provinces powers was obtained in this way last year by the experts of the Commission. The data regarding the Western Provinces was found to be so incomplete that it was decided to make special investigations of the powers in those Provinces, the results of which will be published next year in the form of a report on the "Water-Powers of Western Canada." The engineers of the Commission are now engaged upon this work.

PUBLICATIONS RECEIVED.

Publications of the Canada Department of Mines, Mines Branch. The production of cement, lime, clay products, stone and other structural materials in Canada during the calendar year 1910.

The Production of Coal and Coke in Canada during the year 1910.

The Production of Iron and Steel in Canada in the year 1910.

A general summary of the mineral production of Canada during the year 1910.

The above four pamphlets are edited by John McLeish, chief of the division of mineral resources and statistics.

Geological Surveys Branch. The Bighorn Coal Basin, Alberta. Memoir No. 9E; by G. S. Malloch.

The Clay and Shale Deposits of Nova Scotia and portions of New Brunswick. Memoir, No. 16E; by Heinrich Ries, assisted by Joseph Keele.

Report of the Department of Naval Service for the year ending March 31st, 1911. Price 10c.

Forty-fourth annual report of the Department of Marine and Fisheries, 1910 and 1911. Price 30c.

Bulletin No. 229. Olive Oil, issued by the Laboratory of the Inland Revenue Department, Ottawa, Canada.

Bulletin No. 227. Fertilizers; Laboratory of the Inland Revenue Department, Ottawa, Canada.

Avalanches and Forest Cover in the Northern Cascades; by Thornton T. Munger. Circular No. 173, Forest Service, United States Department of Agriculture, Washington, D.C.

The Year Book of British Columbia, 1911. Issued by the Government of British Columbia; bound in red cloth and containing a manual of provincial information. Copies of the Year-Book may be obtained at $1.15 per copy by applying to the King's Printers, Victoria, B.C.

Report of Proceedings of American Mining Congress. Fourteenth annual session held in Chicago, Ill., October 24th to 28th, 1911. Published by the American Mining Congress at the office of the Secretary, Denver, Col.

The Concrete Institute. Transactions and Notes. Vol. III. Published November, 1911, at the offices of the Concrete Institute, Denison House, 296 Vauxhall Bridge Road, Westminster, England.

Factories and Warehouses of Concrete. Published by the Association of American Portland Cement Manufacturers, Philadelphia, Pa. Price 50c. Part of this volume was published in a recent issue of The Canadian Engineer. The Canada Cement Company, of Montreal, have ordered a number of these books and will send them out free to architects, engineers and manufacturers, except for the cost of mailing, which will amount to 12 cents. Copies may be secured from L. S. Brunner, manager of publicity, Canada Cement Company, National Bank Building, Montreal.

Saxon Portland Cement Company Diary. A diary for 1912 issued by the Saxon Portland Cement Company, of Cambridge. Bound in a very artistic manner with padded blue cover. Copies may be had from the Saxon Portland Cement Company, Cambridge.

CATALOGUES RECEIVED.

Scraper Bucket Excavators. Pamphlet No. 427; issued by the H. Channon Company, Chicago, Ill., illustrating different types of their scraper bucket excavators. A very handsome catalogue.

Automatic Sprinkler Bulletin. Issued by the General Fire Extinguisher Company, New York, January, 1912.

Continuous Feed Bronzing Machine. Pamphlet illustrating the Kolboch Flat Continuous Feed Bronzing Machine. United States representatives, C. B. Henschel Manufacturing Company, Milwaukee, Wis.

Carbonizing Coating. Pamphlet issued by the Goheen Manufacturing Company; illustrating different works on which their carbonizing coating for the preservation of steel has been used.

Compressors. Bulletins 34A, C. E. and H, issued by the Chicago Pneumatic Tool Company, illustrating different types of their steam-driven and gasoline-driven compressors, with instructions for installing and operating. Offices, Fischer Building, Chicago; 50 Church Street, New York.

Air Compressor. Folder issued by Canadian Rand Company, Commercial Union Building, Montreal, illustrating the Rand Class "C2" compound straight line, steam-driven air compressors.

"SKF Radial Bearings" is the title of a bulletin just issued by the S.K.F. Ball Bearing Company., 50 Church St., New York. This bulletin explains the construction peculiarities, particularly the provision of self-alignment, of SKF Radial Bearings, and gives dimensions, speeds and capacities of the principal types and sizes.

Boiler Tools. An illustrated folder showing the Faessler octagonal sectional expanders, roller expanders, and flue cutting machine. Return post card attached. J. Faessler Manufacturing Company, Moberly, Mo.

Sewage Lifting Apparatus. "The Priestman Ejector System" and "Progress in Sewage Treatment No. 7" have just been issued by Merritt & Company, Camden, N.J., and deal mainly with the Priestman Ejector System and the subject of Sewage Pumping. "The Priestman Ejector System" is in the form of a proposition containing 14 pages, size 8½ × 11, and takes up first the various applications of the Priestman hydro-pneumatic ejector, as for instance, in parts of a sewer system at sewage purification works, or for the basement of deep buildings. These applications are discussed at further length after a page devoted to a concise description of how a Priestman Ejector operates without any moving parts in contact with the sewage and how the compressed air is made to work expansively for discharging sewage. In subsequent pages the various advantages of this type of sewage pumping apparatus are given, and also details regarding its construction. A table of standard types covering capacities from 5-2000 G.P.M. and tables giving the dimensions of standard ejectors of both the vertical type and hemispherical type are then given. Standard dimensions of the horizontal type are not included since, as it is stated, the design and installation of horizontal ejectors depends upon local conditions. Ejectors of this type are used where the amount of head room available is very limited. The last two pages comprise data sheets which outline the figures which are necessary for proper recommendation of the ejector systems in basements of deep buildings or for city pumping stations.

The second publication "Progress in Sewage Treatment No. 7" is a technical paper, size 6 × 9, 24 pages, 18 of which are devoted to articles, 3 to editorial matter and 3 to advertisements. The leading article is from a report by Mr. Geo. T. Hammond, M. Am. Soc. C.E., and is entitled "Automatic Sewage Lifting Station Equipment." It analyzes the various advantages of the centrifugal pump and the compressed air ejector, pointing out among other facts that "the pneumatic ejector is an especially satisfactory means of lifting sewage wherever a reliable apparatus is desired for handling a small quantity of flow, or a considerable quantity coming to the plant in a variable amount. The centrifugal pump works best where the flow is quite constant and of considerable quantity."

Several valuable tables are given, as for instance the average efficiency of centrifugal pumps and of compressed air in pneumatic ejectors. Following Mr. Hammond's article, some six pages are devoted to an article on pneumatic ejectors abstracted from the Surveyor, London, and another describing the sewage ejectors at the Pennsylvania Station,

N.Y. The eighteen Priestman Ejectors in use at this plant handle a flow of sewage equivalent to that which would be contributed by a city of 40,000 inhabitants.

In the editorial section a page is devoted to the Water Waste at Memphis, by flush tanks, and another to the subject of Mr. Hammond's paper. Particular reference is made to the table of efficiency of compressed air in ejectors, and a note is given covering the equations for adiabatic air compression.

Both of these publications, i.e., "Progress in Sewage Treatment No. 7," as well as "The Priestman Ejector System" are for general distribution, and will be sent upon application to the Hydraulics Department, Merritt & Company, Camden, N.J.

TESTS OF PULLEYS.

An extended series of tests was recently made with different kinds of pulleys transmitting power by means of leather belts, on a belt-testing machine in the laboratory of Sibley College, Cornell University. The tests were all made with single-ply oak-tanned leather belts 5 in. wide, 0.224 in. thick and 33 ft. long. The pulleys were all nominally 24 in. diam. with 8-in. faces. A constant belt speed of 2,200 ft. per min., or 348 r.p.m. of the driving pulley, was maintained throughout. Cast-iron, wood, and paper pulleys were used, including some with cork projections. The exhaustive character of the tests is shown by the fact that for cast-iron pulley tests alone nearly 9,000 observations of the slip of the pulleys were taken.

The results of these tests were given, in a paper by Prof. W. M. Sawdon, before the National Association of Cotton Manufacturers.

The tests showed that for slips of 1 to 2 per cent., as commonly used in practice, the plain cast-iron pulley had the lowest values of coefficient of friction and the plain paper pulley had the highest. The values of the plain wood pulley lay between these limits. Wood pulleys up to ½ per cent. slip followed very closely the performance of the paper pulleys, after which the slip increased rapidly, and at 1 per cent. the coefficient of friction was only approximately a mean between those of the cast-iron and the paper pulleys. Beyond 3 per cent. slip the coefficient of friction was less than that for cast iron. This condition explained in part a commonly accepted understanding that the wood pulley had a small capacity for carrying an overload. To take care of overload capacities as much as 50 per cent. of the normal load, the wood pulleys must be designed larger in diameter or for use with a wider belt than the normal load would demand.

Pulleys with cork inserts 1¼ in. diameter, set in 1 1/16 in. diameter sockets and spaced 2¼ in. between centres, and of composite construction, were tested. This gave a cork area of from 37 to 39 per cent. of the total pulley face. The usual practice was to make the cork area from 25 to 33⅓ per cent. of the total area. Two separate and complete tests were made on the cork inset pulleys, one for a projection of the corks of approximately 1/32 in. beyond the pulley face and the other for a projecion of approximately 1/64 in. In the case of the cast-iron pulleys, each of the cork-insert curves showed a material increase in the values of the coefficient of friction at lower slips and running up to 3 per cent. For the longer corks the values of the coefficient of friction between 1 and 6 per cent. slip were close to those of the plain wood pulleys. Below 1 per cent. slip the wood pulleys had the higher values. With the shorter corks, considerable advantage was shown over plain cast-iron pulleys as well as plain wood pulleys up to about 4 per cent. slip, after which the coefficients were but little higher than for the plain cast iron. Either of the cork insert cast-iron pulleys, however, showed a large overload capacity at high slips. In the wood pulleys the cork inserts slightly increased the transmitting capacity for very low slips and up to about ½ of 1 per cent. Between ½ and 1¾ per cent. slip the plain wood pulleys had the higher values, while beyond 2½ per cent. the cork inserts again showed an advantage. This was particularly interesting in that, though capable ultimately of carrying much greater loads, through the allowable ranges of slip, the cork inserts actually proved detrimental. The tests on the paper pulleys with cork inserts were also interesting in that in each case the use of cork inserts had proven detrimental to the transmitting capacity of the pulleys for practically the entire range of slip. For the longer cork projection this was more marked than for the shorter. Unfortunately, in the paper and in the cork pulley tests, the capacity of the machine did not permit of higher loads being carried to determine the maximum values of the coefficient of friction and corresponding slips.

A NEW BRIDGE IN EGYPT.

In connection with the opening up for navigation purposes of that branch of the River Nile at Cairo, known as the Bahr-el-Aama, and the proposed realignment of the navigable channel of the river, tenders for the construction of an entirely new bridge to replace the existing Pont des Anglais were invited by the Egyptian Public Works Department from all the leading bridge engineering firms of Great Britain, Continental Europe and North America.

Out of six tenders submitted that of the Cleveland Bridge and Engineering Company (Limited), of Darlington, England, has been accepted. The firm undertakes to complete the bridge in 22 months, the price being $300,000. The bridge is required to accommodate road and tramway traffic and there will be footpaths carried upon cantilevers on either side, the width of the bridge between parapets being 19 metres. In addition to two approach spans there will be a rolling lift span giving a clear opening for river traffic of 63 metres. The bridge is of a distinctly artistic design, and will be finished in ashlar, drawn from quarries near Cairo.

OBITUARY.

The death is reported of Mr. H. J. Fairweather, electrical engineer in charge of the power-house of the Canadial General Electric Works, at Peterborough, Ont. Mr. Fairweather was drowned while cleaning away ice in the flume. His original home was New Brunswick, where his wife, a daughter of Mr. R. B. Rogers, C.E., and a two-weeks-old baby are at present.

PERSONAL.

Captain W. C. Hemeon has been appointed harbor master of the Port of Liverpool, province of Nova Scotia.

Mr. E. C. Miller has been appointed Toronto representative of Messrs. T. Pringle & Sons, Coristine Building, Montreal. Mr. Miller will locate his office at 509 Continental Life Building.

Mr. Chas. K. Howard, former travelling freight agent of the Canadian Pacific Railway, with headquarters at Fredericton, N.B., has accepted an appointment with the St. John and Quebec Railway Company.

James Oborne, general superintendent of the C.P.R. at Toronto, has been appointed general superintendent at Vancouver, B.C.

Prof. L. B. Stewart, of Toronto, has been elected president of the Royal Astronomical Society of Canada. Prof. Stewart is professor of Surveying, Faculty of Applied Science, Toronto University. He was one of the first professors

Prof. L. B. Stewart.

appointed on the staff of the old School of Science, which later became the Faculty of Applied Science and Engineering of the University of Toronto. He is one of the few men in Canada who hold the degree of D.T.S. (Dominion Topographic Surveyor.)

Mr. E. Cousins, as announced in last week's issue, has been appointed to the position of engineer to the Commission of Harbors, City or Toronto. Mr. Cousins has been an as-

Mr. E. Cousins.

sistant engineer for Toronto since July, 1910, having had charge of the railway department since his appointment, and of bridges and docks since last February. The plans which he has prepared for the city include the Ashbridge Bay docks, Princess street dock, groynes at Kew and Balmy Beach, sea wall and the underground railways and civic surface lines. He has also had superintendence over the Don industrial tracks, Sunnyside grade separation, Don high level bridge, completion of Wilton avenue bridge, and Weston road viaduct construction.

Mr. Cousins is an honor graduate of the Faculty of Applied Science, University of Toronto.

Mr. W. L. Woodroofe has been appointed to the position of electrician for the city of Vancouver, B.C. Mr. Woodroofe has had considerable experience with the British Columbia Electric Railway.

THE ANNUAL DINNER OF THE FACULTY OF APPLIED SCIENCE, UNIVERSITY OF TORONTO.

The twenty-third annual dinner of the Engineering Society of the Faculty of Applied Science and Engineering of the University of Toronto, was held on January 18th in the Convocation Hall of the University of Toronto, Mr. W. B. McPherson the president of the Engineering Society was in the chair.

A very interesting address on the progress of the work undertaken by the Dominion Conservation Commission was given by Secretary Patton of that body, who came at the request of the chairman, Mr. Clifford Sifton, after the commission closed its annual meeting at Ottawa.

Dr. Ellis responded to the toast of the University, and Mr. W. F. Tye, consulting engineer, and president elect of the Canadian Society of Civil Engineers, responding to that of "The Engineering Profession," gave the students a history of old-time engineering as compared with that of the present, pointing out the difference in the way the profession and the public used to treat graduates of engineering schools and the way they are now treated.

Mr. George Guess, the new professor of metallurgy, was introduced, and spoke briefly. Dean John Galbraith made a short speech on engineering and university topics in general.

Student representatives were present from McGill and Queen's Universities, and among the guests were Mr. W. B. McPherson, K.C., M.P.P.; Mr. P. W. Ellis, of the Toronto Hydro-Electric Commission; Mr. J. W. Tyrrell, the Arctic explorer, of Hamilton; Mr. P. W. Sothman, chief engineer of the Ontario Hydro-Electric Commission; Mr. C. H. Rust, outgoing President of the Canadian Society of Civil Engineers; Dean B. E. Fernow of the University Faculty of Forestry; Engineers J. G. Sing, Willis Chipman, and T. Aird Murray, and Controller Church. The School of Science Orchestra and the science octette gave several selections.

ANNUAL MEETING BUILDERS' EXCHANGE, MONTREAL.

The keynote of the toasts which were proposed at the annual banquet of the Builders' Exchange in Montreal on January 9th, was constructive throughout, covering the building up of the Dominion, of the city, and of the nation. There were present two Cabinet Ministers, the Postmaster-General, Hon. Louis B. Pelletier, and Hon. Dr. Sproule, as well as ex-Postmaster-General Rodolphe Lemieux, the first named urging better transport facilities for the wheat harvest and the formation of a Canadian Lloyds route, while Dr. Sproule deprecated the letting loose of strikes by unions just at the inopportune time, and also took a fling at the trusts.

There were about 180 guests present at the banquet in the Windsor Hotel, under the presidency of Mr. James J.

Ballantyne. Mr. Ballantyne spoke briefly on behalf of the exchange, and made allusion to the hardship suffered by builders in regard to stone coming in. He advocated the raising of the duty, and pleaded that some measure of protection should be given the builders against American contractors.

ELECTIONS OF ROYAL ASTRONOMICAL SOCIETY OF CANADA.

Professor L. B. Stewart, of Toronto, was elected president of the Royal Astronomical Society of Canada at the annual meeting of the society. Dr. W. F. King, C.M.G., Ottawa, was elected honorary president; Mr. J. S. Plaskett, B.A., Ottawa, first vice-president; Dr. A. D. Watson, Toronto, second vice-president; Mr. J. R. Collins, Toronto, secretary; Mr. Charles B. Sparling, Toronto, treasurer; Mr. Lachlan Gilchrist, M.A., Toronto, recorder, and Dr. W. M. Wunder, Toronto, librarian. The executive committee was the same as last year, with the exception that G. Parry Jenkins, F.R.A.S., of Hamilton, was elected to a vacancy. It was announced by the representatives from Guelph that Mr. Henry Westerby, the president of the branch, had presented the society with a six-inch telescope, which is the same size as the one in the tower in the Meteorological Observatory in Toronto.

COMING MEETINGS.

THE CANADIAN SOCIETY OF CIVIL ENGINEERS.—Jan. 24. 25, 26, 1912, General meeting, 413 Dorchester St. West, Montreal. Prof. C. H. McLeod, Secretary.

CANADIAN FORESTRY ASSOCIATION.—February 7th and 8th, 1912. Forestry Convention Meetings held in the Railway Committee Room, Parliament Buildings, Ottawa. Secretary, Mr. James Lawler, Canadian Bldg., Ottawa.

CANADIAN LUMBERMEN'S ASSOCIATION.—February 6, 7 and 8, 1912. Annual Meeting to be held at the same time and place as the Canadian Forestry Association.

CANADIAN NATIONAL ASSOCIATION OF BUILDERS.—The Sixth Annual Convention will be held in Toronto, February 20, 1912.

ONTARIO GOOD ROADS ASSOCIATION.—Annual Convention to be held at Toronto, February 26, 27, 28. Secretary, J. E. Farewell, Whitby.

THE CLEVELAND ENGINEERING SOCIETY.—Regular Meeting, Tuesday Evening, February 13, 1912, Chamber of Commerce Bldg., Cleveland, O. Address by Mortimer E. Cooley, Dean, Department of Engineering, University of Michigan: Subject: "Public Utilities and Their Relation to the Public." Secretary, F. W. Ballard.

ENGINEERING SOCIETIES.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—413 Dorchester Street West, Montreal. President, C. H. Rust; Secretary, Professor C. H. McLeod.

QUEBEC BRANCH—
Chairman, P. E. Parent; Secretary, S. S. Oliver. Meetings held twice a month at Room 40, City Hall.

TORONTO BRANCH—
96 King Street West, Toronto. Chairman, T. C. Irving; Acting Secretary, T. R. Loudon, University of Toronto. Meets last Thursday of the month at Engineers' Club.

MANITOBA BRANCH—
Secretary E. Brydone Jack. Meets every first and third Fridays of each month, October to April, in University of Manitoba, Winnipeg.

VANCOUVER BRANCH—
Chairman, Geo. H. Webster; Secretary, H. K. Dutcher, 319 Pender Street West, Vancouver. Meets in Engineering Department, University.

OTTAWA BRANCH—
Chairman, S. J. Chapleau, Ottawa; Secretary, H. Victor Brayley, N. T. Ry., Cory Bldg.

MUNICIPAL ASSOCIATIONS.

ONTARIO MUNICIPAL ASSOCIATION.—President, Chas. Hopewell, Mayor, Ottawa; Secretary-Treasurer, Mr. K. W. McKay, County Clerk, St. Thomas, Ontario.

UNION OF ALBERTA MUNICIPALITIES.—President, H. H. Gaetz, Red Deer, Alta.; Secretary-Treasurer, John T. Hall, Medicine Hat, Alta.

THE UNION OF CANADIAN MUNICIPALITIES.—President, W. Sanford Evans, Mayor of Winnipeg; Hon. Secretary-Treasurer, W. D. Lighthall, K.C., Ex-Mayor of Westmount.

THE UNION OF NEW BRUNSWICK MUNICIPALITIES.—President, Councillor Siddall, Port Elgin; Hon. Secretary-Treasurer, J. W. McCready City Clerk, Fredericton.

UNION OF NOVA SCOTIA MUNICIPALITIES.—President, Mr. A. E. McMahon, Warden, King's Co., Kentville, N.S.; Secretary, A. Roberts, Bridgewater, N.S.

UNION OF SASKATCHEWAN MUNICIPALITIES.—President, Mayor Bee, Lemberg; Secretary, Mr. Heal, Moose Jaw

CANADIAN TECHNICAL SOCIETIES.

ALBERTA ASSOCIATION OF ARCHITECTS.—President, G. M. Lang; Secretary, L. M. Gotch, Calgary, Alta.

ASSOCIATION OF SASKATCHEWAN LAND SURVEYORS.—President, J. L. R. Parsons, Regina; Secretary-Treasurer, M. B. Weeks, Regina.

ASTRONOMICAL SOCIETY OF SASKATCHEWAN.—President, N. McMurchy; Secretary, Mr. McClung, Regina.

BRITISH COLUMBIA LAND SURVEYORS' ASSOCIATION.—President, W. S. Drewry, Nelson, B.C.; Secretary-Treasurer, S. A. Roberts, Victoria, B.C.

BUILDERS, CANADIAN NATIONAL ASSOCIATION.—President, E. T. Nesbitt; Secretary Treasurer, J. H. Lauer, Montreal, Que.

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

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Secretary-Treasurer, Wm. Snaith, 57 Adelaide Street, Toronto, Ont.

CANADIAN CLAY PRODUCTS' MANUFACTURERS' ASSOCIATION.—President, W. McCredie; Secretary-Treasurer, D. O. McKinnon, Toronto.

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

CANADIAN FORESTRY ASSOCIATION.—President, Thomas Southworth, Toronto; Secretary, James Lawler, Canadian Building, Ottawa.

CANADIAN GAS ASSOCIATION.—President. Arthur Hewitt, General Manager Consumers' Gas Company, Toronto; J. Keillor, Secretary-Treasurer, Hamilton, Ont.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, W. Doan, M.D., Harrietsville, Ont.; Secretary-Treasurer, Francis Dagger, 21 Richmond Street West, Toronto.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President, Dr. Frank D. Adams, McGill University, Montreal; Secretary. H Mortimer-Lamb, Windsor Hotel, Montreal.

CANADIAN PEAT SOCIETY.—President, J. McWilliam, M.D., London, Ont.; Secretary-Treasurer, Arthur J. Forward, B.A., 22 Castle Building Ottawa, Ont.

THE CANADIAN PUBLIC HEALTH ASSOCIATION.—President, T. A Starkey, M.B., D.P.H., Montreal. Secretary, F. C. Douglas, M.D., D.P.H. 51 Park Avenue, Montreal.

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

CANADIAN STREET RAILWAY ASSOCIATION.—President, D. McDonald, Manager, Montreal Street Railway; Secretary, Acton Burrows, 70 Bond Street, Toronto.

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

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto, President, G. Baldwin; Secretary, C. L. Worth, 409 Union Station. Meets third Tuesday each month except June, July, August.

DOMINION LAND SURVEYORS.—President, Thos. Fawcett, Niagara Falls; Secretary-Treasurer, A. W. Ashton, Ottawa.

EDMONTON ENGINEERING SOCIETY.—President, J. Chalmers; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alberta.

ENGINEERING SOCIETY, TORONTO UNIVERSITY.—President, W. B. McPherson; Corresponding Secretary, A. McQueen.

ENGINEERS' CLUB OF MONTREAL.—Secretary, C. M. Strange, 9 Beaver Hall Square, Montreal.

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

INSTITUTION OF ELECTRICAL ENGINEERS.—President, Dr. G. Kapp; Secretary, P. F. Rowell, Victoria Embankment, London, W.C.; Hon. Secretary-Treasurer for Canada, Lawford Grant, Power Building, Montreal, Que.

INSTITUTION OF MINING AND METALLURGY.—President, Edgar Taylor; Secretary, C. McDermid, London, England. Canadian Members of Council:—Prof. F. D. Adams, J. B. Porter, H. E. T. Haultain, and W. H. Miller, and Messrs. W. H. Trewartha-James and J. B. Tyrrell.

INTERNATIONAL ASSOCIATION FOR THE PREVENTION OF SMOKE.—Secretary, R. C. Harris, City Hall, Toronto.

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

NOVA SCOTIA MINING SOCIETY.—President, T. J. Brown, Sydney Mines, C.B.; Secretary, A. A. Hayward.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, J. N. MacKenzie; Secretary, A. R. McCleave, Assistant Road Commissioner's Office, Halifax, N.S.

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

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

THE PEAT ASSOCIATION OF CANADA.—Secretary, Wm. J. W. Booth, New Drawer, 2263, Main P.O., Montreal.

PROVINCE OF QUEBEC ASSOCIATION OF ARCHITECTS.—Secretary J. E. Ganier, No. 5. Beaver Hall Square, Montreal.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—President, F. S. Baker, F.R.I.B.A., Toronto, Ont.; Hon. Secretary, Alcide Chausse, No. 5 Beaver Hall Square, Montreal, Que.

ROYAL ASTRONOMICAL SOCIETY.—President, Prof. Louis B. Stewart, Toronto; Secretary, J. R. Collins, Toronto.

SOCIETY OF CHEMICAL INDUSTRY.—Dr. A. McGill, Ottawa, President; Alfred Burton, Toronto, Secretary.

UNDERGRADUATE SOCIETY OF APPLIED SCIENCE, McGILL UNIVERSITY.—President, J. P. McRae; Secretary, H. F. Cole.

WESTERN CANADA IRRIGATION ASSOCIATION.—President, Wm. Pierce, Calgary; Secretary-Treasurer, John T. Hall, Brandon, Man.

WESTERN CANADA RAILWAY CLUB.—President, R. R. Nield; Secretary, W. H. Rosevear, 115 Phœnix Block, Winnipeg, Man. Second Monday, except June, July and August, at Winnipeg.

The Canadian Engineer

ESTABLISHED 1893—A WEEKLY PAPER

EDNESDAY, January 24, 1912.

ISSUED IN THE INTERESTS OF THE CIVIL, MECHANICAL, STRUCTURAL, ELECTRICAL, MARINE AND MINING ENGINEER, THE SURVEYOR, THE MANUFACTURER AND THE CONTRACTOR.

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ADVERTISING RATES ON APPLICATION.

The Twenty-Sixth Annual Meeting of The Canadian Society of Civil Engineers opens this morning in the rooms of the Society, 413 Dorchester Street West, and it is certain that it will be as successful as the previous meetings of the Society. Last year, at the Winnipeg meeting, there was a fine turnout, and the members who were present expressed themselves as feeling that that meeting was one of the best ever held by the Society.

This present meeting, held as it is in the home and birthplace of the Society, and in the commercial metropolis of Canada, will, no doubt, go down in the memories of those present as a most pleasant and successful event.

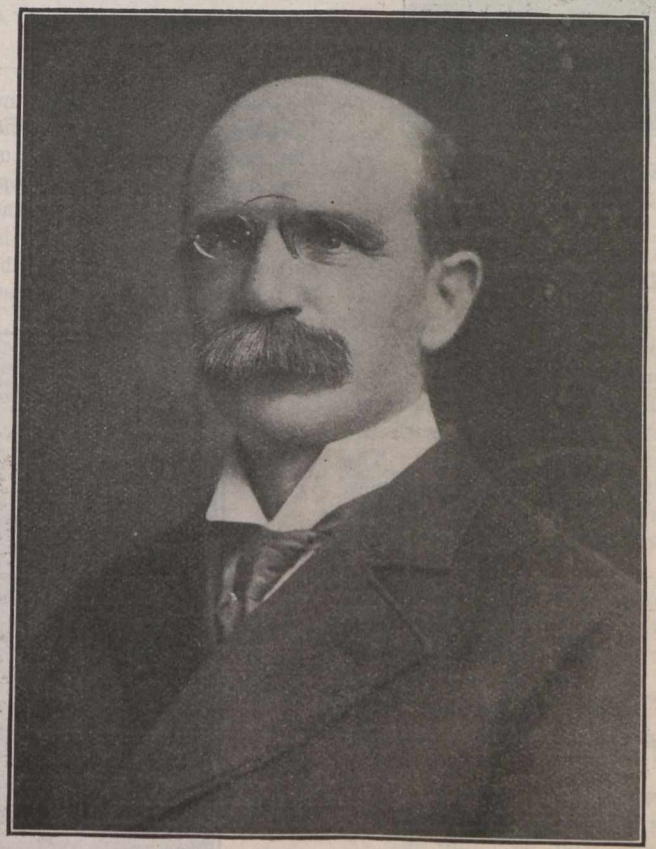
The meeting this morning opens at 10 a.m. The first business is the nomination of scrutineers, followed by the reception of report of Council, reception and discussion of the reports of Committees, and the transaction of the general business of the Society.

At 1.00 p.m. the meeting will adjourn for luncheon in the Windsor Hotel. The members resident in Montreal have very kindly arranged this luncheon for the visiting members.

After luncheon the business meeting will continue, for the discussion of reports and other business. At 4.00 p.m. the retiring President, Mr. C. H. Rust, will deliver his address.

In the evening, Dr. H. T. Barnes will deliver an address on "Iceberg Detection in Navigation," in the Lecture Hall of the Chemistry Building, McGill University, after which there will be a reception by the President and Members of Council, in the Engineering Building of the University, and an inspection made of the laboratories and workshops there.

The Engineering Building will be at the disposal of the Society for the evening, through the courtesy of the Board of Governors. Members and their friends, and ladies accompanying them, are invited to the reception and lecture. Cards can be procured from Secretary, Professor C. H. McLeod, at the rooms of the Society.



MR. C. H. RUST
City Engineer of Toronto—President of The Canadian Society of Civil Engineers.

THURSDAY, 25TH JANUARY.

The above closes the programme for to-day. To-morrow, two parties will be formed for the purpose of visiting different engineering works. The Angus Shops, the Dominion Bridge Company, the Canadian Car and Foundry Company will be visited. In this issue of the *Canadian Engineer* will be found discriptions of these several plants, illustrated by photographs, so that the members may have some idea of what the trips will cover.

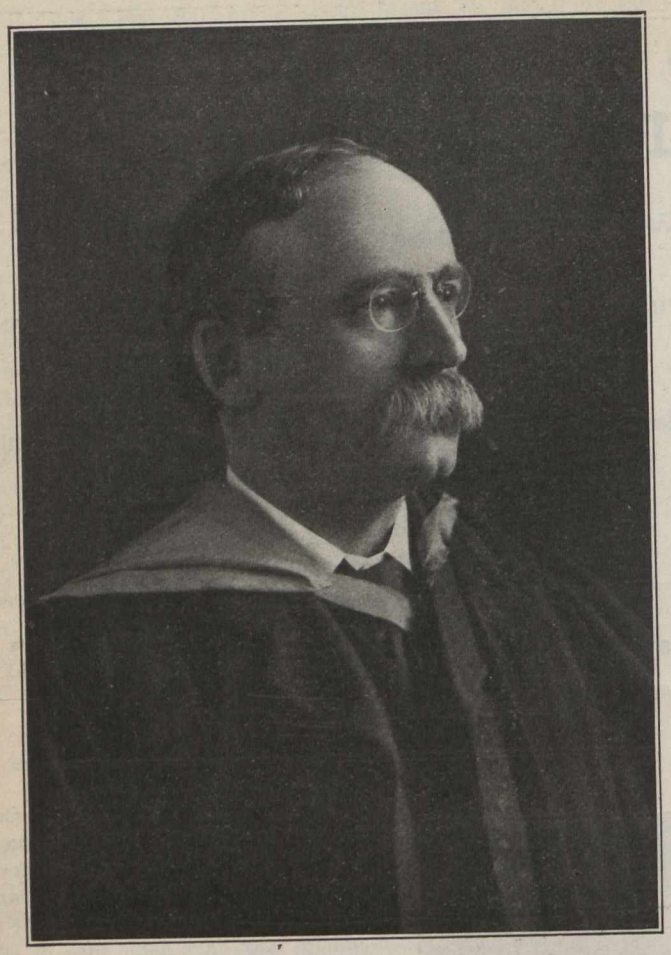
As the excursions will take a considerable time it will be necessary for the members to make a choice of which party they will join. Members intending to join either party must register and procure tickets.

One party will visit the Angus Shops. A special train will leave the Windsor Station of the Canadian Pacific Railway Company, at 10.00 a.m. Dining cars will be attached to the train and luncheon will be served during the inspection of the works.

The other party will inspect the works of the Dominion Bridge Company and the Canadian Car and Foundry Company. The Montreal Street Car Company have kindly furnished cars, which will be waiting at the the Windsor Hotel to convey this party to the Dominion Bridge Company Works. The cars will leave sharp at 10.30 a.m. The Bridge Company will provide luncheon for the party at 1.30 p.m., and the works of the Canadian Car and Foundry Company will be visited on the return journey.

Owing to the difficulties of providing luncheons, the excursions will be limited as to number as follows: To the Angus Shops, 150; to the Dominion Bridge Company and Canadian Car and Foundry Company, 100.

The Annual Dinner of the Society will be held at the Windsor Hotel, Thursday, at 8.00 p.m. Tickets can be procured from Secretary C. H. McLeod, at the rooms of the Society.



PROF. C. H. McLEOD, MA.E.
Secretary of the Canadian Society of Civil Engineers.

THE ENGINEERS CLUB OF MONTREAL.

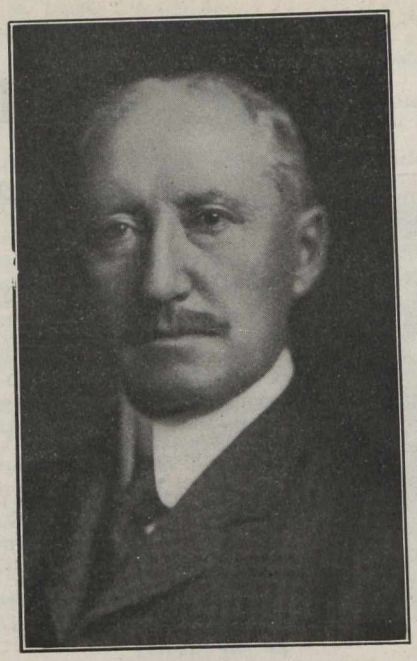
The Engineers Club of Montreal was organized and incorporated in 1903 by a number of Montreal engineers. While the by-laws were made broad enough to admit not only engineers and architects, but also others engaged in engineering work, the majority of the directors must be engineers. This qualification was included with the intention of preserving control in the hands of the engineers. The functions of the club are of a social nature. The charter members were about forty in number; there is now, however, a full membership of four hundred and fifty and a considerable number on the waiting list.

In 1905 the club purchased the Dow property on Beaver Hall Square, midway between up and down town. This is an ideal location for a club of such a character. On the property was located a fine residence, which, with a few additions and changes, was made into very homelike and comfortable quarters. The president of the club is Mr. H. H. Vaughan, and the secretary, Mr. Smith.

CANADIAN SOCIETY OF CIVIL ENGINEERS.

The Canadian Society of Civil Engineers is now in a most enviable position, as may be seen from the Report of Council for the year 1911. The Society is now in its twenty-sixth year. In the early years of its life, it struggled along under severe hardship. Now, however, the results of this early struggle are becoming apparent in the commanding position the Society has achieved. A great deal of praise is due the older members, who have spared no time or energy to further the interests of the Society and the profession.

At the present time the total membership, including honorary members, members, associate members, juniors, students and associates, is over 2,800. There has been an increase in membership during the last year of 143.

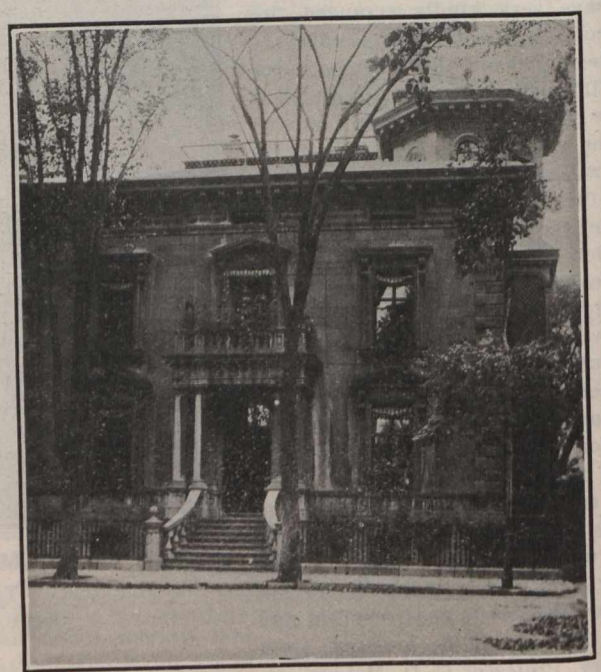


COL. H. N. RUTTAN

City Engineer of Winnipeg—Immediate Past President of the Canadian Society of Civil Engineers.

During the year a great many additional books were added to the library. The Library Committee reports, however, that accommodation for books is now exhausted. No doubt in the designs for the new building large and ample quarters will be given to this most important department of the Society's work.

The Treasurer also in his report states that the finances of the Society are in a most healthy condition. He adds that the revenue is increasing in a commensurate rate with the membership.



ENGINEERS CLUB, MONTREAL

The Society is to be congratulated on the faithful and enthusiastic officers who have had the handling of its business and finances during the past years. To Professor C. H. McLeod, as Secretary, and Mr. Ernest Marceau, as Treasurer, is due in no small measure the present flourishing condition.

Abstract of Report of Council for the Year 1911

Roll of the Society.

The elections took place as follows: Nine Members, eighty-four Associate Members, one Associate, twenty-seven Juniors, one hundred and thirty-four Students; in all two hundred and fifty-five.

Twenty-two Associate Members were transferred to the class of Member, one Associate was transferred to the class of Associate Member, two Juniors were transferred to the class of Associate Member, twenty-seven Students were transferred to the class of Associate Member, twenty-five Students were transferred to the class of Junior.

There have been seven deaths: four Members, one Associate Member, one Associate, and one Student. There have been removed from the rolls by resignation and on account of non-payment of dues, five Members, twenty-three Associate Members, three Associates, and eighty Students.

At present the membership stands as follows:

Hon. Members	14
Members	562
Associate Members	1,083
Associates	39
Juniors	54
Students	1,130
Total	2,882

At the same time last year the total Membership was as follows:

Hon. Members	14
Members	548
Associate Members	949
Associates	43
Students	1,185
Total	2,739

Annual Meeting.

The twenty-fifth Annual Meeting was held in the Royal Alexandra Hotel, Winnipeg, on the 24th, 25th, and 26th January, 1911, under the presidency of Mr. H. N. Ruttan.

The first session was called to order on Tuesday, January 24th, at 10 a.m., and the meeting was adjourned on Friday, January 27th.

Meetings.

The Council has held fourteen meetings during the year. There have been eight sectional meetings and four general or monthly meetings of the Society.

The following papers and addresses were presented:

General Section:

"The Sterilization of a Public Water Supply," by W. Muir Edwards, A. M. Can. Soc. C. E. (Read at the Annual Meeting in Winnipeg.)

"Aesthetics in Bridge Design," by C. R. Young, A. M. Can. Soc. C. E.

"The Upper St. Lawrence, Its International History, Development of Navigation and Future Possibilities," by Henry Holgate, M. Can. Soc. C. E.

"Notes on the Regulation of the River Nile," by A. W. Robinson, M. Can. Soc. C. E.

"Underground Conduit Construction," (illustrated by motion photographs), by Mr. Guy M. Gest.

Electrical Section:

"The Development of Efficiency in High Tension Transmission Insulators," by A. O. Austin.

"The Municipal Hydro-Electric Works of the City of Winnipeg, at Point du Bois Falls," by W. G. Chace, A. M. Can. Soc. C. E. (Read at the Annual Meeting in Winnipeg.)

"The Hydro-Electric Power Development of the British Canadian Power Company," by Messrs. N. R. Gibson, A. M. Can. Soc. C. E., S. M. Waldron, S. Can. Soc. C. E., and A. L. Mudge, A. M. Can. Soc. C. E. (Read at the Annual Meeting in Winnipeg.)

"The Operation, Construction, Application, and Characteristics of Induction Motors," by A. Miller Gray, A. M. Can. Soc. C. E.

"The Illinois Traction System," by Fred H. Williams, S. Can. Soc. C. E. (Read at a monthly meeting.)

"The Southern Power Company's Transmission Lines," by J. W. Fraser.

Mechanical Section:

"Recent Advances in Tool Construction," by Alex. Bertram, M. Can. Soc. C. E.

"The Construction and Operation of the Janney Universal Variable Transmission Device," by Mr. Newman. (Read at a monthly meeting.)

"Pneumatic Caisson Foundations for Tall Buildings," by Alex. Allaire, A. M. Can. Soc. C. E.

Branch Societies.

The several branches of the Society are as follows:

Vancouver—Headquarters, McGill College University.
Chairman, G. H. Webster.
Secy.-Treas., H. K. Dutcher.

Manitoba —Headquarters, University of Manitoba, Winnipeg.
Chairman, C. H. Dancer.
Secy.-Treas., E. E. Brydone-Jack.

Toronto —Headquarters, Engineers' Club, King Street West.
Chairman, H. E. T. Haultain.
Secy.-Treas., E. A. James.

Ottawa —Headquarters, 177 Sparks Street.
Chairman, A. A. Dion.
Secy.-Treas., H. V. Brayley.

Kingston —Headquarters, School of Mines.
Chairman, A. K. Kirkpatrick.
Secy.-Treas., L. W. Gill.

Quebec —Headquarters, City Hall.
Chairman, P. E. Parent.
Secy.-Treas., S. S. Oliver.

Committees.

The following have been the Committees of Council during the year:

Library and House Committee:

L. A. Herdt, Chairman. R. S. Lea.
James White. J. M. R. Fairbairn.
F. P. Shearwood.

Finance Committee:

J. M. Shanly, Chairman. W. J. Francis.
C. N. Monsarrat. E. Marceau.
G. H. Duggan.

The Gzowski Medal Committee:

R. S. Lea, Chairman.
E. E. Brydone-Jack.
W. J. Stewart.
A. E. Doucet.
J. Galbraith.

OFFICERS OF SECTIONS.

General:

Phelps Johnson, Chairman.
H. M. MacKay, Vice-Chairman.

Electrical:

L. A. Herdt, Chairman.
R. M. Wilson, Vice-Chairman.

Mechanical:

H. H. Vaughan, Chairman.
W. J. Francis, Vice-Chairman.

Mining:

H. E. T. Haultain, Chairman.

Educational Committee:

E. Marceau, Chairman.
H. Holgate.
L. A. Herdt.
J. M. Shanly.
C. H. McLeod.

Committee on Papers:

H. H. Vaughan, Chairman.
The Officers of Sections and the Chairmen of the several Branches.

GENERAL.

Two volumes of *Transactions* were published during the year, namely, Volume II for 1910, and Volume I for 1911. There has also been published a Bulletin No. 7, giving notes as to elections, etc.; an index of *Transactions*, Vols. I to XXIV, and a revised edition of Specifications for Portland Cement and Standard Methods for Testing.

In accordance with the Society's By-Law No. 27, a ballot was taken as to the term of office of the Vice-Presidents and Members of Council, elected in January, 1911, as follows:

Vice-President	for	three	years	J. G. Sullivan.
"	"	" two	"	Henry Holgate.
"	"	" one	"	C. E. W. Dodwell.
Councillor	for	three	years	P. S. Archibald.
"	"	"	"	E. E. Brydone-Jack.
"	"	"	"	C. R. Coutlee.
"	"	"	"	Phelps Johnson.
"	"	"	"	J. C. Kennedy.
"	"	"	"	P. E. Parent.
"	"	"	"	J. M. Shanly.
"	"	"	"	A. F. Stewart.
"	"	two	"	J. S. Dennis.
"	"	"	"	H. E. T. Haultain.
"	"	"	"	L. A. Herdt.
"	"	"	"	H. M. Jaquays.
"	"	"	"	J. G. LeGrand.
"	"	"	"	R. M. McColl.
"	"	"	"	J. T. Morkill.
"	"	"	"	W. J. Stewart.
Councillor	for	one	year	F. F. Busteed.
"	"	"	"	F. W. W. Doane.
"	"	"	"	A. E. Doucet.
"	"	"	"	C. L. Fellowes.
"	"	"	"	J. A. Hesketh.
"	"	"	"	H. G. Kelley.
"	"	"	"	D. MacPherson.
"	"	"	"	H. H. Vaughan.

The Council at a meeting held on 17th of February last, elected Mr. J. G. Sullivan to the office of Vice-President, thus filling the vacancy arising from the death of Mr. J. E. Schwitzer, and appointed Mr. H. M. Jaquays as Councillor to replace Mr. Sullivan.

In February last a Branch of the Society was formed in Kingston. There are now six branches in active operation.

Under the proposed amendments to By-Laws now before the Society, the educational status of candidates for admission will in future be determined in a more satisfactory manner than has been possible in the past. It is proposed to place the educational work of the Society under the direction of a special Committee, which will set papers and arrange to hold examinations at regular intervals in convenient centres throughout Canada, under the Chairmanship of approved Deputy Examiners.

The Council reports that the Society's house has been placed under option of sale, and that the Annual Meeting will be authorized to confirm the action of the Council and instruct it regarding the acquirement of new quarters.

Two proposals for a summer excursion were submitted to the membership in June last, but the response was not sufficient to warrant carrying out the suggested trips.

The Chairman of the Nominating Committee for Officers and Members of Council has suggested the following procedure for the conduct of the business of the Committees, and the Council has endorsed the same and recommends it to the Annual Meeting for its approval:

"After the election of a Chairman he should obtain from the three Past Presidents on the Nominating Committee the names of several men whom each of them would suggest to fill the offices of President and Vice-President, and from each of the district representatives several names, say four, of men whom each of them would suggest to represent their own districts on the Council. All of these suggested names should then be submitted to the whole Nominating Committee for ballot, so as to cut them down to two names for each vacancy, except the office of President, which should be cut down to one name only. The one thus selected for President, and the two for each of the other vacancies, or such names as might be substituted to replace men who declined nomination would then constitute the slate of the Nominating Committee to stand for election by the Society at large."

Mr. E. L. Corthell desires to call attention of the Society to a meeting of the Permanent International Association of Navigation Congresses, to be held in Philadelphia in 1912, and urges larger membership for Canada. The last meeting of this Commission, at which Canada was represented by the Hon. Mr. Brodeur, was held in Brussels on July 30th.

The following Committees of the Society have presented reports which have been distributed to the membership and will be presented to the annual meeting for consideration: Roadbed and Ballasting; Railroad Ties; Conservation; Good Roads; Testing Laboratories; Educational Requirements; Sewage Disposal; Steel Bridge Specifications; International Electro-Technical Commission.

In view of recent discussions regarding the relations between members of the Society and corporations employing them and of the reported attitude of members towards one another in connection with such incidents, the Council desires to call attention to the Society's code of ethics and asks the co-operation of the membership in maintaining that dignity and decorum befitting a great profession.

C. H. RUST, *President.*

C. H. McLEOD, *Secretary.*

THE ANGUS SHOPS OF THE C.P.R.

THE Angus Shops of the Canadian Pacific Railway at Montreal are the largest and best equipped shops in America for the manufacturing and maintaining of the rolling stock of a railway. They are situated at the east end of the city, and are built on an elevated plateau, overlooking, and at a height of 175 feet above the St. Lawrence River. With the enclosed yards the shops cover an area of 200 acres, and give employment to 6,000 men.

All of the buildings constituting the plant are laid out very regularly east and west of the main thoroughfare, or "Midway," and give the idea of a well-laid out town. From the engineering standpoint they are admirably located, the plant being laid out so as to ensure that material may be handled with the greatest dispatch.

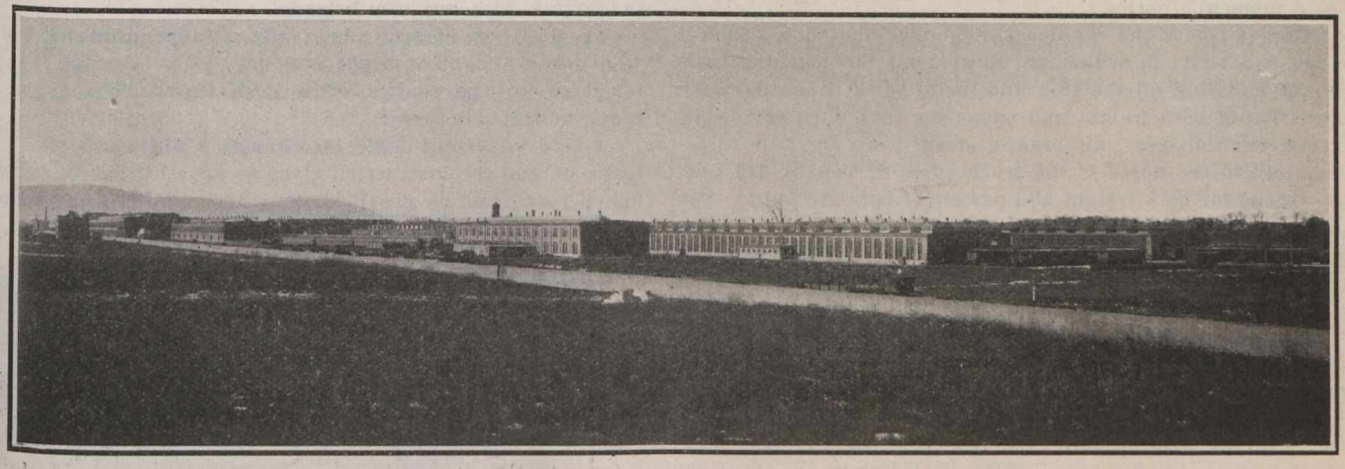
On entering the works from the general offices, the visitor finds himself looking north through the Midway, along the whole length of which travels a twenty-ton crane for handling material to and from the different shops, also for loading and unloading cars and waggons at the general storehouse.

Immediately to the left is the locomotive, erecting, boiler, and machine shop, a building 1,335 feet long by 163 feet wide, and high enough to allow powerful overhead cranes to travel the whole length of the building. It is divided longitudinally into three bays —the erecting shop, eight feet wide, the heavy machine shop, fifty feet wide, and a third bay, twenty-five feet in width, having a gallery the full width running from end to end, on which are located the brass finishing, tool, bolt, and tinsmiths' shops.

collected not only the materials required for use in the shops, but also those for carrying on the railway business in every department throughout the entire system, from a packet of tacks to a complete equipment of a sleeping or dining car. All classes of materials are systematically stored away in their own department, and so arranged that each shelf or bin carries a card showing the number and quantity of each article in stock, and what has been issued during the month, thus enabling the storekeeper in charge to see at a glance his requirements and arrange his orders for replenishing accordingly.

Immediately north of the storehouse, on the same side of the Midway, and separated by three tracks, is the forge and smithy, 435 feet long by 300 feet wide with a wing on one end 146 feet wide and one on the other end 230 feet wide, comprising an area of some 100,000 square feet. In the forge are steam hammers of all sizes suitable for the work, and furnaces for heating the largest billets used in locomotive construction, together with those furnaces for working up scrap, by the faggoting process, into blooms and billets. The smithy is equipped with the most modern and powerful forging machines, bulldozers, and drop hammers, for turning out standard and interchangeable details by the hundreds of thousands, for locomotives and car construction.

All the furnaces use oil as fuel, and in the centre of the shop, away up in the roof, are two large electrical driven fans, connected by capacious smoke ducts with hoods over each smith's hearth,



GENERAL VIEW OF THE ANGUS SHOPS.

The machine shop is so arranged that all machines used in the manufacture of any particular part or parts, are grouped together. This ensures that a part will not have to rtavel from one section of the shop to another in being finished, which is an important item in the scientific management practiced in these shops.

The boiler shop is situated in the west end of the main locomotive building, and is equipped with the most powerful and modern machine tools, capable of manufacturing the largest boiler required for use on any locomotive in the world. In an extension to the main building, separated by a brick wall, the tube cleaning and welding plants are situated, and also the flanging department. Another bay of the same extension forms the tank and tender shop, where the tender frames, trucks, and tanks are built and repaired.

The erecting shop is laid out on the longitudinal pit system, three erecting pits, running parallel with each other for 500 feet, giving standing room for 30 engines at one time. The whole building is well served with cranes.

Coming out of the locomotive shop, and immediately on the opposite or east side of the Midway, stands the general store house, a two storey building 594 feet long by 85 feet wide, in which is

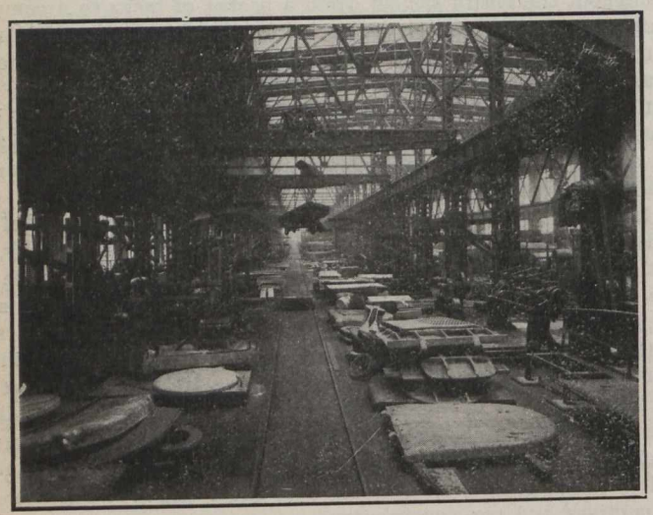
which draw all smoke up a central stack, leaving the shop very free from smoke, thereby conducting to the comfort and healthfulness of the workmen.

On the west side of the midway, to the north of the locomotive shop, is the grey iron foundry, 342 feet long, by 122 feet wide, capable of turning out 35 tons of castings per day. Outside the foundry there is a very convenient sorting and loading stage, with an electrical overhead travelling crane, carried on steel girders, forming a runaway 500 feet long, and a locomotive steam crane equipped with electrical magnets for handling the scrap iron.

Immediately west of the grey iron foundry is the frog and switch shop, a building 120 feet by 265 feet, where all the frogs, switches and their accesories are made for the entire system. Three hundred complete sets are made per month, six very powerful rail planners being a special feature of this shop, together with an immense rail saw for cutting off the rails to the required lengths. It cuts through an eighty pound rail in one minute with perfect ease.

North of the frog shop is the wheel foundry, the main building being 110 by 140 feet. This plant is one of the most modern on the

continent, everything being handled in a scientific manner, the moulds or chills being arranged in long rows, with overhead electric travelling cranes over each row. Three hundred wheels are turned out every day. Next to the foundry, on the same side of the Midway, stands the pattern shop, a two storey building, 50 feet by 232 feet, equipped with the most modern wood-working machines for pattern making, and immediately behind it a two-storey fire proof



building for the storage of patterns, in which they are systematically stored according to classification, so that any pattern can be located at a moment's notice.

Next in order comes the car department machine shop, 288 feet long by 130 feet wide, in which are located all the machine tools necessary for handling all the iron and metal work connected with the construction of both freight and passenger cars, such as wheels, axles, trucks, running gear, air brakes, steam heat, etc.

Immediately to the north is the truck shop, 82 feet by 434 feet, where the trucks for both freight and passenger cars are built. The wheels and axles are handled so systematically by machinery, that two men will turn out 150 pairs per day. A walk through the freight car erecting shop is a revelation to the layman; it is situated directly north of the truck shop, and is 107 feet wide by 640 feet in length. Here you see forty ton box cars, "begun and finished while you wait." The cars are finished and ready for the road, turned out completely at the rate of 30 per day. Crossing over the Midway to the east side, directly opposite the freight shop, and to the north of the power , is the planing mill, 126 feet wide by 500 feet long, equipped with the most up-to-date machinery specially designed for finishing every wooden detail of both freight and passenger cars. The sawdust and shavings are conveyed to large hoppers on the power house roof, from whence they are conducted automatically into the furnaces of the boilers, thus providing fuel for generating the power for driving the machinery; in fact it is acknowledged to be the most complete and up-to-date establishment of its kind in Canada.

The power house is situated just above the centre of the works, and close to the planing mill. There are four 500 kilowatt alternating generators driven by cross-compound Robb-Armstrong engines. One 350 kilo. watt alternating generator, driven by a Robb-Armstrong simple engine, one synchronous motor generator set of 250 kilo. watts, and three exciter sets of 400 amperes, 125 volts each. The switch board of 22 panels, each 2′ 8″ wide, or a total length of 60 feet by 7′ 6″ high, is made of grey marble. There are two sets of buss bars, main and auxiliary.

The passenger car erecting and finishing shops are four in number, each 100 feet by 672. In these shops can be seen baggage cars, mail and express cars, colonist cars, first class day coaches, parlour cars, dining cars, and sleeping cars, in every stage of construction. To the south of the passenger car erecting shop, near the general stores, is the cabinet making and upholstering shop, a two storey building, 62 feet by 581. On the ground floor are located the cabinet makers and inlayers, and also a room where the plateglass and mirrors used in the cars are bevelled and silvered, and upstairs all the upholstering, carpet, and curtain work is done.

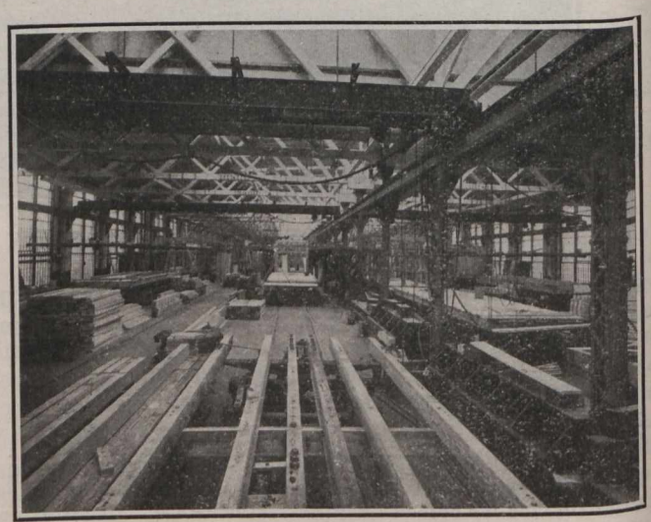
We now wend our way to the Midway, and find ourselves facing the general offices of the works, a three storey building with a basement, 81 feet long by 87 feet wide. The ground floor and basement being occupied by the auditor of stores with his staff of clerks, for keeping the time of the workmen, preparing the pay rolls, and handling all the accounting work.

Connected with the office, but located in the general stores building, is a fully equipped testing laboratory, presided over by a chemist with a staff of qualified assistants, where all kinds of materials used on the railway are subjected to physical, chemical, and analytical tests. Close to the main entrance of the works is also located a branch of the Bank of Montreal, where the men can deposit their savings, and have their wages cheques cashed.

Every building is equipped with modern and model lavatories, and a plentiful supply of good pure water for washing and drinking. The drinking water is supplied from three artesian wells, 850 feet deep, from which is also taken the water for feeding the boilers. Fire protection is provided by all buildings being equipped with the automatic sprinkler system and 72 hydrants placed throughout the yards, each hydrant having 300 feet of hose attached. There are also two well equipped fire stations, where several hose carts, or reels, are kept, together with the clothing, tools, and equipment, and accoutrements of the fire brigade, which consists of 150 well trained men, organized in companies under special officers, like a city brigade. These men, who are all employees of the works, are drilled every week and sometimes are called out without notice by the alarm being sounded for test, and their efficiency will compare favourably with any city brigade.

The Railway Company have also a fully uniformed police force, who patrol the plant night and day, each constable reporting by telephone to the central office from the various shops on their beats, at stated intervals.

A very important detail in connection with the works is the care taken of, and the instruction given to apprentices. A fully equipped instruction room is provided, in which qualified instructors teach

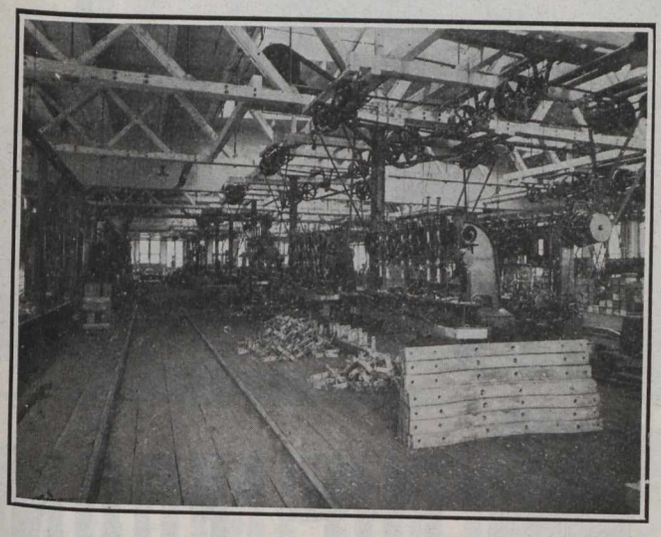


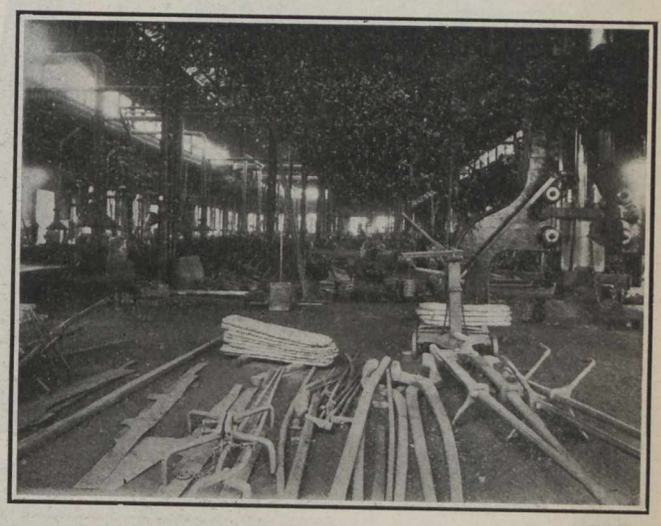
the boys the technical side of their trades. English, Geography, Arithmetic, Geometry, and Mechanical Drawing, with practical talks on Shop Practice being included in the curriculum. Each apprentice spends two hours twice a week in the instruction room, and while in the shops they are in charge of the shop instructor. The company awards six scholarships every year to the boys who gain the highest number of marks in the annual examination. There is also a library,

with 2,500 volumes of technical books, and works of fiction, in French and English.

Another special feature of these extensive works are the large dining halls for the employees, one situated in the locomotive and the other in the car departments, each capable of seating 350 men, where clean, well cooked and substantial meals are provided *a la carte* at minimum rates.

Recognizing the importance of healthy exercise the company gives every encouragement to outdoor sports, and there is a well organized amateur athletic organization in connection with the works. A large piece of ground outside the works is set apart and properly prepared for football, baseball, lacrosse, and running, and where inter-shop and inter-departmental matches are keenly contested.





Some of the Committees Presenting Reports to-day.

Nominating Committee for Officers and Members of Council for 1912.

J. M. R Fairbairn, Chairman, representing Dist. No. 1.
H. N. Ruttan, G. A. Mountain, J. Galbraith, } Past Presidents.
E. A. Stone, Representing Dist. No. 2.
A. R. Decary, " " " 3.
James White, " " " 4.
A. C. D. Blanchard, " " " 5.
F. Crossley, " " " 6.
C. E. Cartwright, " " " 7.

Railway Ties:

D. MacPherson, Chairman.
H. D. Lumsden.
F. P. Gutelius.
H. G. Kelley.
Wm. McNab.
J. G. Sullivan.
T. C. Burpee.
H. A. Woods.
A. F. Stewart.
M. H. MacLeod.
W. A. Bowden.
W. B. MacKenzie.

Transportation Routes:

W. F. Tye, John Kennedy } Chairmen.
C. R. Coutlee.
Wm. McNab.
E. D. Lafleur.
F. W. Cowie.
J. A. Jamieson.
M. H. MacLeod.
C. H. Keefer.

Roadbed and Ballasting:

J. G. Sullivan, Chairman
H. Holgate.
H. D. Lumsden.
F. P. Gutelius.
W. McNab.
T. C. Burpee.
W. B. Mackenzie.
B. B. Kelliher.
H. A. Woods.
M. H. MacLeod.
L. A. Vallee.
R. McColl.

Rail Fastenings and Tie-Plates:

Howard G. Kelley, Chairman.
H. Holgate.
H. D. Lumsden.
F. P. Gutelius.
W. McNab.
J. G. Sullivan.
T. C. Burpee.
A. Stansfield.
B. B. Kelliher.
A. F. Stewart.
L. A. Vallee.
H. A. Woods.
R. McColl.

Cement Specifications:

J. A. Jamieson, Chairman.
C. H. Rust.
D. MacPherson.
C. E. W. Dodwell.
W. P. Anderson.
F. P. Gutelius.
J. S. Dennis.
H. Holgate.

Improved Engineering Service:

H. Holgate, Chairman.
A. W. Campbell.
J. A. Jamieson.
F. L. Wanklyn.
G. J. Desbarats.
A. St. Laurent.
L. A. Vallee.
H. J. Lamb.

Establishment of Testing Laboratories:

C. H. Keefer, Chairman.
J. Galbraith.
H. M. Mackay.
J. A. Jamieson.
P. Gillespie.
G. E. Perley.

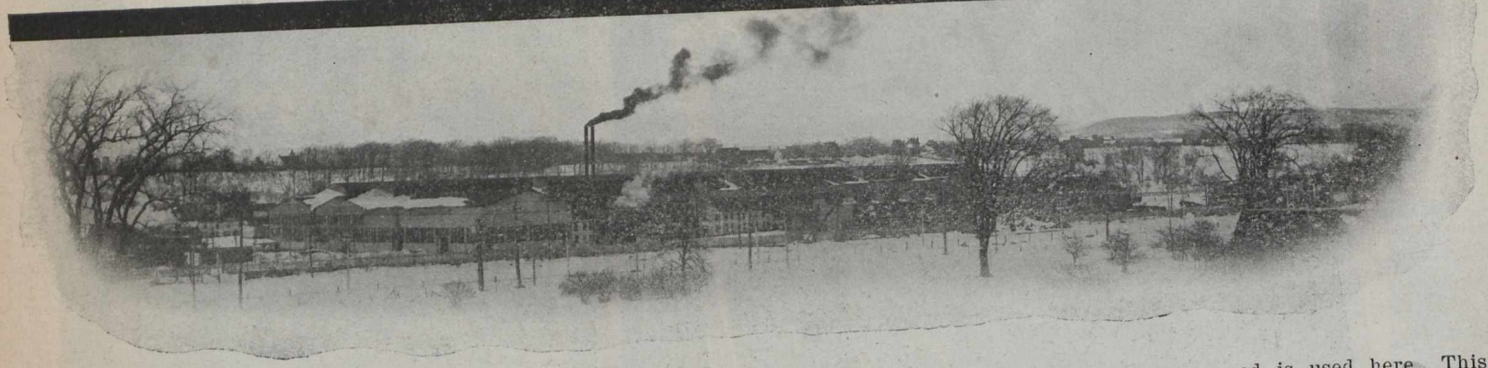
Usefulness of the Society and Educational Requirements:

E. Marceau, Chairman.
R. W. Leonard.
W. F. Tye.
J. B. Porter.
H. Holgate.
H. Irwin.

Sewage Disposal, Etc.:

R. S. Lea, Chairman.
Willis Chipman.
J. S. Dennis.
C. E. W. Dodwell.
John Kennedy.
R. W. Leonard.
C. H. Keefer.
C. R. Coutlee.
E. J. Walsh.
H. N. Ruttan.
C. H. Rust.
T. A. Murray.
W. M. Edwards.

Visit of Inspection to "Canadian Car"



ON Thursday afternoon, January 25th, the members of the Canadian Society of Civil Engineers will have the privilege of inspecting the works of the Canadian Car and Foundry Company. After luncheon, at 1.30 p.m., at Lachine, provided by the Dominion Bridge Company, the party will proceed to the Dominion plant.

View No. 2.

DOMINION PLANT.

The Dominion plant of the Canadian Car and Foundry Company is well illustrated by view No. 1. This is a general photograph, taken about two years ago. Since this was taken the main car shop has been extended 500 feet, with various other additions.

Bolster Shop.—View No. 2 is an interior view of the bolster shop, in which the well-known Simplex truck and body bolsters are made. One of the matters in this shop, which will be of more than ordinary interest to the visiting Engineers, is a special apparatus on the bull-dozer for wrapping the tension plates on the trucks and body bolsters. These were specially designed by the Car and Foundry Company.

The Simplex truck is now used on the Canadian railroads, and is generally replacing the older type of wooden steel construction. This shop was laid out with special reference to the economical manufacture of these devices. For that reason the manner of handling the material, as it advances from one step to another, during the process of fabrication, will be viewed with interest. The Simplex brake beams for both freight and passenger cars are fabricated in the same shop, also the Susemihl frictionless side bearings for both freight and passenger equipment.

Main Car Shops.—Leaving the bolster shop, the visitors will pass on down to the main car shops, where steel cars of all kinds and for all purposes, are built. Practically no wood is used here. This shop, being one of recent construction, is equipped with the latest and most modern machinery for the building of steel cars. View No. 3 is a photograph showing a portion of the interior.

View No. 4 shows one of the large punching machines with automatic spacing table. This punch has a capacity of punching 36 ¾ inch holes at one stroke. While designated the main car shop this is really the assembly shop. All punching, shearing, assembling, and riveting is done here.

Truck Shop.—The trucks are built complete in a separate shop and transferred to the main shop by means of industrial tracks connecting them. View No. 5 is an interior view of the truck shop. There is also a separate blacksmith shop, where all the forging and blacksmith work is done.

Machine Shop, etc.—The machine shop is an annex to the south side of the main car shop. The shop is small, compared to the rest of the works, as it is used only for local work, such as repair of dies and machines. The works are also well equipped with pattern shop and template shop.

The shops are driven exclusively by electrical power, the machines being directly connected where possible. Group drives are used only for some of the smaller machines. The power is supplied from the local electrical power companies.

View No. 6 is a photograph of the interior of the power house, the chief office of which is compressing air for the operation of the compressed air tools. This view shows two

View No. 3.

compound air compound steam Canadian Rand compressors, which are used for the above purposes. One of these is a 15 x 24 "D2" 1200

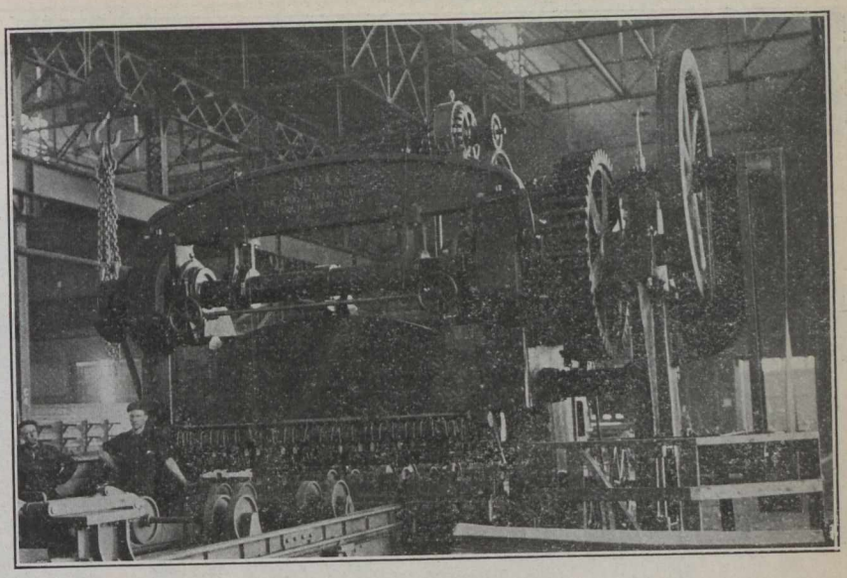
ft. capacity cross-compound belt-driven compressor. This machine was installed in 1905, and has been used continuously. The second machine is an 18 x 36 "BB-3" 2300 ft. capacity cross-compound direct driven compressor of 400 H.P. This machine was installed in 1907.

TURCOT PLANT.

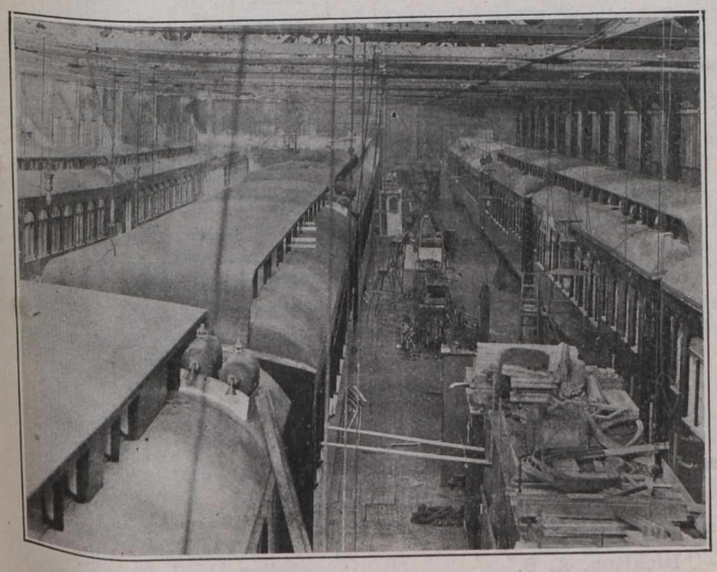
Until recently the Turcot plant was used exclusively for the building of wooden freight, passenger, and street car equipment, but owing to the increased demand for all steel and steel under-frame cars the company found it necessary to meet this demand. This demand was met by constructing a separate shop at the Turcot plant for the building of steel underframes. Previous to this, when steel underframe cars were required, it was necessary to build the steel underframes at the Dominion plant and transport them to the Turcot plant. The new addition to the plant is now completed and in a position to manufacture steel underframes of all types.

View No. 7 is an interior view of the freight car erecting shop. View No. 8 illustrates the interior of the passenger car erecting shop, showing cars in different stages of construction. View No. 9 shows the interior of the planing mill.

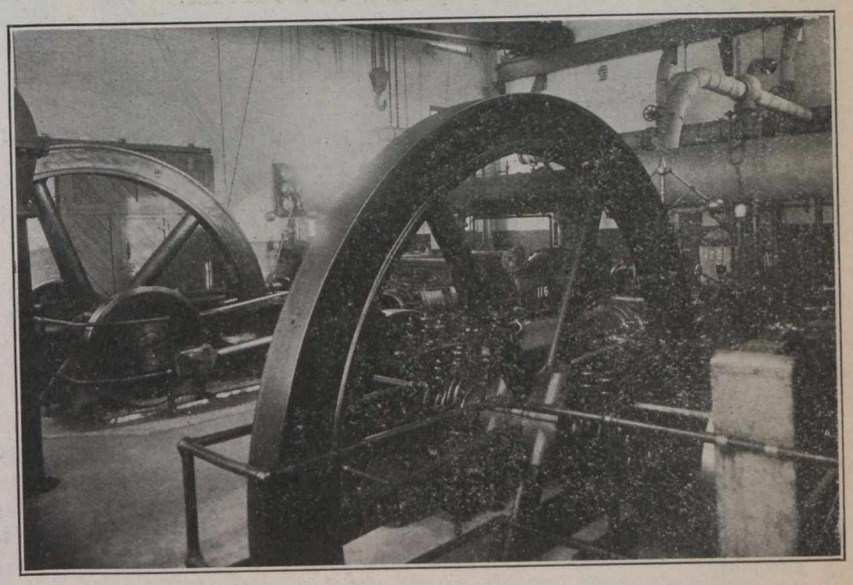
The Turcot plant is complete in every way, having its own wheel foundry, grey iron foundry, machine shop,



View No. 4.

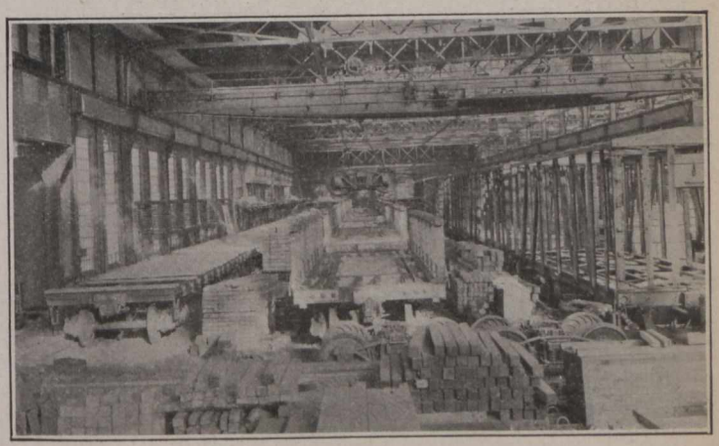


View No. 8.

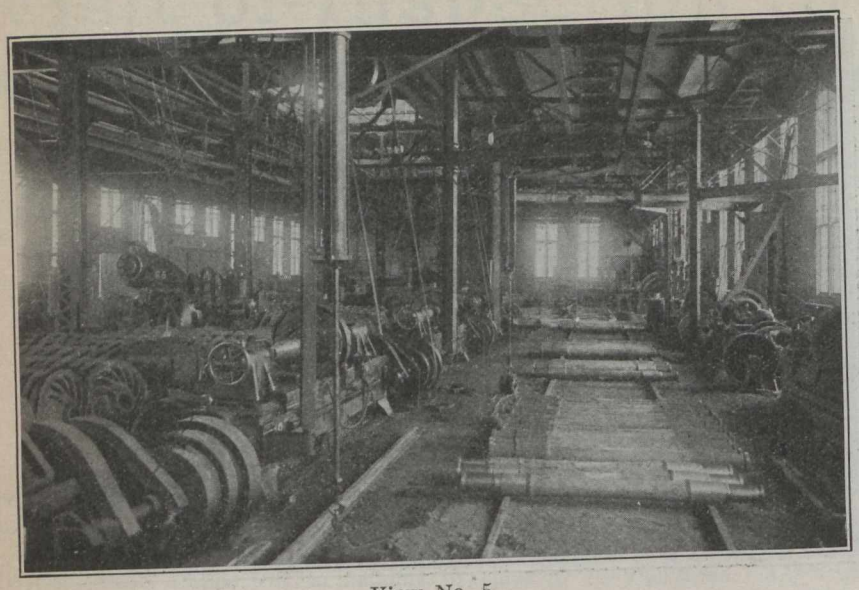


View No. 6.

View No. 7.



View No. 9.



View No. 5.

blacksmith shop, truck shop, etc.; in fact, all equipment necessary for the fabricating of all types of wood or steel underframe freight and passenger cars. The power used on this plant is generated there. Several extensions are now being made which will further increase the capacity, both as regards freight and passenger cars.

Both the Dominion and the Turcot plants furnish cars complete in every respect, ready for service. The visitors will notice ten new first class sleeping cars just finished for the Canadian Northern Railway Company. These cars compare favourably with any sleeping cars built.

The company also has a large plant at Amherst, Nova Scotia. This was formerly the Rhodes-Curry plant. There also all types of freight and passenger cars are manufactured.

The President of the Canadian Car and Foundry Company is Mr. N. Curry; Vice-President, W. W. Butler; 2nd Vice-President, V. G. Curry; Secretary-Treasurer, F. A. Skelton; General Superintendent, F. Ditchfield; General Purchasing Agent, A. H. Chave; and the Chief Engineer, W. S. Atwood.

RECENT MEMBERSHIP ELECTIONS.

The following is a statement of elections which have taken place since the issue of Bulletin No. 7:

October 14th, 1911.

Members:

Bertram, A.
Depencier, H. P.
Green, S. M.
Hazen, A.

Associate Members:

Adams, A.
Bain, P.
Creer, A. D.
Currie, A.
Frith, A.
Kennedy, T. D.
Munro, G. R.
Rennison, W. G.
Reid, J. R.
Robertson, J. D.
Robinson, T. E.
Sutherland, J. R. S.
Vanaesch, A.
Walker, T. M.
Wilson, L. E.

Associate:

Money, K. E.

Juniors:

Berry, B. C.
Biggs, J. R.
Elliot, G. R.
Harkness, R. B.
Sneath, T. D.
Wickenden, A. A.
Wright, W. W.

Transferred from Associate Member to Member:

Amiot, P. E.
Byers, A. F.
Dodge, G. B.
Fellowes, F. L.
Hoard, C.
Parks, J. H.

Transferred from Student to Associate Member:

Bishop, W. J.
Christie, C. V.
Desy, J. E.
Everall, W. M.
Frame, S. H.
Grant, J. R.
Gransaull, L. R.
Greenlees, A. H.
Heygate, H. J.
Kinghorn, A. A.
MacArthur, F.
Moffat, F. P.
Moon, C. G.
Murdoch, G. G.
Otty, G. N. D.
Smith, R. S.
Trottier, J. P.
Tweedie, A. G.
Williams, V. H.

Transferred from Student to Junior:

Burr, E. G.
Marr, N.
Polyblank, K. G.
Reed-Lewis, E. W.
Ross, R. W.
Saunders, R. G.

Students:

Belanger, J. C.
Bourbonnais, J. A. A.
Bremner, F. E. A.
Briercliffe, H. D. C.
Calder, A.
Dalziel, W.
Duncan, W. E. P.
Elliot, J. A.
Kirk, E. W. H.
Leigh-Mallory, G. E.
MacKay, L. F.
McKinnon, H. W.
Meadows, C. A.
McLerie, A. G.
Morency, G. E.
Ross, C.
Tremblay, J. A.
Stanger, E. A.
Wagner, E. B.
Wermenlinger, E. J.
Zammers, C. F.

9th December, 1911.

Associate Members:

Cate, C. L.
Courtright, M.
Dickison, A. S.
Erikson, A.
Garrow, A. B.
Knight, R. R.
MacKintosh, C. D.
Meadows, J. O.
Melanson, H. W.
Mullon, J. M. L.
Murray, N.
Murray, R. H.
Tuzo, J. A.

Juniors:

Blizard, D. C.
Campbell, W. I. H.
Faus, H. W.
Hamilton, J. R.
Hogarth, G.
Leblanc, P. M. H.
Mackenzie, C. J.
Mungall, A. N.
Murray, W. P.
Sherman, N. C.
Webb, E. E.

Transferred from Associate Member to Member:

Blanchard, A. C. D.
Clement, S. B.
Forward, E. A.
Jenssen, L. N.
Macredie, J. R. C.
Sims, H. B.
Tennant, D. C.

Transferred from Junior to Associate Member:

Hick, H. C.

(*Continued on page* 15.)

TRIP TO THE DOMINION BRIDGE WORKS

Interior view of Structural Shop No. 2.
Taken from West Side.

THE works of the Dominion Bridge Company, Limited, which are to be visited on Thursday, are illustrated by the accompanying photos.

The works are situated on a railway line connecting the Canadian Pacific Railway at the Lachine Canal with the Grand Trunk Railway at Dominion Station. The property extends from the main line of the Grand Trunk to the bank of the Lachine Canal, and affords shipping facilities by both railways and by water, as well as by electric railway, as the Park & Island Railway Co. also have a siding into the works.

Material is received by rail and by water, and is now stored principally between the Lachine Road and the Canal Bank, from which it is delivered to the north end of the shops by means of derrick cars, standard gauge railway trucks and locomotives. Alterations are now, however, under way which will make the storage more convenient at the north end of the shops under a series of electric travelling cranes, so that material can be more promptly sent in to be worked up.

The original shop built in 1885, marked No. 1 on the plan, was considered too large for the needs of the country at the time, and so it proved until about 1897, when the extensions commenced. The area now under roof is six and a half times the original area of this shop, and the annual capacity of the works about twelve times the quantity that was output up to 1893. The increase in capacity has necessitated the acquirement of additional land and the changes in the method of handling material above noted.

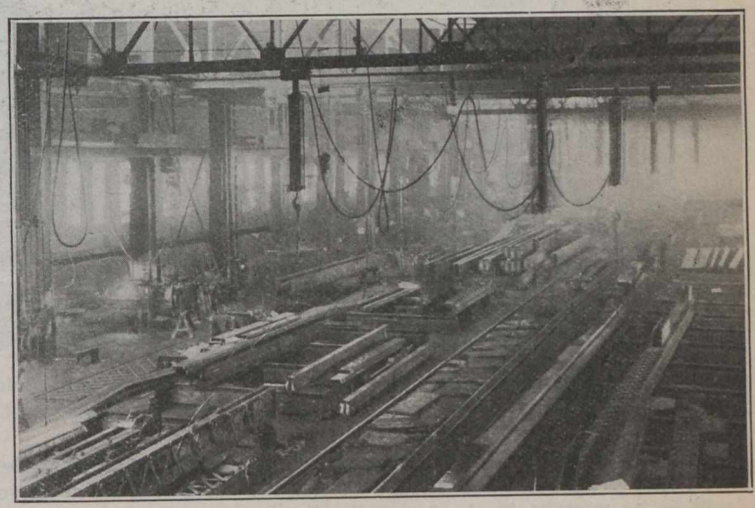
The buildings shown have approximately the following inside dimensions:

No. 1 Girder Shop, 118′ x 512′, with additions, making a total length of 840′.
No. 2 Girder Shop, 895′ x 121′.
Shipping House for No. 2 Shop, 502′ x 78′.
Blacksmith's Shop, 280′ x 90′.
Machine Shop, 340′ x 78′.
Assembling Shed, 400′ x 84′, with a crane run way 800′ long.
Template Shop is situated over the north end of the No. 2 Girder Shop and is 300′ long x 121′ wide.
Pattern Shop, 60′ x 60′.
Pattern Storage, 90′ x 60′.
Total area under roof about 380,000 sq. ft., nearly 9 acres.

The old office building, situated on the Lachine Road, 130′ x 40′, with extensions, is now used as a shipping office and for recreation and class rooms for workmen.

The new office, 110′ x 44′, with two wings 82′ x 33′, is a modern fire-proof office building of four storeys recently constructed.

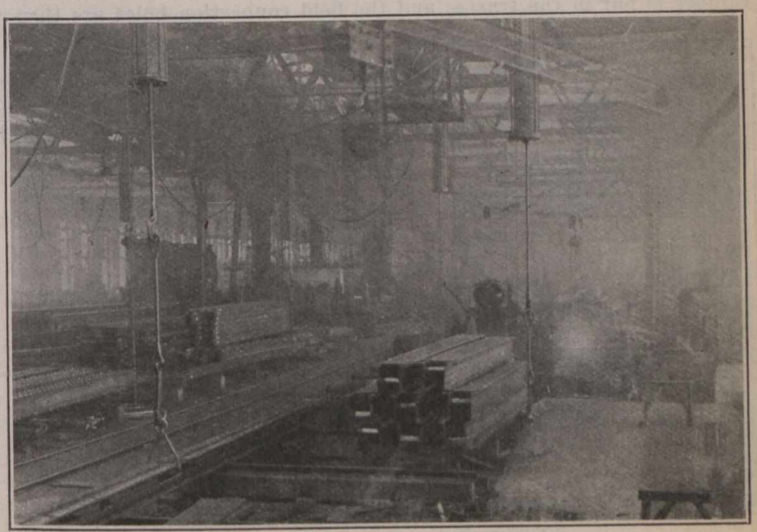
The Company also operates shops in Winnipeg and Toronto. At Winnipeg there is a full staff of draughtsmen, but the detail drawings for the Toronto shop are now made at the Lachine office. The Lachine office has about 160 men in the Engineering Department



Interior of Structural Shop No. 1.
Taken from South End.

at present, a force which will be considerably increased during the summer. The Engineering Staff is divided into Contracting, Designing, Construction and Mechanical Departments, the Contracting being under E. S. Mattice, M.C.S.C.E., the Designing under F. P. Shearwood, M.C.S.C.E., Construction under R. B. Kenrick, M.C.S.C.E., with D. C. Tennant, M.C.S.C.E. as principal assistant, and the Mechanical under A. E. Johnson.

The shops and field operations of the Company are under the general direction of James Finley, General Superintendent, with J. R. Bowlby, Shop Superintendent of the Lachine Shops, and Charles Dawson, Mechanical Superintendent.

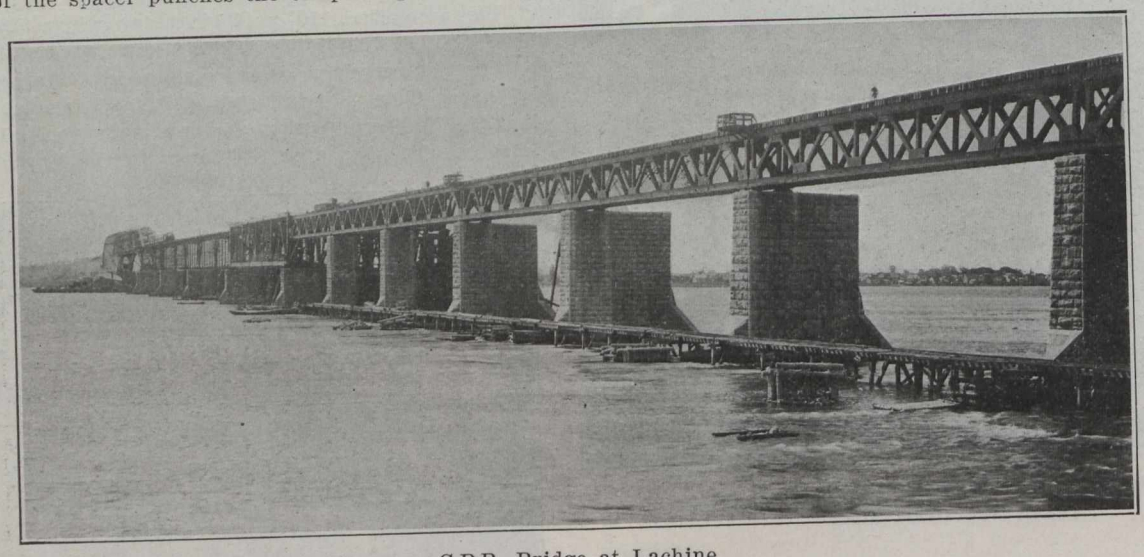


Interior of Structural Shop No. 1.
Taken from South End Corner.

All details for whatever kind of work are designed in the office, from whence the drawings for bridge and structural work go to the template shop. In the template shop the wooden templates are made showing the position of every hole, the number of pieces to be laid off from these templates, sizes of rivets and all necessary information for the succeeding operations. Drawings are also sent to each of the other departments. From the template shop the templates are taken to the laying-off end of the shop, where all material is marked for punching and shearing. If it is intended to punch it on one of the spacer punches the template goes direct to the punch at which it is to be used. Before being sent down, the templates are pinned together on the floor to make sure that there will be no mistake in the drawing, office, or in the template work. From the laying-out end of the shop the material passes in each structural shop by regular stages through the various processes of straightening, shearing, punching and assembling. After assembling, the work is reamed, to insure good holes, and in all railway work the holes are punched ¼" smaller than the finished rivet and reamed to size, both for the sake of insuring good holes and to remove any material injured by punching. Material then passes on to the riveting department; afterwards it passes to the finishing end of the shop, where it is planed, bored, chipped or otherwise finished, as called for by the drawings.

After the several pieces of a bridge are finished in the shops, they are taken to the assembly shed on the West side of the property, where each truss is assembled complete with every piece in the position it will finally occupy in the finished work. The correct camber is put in the trusses and the field connection holes are then reamed with twist drills so that they will all come fair in the field. A good many of the connection plates have been left loose up to this time to make sure of good holes; these are now rivetted on after reaming, the various pieces are match marked, and then taken down and shipped or stored as may be required.

The assembly shed is equipped with 2 30 ton travelling cranes, a full complement of reamers, electrical and air, and air riveting tools. This is a feature on which the Company rather prides itself, most other companies contenting themselves with assembling isolated joints, and in some cases depending on the accuracy of the template work.

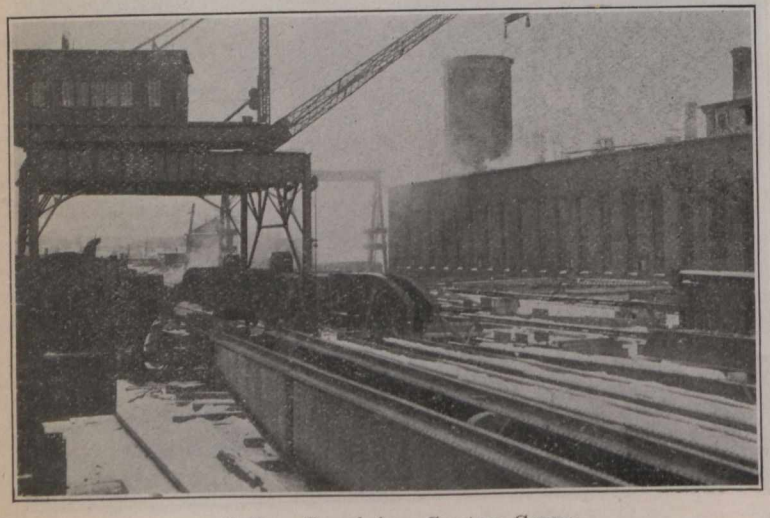


C.P.R. Bridge at Lachine.
Superstructure built by Dominion Bridge Co.

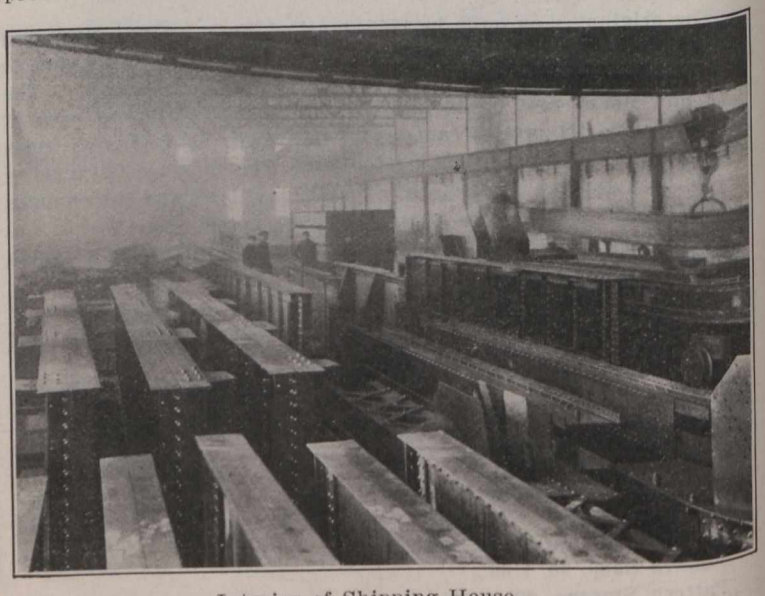
In addition to the ordinary structural work above described, the Company has executed many large and important contracts involving heavy machine work, such as the lift locks on the Trent Canal, the movable dam at the Soo, etc. Its smith and machine shops are larger and more fully equipped than are usually found with structural shops of this size.

In the machine shop, besides the regular swing bridge and turntable work, will be found work for electric travelling cranes, of which the Company makes rather a specialty, machine work for the stoney regulating gates of the Shawinigan Company, regulating gates for the Trent Canal, etc.

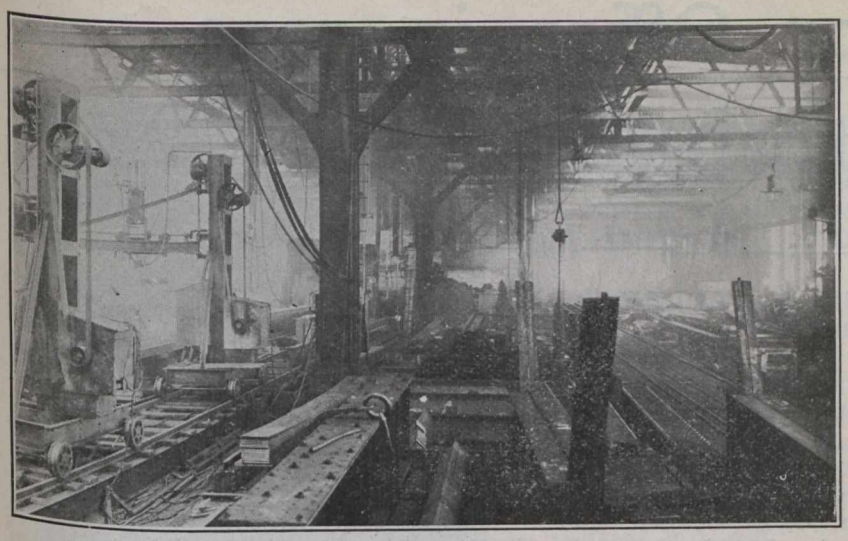
This work, which is at present passing through the shops, will be of interest to the visiting engineers. The members of the Canadian who take this trip through this plant will spend a most profitable forenoon.



25-Ton Revolving Gantry Crane.
Main Shipping Yard.



Interior of Shipping House.
View taken from near East End.



Interior of Structural Shop No. 2, Dominion Bridge Works.
Taken from South East Corner.

ELECTIONS—CONTINUED FROM PAGE 12.

Transferred from Student to Junior:

Jenkins, G. A.
Jones, W. H.
Lumsden, H. A.
Spicer, P. O.
Tipper, G. A.
Walker, J. A.

Students:

Bagshaw, F.
Bellhouse, R. W. S.
Brownell, N. W.
DeCardaillac, G. R. E.
Deschenes, A. M.
Downes, A.
Eliasoph, J. E.
Ford, J. W. H.
Gareau, J. R.
Gneadinger, F. T.
Goorevitch, A.
Hunt, W. H.
Irving, J. C.
Jette, J. C. H.
Lovell, W. E.
Marchblank, O. J.
Montgomery, C. S.
Morton, H. A.
Pearson, C.
Pearson, H. J. C.
Prieur, H. A.
Rosher, J. H.
Somers, N. S.
Staples, G. J.
Starodvoroff, A.
Walley, C. A.

13th January, 1912.

Member:

Field, F. E.

Associate Members:

Iyer, R. P.
Legge, A. H.
Mill, D. W.
Murray, G.
Ouimet, G.

Juniors:

Fredette, J. F.
Lyon, C. D.
Marshall, J. A. P.
Pequegnat, M.
Rutledge, L. T.

Transferred from Associate Member to Member:

Armstrong, C. J.
Gill, L. W.
Scammell, J. K.

Transferred from Junior to Associate Member:

Burr, E. G.

Transferred from Student to Associate Member:

Amireault, C.
Ashton, A. W.
Bristol, C. F.
Brunner, G. H.
Bunnell, A. E. K.
Cameron, E. G.
Campbell, N. M.
Dingwall, M. S. W.
Drysdale, W. F.
Gzowski, H. N.
Harcourt, R. H.
Huddleston, G.
Johnston, H. S.
McLean, F. A. W.
McKay, F. A.
McKergow, C. M.
Moorehouse, W. N.
Murray, E. W.
Ogilvie, W. M.
Peppard, H. M.
Prefontaine, R.
Read, H. E.
Roberts, A. R.
Smith, D. A.
Van Tuyl, L. G.
Waldron, S. M.
Wilcox, S. C.
Wilson, W. S.
Wolff, M.

Students:

Griesbach, W.
McNeil, H.

Transferred from Student to Associate Member:

Batho, C.
Beaton, N. H.
Bradt, A.
Carscallen, H. R.
Crerar, S. R.
Fairlie, T. U.
Gillies, G. A.
Kingston, L. B.
Klingner, L. W.
Lawledge, F. M.
McLean, D. L.
Oxley, A. C.
Paris, J.

Transferred from Student to Junior:

Kennedy, W. A.
Morrissette, R.
Sproule, G. St. G.
Schenk, T. M.

SOME OF THE COMMITTEES PRESENTING REPORTS TO-DAY.

Conservation:

C. R. Coutlee, James White } Chairmen. J. B. Hegan.
H. F. Laurence. C. E. W. Dodwell.
R. McColl. A. E. Doucet.
R. O. Sweezey. R. S. Lea.
J. M. Shanly. R. W. Leonard.
W. H. Breithaupt. E. E. Brydone-Jack.
G. A. Bayne. W. R. W. Parsons.
A. J. MacPherson. John Chalmers.
J. S. Dennis. T. H. Tracy.

Good Roads:

A. W. Campbell, Chairman. W. D. Ballairge.
H. N. Ruttan. A. F. MacAllum.
R. McColl. W. A. McLean.
G. G. Powell. C. E. Cartwright.

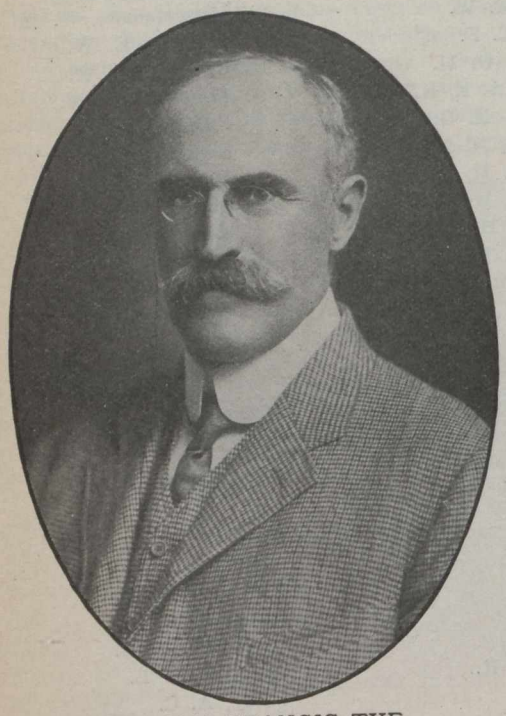
Steel Bridge Specifications:

C. N. Monsarrat, Chairman. N. M. McLeod.
F. P. Shearwood. H. G. Kelley.
J. G. LeGrand. W. A. Bowden.
R. F. Uniacke. P. B. Motley.
H. E. Vautelet. F. C. McMath.

The Electro-Technical Commission:

L. A. Herdt, Chairman. L. A. Roseburg.
O. Higman. J. Kynoch.
H. T. Barnes. J. Murphy.
L. W. Gill. A. B. Lambe.
W. A. Duff.

Nominees for Office in 1912



WILLIAM FRANCIS TYE
The Presidential Nominee

WILLIAM FRANCIS TYE

BORN at Haysville, Ontario, March 5th, 1861, Mr. William Francis Tye was educated at Ottawa University, and at the School of Practical Science, Toronto (1878 to 1881). He entered railroad service in 1882. From then until 1885 he served successively as rodman, leveler, transitman on location, and afterwards as assistant engineer on construction of the Canadian Pacific. During 1886 and 1887 he was transitman and assistant engineer on the St Paul, Minneapolis & Manitoba.

The next year he served as Engineer of Track and Bridges on the Tampico branch of the Mexican Central. In 1890 he was Locating Engineer of the Great Falls & Canada Railway in Montana, and in 1891 and 1892 Engineer in charge of location and Division Engineer of the Pacific extension of the Great Northern. For about two years he was in the west as Engineer in charge of the change of gauge of the Alberta Railway & Coal Company's road. In 1895 he was Chief Engineer of the Kalso & Slocan Railway, and for four years following 1896, he held a similar position on the Columbia & Western. In 1900 Mr. Tye became Chief Engineer of Construction of the Canadian Pacific, in June, 1902, was appointed Assistant Chief Engineer of the System, and in May, 1904, he was appointed Chief Engineer. In February, 1906, he resigned to take up the construction of electric tramways, power and mine developments, on his own account

LOUIS A. VALLEE

THERE are two nominations by the Nominating Committee for the position of Vice-President of the Canadian Society of Civil Engineers, one of whom will be elected to fill the place of Mr. C. E. Dodwell, whose term of office has just closed.

Mr. Louis A. Vallee is one of the two gentlemen nominated for the Vice-Presidency. Mr. Vallee, whose photograph appears herewith, is Chief Engineer of Public Works for the Province of Quebec. His official designation is Engineer and Director of Railways, and his headquarters are in Quebec City.

In 1894, Mr Vallee was elected as Member of Council of the Canadian Society, and was also a Member of Council for the years 1895, 1903 and 1909.

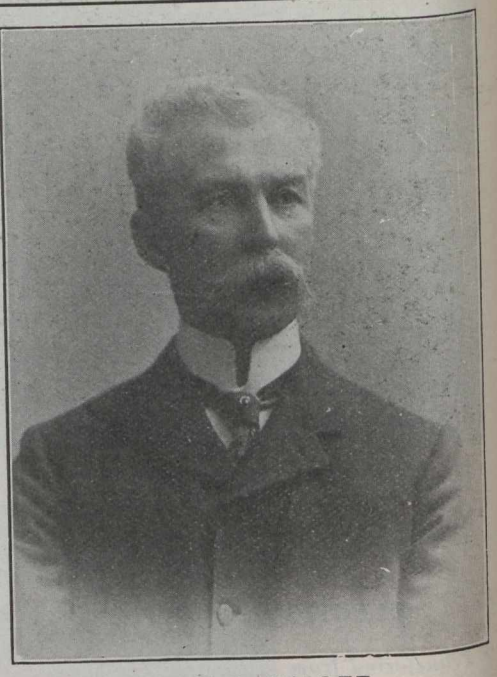
HENRY HAGUE VAUGHAN

KENT, England, was the home of Mr. Henry Hague Vaughan's forefathers. Born December 28th, 1868, he was trained in the three R's at Forest Hill School, Woodford, Essex. He had just passed his sixteenth birthday when he matriculated at King's College, London, in the Applied Science Department. It was an early choice of profession, but, as later events have proven, an eminently wise one.

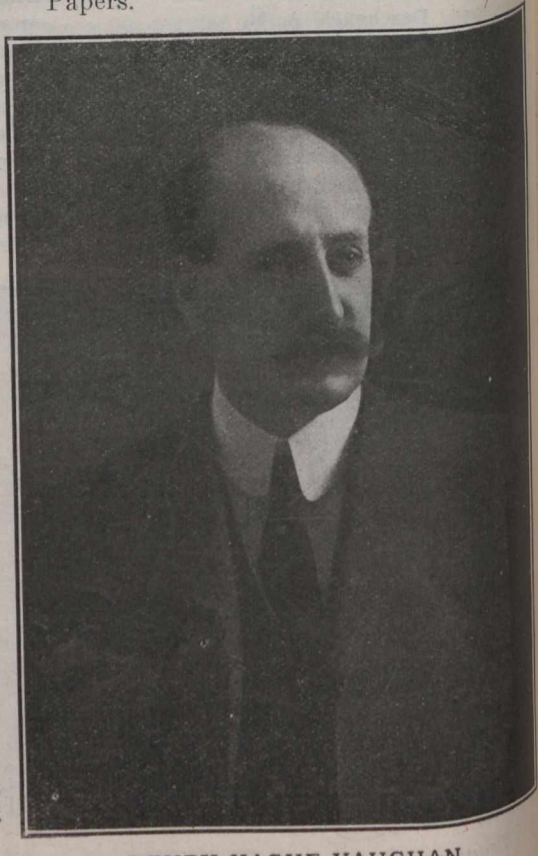
In 1891 Mr. Vaughan came to America, and after various positions, in 1898 had become Mechanical Engineer for the Great Northern.

From then until the present day has been one continued forward march: Till November, 1899, Mechanical Engineer with the P. & R. Railway, Reading, Minn.; till March 1902, Mechanical Engineer with the Q. & C. Company, Chicago; till February, 1904, Assistant Superintendent of Motive Power with the L. S. & M. S. Railway, Cleveland, Ohio; till November, 1905, Superintendent of Motive Power with the C. P. R. at Montreal; and from then until the present time, Assistant to the Vice-President of the Canadian Pacific Railway.

Mr. Vaughan is President of the Engineers Club of Montreal, and for a number of years has been a member of the Canadian Society of Civil Engineers. He has been a member of the Council of the Society for the past two or three years, and in 1911 was Chairman of the Mechanical Section and of the Committee on Papers.



LOUIS A. VALLEE
Nominee for Vice-President



HENRY HAGUE VAUGHAN
Nominee for Vice-President

The Canadian Engineer

ESTABLISHED 1893—A WEEKLY PAPER

THURSDAY, January 25, 1912.

ISSUED IN THE INTERESTS OF THE CIVIL, MECHANICAL, STRUCTURAL, ELECTRICAL, MARINE AND MINING ENGINEER, THE SURVEYOR, THE MANUFACTURER AND THE CONTRACTOR.

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ADVERTISING RATES ON APPLICATION.

ICEBERG DETECTION IN NAVIGATION

Last night Dr. H. T. Barnes, the Macdonald Professor of Physics, delivered a very interesting lecture on "Iceberg Detection in Navigation" in the Lecture Hall of the Chemistry Building of McGill University. A large number of members of the Canadian Society were present and thoroughly enjoyed the talk, which was well illustrated with lantern slides. An abstract of the address is given below, with some interesting charts:

Exactly eleven years ago I had the honor to bring before this Society the result of a study of the conditions underlying the formation of frazil and anchor-ice. It was shown that the minute temperature variations in the water of the order of a few thousandths of a degree determined the character of the ice. Since then it has been possible to develop the microthermometer by means of which more extensive measurements have been made, and the previous work confirmed. So practical has the microthermometer become that records of water temperature in winter have been made from the Government ice-breaking steamers at work in clearing the ship channel. Measurements showed that the proximity of ice in the river could be told from the records, even with the water only a small fraction of a degree above freezing. Thus a temperature change of one-tenth of a degree per mile could be accurately determined. The curve, shown in *Fig.* 1, is taken from the records made by my assistant, Mr. L. V. King, from the "Lady Grey," steaming up to an ice-sheet from open water in Lake St. Peter. The map shown at the bottom explains the character of the curve. The edge

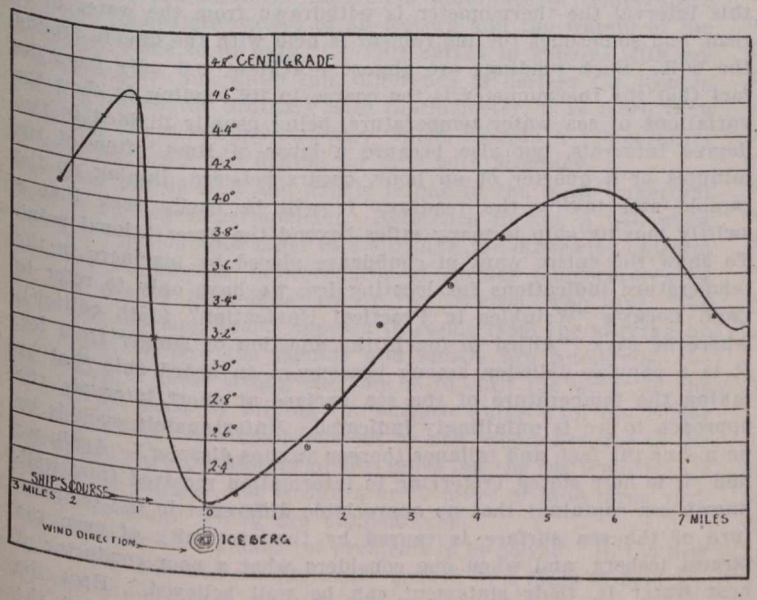


Figure 3.

of the ice-cut was irregular, and a current of approximately one mile per hour flowed from under the ice in the direction of the dotted lines. It will be seen that the distance from the ice measured parallel to the current flow determines the temperature of the water, and that the curve of temperature gradient is a measure of the contour of the ice line. With this extremely delicate instrument I was desirous of making measurements of the temperature gradient around an iceberg, feeling sure that some slight indication could be obtained of the proximity of so large a mass of ice in the almost uniform temperature of the sea. During the summer of 1910, the Department of Marine and Fisheries granted me passage on the C. G. S. "Stanley," during her trip to Hudson's Strait and Bay. Not being able to be away so long as the trip required, I sent my assistant, Mr. King, who ably carried out the measurements. Several icebergs were passed on the journey north, but unfortunately the ship could not be delayed for a complete series of measurements. Such indication we obtained were made as the ship steamed by the bergs, at a distance never less than half a mile. On the return journey no icebergs were met with, and consequently the work was left incomplete. I am glad to say, however, that this year the Hon. J. D. Hazen, Minister of Marine, has promised me a ship in the early summer, which is most satisfactory, and excellent results should be obtained. No thorough study can be made from a ship chartered for other purposes, and I am exceedingly gratified that the Department of Marine has recognized the value of the work. The main reason why I felt entire confidence in the outcome of the tests was from a study of Pettersson's theory of ice melting in salt water. According to this an iceberg (*Fig.* 2) floating in salt water, produces through melting a layer of fresh water which being lighter than salt, rises and spreads far and wide over the surface of the sea. A current of warm water sets in towards the berg under this surface of fresh water, and the sea water, cooled by melting, sinks downwards. If anyone has tried to mix thoroughly currents of water of different density, it will be seen how difficult it is. It seemed to me probable that a delicate microthermometer would show the presence of this cold surface current, even in

List of Who's Who on Page 32

spite of considerable wind agitation. That this was realized by Mr. King on his trip is illustrated in *Fig.* 3, where the temperature gradient near a good-sized iceberg is shown. The ship's course is shown in the direction of the arrow. A heavy wind was blowing in the direction of the ship's course: thus the gradient is steeper on the windward side of the berg than on the lee side; but it is seen that the effect is first noticed almost two miles away and continued for seven miles past the berg. It is important to see that the effect was distinct, even with waves which averaged 15 feet in height. One unexpected feature was the rise of temperature first followed by a sharp fall as the iceberg was neared. This is easily explained by the heating of the fringe of fresh surface water by the sun. The fresh water flowing away from the berg becomes heated on its outward edge to a temperature above that of the surrounding sea, and nearer to the berg the temperature rapidly falls below the sea temperature. Several other bergs were passed on the trip, and they all showed a characteristic dip on the microthermograms. *Fig.* 4 shows a very large rise of temperature, followed by a fall, but the berg which was responsible for this was passed at 2 p.m., at which time the strength of the sun was at its maximum. At night it is to be expected that a cooling of the fringe of fresh water would result by nocturnal radiation, but this has not been as yet verified by experiment. If so, the distance available for detecting ice will be very greatly increased.

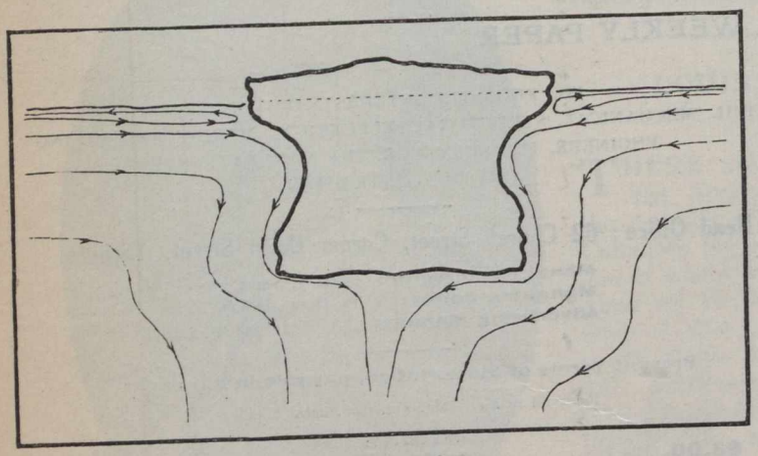


Figure 2.

Up to the time of these experiments all sea temperatures had been made by means of the ordinary mercury thermometer. Everyone who has crossed the Atlantic is familiar with the method. A bucket is dropped into the sea and a sample of water is hauled up, carried to the bridge deck where a copper case mercury thermometer is inserted for some minutes before the reading is obtained. After this interval the thermometer is withdrawn from the water to be read, and sometimes the instrument is held with the fingers around the bulb. Such readings are almost worthless, not only from the fact that the thermometer is too coarse in its reading to show the variations of sea water temperature, being usually divided in two degree intervals, but also because a lapse of time, often of ten minutes or a quarter of an hour, occurs between dipping up the sample and taking the reading. It will be easily seen that a swiftly moving ship is many miles beyond the observational point. To show the entire want of confidence placed by mariners in the temperature indications for locating ice, we have only to refer to Capt. Lecky's "Wrinkles in Practical Navigation" (15th edition), where he says: "Allied to fog is the question of danger from ice. It is a popular delusion among passengers on board ship that by taking the temperature of the sea surface at short intervals, the approach to ice is unfailingly indicated. Unfortunately such is by no means the fact, and reliance thereon invites disaster." Again we find "it is here stated (referring to information received from well-known sea captains) that no appreciable difference in the temperature of the sea surface is caused by the proximity of even the largest iceberg, and when one considers what a poor conductor of heat water is, their statement can be well believed." Here the standard of measurement is the ordinary thermometer, but the reason given for no temperature effect shows the absence of a knowledge of ice melting. In conclusion, we find the following by Capt. Lecky:

"It may be fairly assumed, therefore, that no reliance is to be placed upon the thermometer as an immediate or direct means of detecting the presence of ice, especially when it takes the form of stray bergs."

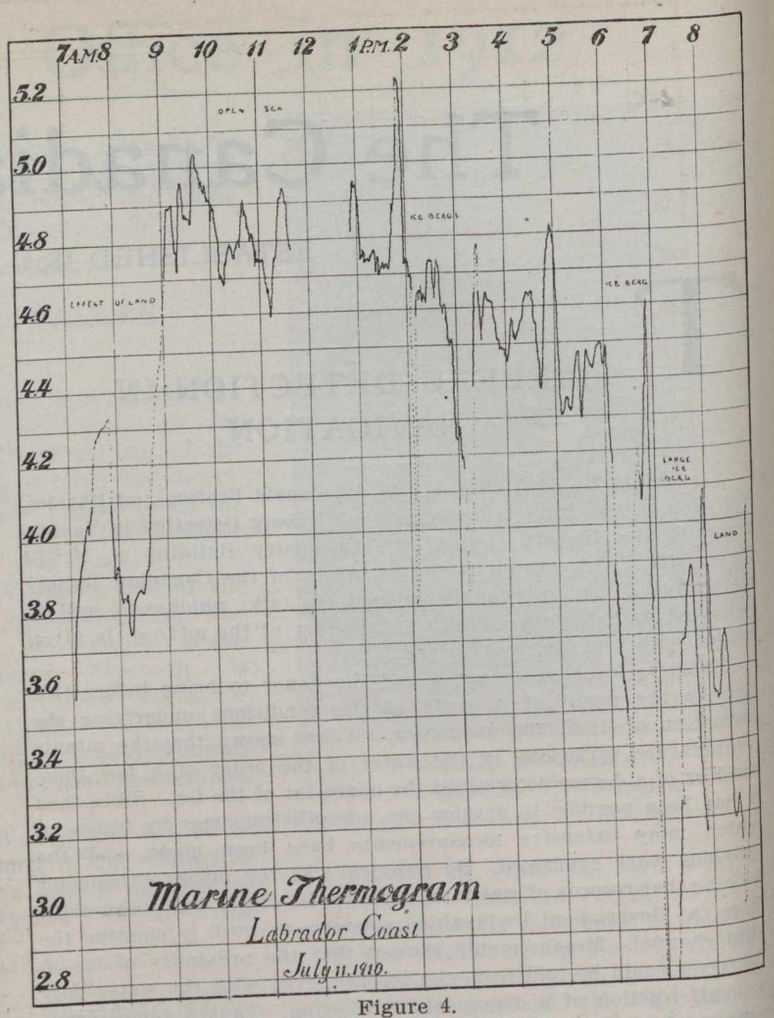


Figure 4.

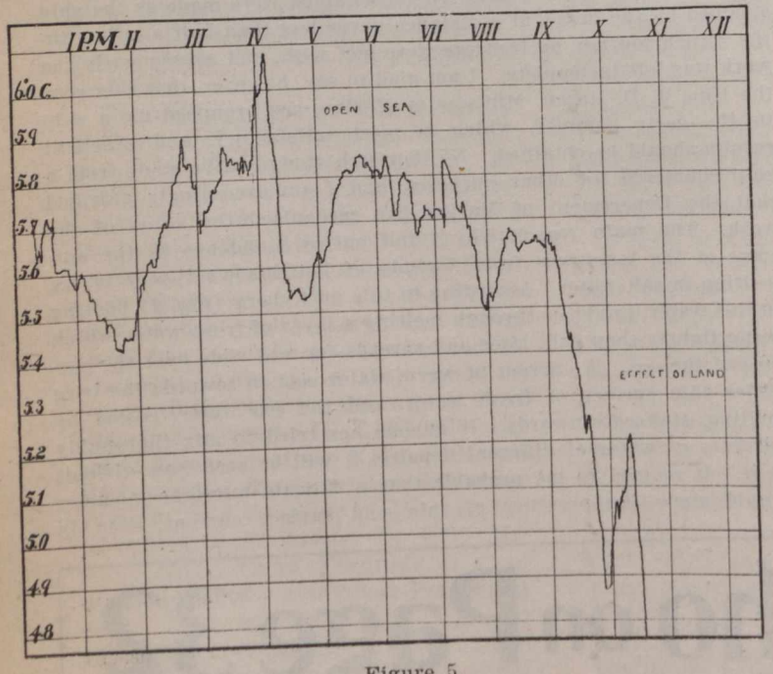


Figure 5.
Marine Microthermogram taken over a distance of 80 miles.

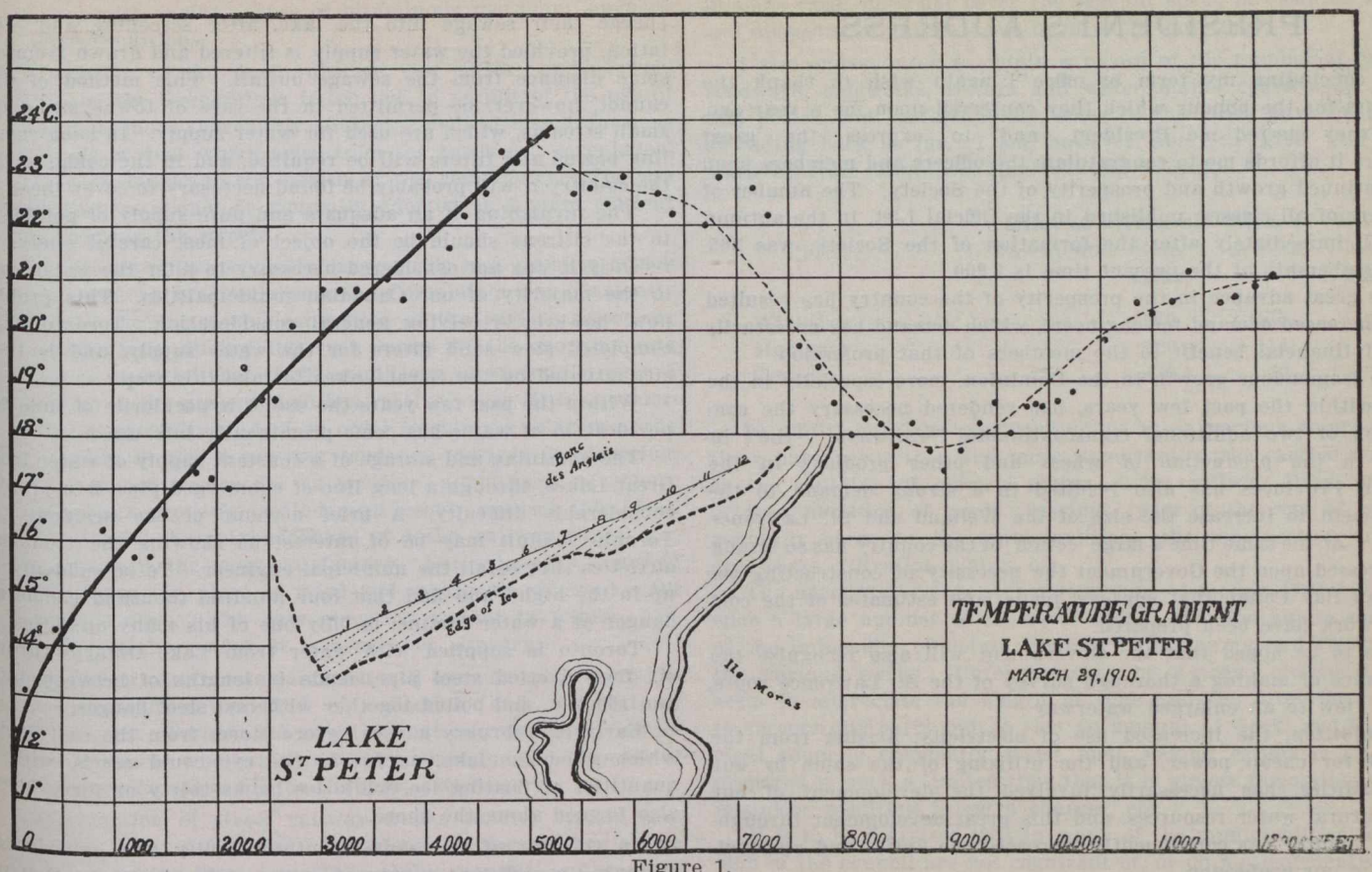


Figure 1.

Advice is given, however, that the thermometer should be used as " it is unwise to neglect *any* precaution. "

The reason why the microthermometer succeeds in detecting ice is that it is self-recording, and the temperature is given of the sea in the immediate proximity of the ship and not of water five miles behind. It records so minutely as to pick out the slightest variation in sea temperature. It opens up a new field of work in studying the small variations in the surface temperature of the sea.

Dr. W. Bell Dawson, Director of the Hydrographic Survey work of our Government, finds the maximum difference of temperature between the immediate waters of an iceberg and the waters of the Strait of Belle Isle to be only 2°. This agrees in general with my own observations, but while this difference is useless for iceberg detection work on the ordinary ship thermometer, it is more than required for the microthermometer, which records a temperature gradient of one-tenth of a degree per mile with accuracy.

The detection of land and shoals is one of the most important features of the microthermometer. Reference to *Fig.* 5 will show the effect of the Labrador coast in disturbing the otherwise uniform temperature of the sea. Disturbances of surface temperatures by shoals has already been observed by Dr. Dawson, who says, "the effect is very distinct, and it appears to result from the stirring up of the water. Where the islands and shoals are numerous, the general effect of these strong currents is to chill the water in the vicinity of the coast by mixing the surface water with the colder water from below." This is borne out by our experience, for as the records show, when the ship is twenty miles out the sea temperature is remarkably uniform, but within 5 or 10 miles of land large variations are produced which are unmistakable.

There remain yet a number of problems to be solved. In the first place, how will the microthermometer behave in a mass of field ice, or how will the presence of ice be told in winter when the temperature of the water falls to the freezing point? Only experience can decide, but we know that the great danger from ice is in time of fog, when the sea is still and the water comparatively warm. Under such circumstances it is difficult to see how the microthermometer could fail in its indications. When navigation is most important, the conditions are the best for the operation of the microthermometer. It is unsafe to predict the whole result of the most unfavorable condition until the experiments are actually tried.

At 8 o'clock, in the evening, Dr. H. T. Barnes gave an extremely interesting address, illustrated by lantern slides, before a large audience, in the Lecture Hall of the Chemistry Building of McGill University. This feature of the meeting was a decided succses, the practical lantern demonstration by means of water cell into which a piece of ice was dropped, to illustrate the action of an iceberg in melting, being greeted with well merited applause. A synopsis of this paper will be found on page 17. After this the meeting adjourned to the Engineers' Building, where a reception was held by the President and Members of Council. The various rooms belonging to the different departments were thrown open for inspection in such a manner as to allow every one to see clearly the equipment of the Engineering Faculty of McGill University. That this act of courtesy was well appreciated was attested to by the large number of the members of the Society who availed themselves of the opportunity. The entire evening's programme, besides being enjoyable, was ,to say the least, most instructive.

Among the English and American machinery to be noted on the trip to-day are the following:

At the Angus Shops: Large Rail Saw, by Roberts Bros., Manchester; 3,000 lb. Steam Hammer, made at Chamsberbury, Pa.; Rotary Shear, J. T. Ryerson, Chicago; Sibley Drill (Hispeed), Sibley Machine Co., South Bend, Ind.; No. 8 Vertical Mill, No. 2C Capstan Lathe, Two No. 2 Automatic Lathes, No. 4 Automatic Lathe, Herberts, England; Eight Pratt Punching and Shearing Machines, F. Pratt & Co., England; Two 20-inch Lathes, Dean, Smith & Grace, England.

At the Dominion Bridge: Ten 6-ft. Asquith Central Thrust Girder Radial Machines.

At the Canadian Car: 6-ton Electric Crane, by Joseph Booth & Bros., England.

All of the above machinery was purchased through Mussens Limited.

PRESIDENT'S ADDRESS

In concluding my term of office I again wish to thank the members for the honour which they conferred upon me a year ago, when they elected me President, and to express the great pleasure it affords me to congratulate the officers and members upon the continued growth and prosperity of the Society. The number of members of all classes, published in the Official List, in the autumn of 1887, immediately after the formation of the Society, was 365. The membership at the present time is 2,900.

The great advance in the prosperity of the country has resulted in an increased demand for engineers, which demand has necessarily been of financial benefit to the members of that profession.

The tremendous growth in the Dominion, more especially in the West, within the past few years, has rendered necessary the construction of two additional transcontinental railways; the increase in the production of wheat and other products in the Western Provinces has also resulted in a strong demand to the Government to increase the size of the Welland and St. Lawrence Canals. At the same time a large ection of the country has so strongly impressed upon the Government the necessity of constructing the Georgian Bay Canal, that surveys, plans, and estimates of the cost of the work have been prepared.

It is to be hoped that the Government will also recognize the importance of making a thorough survey of the St. Lawrence route, with a view to an enlarged waterway.

In addition, the increased use of electricity, arising from the demand for cheap power, and the utilizing of the same by our municipalities, has necessarily involved the development of our great natural water resources, and this great development throughout the country has consequently increased the duties and responsibilities of our profession.

As my entire professional career has been devoted to municipal engineering, I propose to confine my remarks to this subject.

Municipal engineering is now recognized as a distinct branch of the profession, and includes a great variety of subjects, in which the engineer, embarking in this field, is supposed to be well versed. It is also necessary for him to possess considerable tact in dealing with the various members of his council, and with the public.

A municipal engineer, from the very nature of his duties, must be somewhat of a sanitarian. At present considerable attention is being paid to the health of the people, with the satisfactory result of a decreasing death rate. People moving into cities naturally ask, where do you dispose of your sewage, and from where do you obtain your water supply?

The old method of disposing of sewage by depositing it into the nearest stream, without any regard to the fate of the town situated lower down, is now very properly being discontinued. Plans for the purification of water supplies, and disposal of sewage are being considered, and plants constructed by a number of our municipalities. These plans for sewage disposal and water supply have now to be approved of by the boards of health of the different provinces. It is a regrettable fact that on very few of these boards of health there is any person qualified to advise upon engineering matters. In most of our provinces these boards are composed entirely of members of the medical profession, who have only a superficial knowledge of the engineering features of the plans submitted, and are consequently not competent properly to decide upon them.

There is now a bill before the Senate, which will be most drastic if it becomes law. The bill entirely prohibits the disposal of sewage into any body of fresh water. This will be a great hardship to many small municipalities who will be unable, for financial reasons, to put in a sewage disposal plant to comply with this act. From the wording of the bill it seems that they have entirely overlooked the fact that spring freshets yearly remove from the streets, roads, and farm yards large accumulations of filth, which eventually find their way into the rivers and lakes.

The question of the proper method of disposing of sewage is one of great difficulty, and no general scheme suitable to all towns can be approved. Each locality of necessity requires special study. Municipalities situated upon the Great Lakes may be allowed to discharge their sewage into the lake, after screening and sedimentation, provided the water supply is filtered and drawn from a point some distance from the sewage outfall. This method of disposal cannot, however, be permitted in the case of towns situated upon small streams, which are used for water supply. In such cases settling basins and filters will be required, and in the colder section of the country it will probably be found necessary to cover these filters.

The furnishing of an adequate and pure supply of potable water to the citizens should be the object of most careful study. Until recently it was not considered necessary to filter the water supplied to the majority of our Canadian municipalities. This problem is now, however, receiving general consideration. Toronto has just completed slow sand filters for the water supply, and is the first city situated on the Great Lakes to take this step.

Within the past few years the use of hypochlorite of lime for the purification of water has come prominently into use.

The obtaining and storage of a constant supply of water from the Great Lakes, through a long line of submerged pipe, is a problem of considerable difficulty. A brief account of the accident to the Toronto conduit may be of interest as showing the troubles and anxieties that befall the municipal engineer. To be suddenly called up in the night, and find that four hundred thousand people are in danger of a water famine, is only one of his many anxieties.

Toronto is supplied with water from Lake Ontario through a six foot rivetted steel pipe, made in lengths of between 150 feet and 160 feet, and bolted together with cast steel flanges.

Early in February a very severe storm from the east occurred, which filled the lake, as far as the eye could reach, with large quantities of floating ice, while ice banks thirty or forty feet high also formed along the shore.

On the 7th of the same month difficulty was experienced in obtaining a sufficient supply of water, and, on examination of the shore crib, a great many branches of trees and other debris were discovered. During the night all the pumps were closed down, and then started up, with the expectation that this would remove the obstruction. This method, however, proved unsuccessful. Divers were then sent down into the pipe where a log, twelve inches in diameter and twelve feet long, was found, as well as other small pieces of timber and a large accumulation of sand. Steps were immediately taken to have this sand removed by pumping, using a centrifugal pump. The supply of water to the city was entirely stopped and had to be obtained directly from the Toronto Bay.

Upon a further examination of the pipe it was found that about 600 ft. from the shore there was an opening of about four and a half inches in one of the joints, only ten bolts being left out of forty. Four other breaks were found in the pipe line, three pipes being entirely separated, all bolts removed and a great many of the rivets sheared off, making it necessary to have these pipes lifted and taken to the city for repairs. The four and a half inch opening, however, was repaired by putting in a tapered wooden gasket. Piles were then driven close together on each side of the pipe and the space filled in with concrete. The work of removing the sand from the pipe was one of considerable difficulty. We are now driving steel sheet piling on either side of the pipe for a distance of twelve hundred feet from the shore, leaving a space of about one foot between the pipe and the piling, and filling this space with concrete. The total cost of making these repairs will be nearly $100,000.

As a test of the efficiency of the hypochlorite of lime treatment for water purification, it may be pointed out that during the period of some weeks, when the city was using polluted water from the Toronto Bay, no considerable increase in typhoid occurred. Without this plant no doubt Toronto would have had a most appalling epidemic of typhoid.

The designing and construction of roadways is a branch of the municipal work that has not been so carefully considered as that of sewage and water supply. Macadam, especially in our large cities, is rapidly giving way to a more permanent and sanitary type of roadway. The ever increasing use of self-propelled vehicles demands a roadway which is dustless and capable of resisting the wear and tear of motor cars travelling at a speed of from twenty to twenty-five miles an hour. At the present time roadway engineers are

experimenting with various types of bituminous macadam surfaces to meet these conditions.

The alleviation of the dust nuisance in cities and towns, especially when the temperature is too low to permit of the use of water, should be more thoroughly studied. Medical men inform us that the clouds of dust which arise from the roads are germ-laden, and a source of danger to the health of the community. The use of vacuum-cleaners should be generally adopted as a more efficient method of cleaning the streets.

The transportation of people in large cities is a problem which has not yet been satisfactorily solved. Complaints are constantly being heard of the disgraceful congestion of the various street car services, particularly during the rush hours in the morning and evening. It is essential that traffic conditions in various streets, a subject that up to the present time has received very little consideration, should be carefully studied, in order to obtain a solution of the difficulty. There is also a growing tendency towards constructing, in the business centres, as far as possible, a noiseless pavement. The wooden block properly treated most nearly realises this ideal. For heavy traffic in the neighbourhood of docks, railway yards, etc., the granite block is the most satisfactory. For sidewalks, concrete has entirely taken the place of wood and makes an excellent walk at a reasonable cost. The only objection is that in winter, particularly upon slight grades, it is somewhat slippery.

A great deal of careful consideration will have to be given to the proper and most efficient method of collection and disposal of garbage, ashes, etc. Toronto has now this matter prominently before it, and has to decide whether a reduction plant, or the disposal of the refuse by incineration will be the most satisfactory.

The construction of street railway tracks in city streets is a work involving many difficulties. Experience in Toronto has shewn that T-rails, weighing from seventy to eighty pounds, and grooved girder rails, weighing from ninety to one hundred pounds, are the most satisfactory. T-rails are used on residential streets and in the out-skirts, but the heavy grooved girder type of rail is used upon streets subjected to heavy traffic. The rails are laid upon steel ties, six feet centres, with suspended joints. Under the whole of the track allowance pavement for about a width of 18 ft., a concrete foundation 12 inches in depth is used. This is increased to 18 inches at intersections. The City of Toronto has been experimenting this year with wooden ties, having two feet centres, to ascertain if the vibration and noise caused by the use of the rigid type of construction necessarily involved by the steel ties could not be got rid of.

Following the almost universal practice in England, within the past two or three years, municipalities have evidenced a strong tendency towards operating public utilities, and, providing these services can be kept clear of politics, there is no reason why they should not be administered as economically and satisfactorily as by a private corporation, with the consequent result of decreased cost to the people.

The universal adoption of the telephone, and the great increase in the use of electricity, etc., has multiplied the number of unsightly poles and wires which now disfigure our streets. In European cities such poles and wires are very rarely seen, but up to the present time American municipalities have not taken very active steps towards disposing of these unsightly and dangerous nuisances. Montreal, I believe, has taken some steps towards the construction of lines of conduits for the use of the various companies. It is to be hoped that within the next two or three years other cities also will take this matter up.

The growth of the municipalities in the Dominion, as shown by the recent census, gives some indication of the large amount of money expended in constructing the facilities which are imperative in rapidly growing communities. With a view to presenting to the members an idea of the vast amount of money spent by the municipalities within the past ten years, I obtained, from twelve of the most important cities in Canada, a statement of the expenditure upon engineering matters only, amounting to the enormous sum of approximately one hundred million dollars. This does not include money expended upon the construction of street railway lines, and in some cases does not cover the amount spent in cleaning streets, and disposing of garbage, nor upon public buildings.

I also endeavoured to obtain a record of the number of miles of roadways, sidewalks, sewers and water mains constructed during this period, but, unfortunately, some of the cities have no records extending back so far. I am, however, able to give you these statistics from Winnipeg, Montreal and Toronto.

CITY.	Miles of Pavements.	Miles of Side-walks.	Miles of Sewers.	Miles of Water Mains.
Winnipeg	85	266	135	144
Montreal	37	120	114	40
Toronto	251	410	70	114

In addition to the construction of these various improvements there have been other and more important works carried out, such as the building of electric plants, street railway lines, subways, bridges, abolition of grade crossings (part of the cost of which is generally borne by the municipalities), the construction of sewerage works, filtration plants, etc.

The spending of this stupendous sum of money distributed over such a large number of contracts should give the public some idea of the immensity of detail required in designing and carrying out the various works. Unfortunately, the average citizen does not seem to appreciate the length of time and the attention required to successfully carry out so vast an amount of work, and the municipal councils frequently insist upon having estimates and plans prepared in such a limited time that it is almost impossible to avoid mistakes, resulting in extra charges, etc.

It is to be regretted that in many of the municipalities the members of the council are not cognizant of, or do not sufficiently realize the importance of the work undertaken by their engineer. This, I think, is one of the reasons for the unfortunate criticism, fault-finding, etc., which so frequently occurs. The engineer, as an advisor of the council, should receive more assistance than the head of any other department, because his department is the one which involves the greatest expenditure in the city service, and the one which naturally the citizens are apt to consider critically. During the past year I have heard of two or three cases in which the engineer considers he has been treated most unfairly by the municipality, and this tendency to censure unjustly an engineering officer seems to be increasing. This is a very difficult matter to deal with, but could perhaps be alleviated if the members of our profession asserted themselves more emphatically, and could induce the press to realize the difficulties that beset the engineer in carrying out the various works. Unfortunately it seems to have become the habit of some members of the press to make assertions derogatory to the engineers without first ascertaining whether they are based upon fact or otherwise.

A very large number of the members of the Society are brought into daily contact with laborers. This is especially the case on railway construction and other works remote from civilization, and, whilst it is not an engineering question, it has occurred to me that by some effort on the part of engineers the conditions of the men engaged upon these works could be materially improved. We all realize that the more perfect the sanitary conditions of these camps, the better the food, etc., the better is the quality and quantity of the work performed. The consideration of the labor problem should receive more attention than is usually accorded it.

The question of deciding upon the proper examination for admission to the Society of applicants who are not graduates of any recognized engineering school, is one which will have to be carefully considered by the incoming Council.

In concluding this address, I regret that, owing to my residence away from head-quarters, I have not been able to give the attention to the affairs of the Society which I have wished, but through the untiring efforts of the Members of the Council, and of our Secretary, the interests of the Society have been well looked after, and, upon retiring from the office of President, I wish to thank those gentlemen for the able manner in which they have assisted me during the year.

Report of Yesterday's Meeting

Report of Proceedings of the Twenty-sixth Annual Meeting, held at the Rooms of the Society, 413 Dorchester Street West, Montreal, 24th to 26th January, 1912.

THE PRESIDENT, C. H. RUST, in the Chair.

Morning Session—January 24th, 1912.

At 10 a.m. the meeting was called to order by the President.

THE PRESIDENT: The first order of business, gentlemen, is the reading of the minutes of the last Annual Meeting. The Secretary will read the minutes.

The Secretary here read the minutes of the last Annual Meeting.

THE PRESIDENT: The next business on the order of the day is Report of Scrutineers. I would appoint, subject to the approval of the meeting, for officers and members of Council, Messrs. C. S. Leech, E. Mauer, and R. C. F. Alexander, and for amendment to by-laws Messrs. H. B. Stuart, J. Openshaw, and C. A. Meadows. Is it your pleasure that these gentlemen be appointed?

Carried.

THE PRESIDENT: The Report of Council is the next order of business. It is not necessary, I presume, to read it. Will some one move that the report be received.

Mr. SKAIFE: I move that the report be received.

Dr. GALBRAITH: I second the motion.

Carried.

THE PRESIDENT: Is there any discussion on the report of Council?

MR. JAMIESON: Gentlemen, just a few words on the Report of Council. I think reading from the report that it is particularly notable for one thing, that is, what it does not contain. In fact we have a Council and Officers of the Society that during the past year undoubtedly have transacted a good deal of business at their meetings, and important matters no doubt have come up, but they have not seen fit to take the great body of the membership into their confidence in any respect. They do not tell us a single thing in their report of what business they have transacted, or the questions they have before them. It is made up partly of the financial statement with additions to members and so on, but in none of our publications during the year, is there any synopsis given of matters of importance that the Society had to deal with that may affect the general welfare of the Society or of the individual members.

It is particularly notable the difference that exists between this Society and other societies of a like nature. The American Society of Civil Engineers, for instance, in their monthly Proceedings, gives a synopsis of the matters that have been brought before their Board of Directors at each meeting, and they tell the members what the members of the Board have been considering, but there is not one word of anything of the kind to be found in this report of Council or in our Proceedings.

Let us take up our by-laws. Under "Objects of the Society" I find "The object of this Society shall be (1) to facilitate the acquirement and interchange of professional knowledge among its members, and (2) to encourage original investigations."

The fulfilment of this object is the only real reason to justify our existence, and yet there is no tangible evidence that we are fulfilling that object.

I know that the Chairman of the Committee on Papers has worked particularly hard during the past year to bring out good papers. When I speak of papers I mean regular papers for the Society, but he has had very little success. He has succeeded in getting a number of interesting lecturers to give lectures on matters that were very interesting at times, but which did not bring out any discussion.

Now, another matter that I want to bring before this meeting is this. I refer to the officers in the Council. We seem to lack an executive head; that is to say, the President is most of the time residing at very considerable distances from headquarters, and if he attends the meeting he has to do so at considerable expense and sacrifice of time, and the result has been that we do not always look upon the president as the executive head, but that it is very largely an honorary position as presiding officer at our annual meeting and on every other occasion when he can be present.

I thought possibly there might be some further discussion on this matter, not with a view of criticizing, because I do not like that, but with a view of the betterment of the Society. I sincerely hope that some plan will be formulated by which there will be an improvement.

THE PRESIDENT: I would like to ask Mr. Jamieson what additional information he wants in the report of the Council. As to the executive head in Montreal, this past year you have had Mr. Holgate. I am very sorry he is not here at the moment, but I know for a fact that he devoted a great deal of his time to the interests of the Society. I think the chief problem has been the difficulty in getting papers read before the meeting, but that rests entirely with the members themselves. I know that Mr. Vaughan has done all he possibly could in this respect. He has drummed up the members and written to them. Now, the question of papers rests entirely with the members of the Society and I think there is a little lacking in that respect. I do think we ought to get better papers and more of them, but it is certainly not the fault of the Council.

MR. JAMIESON: I quite agree with what you say that it is up to the members of the Society to supply papers, but until we are able to improve our Transactions and get them on a higher plane, we cannot expect to get papers of the quality we are looking for.

Another criticism I would make is that our members come in from all over the country and a great many are unknown to each other, and there is nobody here to meet them or to make them at home, or introduce them to each other. It seems to me we must do something to wake up and create an interest in the Society.

THE PRESIDENT: Is not that the fault of the local members themselves?

MR. JAMIESON: Perhaps it is, but it seems to me the Council is open to criticism for their inaction in this respect.

MR. THOMPSON: If you will permit me, gentlemen, I would say, just having been elected a Director of the American Society of Civil Engineers, that I have come up here to learn something, because down in our country we think the Canadian Society of Civil Engineers is an example to be followed. As you know we have four great national societies instead of one as you have here, and in consequence we cannot get any legislation. The four societies have all got entirely different grades of membership, so that I say there is a good deal of envy in our country of your Society on account of your having started in the right way. I would say that I had not been elected a director of the Society one hour before I had probably a dozen members telling me very urgent things that ought to be carried out, and I had other members forming themselves on the opposite side of the question. For every one who made a suggestion there would be others who opposed it, and who would insist that it should not be done.

Now, I would like to make one suggestion to you in connection with papers that are presented to the Society, and that is in reading abstracts from the paper, rather than reading a long and possibly tedious paper. We have cut out altogether the reading of long mathematical papers, because we consider that the chief interest of a meeting of that kind is in the discussion, and the only way you can get that is by having the author of the paper go around and have a dozen or so members of the Society who are willing to come to the meeting and start the discussion. When I write a paper I would rather have the members tear it to pieces than not to have any criticism of it whatever.

Now, there is another point that I would call to your attention. Over on our side we have a membership of about 6,000 and the full members pay $25. It seems to me you would get a lot more if you would put it up.

MR. SKAIFE: I think that Mr. Jamieson's trouble would be remedied if the Society would appoint a reception committee to outside members and introduce them to each other.

MR. VAUGHAN: Surely Mr. Jamieson does not wish us to publish the discussions of the Council or the routine work that goes on all the time. The Council meetings are largely devoted to a classification of members and discussion of the details of branches and that sort of thing, and I really do not know of anything that has been left out of this reportthat could be put in to advantage.

Now, as far as an executive head is concerned, I think an executive head is a pretty good thing, but I would say that the Montreal portion of the Council does practically constitute itself an executive committee for the conduct of the affairs of this Society. The members of the Council do constitute themselves practically the executive head, and whilst perhaps they might have a formal one, it is doubtful in my mind whether any great advantage would be obtained from it.

In connection with the papers, the fact of the matter is that you cannot get good papers out of a Society like this as long as Canada is as properous as it is, and as long as everybody is busy and doing things as we are at present. In a Society like this where the members are scattered over an immense territory, and in the properous conditions of the country, everybody is too busy to write papers. Papers come better when you have more men who are not quite so busy and have time to write and desire to write papers in order to advertise themselves or tell what they are doing. To-day everybody is busy and it is very difficult to get papers from engineers in Canada.

The question of papers must I think be left to settle itself. Speaking as Chairman of the Committee on Papers all I can say is that any good papers will be heartily welcome and arrangements made to present them to the meeting. We cannot make members write papers. We can only keep telling them that we want them to do so.

Now, as far as this discussion is concerned, and the reference that has been made to the officers of the Society, I must say that our Secretary has certainly done good work. (Applause). He has been after every member, urging them to come to the meetings and enter into the discussion. I do not think that any more could be done, and I am sure no executive committee could do anything more than Professor McLeod has done in endeavouring to get good attendance at our meetings, and arranging the details of the same.

As far as the members of the Council being present at all these meetings is concerned, when you have a meeting every Thursday and the Council has been meeting every Saturday, it is a good deal to expect a man to attend every meeting all through the session.

MR. JAMIESON: Do I understand that in moving the adoption of the Council's report that that includes everything in the report?

THE PRESIDENT: Yes, everything done during the year.

MR. JAMIESON: That is down to page 14 of the report.

THE PRESIDENT: Yes.

MR. JAMIESON: Well, on page 13 of the report, I find the following:

> "The Chairman of the Nominating Committee for Officers "and Members of Council has suggested the following "procedure for the conduct of the business of the Com- "mittees, and the Council has endorsed the same and re- "commend it to the Annual Meeting for its approval."

Does that mean, Mr. President, that this will be adopted without any discussion?

THE PRESIDENT: Well, I was asking the members for discussions on the report of Council.

MR. JAMIESON: If it is in order to discuss it now I may say very emphatically that I do not agree with the suggestions made there by the Council.

I do not think that this meeting should concur in the suggestion that has been made in regard to the Nominating Committee. Let us have our Nominating Committee so independent and so much in touch with the members as a whole that they will have no cause for complaint.

MR. THOMPSON: I know a number of different societies in the United States that are radically different in their constitution and method of procedure. One society I believe has absolutely free and open nominations. They have their annual meeting, and any member can get up and nominate any person he wishes, for the most important office. Now, imagine Andrew Carnegie, for example, calling a meeting at his works and allowing anybody to nominate any person he wished to fill the position of President of the Carnegie Steel Company. It seems to me that no person should be nominated that is not perfectly competent to fill the position, and it seems to me that a member should first be vice-president and then, perhaps, if his services are satisfactory, the Society at its annual meeting should make him president. The most vital part of any society of this kind is the Nominating Committee (Hear, hear). I think the best organized rules of any society I know is where all the past presidents of the society are made the nominating committee, of which the last past president is chairman.

If you adopt the system of the American Society of Civil Engineers, I will give the Nominating Committee a tip; that is to pick the men whose names commence with letters near the beginning of the alphabet, because in the list of names they are generall printed alphabetically, and a great mapority of the voters do not know any of the applicants, and they nearly always vote for the first ones on the list (Laughter).

DR. GALBRAITH: I may say that I do not quite understand Mr. Jamieson's attitude with respect to either the Nominating Committee or with this proposal as to the mehod of action in making nominations.

It seems to me with regard to this matter that the nominations are on exactly the same footing under the present arrangement. There are certain nominations made by the Nominating Committee, and there are certain nominations that may be made by certain members according to the gy-laws. The peculiarity of these nominations is this: That not only the persons who are nominated are known to the Society beforehand, but also the names of the persons who nominate them. The Society knows the members of the Nominating Committee. The Society knows the names of the gentlemen who make the nominations. They are all exactly on the same footing as far as that goes. If the names were put in the same list and no names of the nominators other than the Nominating Committee were published, then the Society would be under a false impression.

MR. JAMIESON: Pardon me, Dr. Galbraith. Of course they do send out the names of the nominators in a separate letter, That has been sent out previously.

DR. GALBRAITH: Well, you do not intend that all the names

of the nominees should be published in one list without at the same time naming the others who nominated them.

MR. JAMIESON: No, when the final ballot goes out it goes out only with the names on it, but previously all members have been advised of the extra nominations and the names of those who nominated them.

DR. GALBRAITH: I misunderstood your statement, and I have therefore nothing more to say on that question. It is quite proper that every one should know who nominated a person to office.

One point, Mr. President, and that is that I think we are taking up this report by the Council in a manner that is not altogether correct, or systematic. There are certain proposals made by Council in this report. It seems to me that it would be better for our record if the report were taken up clause by clause, and motions proposed on each of the suggestions that are made, and the matter discussed and carried systematically. For instance, there is a proposal before the one which Mr. Jamieson has spoken of, and while it may save time to proceed in that way with the question of the Nominating Committee, and its methods of working now, yet I would propose after we dispose of that, to go back and take up the suggestion clause by clause, and that somebody move their adoption and let us have a discussion on them and decide what we will do.

THE PRESIDENT: I would ask Mr. Fairbairn, the Chairman of the Nominating Committee, to address the members.

MR. FAIRBAIRN: In handling the question of nominations this year there were one or two conditions which arose that led me to think that possibly a more systematic method might be followed than has been followed in the past, and it was with that in view that I made the suggestion contained in the report of Council, the idea being that our by-laws have been so worded as to make our members of the Nominating Committee practically representative of the various districts, the idea being that the representatives of district would know better than anybody else which members were eligible for Council in the various districts in order that they might get in touch with the members in that district. Therefore the Committee made the suggestion as embodied in the report.

MR. JAMIESON: I want it to be distinctly understood that I am not criticizing the work of the Nominating Committee in any sense. We now have a term of office for the Council of three years, and at the end of three years, I think, they should step out. I do not believe in making a hard and fast rule, but I should think it would generally be considered advisable that the members of the Council should retire at the enl of three years.

MR. WHITE: I am quite in agreement with part of what the gentleman has just said, and I think the arrangement as suggested by Mr. Fairbairn with possibly a little amplification will meet the case admirably.

The system where we are all divided up in districts, if we have a ballot fro mthe member of that district, seems to me to fill the bill adequately.

MR. FAIRBAIRN: Do I understand that you do not think the past presidents should have a voice in the nominations in connection with the offices of President and Vice-President, or that only the members of the Council should have that right?

MR. WHITE: I think the past presidents, as such, should not be members of the Nominating Committee for Council.

MR. FAIRBAIRN: Under the by-laws at the present time they are members of the Nominating Committee, and the idea in this was to limit them to the office of president and vice-presidents.

MR. WHITE: As I understand this proposed amendment, they would have the whole say with regard to the president and vice-president.

MR. FAIRBAIRN: They would have the whole say in suggesting the nominations, but the whole Nominating Committee at large has the cutting down of the list that they would suggest. The Nominating Committee has the right to ask for as many names from them as they like.

MR. WHITE: The only objection I have to that is that there are nine districts. Therefore there are nine members of the Nominating Committee plus the three past presidents, which would make twelve in all. I would say that the past president and vice-president should have one vote out of twelve; that is to say, that they should not have the whole say in regard to the nominations of president and vice-president, and I would exclude them from any nomination with regard to Council. (Applause).

MR. THOMPSON: If you will permit a visitor to speak again, I think the only mistake in having the presidents on the Nominating Committee is that it is limited to three. If you make all the past presidents members of the Nominating Committee it would be only a question of time before every section of the country will be represented. To my mind the Chairman of the Nominating Committee is a more important position than that of the President of the Society. The idea of having an open nomination for the Nominating Committee is one of the most easily controlled things in the world. You send out and ask three thousand to six thousand men to propose some member for the Nominating Committee. You may get one thousand names with one vote each, and one or two men can put in anybody they like.

MR. JAMIESON: Do I understand Mr. Thompson to say when he refers to the past presidents to make them a nominating committee exclusively without any other nominating committee?

MR. THOMPSON: I think you are quite right in saying that they abuse their office. Anybody at the last moment can get up and nominate whom they choose. I don't think that any ten men could have made the same prestige as all the past presidents have.

MR. CLEMENT: Does the Council include this in their report as a hard and fast practice that is to be approved, and if so, does it have to be a matter of by-law, or is it a suggestion of the Nominating Committee?

THE PRESIDENT: I don't think a by-law is necessary.

MR. CLEMENT: Is it to go in the rules and by-laws of the Society as a procedure of the Nominating Committee, or is it a recommendation for Nominating Committees?

THE PRESIDENT: No. If this is carried it is adopted by the Society as the proper procedure.

MR. JAMIESON: I don't think you can do that. I think we have by-laws already governing this. I think it has to be an amendment to that by-law.

MR. CHIPMAN: I for one am quite satisfied to leave the by-laws as they are. I think Mr. Fairbairn has interpreted them in the proper way.

(*Continued in Issue No. 3*)

REPORT OF THE GOOD ROADS COMMITTEE

LETTER TO MEMBERS OF COMMITTEE.

As Chairman of the Committee appointed to consider the question of good roads and street construction and maintenance, and to draw up a standard of classification and specification of good roads in Canada, I beg to say that owing to the different members of this Committee being so widely separated, the Committee has not had an opportunity of jointly conferring on this subject, except by

correspondence. You will note from the correspondence, which I submit herewith, that the majority of the opinions received from the different members of the Committee is that it would be very difficult to prepare a standard specification which would meet the requirements of all sections of the country, with the varying conditions, climate, soil, traffic and available material. At the same time your Committee is of the opinion that a draft specification such as the attached, embodying the principle of broken stone construction to meet the average requirements, would be of very great service and assistance to many engaged in this particular line of work, and would suggest, at least, the best practice resulting from our experiences up to the present time.

Ottawa, Nov. 9th, 1911. A. W. CAMPBELL,
Chairman.

Road Specifications.

A standard specification should not be understood as one to be followed rigidly under all circumstances. Properly treated, no two miles of road should be constructed in precisely the same way. For this reason every road should be a problem in itself, to be treated in accordance with local conditions and requirements, always, however, following the scientific principles underlying the making of good roads. A standard specification is one that may be drawn upon to meet average conditions, but in every case it should be varied to meet the special requirements of the work undertaken.

Owing to the great variation in requirements, particularly in the grading and drainage of a new road, it is exceedingly difficult to draw up a specification which will not be cumbersome and which will not, because of intricacy and indefiniteness, cause contractors to be alarmed to such an extent that their prices will be considerably advanced. For this reason the great majority of municipal councils have been in the habit of building roads by day labour rather than by contract. In justice to the work, road specifications should be simple and definite, but the necessity of safe-guarding the municipality from "scamped" work makes an ideal difficult to reach.

As between work wholly performed by day labour, and the other extreme of contract work there is a middle field of safety to the municipality. It is that all earth work, including draining and grading, should be done by day labour under the municipal road superintendent. For this work he could use the grading equipment which all municipalities possess, and could carry on the work at the most favourable seasons of the year. Having provided for grading and drainage, with incidental details, the placing of stone or other road metal could readily be let by contract.

The standard specifications in this report have been prepared with a view of a simple treatment of all classes of work performed under contract, but should be modified to meet special requirements. They express a standard required for county road systems, but in their application to municipal work should be accompanied by general conditions such as those attached to the specification for steel bridges.

Standard Specification for Stone and Gravel Roadways.

Scope of Specifications.—(1.) The work covered by these specifications is to include the supplying of all labour, machinery, plant or materials which are needed to construct durably and expeditiously, and to fully complete ready for travel a roadway which is, in general, to be straight and in the centre of the road allowance, with a uniform width between the inside of open ditches. Roads are to be given an easy flowing grade, cutting hills and knolls, and filling depressions. The steepness of hills is in no case to exceed a rise of four per cent. On roads not previously metalled, earth excavated from the ditches is to be drawn to the centre to form the grade or turnpike. On old stone or gravel roads, earth shoulders are in general to be turned away from the centre, across the open ditches, if so directed, and the crown of the road restored by placing new metal on the old stone or gravel base.

Plans, stakes, etc.—(2.) All work under these specifications is to be in accordance with the plans, profiles, and schedules forming part of these specifications, and to the lines and levels given on the ground by the engineer. Stakes and bench-marks placed for this purpose are not to be moved or effaced when avoidable.

Width of road.—(3.) The width of road shall be uniform unless otherwise directed, for curves or other irregularities, widths of grade between shoulders to be twenty-four feet, and the stone or gravel 8 feet wide for single track roads, and 14 feet wide for double track.

Crown.—(4.) The finished and consolidated roadway is to be circular and have an average crown of one inch to the foot from side to centre. Earth excavation and the placing of stone are to be uniformly such as will produce that camber, except as otherwise directed by the engineer in case of hills, swamps, rock outcrops, and other irregular conditions. Where the width and quality of stone used in the road will permit, the average crown may be reduced to one-half an inch to the foot, if so directed by the engineer.

Excavation and fill.—(5.) Excavation or fill is to be made in all cases to the required depth below the elevation of the finished roadway. Surface soil, vegetable mould, logs, stumps, or other weak or perishable material are to be removed to a sufficient depth to secure a firm foundation, and such excavation shall be filled with durable material to the height of the sub-grade. The sub-grade thus obtained is to be made thoroughly firm and solid by pounding and rolling. In swamp land, roots and muck are, if practicable, to be removed in advance of filling, to a firm bearing.

Roadsides.—(6.) The land at the sides of the road, between the gutters or open drain, and the fences, is to be graded from margin of the roadway, as may be directed, the roadsides to be left smooth by grading and levelling, care being taken not to injure or bark trees and shrubs that may be marked for preservation, or where such preservation is directed by the engineer.

Lane and street intersections.—(7.) All intersections of roads, lanes and entrances are to be properly graded, and stoned or gravelled as directed, to conform to the finished grades of the intersecting roadways; and tile or other culverts or crossings are to be well laid, under instructions from the engineer.

Broken stone surface and quality of stone.—(8.) The surface of the roadway is to be covered with crushed stone to a minimum depth of eight inches after consolidation, to be regularly and perfectly spread over the whole of the roadbed to a depth to conform to the cross-section shown on the drawings. The crushed stone is to be durable limestone, granite or field stone, of such quality and broken to such dimensions as may be approved by the engineer. All stone used must be free from clay, loam or earthy material. Samples of material to be used are to be placed with the engineer, and all material is thereafter to conform to the quality of such samples.

Placing stone on the roadway.—(9.) The broken stone is to be placed on the roadway in the following manner:

(*a.*) Coarsely crushed stone or "tailings" of a size that will pass through a four-inch ring, and be retained by a two and one-half inch ring, is to be placed over the central portion of the sub-grade to such a depth and width as the total depth of stone will permit; this is to be rolled dry to a firm and even surface, and additional stone is to be added wherever depressions appear, or the camber becomes too flat under the roller. Where "tailings" are not available, their place shall be taken by the grade of stone described in the following sub-section:

(*b.*) Upon this shall be spread a layer of crushed stone, such as will pass through a three-inch ring, and be retained by a one and one-half inch ring. to be four inches in depth after consolidation at the centre, and such further depth at the centre and sides as will bring the roadway to the line of the finished grade. This is to be rolled dry, to a firm and even surface. Additional stone is to be added wherever depressions appear or the camber becomes too flat under the roller.

(*c.*) The roadway so formed shall be coated with screenings; these to be thoroughly saturated and rolled until perfectly consolidated to the satisfaction of the engineer. Screenings are to consist of stone chips and dust, such as will pass a one and one-half inch ring, an excess of dust to be removed by a dust jacket attached to the screen, if required by the engineer. Screenings are not to be dumped from wagons on the stone, but are to be spread from the wagons or from piles deposited along the roadside.

Screenings not to exceed necessary amount.—(10.) Special care must be taken that the screenings shall not be in excess of the quantity necessary for consolidating the road, nor shall less be used than is needed to maintain a smooth surface. The screenings shall be uniform and thinly spread, and additional quantities shall be added as may appear necessary after watering. Screenings are to be added to or removed from the surface as may appear necessary to the engineer, at any time during the progress of the work.

Manner of rolling and wetting roadway.—(11.) Rolling shall be commenced at the edges or curb of the road, working towards the centre, and shall be continued until the earth sub-grade and each layer in succession is firmly set. The final rolling must be continued until the roadbed is perfectly consolidated and unyielding, to the satisfaction of the engineer. During the whole of the final rolling herein specified, a sprinkling cart is to pass immediately in front of the roller, so that at all times the surface of the road will be saturated with water.

Gravel.—(12.) Gravel where expressly permitted by the engineer shall have a minimum consolidated depth of eight inches, and the widths of metal, drainage, grading and all other details and requirements wherever applicable, as stated elsewhere in this specification, shall apply. The gravel used shall be clean, free from an excess of clay, loam or sand; shall be compact and composed of varying sized grains up to two inches diameter. If the gravel contains large stones these are to be removed at the pit, or if drawn to the road may be raked forward and spread in the bottom of the road. Should the gravel contain an excess of large stone, or of fine material, treatment by crushing, or screening, or both, shall be provided, such as is necessary to produce a satisfactory road metal. Where gravel does not consolidate readily or sufficiently by rolling, approved material, such as limestone or screenings may be lightly spread over the surface to provide the necessary bond. The gravel, spread to a uniform depth, shall be made wet by sprinkling and rolled until thoroughly consolidated. When crushed or screened gravel is use, care must be taken to use no more screenings on the surface than is necessary for consolidation. The quality of gravel, preparation, method of placing on the road, and means of consolidation must be, in all respects, approved by the engineer.

Surface drainage.—(13.) Open drains or gutters shall be formed along each side of the roadway, of sufficient capacity to carry to an outlet all water entering them, the grade of such drains to follow, where practicable, that of the roadway, but preferably having a minimum fall of three inches in 100 feet. The slope of gutters is to be uniform and without pockets or depressions. On hills and hillslides, where suitable outlets cannot otherwise be obtained, surface water shall be received into catch-basins at suitable intervals, and discharged to an outlet through underground tile, vitrified sewer pipe being preferably used for that purpose. On hills, concrete or cobble gutters may be required where the rush of surface water is likely to cause erosion.

Tile drainage.—(14.) Tile drains, where required to remove an excess of sub-soil water, to tap springs, to dispose effectively of surface water, to protect hills or road intersections, shall in general be placed along the side of the roadway, under the open drain or gutter, and shall be of not less diameter than five inches. The tiles are to be placed in an eight-inch trench, the bottom of the trench to be 36 inches below the sub-grade of the roadway. They are to be uniformly and evenly laid with a fall of not less than three inches in a hundred feet to a proper outlet, and with ends closely abutting. All tile used shall be of the best quality of clay, manufactured expressly for drain purposes, in lengths not less than one foot, and of uniform diameter throughout. Earth excavated in the laying of these drains shall be returned to the trench, being consolidated on hills, or slopes, if considered necessary by the engineer, to prevent its being washed out, and in every case so disposed of as not to interfere with surface drainage. Where the bottom of the trench is in quicksand, satisfactory means are to be used to keep the tile in a true line, and free from sediment, by laying on a board, surrounding with cinders, sawdust, cotton or cheesecloth.

Foundation of large stone.—(15.) Where the natural roadbed is weak, flat, or for any other reason a strong foundation is desirable, a foundation shall be laid below the stone referred to in Section 9 of this specification, such foundation to be constructed of cobble stone, coarse gravel or rough quarry stone of a size not exceeding eight inches in largest dimensions, and of such depth as, in the opinion of the engineer, the work may require. This foundation is to be rolled to the satisfaction of the engineer; this to be followed by a layer of crushed stone described in Section 9 (*a*) of this specification. Roads of light or blow sand are to have an eight-inch layer of clay, or gravel containing clay, laid as base for the metal covering, such clay or gravel to be thoroughly rolled and consolidated before the metal surface applied.

Side slopes.—(16.) Side slopes in cuts and fills are to be one and one-half feet horizontal to one foot vertical. Earth for fills on side-hills and through ravines, where the grade cutting does not provide sufficient material, is to be obtained from the tops of hills, or such other point as directed, in order that the natural slope of the earth may be maintained and slipping prevented, as far as practicable.

Rip-rap.—(17.) Rip-rap, where required to protect the face of embankments or the foot of slopes, unless otherwise directed, shall be of undressed field or quarry stone, laid by hand to a uniform thickness, each stone to be firmly embedded, and at a slope not exceeding one foot horizontal to one foot vertical. The largest stone adapted to the work is to be used.

Concrete tile culverts.—(18.) Concrete tile culverts, where required, are to be of such size and length and at such depths as may be determined by the engineer, and are to be placed where shown on the plans hereto attached, are to be placed and connected with tile and free outlet, so that water will not stand in them. The spigot end is to be down grade and joints are to be fitted and made tight with cement mortar. The trench to receive the tile is to have a concave bed, so that the tile will have an even bearing, the earth is to be firmly packed and rammed around the tile, and a minimum depth of one foot of earth is to cover the tile. Each end of the culvert is to have a concrete headwall sunk below the frost line and of such dimensions as may be necessary for a retaining wall to suit the situation. Concrete tiles are to be strong and of the best quality, sound, free from all defects, smooth, uniformly circular and made in accordance with an approved specification.

Catch basins.—(19.) Concrete catch basins, in accordance with the plans hereto attached. Culverts are to be laid with a good fall drains, at such point and at such depth as the engineer may designate, iron covers, for this purpose to be provided.

Cobble-stone gutters.—(20.) Cobble-stone gutters will generally be three feet wide, but are to be of such width and contour as the situation may require. They are to be made of stones from 4 inches to 6 inches long, and from 2 inches to 4 inches wide, set on end and bedded in an 8-inch layer of gravel or coarse sand. The upper interstices of the stones are to be filled with fine gravel or coarse sand, and the whole thoroughly rammed to a firm bearing.

Concrete gutters.—(21.) Concrete curbs and gutters, if required, shall, unless otherwise directed, be in accordance with the dimensions shown on the drawings hereto attached. The Portland cement, all materials, methods and workmanship, shall conform to the best of modern practice and standards. The curbing and gutters shall be laid on a six-inch bed of gravel or broken stone, which shall be thoroughly tamped and consolidated. The curb and gutter shall consist of a concrete core or backing, with a one-inch surface coat of mortar; the concrete core to be mixed in the proportion of one part of Portland cement, three of sand, and five of broken stone; the surface coat to consist of one part of cement and two parts of sand.

The entire exposed surface shall be neatly faced by floating and trowelling with a coat of neat cement, and finished with a dampened bristle brush, so as to give a uniform colour throughout.

The work shall be carried on as rapidly as the concrete can be thoroughly rammed, and the whole curb and gutter shall be completed while in a soft and plastic state, so that it will be monolithic when set.

The curb shall be divided into sections eight feet in length by such means as will insure complete separation. At road and lane intersections the curb shall be made on a curve of suitable radius, with true and even joints.

The temporary forms used in shaping the gutter and curb shall be set accurately and firmly in place.

REPORT OF THE COMMITTEE ON TIES

Ottawa, November 28th, 1911.

The Secretary, Canadian Society of Civil Engineers,
Montreal, P.Q.

DEAR SIR,

Referring to your request of 25th inst., that the Report of Tie Committee for 1911 be submitted to the Council before December 9th, I attach for the Council's information copies of correspondence I have had in this connection, from which it will appear that only four out of the nine members have taken any part in the discussion, and that two of them are in favour of using ties not longer than 8′ 6″; one sticks to the 8 foot length without, however, advancing any reasons to support his views. Under these circumstances it seems impossible to present anything that could be called a Report of Tie Committee, hence I submit the correspondence for such action as the Council may deem advisable, and in doing so desire to say that this year's discussion, in my opinion, has not disclosed any definite or conclusive reasons to prove that ties shorter than 10 feet meet the requirements of the standard modern track, required to support the immensely increased loads of up-to-date rolling stock.

Perusal of the reports and discussions of the Committee on Ties of the American Railway Engineering Association for several years past will disclose the fact that many members of that association are of the opinion that longer ties are necessary, but that they hesitate to recommend the same definitely for fear of seeming to commit the roads they represent to large increases of expenditure. It would be equally logical to advocate using a 56 lb. rail for the same reason. The chief engineers of the London and Northwestern, and of the Midland Railway, of England, inform me that their standard tie is 9 feet long. These are two of the best maintained roads in the country, but their engines are probably not more than two-thirds the weight of the heavy engines used on this continent, and the axle loads are lighter in proportion.

Ties 9 feet long have been used in Texas over 30 years with mud ballast, which would indicate that the advantage of increased bearing must more than offset the disadvantages of drainage, even in bad ballast, and these disadvantages would not be so great in gravel ballast.

The chief engineer of the Louisville and Nashville Railway informs me that they have used 10 ft. ties with sand ballast and had no difficulty with drainage, or trouble with ties breaking under the rail. They now use blast furnace slag for ballast in place of the sand, and their standard tie is 9 feet long.

Some ten years ago I had personal experience with a piece of track, about one-half mile long, over Muskeg, on the Canadian Pacific Railway, which piece of track is was impossible to keep in surface or line with ties 8 ft. long. An experiment was tried with ties 12 ft. long, and that length of tie has been used there ever since with perfectly satisfactory results. The roadmaster recently informed me that he had no trouble with the long ties breaking, and that this summer he had treated another muskeg the same way, with the result that a-half mile of 7 mile section, which with 8′ ties had taken 50% of the time of the section gang to keep in order, had, since the placing of the 12′ ties, scarcely needed any attention, and remained in good surface and line.

These examples would indicate that there is not much danger of 10′ ties breaking, and that they do give the much needed additional support.

I am sending a copy of this letter to each member of the Committee, but do not propose to submit any further formal report.

Yours very truly,
D. MACPHERSON,
Chairman of the Committee on Ties.

CANADIAN PACIFIC RAILWAY COMPANY.

Winnipeg, June 5th, 1911.

D. MacPherson, Esq.,
Assistant Chief Engineer, N. T. R.,
Ottawa.

DEAR SIR,

I have the Secretary's circular letter of May 23rd, notifying members of the Railway Committee of their re-appointment, and asking that we reply to you accepting the same. I will be pleased to serve on this Committee, and do what my spare time will permit.

I also have copy of your letter, May 5th, to the Secretary, regarding an error in the Committee's report. I think, if you will give this matter a little further study, you will find that there was not only an error in figures, but there was also a very serious error in principles. Leaving aside all the features that make it unnecessary to tamp under the centre of the ties, and assuming that it would be good railroading to so tamp ties, (which, of course, I do not admit), the only place a tie is apt to break is under the rail or at the centre. Now, if you will figure up the strain, putting the moment at the centre of the tie equal to the moment underneath the rail, I think you will soon discover the error I allude to.

To make the case a little more clear. Imagine the tie turned upside down, the rails a support, and the tie carrying a uniform load. I think you will find that theoretically the length of tie for a safe load is considerably less than 9 ft.

Yours truly,
J. G. SULLIVAN.

TO THE MEMBERS OF THE COMMITTEE ON TIES, CANADIAN SOCIETY OF CIVIL ENGINEERS.

As the Committee on Ties has been continued from last year, with the understanding that only those who expressed a willingness to act need be considered as members, I would advise you that the men whose names appear on this letter have stated their readiness to act, which should assure a good live report for next Annual Meeting. Unless the majority of the members of the Committee wish otherwise, it might be well to confine our work this year entirely to determining what, in our opinion, are the best dimensions for ties for a standard trunk line railway, and not go into tie preservation or cost at all.

Of course the question of cost is very vital, but the first and most important things to determine are the proper dimensions to give the best results.

I enclose copy of some correspondence between one member of the Committee and myself, which may help to set the ball rolling, and I would ask each member to contribute something definite on the subject as early as possible, avoiding generalities and giving logical reasons for all theories advanced. As soon as all the members contribute something on the subject, I shall call a Committee meeting, when we can exchange views more fully and perhaps evolve matter for further inquiry or discussion.

In the meantime, I hope you will pitch into the two of us who have so far committed ourselves to paper and handle our theories without gloves, so long as you evolve something better or advance arguments which prove our points of view to be erroneous.

COMMITTEE.

E. P. Gutelius.
H. G. Kelley.
Wm. McNab.
J. G. Sullivan.
T. C. Burpee.
H. A. Woods.
M. H. MacLeod.
W. A. Bowden.
W. B. MacKenzie.

D. MACPHERSON,
Chairman.

July, 1911.

J. G. Sullivan, Esq.,
Assistant Chief Engineer, C. P. R.,
Winnipeg, Man.

July 20th, 1911.

DEAR SULLIVAN,

I am obliged for yours of the 5th ult., *re* ties, and, if all members of the Committee, in addition to the interest they take in this matter, would show that interest as practically as you are doing, we should soon thresh out some useful information. We must, however, each be careful to try to look at the matter, not only from our own,

but from the other fellow's point of view. I am quite willing to admit the words "firmly tamped for its entire length" may be misleading. It would be better to say tamped for its entire length in such a way as to give, as nearly as possible, uniform support, having regard to the distribution of the load, that is, tamped hard under the rail and for a distance of say 18 inches each way, from edge of rail base, and outer ends tamped more firmly than at centre of track. I have not entirely overlooked the principles of the bending moment you refer to, and agree with you that the moment is greater under the rail for a 10′ tie than for an 8′ tie, but it is less at the centre for the longer tie. Ties are more apt to break at the centre than under the rail, when frost is coming out, and that is about the only place and time good ties ever break, therefore, the lessening of the moment at centre should be an improvement. I have used 10 ft. and 12 ft. ties, with excellent results, over bogs and places where track could not be kept in surface or line with 8 ft. ties, and have never known a long tie to break under such circumstances. Does not this indicate that the bending moments in the tie may not be as important as providing an increased area of foundation for the immensely increased weights of recent years. Your illustration of turning the tie upside down, supported on the rails, and assuming load uniformly distributed, certainly facilitates calculation of the stresses, but unfortunately we know the load is not uniformly distributed, hence calculations based on that assumption are inconclusive. In any case, they only refer to the strength of the tie and not to its effectiveness in providing, as nearly as as possible uniform minimum unit pressures on the ballast. I will in turn make a suggestion to illustrate my point of view. Assume that the ties are sawn straight through in the centre and the spreading of the track taken care of by steel the rods bolted to the rails. Would not the outer ends of 8 ft. ties be immediately crushed into the ballast and the inner ends be cocked up? Would this happen if ties were of equal length each side of rail, and if not, does it not prove that lengthening the ties is not altogether folly?

I shall be glad to hear further from you on the whole question, and hope you will raise as many points as possible.

Yours truly,

D. MACPHERSON.

GRAND TRUNK RAILWAY SYSTEM.

Office of the Chief Engineer,

July 31st, 1911.

Mr. D. MacPherson,
Chairman Tie Committee,
Canadian Society of Civil Engineers.

DEAR SIR,

I have read with interest the letter from Mr. J. G. Sullivan, under date of July 20th, addressed to you upon the subject of ties, and your circular letter to the Committee.

The matter seems to have been well studied from a mathematical point of view, yet without reaching a unanimous conclusion.

I intend, therefore, in this letter to discuss it purely from practical conclusions derived from experience and observation.

Upon first class rock ballasted track with embankments and ballast, old and well settled, there is but little trouble with ties breaking.

Upon good gravel track, well maintained, the breakage under the rail is more frequent than breakage in the centre of the track, except in the case of centre bound track.

Upon unballasted or earth surfaces track, the breakage is about evenly divided; if there is any difference, I believe the breakage under the rail is in excess.

In the above three cases, I am considering track laid with the ordinary sized tie, 6″ x 8″ x 8′ long.

Would not the above indicate that so far as strength is concerned, the extension of an 8′ tie beyond the rail is already as long as it should be to balance the stress upon the middle of the tie?

Upon all track, the primary object to be attained is drainage, and any type of construction which retards the drainage, injures the track and places a greater physical stress upon the ties.

In the Southern States of the United States many years ago, where ballast was scarce, rains plenty and track bad, a road running from Memphis, Tenn., to Little Rock, Ark., tried the experiment of using ties 9′ long. After a few years their use was abandoned as being a detriment to the track on account of the retarding of the drainage, and the company returned to the use of ties 8′ long.

Other roads in the northern parts of the United States have used 9′ ties, but so far as I know, their use has been discontinued, and only in some instances have the roads adopted as their standard ties 8′ 6″ in length.

In view of the above facts, I believe that the maximum length of the tie should not exceed 8′ 6″, and that a tie 8′ long will answer all purposes for modern traffic, and enable the maintenance departments of railroads to maintain first class track. I believe, however, that ties 6″ thick are not sufficiently strong, and that ties for main line traffic should be 7″ thick by at least 8″ wide, but that in no case should they be more than 10″ wide.

Yours truly,

H. G. KELLEY.

Montreal, Que., August 9th, 1911.

Mr. D. MacPherson,
Chairman of Tie Committee, Canadian Society of Civil Engineers.
Ottawa, Ont.

DEAR SIR,

In your circular letter to the Committee on Ties, you suggest that the Committee confine the work of this year entirely in the effort to determine what, in its opinion, are the best dimensions for ties for standard trunk line railway.

I think the Committee will agree that the ordinary tie, 6″ x 8″ x 8′ in length, with, as generally spaced, 22″ centres, does not give sufficient bearing for the rolling stock now in use.

To add to this bearing surface, shall we increase the length of the tie, as suggested in your report to the Society last season, or adopt some other conclusions?

Evidently, there is a diversity of opinion as to the actual theoretical length of a tie for a safe load, and there will doubtless be a further discussion on that subject.

Personally, I think the increased length suggested is hardly justified by past experience. Several railways in the United States at one time called for ties 9′ in length, but I do not know of any using that length at the present time. The Pennsylvania Railway and the New York Central, with some of its allied lines, are calling for ties 7″ x 7″ x 8′ 6″ in length. Would not this indicate, in a measure at least, that ties even 9′ in length were undesirable, either on account of additional cost, or difficulty in procuring them.

In my opinion a 10′ tie, aside from the difficulty in procuring it, and the additional cost, (which would be almost prohibitive), has other disadvantages, among which are increased breakage over the shorter tie, retarded drainage and additional ballast required.

Personally, I believe that ties should not be less than 7″ in thickness, 8″ on face, and 8′ or 8′ 6″ in length; that they should be laid with 20″ centres, 20 to a 33′ rail length.

Ties are so spaced on several railways at the present time. With this number of ties of the dimensions named, and with proper ballast, I believe that first class track can be maintained.

Very truly yours,

H. A. WOODS.

CANADIAN PACIFIC RAILWAY COMPANY.

Montreal, October 7th, 1911.

D. MacPherson, Esq.,
Assistant Chief Engineer, N. T. Ry.,
Ottawa.

DEAR SIR,

Replying to your circular letter of October 2nd, to the Tie Committee of the Canadian Society of Civil Engineers.

I regret that I will not be able to attend the meeting on the 14th instant. I desire, however, to put myself on record as being opposed to making ties more than 8 ft. in length.

Yours truly,

F. P. GUTELIUS.

ALPHABETICAL LIST OF MEMBERS PRESENT

Allaire, A., Montreal.. 82
Amireault, C., Montreal.. 112
Amos, L. A., Montreal.. 148
Amstrong, J. S., Federicton, N.B.. 46
Armstrong, C. J., Montreal.. 79
Atkinson, M. B., Montreal.. 158

Baillairge, W. D., Quebec.. 17
Balloch, G. R., Rutland, N.Y.. 60
Barnett, J. B., Stratford, Ont.. 71
Baulett, N., Montreal.. 162
Beaubien, deGaspe, Montreal .. 93
Belanger, E., Montreal.. 25
Berlinguet, F. X. T., Three Rivers.. 174
Beullac, M., Montreal.. 116
Blais, R., Montreal.. 161
Blumenthal, S., Montreal.. 157
Borden, H. P., Montreal.. 103
Boyer, A., Montreal .. 169
Breen, Thos., Quebec.. 14
Brown, F. B., Montreal.. 138
Byers, A. F., Montreal.. 86

Cagnat, G. H., Ottawa.. 61
Carnegie, J. L., Montreal.. 97
Chadwick, D. M., Montreal.. 89
Chapleau, S. J., Montreal.. 51
Charlton, R. M., St. Eeleuthere.. 75
Charlton, P., Montreal.. 49
Chausse, A., Montreal.. 36
Chipman, Willis, Toronto.. 12
Clement, S. B., North Bay.. 26
Cole, H. F., Ottawa.. 147
Costigan, J. B., Montreal.. 133
Cowie, F. W., Montreal.. 32
Currie, A., Westmount.. 47

Dakin, F. W., Montreal.. 16
Daniel, W. T., Regina, Sask.. 34
Davy, H. M., Montreal.. 50
Day, V. A. G., Montreal.. 143
Delaute, F. J., Ottawa.. 57
Deschienes, A., Montreal.. 153
Deubelbeiss, H. S., Montreal.. 155
Duggan, G. H., Montreal.. 135
Duggan, H. S., Montreal.. 62
Duchastel, J., Montreal.. 120
Duckworth, W. H., Montreal .. 65
Dupont, J., Montreal.. 98

Ewing, J., Montreal.. 105

Fairbairn, J. M. R., Montreal.. 107
Farmer, J. T., Montreal.. 168
Feskin, A. D., Toronto.. 59
Finlayson, J. N., Montreal.. 164
Fisher, S. J., Montreal.. 141
Fleury, P. A., Paris, France.. 167
Forrest, E. J., Montreal.. 127
Francis, W. J., Montreal.. 137
Fredette, J. F., Ottawa.. 85
Fraser, R. J., Ottawa.. 48
Fripp, F. B., Sault Ste. Marie.. 55

Galbraith, J., Toronto.. 80
Ghysens, A., Montreal .. 111
Girouard, E. C., Ottawa.. 123
Glassco, A. P., Montreal.. 88
Grieve, John, Montreal .. 13
Guillet, G. L, Montreal.. 114
Hannaford, R. M., Montreal.. 81
Harkom, J. W., Melbourne, Que.. 18
Haultain, H. E., Toronto.. 63
Heckman, J. W., Montreal.. 35
Hebert, L., Montreal.. 152
Holgate, Henry, Montreal .. 2
Howard, Major Stewart, Montreal.. 159
Howie, G. E., Fredericton, N.B.. 27
Hogg, T. H., Toronto.. 100
Hunter, J. H., Montreal.. 115

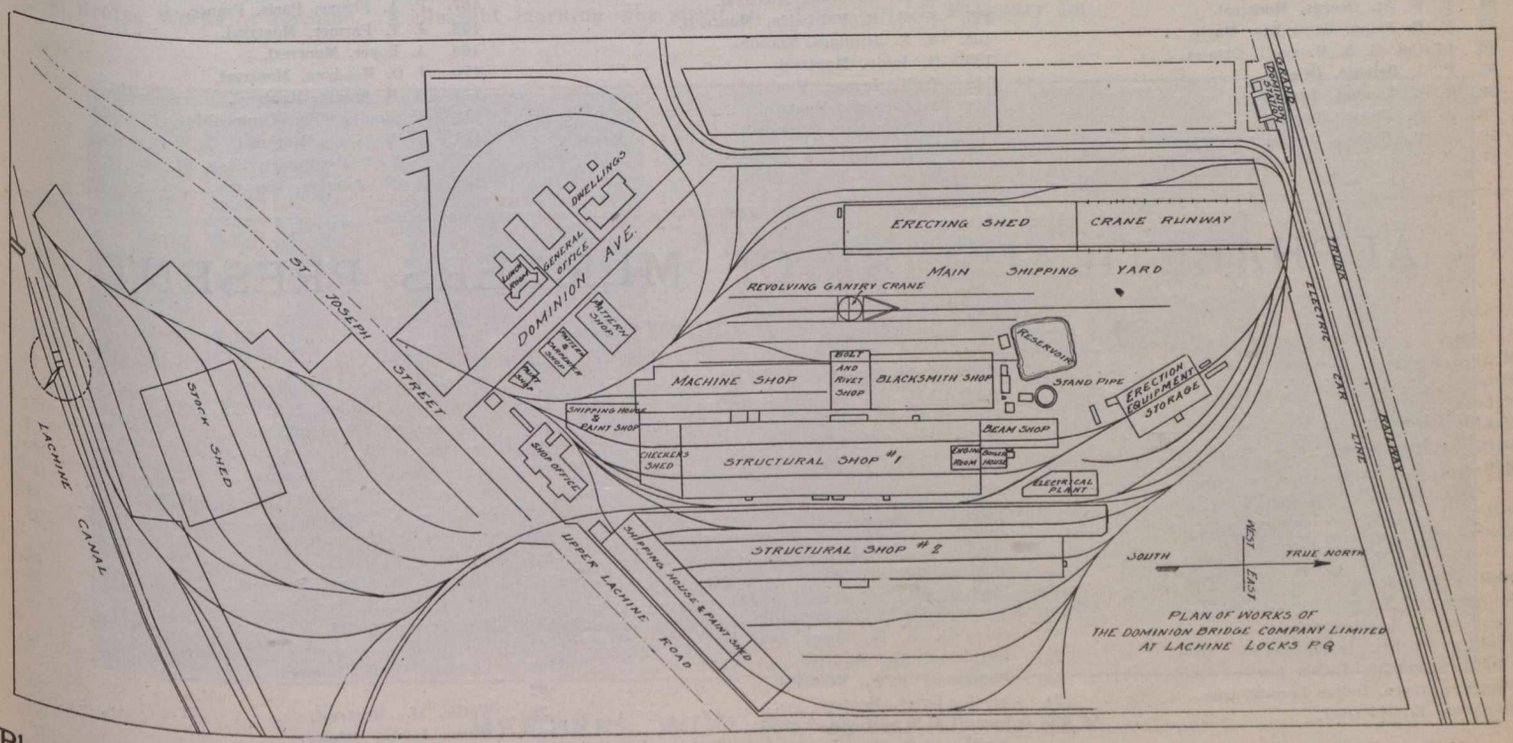
Irving, T. C., Jr., Toronto .. 90

Jackson, J. H., Niagara Falls.. 78
Jacquays, H. M., Montreal.. 175
Jamieson, J. A., Montreal.. 29
Janin, A., Montreal.. 99
Janin, G., Montreal.. 109
Jennings, A. E., Toronto.. 108
Jette, C. H., Montreal.. 154
Jewett, F. C., Campbellford.. 96
Jewett, G. W., Maugerville, N.B.. 72
Jost, L. G., Montreal.. 134
Johnson, E. V., Ottawa.. 125
Jones, A. M., Ottawa.. 122
Johnson, Phelps, Montreal.. 4
Kelly, Albert J., Montreal.. 15
Kennedy, John, Montreal.. 45
Kennedy, Wm., Jr., Montreal.. 124
Ketterson, A. R., Montreal.. 136
Keefer, C. H., Ottawa.. 77

Laberge, F. C., Montreal.. 119
Labrecque, H., Montreal.. 150
Lalonde, J. A., Montreal.. 140
Lawrence, W. D., Montreal.. 43
Leech, C. S., Montreal.. 139
Lefebvre, H., Montreal.. 53
LeGrand, J. G., Winnipeg.. 38
Leofred, A., Quebec.. 39
Lesage, R., Montreal.. 42
Lesage, T. W., Montreal.. 110
Lindsay, V. G., Belleville, Ont.. 118
Loudon, T. R., Toronto.. 58
Lordly, H. R., Montreal.. 20

Malvern, E. E., Montreal.. 156
Marceau, Ernest, Montreal.. 9
Maunsell, Lt.-Col. G. S., Ottawa.. 56
Mauer, E., Montreal.. 33
Mattice, E. S., Montreal.. 91
Meadows, A., Lachine.. 40
Meadows, J. O., Montreal.. 170
Mitchell, C. H., Toronto.. 74
Monsarrat, C. N., Montreal.. 84
Morkill, J. M., Sherbrooke.. 126
Mountain, G. A., Ottawa.. 5
Motley, P. B., Montreal.. 104
Munro, G. R., Peterborough.. 83
Murdock, G. G., St. John, N.B.. 52
Murray, T. A., Toronto.. 67
MacBean, T. L., New York.. 94
MacGowan, A. R., Moncton, N.B.. 76
MacLean, T. A., Marblemountain, N.S.. 113
MacKenzie, W. B., Moncton, N.B.. 132

(Continued at bottom of next page).



Plan of works of Dominion Bridge Company. This will be of assistance to those members who take the excursion to the plant to-day.

WHO'S WHO

1. C. H. Rust, Toronto.
2. Henry Holgate, Montreal.
3. W. F. Tye, Toronto.
4. Phelps Johnson, Montreal.
5. G. A. Mountain, Ottawa.
6. P. E. Parent, Quebec.
7. W. J. Stewart, Ottawa.
8. H. H. Vaughan, Montreal.
9. Ernest Marceau, Montreal.
10. James White, Ottawa.
11. C. H. McLeod, Montreal.
12. Willis Chipman, Toronto.
13. John Grieve, Montreal.
14. Thos. Breen, Quebec.
15. Albert J. Kelly, Montreal.
16. F. W. Dakin, Montreal.
17. W. D. Baillairge, Quebec.
18. J. W. Harkom, Melbourne, Que.
19. H. W. Read, Stonehaven, N.B.
20. H. R. Lordly, Montreal.
21. M. Wolff, Quebec.
22. Henry G'Sullivan, Indian Lorette, Que.
23. Patrick O'Sullivan, Indian Lorette, Que.
24. Owen O'Sullivan, Indian Lorette, Quebec.
25. E. Belanger, Montreal.
26. S. B. Clement, North Bay, Ont.
27. G. E. Howie, Fredericton, N.B.
28. Lewis Skaife, Montreal.
29. J. A. Jamieson, Montreal.
30. Ch. Norton, Latchford, Ont.
31. G. Stead, Chatham, N.B.
32. F. W. Cowie, Montreal.
33. E. Mauer, Montreal.
34. W. T. Daniel, Regina, Sask. k
35. J. W. Heckman, Montreal.
36. A. Chausse, Montreal.
37. J. R. Openshaw, Montreal.
38. J. G. LeGrand, Winnipeg.
39. A. Leofred, Quebec.
40. A. Meadows, Lachine.
41. W. B. McLean, Montreal.
42. R. Lesage, Montreal.
43. W. D. Lawrence, Montreal.
44. A. Surveyor, Montreal.
45. John Kennedy, Montreal.
46. J. S. Armstrong, Fredericton, N.B.
47. A. Currie, Westmount.
48. R. J. Fraser, Ottawa.
49. P. Charton, Montreal.
50. H. M. Davy, Montreal.
51. S. J. Chapleau, Montreal.
52. G. G. Murdoch, St. Johns, N.B
53. H. Lefebvre, Montreal.
54. P. W. St. George, Montreal.
55. F. B. Fripp, Sault Ste. Marie.
56. Lt.-Col. G. S. Maunsell, Ottawa.
57. F. J. Delaute, Ottawa.
58. T. R. Loudon, Toronto.
59. A. D. Fiskin, Toronto.
60. G. R. Balloch, Rutland, N.Y.
61. G. H. Cagnat, Ottawa.
62. H. S. Duggan, Montreal.
63. H. E. T. Haultain, Toronto.
64. C. M. Odell, Glace Bay.
65. W. H. Duckworth, Montreal.
66. J. M. Wilson, Moose Jaw, Sask.
67. T. A. Murray, Toronto.
68. R. G. Saunders, Moose Jaw, Sask.
69. H. D. Parizeau, Victoria, B.C.
70. R. O. Sweezey, Quebec.
71. J. B. Barnett, Stratford, Ont.
72. G. W. Jewett, Maugerville, N.B.
73. H. Wallis, Montreal.
74. C. H. Mitchell, Toronto.
75. R. M. Charlton, St. Eleuthere.
76. A. R. Macgowan, Moncton, N.B.
77. C. H. Keefer, Ottawa.
78. J. H. Jackson, Niagara Falls.
79. C. J. Armstrong, Montreal.
80. J. Galbraith, Toronto.
81. R. M. Hannaford, Montreal.
82. A. Allaire, Montreal.
83. G. R. Munro, Peterborough.
84. C. N. Monsarrat, Montreal.
85. J. F. Fredette, Ottawa.
86. A. F. Byers, Montreal.
87. W. Chace Thomson, Montreal.
88. A. P. Glassco, Montreal.
89. D. M. Chadwick, Montreal.
90. T. C. Irving, Jr., Toronto.
91. E. S. Mattice, Montreal.
92. F. P. Shearwood, Montreal.
93. deGaspe Beaubien, Montreal.
94. T. L. MacBean, New York.
95. T. K. Thomson, New York.
96. F. C. Jewett, Campbellford.
97. J. L. Carnegie, Montreal.
98. J. Dupont, Montreal.
99. A. Janin, Montreal.
100. T. H. Hogg, Toronto.
101. D. Nelles, Ottawa.
102. J. M. Shanly, Montreal.
103. H. P. Borden, Montreal.
104. P. B. Motley, Montreal.
105. J. Ewing, Montreal.
106. A. W. Robinson, Montreal.
107. J. M. R. Fairbairn, Montreal.
108. A. E. Jennings, Toronto.
109. G. Janin, Montreal.
110. T. W. Lesage, Montreal.
111. A. Ghysens, Montreal.
112. C. Amireault, Montreal.
113. T. A. MacLean, Marblemountain, N.S.
114. G. L. Guillet, Montreal.
115. J. H. Hunter, Montreal.
116. M. Beullac, Montreal.
117. A E. Smaill, Ottawa.
118. V. G. Lindsay, Belleville, Ont.
119. F. C. Laberge, Montreal.
120. J. Duchastel, Montreal.
121. R. F. Ogilvy, Montreal.
122. A. M. Jones, Ottawa.
123. E. C. Girouard, Ottawa.
124. Wm. Kennedy, Jr., Montreal.
125. E. V. Johnson, Ottawa.
126. J. M. Morkill, Sherbrooke.
127. B. J. Forrest, Montreal.
128. J. B. Porter, Montreal.
129. C. H. Sutherland, Montreal.
130. E. O'Sullivan, Montreal.
131. F. H. Pitcher, Montreal.
132. W. B. Mackenzie, Moncton, N.B.
133. J. B. Costigan, Montreal.
134. L. G. Jost, Montreal. i
135. G. H. Duggan, Montreal.
136. A. R. Ketterson, Montreal.
137. W. J. Francis, Montreal.
138. F. B. Brown, Montreal.
139. C. S. Leech, Montreal.
140. J. A. Lalonde, Montreal.
141. S. J. Fisher, Montreal.
142. W. J. McAllister, Montreal.
143. V. A. G. Day, Montreal.
144. J. B. McRae, Ottawa.
145. J. P. McRae, Montreal.
146. A. W. Sullivan, Valleyfield.
147. H. F. Cole, Ottawa.
148. L. A. Amos, Montreal.
149. A. Bronley Smith, Montreal.
150. H. Labrecque, Montreal.
151. G. L. Papineau, Montreal.
152. L. Hebert, Montreal.
153. A. Deschenes, Montreal.
154. C. H. Jette, Montreal.
155. H. S. Deubelbeiss, Montreal.
156. E. E. Malvern, Montreal.
157. S. Blumenthal, Montreal.
158. M. B. Atkinson, Montreal.
159. Major Stuart Howard, Montreal.
160. G. F. Porter, Westmount.
161. R. Blais, Montreal.
162. N. Baulet, Montreal.
163. A. Roy, Montreal.
164. J. N. Finlayson, Montreal.
165. J. Spelman, Montreal.
166. H. Rolph, Lachine.
167. P. A. Fleury, Paris, France.
168. J. T. Farmer, Montreal.
169. A. Boyer, Montreal.
170. J. O. Meadows, Montreal.
171. H. B. Stuart, Montreal.
172. R. Sandover-Sly, Campbellton, N.B.
173. R. McKillop, Montreal.
174. F. X. T. Berlinguet, Three Rivers.
175. H. M. Jaquays, Montreal.

ALPHABETICAL LIST OF MEMBERS PRESENT

(Continued from page 31)

The Canadian Engineer

ESTABLISHED 1893—A WEEKLY PAPER

FRIDAY, January 26, 1912.

ISSUED IN THE INTERESTS OF THE
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ADVERTISING RATES ON APPLICATION.

THE ANNUAL MEETING THIS YEAR A GREAT SUCCESS

Yesterday's trips to the Angus Shops, the Dominion Bridge Company and the Canadian Car and Foundry Company will be remembered with pleasure for a long time.

The members of the Society met at the Windsor Hotel at 9.45 a.m. The party who had chosen the trip to the Angus Shops then proceeded to the Windsor Station, where a special train made up of Pullman and dining cars awaited them. Over 150 availed themselves of this opportunity of viewing the largest railroad shops in Canada. Promptly at 10 a.m. the train pulled out, and at the shops were met by guides provided by the C.P.R. Parties of ten were formed, and a general inspection of the plant was made.

Each member received a blueprint showing a complete plan and layout, and with these in hand, and the guides to explain and direct, it was easy to find the various shops, storehouses, foundries, etc. The route to be followed was laid on the plan, which, with the accompanying index, made the trip much easier, and allowed of the ready handling of the large crowd.

At 1.30 luncheon was served in the dining cars attached to the train. This luncheon was tendered to the members by the C.P.R. The afternoon was spent in finishing the inspection trip.

The party for the Dominion Bridge Company and the Canadian Car and Foundry Company proceeded by street cars, placed at their disposal by the Montreal Street Railway Company, to the Dominion Bridge Works at Lachine. A pleasant morning was spent in a tour of inspection of the plant there. After luncheon, which was provided by the Bridge Company, the party inspected the Canadian Car and Foundry Company's plants and then returned to the city to prepare for the annual dinner.

At 8 p.m. the annual dinner was held at the Windsor Hotel. Over 200 members attended, and after having a most elaborate repast, enjoyed numerous excellent speeches.

To-day's session will be the last of this Convention, which practically every member present has regarded as one of the most successful ever held by the Society. An account of to-day's events will be found in the regular weekly issue of the CANADIAN ENGINEER for February 1st.

MEMBERS WHO REGISTERED EARLY

And were photographed while leaving the Society's building after Wednesday morning's session

REPORTS AND DISCUSSIONS

(*Continued from page 26 of yesterday's issue.*)

MR. JOHN KENNEDY: I fully agree with the last speaker. I think we had better continue as we are; it has worked all right and I would suggest that we go ahead as we have been.

THE PRESIDENT: Are there any other matters in the Report of the Council that the members wish to discuss?

MR. HARKOM: There is one little thing that seems to be overlooked in Mr. Jamieson's remarks, and that is the placing of the nomination by the ten members according to the privilege on a separate list. It seems to me that the Executive, or whoever is responsible for putting out these lists, should bear that matter in mind, and that the names nominated by the ten members have just as much right to be submitted to the Society as the others, without any distinction whatever.

THE PRESIDENT: That is mentioned in the by-law.

MR. HARKOM: Yes, that is a matter that ought to be looked into.

MR. JOHN KENNEDY: That has been looked into a good deal, and I agree with Dr. Galbraith when he says that when a nomination is put out we ought to be informed of the members nominated by the Nominating Committee, and who are the members nominated by others.

THE PRESIDENT: It is in order now for a motion to adopt the report.

MR. MOUNTAIN: I move the adoption of the report.

MR. JOHN KENNEDY: I would like to know if this is a recommendation to the Nominating Committee for their consideration rather than an order which would have the effect of changing the by-laws.

THE PRESIDENT: The report reads "The Chairman of the Nominating Committee for Officers and Members of Council has suggested the following procedure for the conduct of the business of the committees, and the Council has endorsed the same and recommends it to the Annual Meeting for its approval."

MR. CHIPMAN: Surely that does not empower us to change the by-laws of the Society?

THE PRESIDENT: No, I do not think so.

MR. SKAIFE: I would like to ask if the second paragraph on page 13 of the report of Council is under discussion.

THE PRESIDENT: No, not at the moment. I understand that matter will come up for discussion some time during the meeting, because we have had an offer for the property of the Society, and we will have to decide what we are going to do about it.

MR. JAMES M. SHANLY: I would like to ask a question. Mr. President, I would like to know if there is anything in the by-laws that prescribes the mode of procedure by the Nominating Committee. There is a provision in the by-laws as to the appointment of the Nominating Committee, and that the Nominating Committee are instructed to go ahead and make certain nominations, but I understand there is nothing said as to how they shall make the nominations or what their procedure shall be.

THE SECRETARY: That is right. In answer to Mr. Jamieson, I will say that the paragraph that he referred to is as follows:

"All nominations shall appear on the same ballot sheet and shall "be grouped separately, the list provided by the Nominating Com- "mittee being indicated as such, and any list submitted under by- "law 38 shall give the names of the members making the nomina- "tions."

MR. JAMIESON: Well, that is distinct and we will have to change the by-laws in order to bring that into force and effect.

THE PRESIDENT: It has been moved by Mr. Mountain, seconded by Mr. Fairbairn, that the report of Council be adopted.

Carried unanimously.

MR. SHANLY: Before proceeding I would like to ask another question, Mr. President. Are we to understand that the Nominating Committee are in future obliged to follow out that recommendation?

VOICES: No, no.

THE PRESIDENT: The next order of business is the Library and House Committee Report.

MR. MOUNTAIN: I move the adoption of this report.

MR. SHANLY: I second the motion.

Carried.

THE PRESIDENT: The Secretary will now read the financial report.

(The financial report was here read by the Secretary.)

MR. TYE: I move that the report be adopted.

MR. DUGGAN: I second the motion.

MR. ST. GEORGE: The only thing about this that I would make an enquiry on is in regard to the value of our property. I see you have kept it at the same valuation practically every year, less depreciation. If we want to borrow any money at any time our valuation for the property is very low. We all appreciate the fact that the value of land has enhanced materially in the last few years, and is it wise to keep it at this fixed figure in our financial report? Of course the question of taxation comes in. Supposing we should want to go into a new building and we did not have enough money, and we wanted to borrow some money, we would not be able to borrow it according to this statement.

THE SECRETARY: That figure represents what that stands now at on the books of the company.

THE PRESIDENT: I understand that the property is now sold or practically sold.

THE SECRETARY: Well, it would be the assessor's valuation at all events, and it would not be our valuation that would govern it.

THE PRESIDENT: You have heard the motion of Mr. Tye, and seconded by Mr. Duggan, that the financial report be received. What is your pleasure?

Carried.

THE PRESIDENT: The next order of business is the reports from the different Branches. Mr. White will read the report of the Ottawa Branch.

(The report of the Ottawa Branch was read by Mr. White.)

A MEMBER: May I ask if it is the intention that the papers from the Branches be inserted in the general *Transactions* of this Society?

THE SECRETARY: I understand that the arrangement arrived at the meeting in Winnipeg was a recommendation being made by the Branches in regard to papers they wished to appear in the *Transactions*, and these recommendations will be submitted to the Committee on Papers and action taken accordingly.

THE PRESIDENT: Will somebody move the adoption of the Ottawa Branch?

MR. A. S. CHAPLEAU: I move the adoption of this report.

MR. STUART: I second the motion.

Carried.

The Report of the Toronto Branch was read by Professor Haultain.

THE PRESIDENT: Is it your pleasure, gentlemen, that this report be received?

MR. VAUGHAN: I move that we receive the report, and that the recommendations contained therein be referred to the incoming Council.

PROFESSOR HAULTAIN: I second the motion.

Carried.

(The Secretary here read the report for the Manitoba Branch.)

MR. LEGRAND: I wish to make the same motion as made by Mr. Vaughan that this report and its recommendations be received and referred to the incoming Council.

Carried.

(The Secretary here read the report of the Kingston Branch.)

Mr. LINDSAY: I move that this report be received.

Carried.

The report of the Quebec Branch was read by Mr. Baillairge.

MR. BAILLAIRGE: I move the reception of this report.

Seconded by Mr. Parent and carried.

THE PRESIDENT: The Council reports the award of the Gzowski medal to Mr. W. G. Chace, Associate Member of the Canadian Society of Civil Engineers, for his paper on "Municipal Hydro-Electric Works for the City of Winnipeg," on the report of the committee. (Applause.)

The meeting adjourned at 1 p.m.

AFTERNOON SESSION.

January 24th, 1912.

The meeting was called to order, the President in the Chair.

THE PRESIDENT: If you will come to order, gentlemen, we will take up the report of the various committees.

The first is the report of the Committee on Roadbed and Ballasting. Mr. Sullivan is the Chairman of that committee. I do not think he is here at present. Are there any other members of the committee present who can take up this report. If not we will pass on to the next report—Railroad Ties.

MR. MOUNTAIN: I might say that Mr. Macpherson is on his way down this afternoon, but we might leave this over until Friday morning.

THE PRESIDENT: Very well, we will take up the next report, which is the report of the Committee on Conservation. Mr. White is the Chairman of this committee, and he will present the report.

(Here insert the report of the Committee on Conservation.)

DR. GALBRAITH: I would suggest, Mr. President, that these different reports be taken as read, and that we immediately proceed with the general discussion of the different reports.

THE PRESIDENT: Is that your pleasure, gentlemen?

Carried.

REPORT OF THE COMMITTEE ON CONSERVATION.

As the undersigned was only appointed Chairman of this Committee in November last, it was not possible in the few weeks intervening between the appointment and the submission of this report to Council, to initiate any Conservation work. In default of a report on work done by the Committee, a statement of Conservation work now being carried on by the Commission of Conservation is appended. This, it is believed, will be of interest to the members of the Society, and will also, to a certain extent, indicate the lines along which it is desirable that engineers should co-operate with the Commission of Conservation.

The Commission of Conservation has been organized into seven committees and the work it has done can best be outlined under the heads of these committees. The committees deal with Waters and Water-Powers, Minerals, Forests, Fisheries and Game, Lands, Public Health, and Press and Co-operating Organizations.

The recently issued report on the water powers of Canada is evidence of the wide range of the activities of the Committee on Waters and Water Powers. It includes the results of all previous investigations on this subject in addition to the data obtained by the engineers of the Commission during the past two years. The laws governing the disposal of water powers are summarized, descriptions of many of the larger developments are given, and physical data given for every power in Canada upon which information was available. The report is illustrated and is accompanied by a series of reference maps in which all the powers mentioned in the statistical tables are indicated by reference numbers.

In 1910, circulars requesting information respecting water powers were sent to each member of the Society, and much information was thus obtained. Copies of the report have been sent to each member and associate member resident in Canada, and, later, will be sent to the junior members and students. All recipients of the report are earnestly requested to send addressed "Secretary, Commission of Conservation, Ottawa," any additional information that they have or may procure, particularly as regards the flow of streams, height of fall, etc.

In preparing this report, the data on the powers of Western Canada were found to be so meagre that the Committee decided to make a special survey of the water powers of those provinces. The engineers of the Commission have been working on this during the past summer and it is hoped that the work will be sufficiently advanced to allow of a report on it being published next year.

The results of the work done by the Committee on Minerals are also embodied in a report published in 1911. It contains a summary of the mining laws of the Dominion and of the various provinces. An exhaustive article on the mineral resources of Canada describes the extent and nature of the most important mineral deposits and suggests measures for lessening the wastes now incident to their exploitation. Another article treats of the subjects of mine accidents in Canada and foreign countries.

During the past summer the mining engineer of the Commission visited the producing coal mines of the Western Provinces and a report on the conditions obtaining in these will be issued shortly.

The Committee having charge of the Forestry work of the Commission has concentrated its attention on the prevention of forest

fires. In 1910 an investigation was made into the causes of forest fires, and it was found that in that year about 34 per cent. of those for which a cause could be assigned and 25 per cent. of all fires in British Columbia, were set by railways. Representations were made to the Dominion Government with a view to securing legislation and, in the last session of Parliament, the Railway Act was amended so that the Railway Commission may compel the railways to maintain an efficient and properly equipped fire patrol. The railways were also made liable for damages caused by sparks from their locomotives, whether it was proved that they had been negligent or not; but such liability for damages was not to exceed $5,000 if modern and efficient fire prevention appliances were used. The Committee on Forests has also taken an active part in furthering the reservation of suitable territory for forest reserves. In 1910, it recommended the setting aside of the eastern slope of the Rocky Mountains as a reserve. This was done by an Act passed by the late Parliament.

The Committee on Fisheries and Game is likewise gathering together facts as a basis for future investigations. The results of the work for 1911 have been published in the form of a report. This contains a digest of the clauses of the British North America Act relating to the jurisdiction of the Dominion and the Provinces in the matter of fisheries, a summary of all the Dominion and Provincial laws respecting fisheries, an article on the North Atlantic fisheries dispute recently terminated by the decision of the Hague Tribunal, and an article on the Canadian oyster industry which, on account of the long standing jurisdictional dispute between the Dominion and the Provinces, is in danger of extinction. The report also contains articles on the fish and game resources of the various Provinces and a statement of the Dominion and Provincial revenues received from these resources. Tables are given showing the fish production of Canada and each of the Provinces as far back as figures are available. The amounts given in these tables have, with a great deal of labour, been compiled in terms of *weight* instead of *value*, in order that the actual state of the fish supply would not be disguised.

During the past year the Committee on Lands has continued the work begun in 1910, of ascertaining the condition of agriculture in Canada. In this work the Committee had the benefit of the assistance of the Agricultural Colleges and the Provincial Departments of Agriculture. In each province, a hundred representative farms were selected and a census of these was taken by specially instructed men in order to find out what state of efficiency farming operations had reached. Some of the more important topics on which information was obtained were crop rotation, the prevalence of weeds and insect pests, the use of fertilizers and the sanitary conditions of the farm home. The results of this inquiry are being condensed and tabulated. This work is in the nature of a diagnosis of the condition of agriculture and will furnish data that will largely determine the direction that the future work of the Committee will take.

In addition to this the Committee on Lands is conducting experiments with alfalfa growing in several districts of Quebec in order to determine under what conditions and in what localities of the Province this important forage crop can be most advantageously grown. These experiments are being made under the supervision of Prof. L. S. Klinck, of Macdonald College.

The Public Health Committee has dealt with a variety of subjects during the year. Early in 1911, the epidemic of typhoid in Ottawa was investigated. The cause of the outbreak was traced to the water supply, which had been contaminated by sewage that had entered the mains when an emergency valve in the intake pipe had been opened to increase the pressure during fires. Special attention is now being given to the subject of slums and city planning by the Medical Adviser of the Committee, who visited Europe last summer in order to learn the latest developments in connection with these subjects. In addition to this, infantile paralysis, a disease new to Canada, is being investigated. As a result of the meeting of Dominion and Provincial Health Officers called by the Commission in Ottawa last year, the Government approved of the establishment of a national laboratory and the creation of a permanent Central Council of Health to advise Governments and Municipalities on public health matters. This conference of Dominion and Provincial Health Officers submitted to the Government the draft of a bill designed to prevent the pollution of waterways by sewage. A bill on this subject introduced into the Senate by Senator Belcourt embodies some of the points recommended by the Conference.

Though possibly not connected with the conservation of natural resources as generally understood, the writer has commenced the compilation of a second edition of the "Altitudes in Canada," believing that its publication will conserve the financial resources of capitalists, railway companies, etc., who propose to develop our resources. A work of this nature is of material assistance to engineers when making preliminary reports respecting the feasibility of railways in certain areas, the probability of securing certain grades, etc. Mr. G. H. Ferguson is now employed on this work and it is hoped that it will be printed next summer. All members of the Society who have additional information respecting altitudes are requested to forward it to the writer. Requests have already been sent to the various railway companies and have met with hearty responses that are extremely gratifying as evidencing an appreciation of the value of the work.

Another matter to which the Commission is devoting attention is the destruction of property by fire. The annual fire waste in Canada is extremely large, being, as a matter of fact, from seven to ten times as large as it is in the large European countries. The investigation being conducted will endeavour to point out the chief causes of this large loss and suggest means whereby it may be lessened.

The Committee on Press and Co-operating Organizations has charge of the publicity work of the Commission. This is done through the press, the publication, in suitable form, of the reports of the Commission, and also by means of the public platform. The aim is to issue the publications in an attractive and substantial form, and, by means of a large and well classified distributing system, to place them where they will be most effective.

JAMES WHITE,

Ottawa, December 7th, 1911. *Chairman.*

THE PRESIDENT: Is there any discussion on the report of the Conservation Committee, which has just been read by Mr. White?

MR. C. H. MITCHELL: I must say that we should consider ourselves very fortunate in having as chairman of the Conservation Committee our friend Mr. White, who is doing so much in the National Commission. There is evidently a great deal of work which it was expected would be done by the Society's Committee, that is now being done by the National Commission, but it seems to me there are some things which Mr. White's report has opened up to us, that are specially interesting to our Society, or rather that would be interesting to the Society if they were followed up by Mr. White's committee, with perhaps a little more detail than that given in the National Commission's report, or in such reports as have already been published.

One of these things that I have particularly in mind is the fuel question. We in this country are dependent—at any rate the central portion of Canada is dependent on, a foreign country for its fuel supply. Now, it seems to me, it would be opportune for this Society to make a special study of the possibilities of developing the fuel supplies in the central portion of Canada. I have no doubt the National Commission has that prominently before it in its study, but I simply throw out this suggestion in order that the members of our Society may have this question before them, and, perhaps, be able to assist the National Committee in that respect.

Another matter is with reference to the water powers. The National Commission, as far as I can gather, and as Mr. White has indicated, in touching only the general details in respect to the water powers. There are some things with respect to our Canadian water powers which perhaps would fall more particularly under the pervue of our Society's Committee—such for instance, the study of winter conditions in our power development, the action of ice, the conservation of power with respect to ice troubles, and other features of that nature. I speak of this merely as suggestions, and,

perhaps, some of the members may have suggestions along similar lines.

MR. LEOFRED: Mr. Chairman, if you will allow me to make a few remarks on this report, I should be glad to do so. I understand that the report of the Conservation Committee, as read by Mr. White, is not the report of this Conservation Committee. It is the report of Mr. White, as secretary of the Conservation Commission appointed by the Dominion Government, but I see there have been nineteen engineers who are members of this Society appointed to form a committee, and who were supposed to do something. (Laughter.) They were supposed to do something in connection with the conservation of the natural resources of the Dominion, and the only thing they say as an excuse is that Mr. White has been appointed only in November the chairman. They do not say why those nineteen members, who have been appointed more than a year ago, have not done anything at all. (Laughter.) I appreciate very much the report of Mr. White, as Secretary of the Conservation Commission. I wish his report could be considered the report of the Committee of the Canadian Society of Civil Engineers on Conservation, because I expect that the nineteen members of the Society selected from amongst the big lights of the profession throughout the whole Dominion, and who were chosen with great care and great caution by the Society, would do a little more than they have done.

THE PRESIDENT: Are there any of the noble nineteen here?

MR. MOUNTAIN: In all fairness to that committee, Mr. President, and I think Mr. White will bear me out, the previous Chairman was Mr. Coutlee, who did a large amount of work in connection with this commission before he turned it over to Mr. White.

MR. WHITE: In regard to what has been said about the immortal nineteen. I, of course, was only appointed Chairman in November. Mr. Coutlee was appointed Chairman before the last Annual Meeting, and if any one will turn up the report of last year they will see that he handed in a very valuable report from the committee. Obviously I was not able, in the space of time since my appointment, to be able to hand in a report and be able to compile such as I have read to you.

One thing I did find since the committee was organized, is the difficulty in deciding exactly what the committee would do. At the time, of course, I had in hand this investigation respecting water powers. Circulars were sent to each Member, each Associate Member, each Student Member of the Society, and they were asked to furnish any information in respect to water powers, the discharge, and any information of that nature; in answer to those circulars we received a large amount of valuable information, and the conclusion I have come to is that the committee, can largely serve as a means of propaganda. For that reason I am supplying copies of all our reports to the members of the committee, and to the members of the Society. What I would like to see is that the members of the committee would address the various branches throughout the country and give talks based on the information which we can supply them. The average number of the members of the Society cannot go through a report from cover to cover, in order to get a full and complete idea of its contents, and if we can get the committeemen to take up and deliver a digest at the meetings of the various branches, I think we would have succeeded in doing a great deal.

This question of conservation is really a very old one—the only thing it required was a name. Every engineer who utilized an extra foot of fall in water power, or who reduced a grade, was a conservationist of a very practical character. I might say that all we are trying to do is to formulate in a definite way the basic principle of conservation, and endeavour to wake people up to the necessity of conserving our natural resources so as not to tie them up, but to get the maximum benefit from them during their exploitation.

There is a great deal more to say on the subject, of course, but we have so much business to go on with this afternoon that I trust that will be sufficient explanation for the gentleman who spoke before Mr. Mountain. (Applause.)

THE PRESIDENT: We will now take up the report of the Committee on Ties.

MR. HOLGATE: There is nothing, Mr. President, that I would like to add to the report.

MR. MOUNTAIN: That does not mean, I presume, that the report is not open for discussion.

THE PRESIDENT: Certainly, it is open for discussion.

MR. MOUNTAIN: There is a question here that was largely discussed in committee, I understand, as to good results in the length of ties. It seems to me the question of long ties over bogs and places of that kind is important, and then there is another question as to the length of ties generally. I don't know whether the committee means that the length of the tie generally should be ten feet.

THE PRESIDENT: No, there is no recommendation. Just the correspondence.

MR. MOUNTAIN: Mr. Chairman, in connection with the Good Roads Committee report, I received a telegram from Mr. Campbell. He thought he would be able to get down this afternoon. He is generally fitted to take up the Good Roads Committee report, and I would suggest it might be left over until Friday morning.

THE PRESIDENT: Are there any other members of that committee present? If not, is it your pleasure to leave this report over until Friday, until Mr. Campbell is present?

Carried.

THE PRESIDENT: Now, we come to the report of the Committee on the Establishment of Testing Laboratories. Mr. Keefer is the Chairman.

Report of Committee on The Establishment of Testing Laboratories.

Ottawa, November 2nd, 1911.

The Secretary,
Canadian Society Civil Engineers,
Montreal.

Dear Sir:

For the information of Council I beg to submit on behalf of the members of our committee, Professors J. Galbraith, Past President, Peter Gillespie, H. M. Mackay, and Messrs. A. St. Laurent, Geo. E. Perley, J. A. Jamieson, Phelps Johnson and myself, the following report of the Committee on Establishment of Testing Laboratories.

On my return to Canada in September, after an absence of six months, I consulted the two Ottawa members of our committee, Messrs. A. St. Laurent and Geo. E. Perley, and found that as the result of our previous efforts the Minister of Public Works, the Hon. William Pugsley, had fulfilled his promise, as expressed in his letter of November 14th, 1910, and recognized the "importance of this matter," and in answer to our suggestions sent an officer of his Department, Mr. Geo. E. Perley (a member of our committee), with Mr. Arthur Surveyor, to obtain information as to existing American Government Laboratories. The result of their examinations is embodied in a report with which Mr. A. St. Laurent (also a member of our committee), has kindly furnished us with a copy, enclosed herewith.

In answer to a circular letter, a copy of which I enclose, dated October 4th, 1911, sent to the members of the committee, I find that we are of the general opinion, that owing to the late change of Government and administration of Public Works Department, nothing further can for the present be accomplished by our Committee. A suggestion has been made by members of our committee that we might lay before the present Minister, at the proper time, a statement of the facilities for testing materials already in Canada. Also that the object which the Society has in view would be best accomplished by co-operation between the existing Testing Laboratories and whatever Government Testing Laboratories may be established to secure greater economy and avoid unnecessary duplication of equipment.

Yours etc.,
C. H. KEEFER,
Chairman, Committee on
Testing Laboratories.

Ottawa, Ont.,
November 29th, 1911.

The Secretary, Canadian Society Civil Engineers,
Montreal, P.Q.

DEAR SIR,

I received your letter of the 11th inst. *re* report of Committee on "Establishment of Testing Laboratories," acknowledging receipt of our report, and instructing me, on behalf of Council, to call on the Hon. Mr. Monk, Minister of Public Works.

I arranged to secure a necessarily brief interview with the Minister this afternoon, as he is very busy, he however expressed generally sympathy with the movement, and asked me to see him later when he would have more time to discuss the matter.

Yours very truly,
C. H. KEEFER,
Chairman.

Office of the Assistant Deputy Minister,
Ottawa, September 29th, 1911.

DEAR SIR,

I beg to enclose herewith for your information and that of the Committee on the Testing of Materials two copies of the report of Messrs. Geo. E. Perley and Arthur Surveyer in connection with the proposed establishment by the Government of a General Testing Laboratory.

Yours very truly,
A. ST. LAURENT,
Assistant Deputy Minister.

C. H. Keefer, Esq.,
Civil Engineer,
Metropolitan Building,
Ottawa.

REPORT ON THE INITIAL AND MAINTENANCE COST OF A LABORATORY FOR TESTING MATERIALS.

We want to state at the very beginning that we found it very difficult to arrive at the cost of a fully equipped laboratory, as the Directors of the different laboratories were loath to give the prices, and the manufacturers refused to mark prices in their catalogues and insisted on having a full list of the machinery required before giving out any quotation.

Not knowing how much money the Government would be willing to spend, we have made out a list including the machinery for the testing of building materials, and also the machinery for the testing of road materials. Since the recent development in reinforced concrete, construction wire has been used extensively both as mesh for floor fabric and as spiral wound columns, so that we have thought advisable to include the wire testing machines.

In order to justify our list, we give below some of the resolutions of the Conventions held at Munich, Dresden, Berlin and Vienna, for the purpose of adopting uniform methods for testing construction materials with regard to their mechanical properties.

1. *Tests of wrought iron, mild steel, steel, cast iron, copper and alloys.*
   - Tension tests (wrought iron, mild steel, steel, cast iron, copper and alloys).
   - Transverse tests (wrought iron, mild steel, steel, alloys).
   - Bending hot and cold (wrought iron, mild steel, steel, copper and alloys).
   - Compression tests (cast iron, alloys).
   - Impact tests for brittleness (wrought iron, mild steel).
   - Penetration tests (wrought iron, mild steel, steel).

II. *Tests of wire (steel and copper).*

- Tensile tests.
- Torsion tests.
- Repeated bending tests.
- Twisting tests.

III. *Tests of Wood.*

- Compression tests.
- Transverse tests.

IV. *Tests of Building Stone (Natural and Artificial).*

- Compression tests.
- Tensile tests.
- Transverse tests.
- Specific gravity.
- Resistance to frost.
- Resistance to fire.
- Porosity.
- Abrasion tests.
- Chemical analysis.

V. *Tests of Paving and Ballast Material (Natural and Artificial).*

- Determination of French co-efficient of wearing.
- Compression tests.
- Abrasion tests.
- Resistance to frost.
- Cementation tests.
- Hardness tests.
- Chemical analysis.

The nucleus of all testing laboratories, with the exception of the laboratory of the U. S. Bureau of Standards at Washington, seems to be several universal testing machines ranging in capacity from 100,000 pounds to 600,000 pounds.

The U. S. Bureau of Standards in Washington is in charge of Col. J. E. Howard, of the U. S. Army, who has been identified with the experiments made in the last 20 years at the U. S. Arsenal at Washington, Mass.

The Colonel showed us the blue prints of two testing machines (similar in design to the Waterton machines), which are made by A. H. Emery, of Stanford, Conn. Both the machines are horizontal and have the following capacity: Machine No. 1 will develop 230,000 pounds in tension or compression, will test pieces 30 inches long, and cost $10,000.

Machine No. 2 will develop 2,300,000 pounds in compression, 1,150,000 pounds in tension, will test pieces 30 feet long, and cost $150,000.

We consider, however, that besides being too expensive, these horizontal machines will not give as accurate results as the vertical machines in the testing of beams and columns. When we expressed the opinion that in practice, pieces working in compression were not generally horizontal, the Colonel gave us the example of the top chord of a Pratt Bridge and added that anyhow, the pieces could

be supported. This example, however, is the only exception, and applies to steel pieces only, whilst the most interesting researches nowadays are made on reinforced concrete, and to support pieces sufficiently to annul the bending moment would introduce a coefficient of friction which would certainly alter the results.

The vertical universal testing machine as manufactured by Olsen and Riehlé, of Philadelphia, can make tensile, compression, and transverse tests of either beams or columns, steel rods or steel cables, and is not very expensive.

The Department has already a vertical universal testing machine of 150,000 pounds capacity, made by Riehlé Bros., of Philadelphia, but we consider that a more powerful machine should be bought, especially if there is room enough for the testing of columns.

One vertical universal testing machine, electrically driven, of 400,000 pounds capacity (for columns and beams), length 12 ft., height 11 ft., breadth 5 ft. 4in., weight 23,000 lbs.	$4,500
4 Johnson's Extensometers for measuring extension or compression in concrete beams, columns and structural members	300
One Ewing Extensometer, for use with standard 8" small diameter specimens	150
One Berry Extensometer	150
One travelling crane (for beams)	1,000
One steel carriage for raising and moving concrete beams	200
Moulds for beams, cylinders, and cubes	250
One overhead traveller	250
One compound generator 25 K.W., capacity 125 volts	500
Small gauges, punches, hammers, micrometers, per cent. gauges, deflectormeters, compressometers, inclinometers, etc.	1,000
One Ransome Mixer, 4 cubic feet capacity, belt driven with hopper on skids	320
Gripping wedges and specimen holders	100
One five horse power motor	300
One void apparatus	100
One furnace, blower, pyrometer, for testing resistivity of material to fire	400
One Brunswick freezing machine capable of giving temperature of —10°	400
One repeated stress machine for testing endurance of steel and other metals under repeated alternate stresses of tension and compression, for testing shafts, etc.	700
One cold bending testing machine	300
One encased abrasion cylinder for building stone	400
One rotating grinder for building stone	400

Machinery Required for Wire Testing.

One wire torsion testing machine	200
One wire twisting testing machine	200
One direct motor driven vertical wire tester; capacity 10,000 lbs., length 4 ft. 6 in. height, 5 ft., breadth 2 ft. 6 in., W. 825, 2 wire extensometer	700
	80

Machinery Required for the Testing of Road Material.

One standard abrasion cylinder, designed by L. W. Page	600
Two impact testing machines, as designed by L. W. Page	1,000
One Ball Mill	500
	$15,000

To this should be added about $7,000 for duty, transportation and erection, bringing the total required for the equipment of the physical testing laboratory to $22,000.

The present chemical laboratory would need an additional expenditure of say $3,000, bringing the grand total to $25,000.

During our visit we did not see any arrangement for the testing of reinforced concrete slabs, yet, in no other branch of reinforced concrete construction is there so much disagreement between the different designs. As a proof of this assertion we give below a table taken from an article published some months ago by Louis F. Brayton in the *Engineering News*, giving the weight of steel required in a panel 20 ft. by 20 ft., supporting a live load of 200 lbs. per square foot, calculated by different methods. The working stress of the steel is taken in every case as 16,000 pounds per square inch.

	Thickness of slab.	Pounds of steel in rail.
1 Cantilever	8 inch.	2,189
2 Turneaure and Maurer	12 "	1,391
3 Grashof	8 "	784
4 Mensch	8 "	2,120
5 Turner	8 "	545
6 McMillan	8 "	1,084
7 Brayton	8½ "	1,900

This table indicates a variation of about 400% between the lowest and highest amount of steel under the various methods of computation, and it stands to reason that both extreme methods cannot be right.

If the Cantilever method is best, we stand a chance of seeing the slabs designed under the other methods break down at any moment, and if the Turner is right in its supposition there is an awful quantity of steel being wasted; in any case it is bad engineering practice, and since the theory pure and simple has failed to give a satisfactory analysis of the stresses developed in the slabs, it is time for the laboratory-trained observer to measure accurately the deformation of the slabs under various loads and by the simple transformation of these deformations into stresses to give new basis for future designs.

In a paper read before the National Association of Cement Users, Mr. Arthur Lord, research Fellow in the Engineering Experiment Station of the University of Illinois, describes a test of a flat slab floor in a reinforced concrete building now under construction at Minneapolis, Minn. This test gave valuable information which could not probably have been secured in a laboratory except at a very large expense, but on the other hand the author recognizes the disadvantages arising from the fact that the test could not be carried to destruction. It would seem from the above that the two methods of experimenting will be required before the Engineering profession at large can adopt a fairly uniform method of designing reinforced slabs.

These tests could be made easily in a large room 12 ft. or 14 ft. high, so as to allow one man to stand under the slab to observe the deformation and another to stand over the slab and regulate the loading. This loading could be done by a travelling crane and the load consist of bricks or cement bags or any other easily handled weight.

Cost of Maintenance.

To the present staff of the Cement Testing Laboratory should be added two new assistants. One of these should be well up in chemical analysis and both should be graduates of a recognized school of engineering.

In the Public Roads Bureau at Washington the candidates must be graduates of recognized schools of engineering and are also compelled to pass a stiff examination. In the U. S. Bureau of Standards they are only obliged to pass an examination, but Col. Howard told us that he did not think it possible for a candidate to pass that examination without having attended a school of engineering.

We do not believe that an examination would be necessary unless there were very many candidates, but we think it absolutely necessary that no application should be considered unless the applicant is the holder of a degree from a recognized Canadian Engineering School.

In order to form an estimate of the cost of maintenance of such a laboratory, we give herein the annual report of the Waterton Arsenal for the year 1906.

Number of specimens tested during the year:

Gun specimens	50
For Ordnance Department	1,531
For other Government Departments	180
Investigate tests	514
Tests for private parties	951
Total	3,226

The receipts and expenditures were as follows:

Amount appropriated for testing machine and testing work	$15,000.00
Received from private parties	1,087.11
Total received	$16,087.11
Amount expended for services and labour	$11,197.35
Amount expended for light, power, tools, implements and material for tests	4,889.67
Deposited to credit, Treasurer of United States	.09
Total	$16,087.11

It will be seen from the above that the returns from the tests made for private parties alone probably would not pay, at least in Ottawa, for the maintenance of the Laboratory. The simpler tests of steel bars and cements would in all probability be handled by the private testing laboratories in Montreal, and this would leave for the Government Laboratory the largest steel members turned out by the bridge company and the investigation on road material for the different municipalities.

Of course, to these should be added the tests on materials used by the Public Works and by the other Departments which would have to be made by the private laboratories if the Department did not have such a laboratory.

The cost of these tests would mount up very rapidly, as the private laboratories would have to buy special machinery in order to test the complicated pieces (especially if the Naval Department begins to build ships) used only in Government construction, and would charge accordingly.

Another very valuable return for the money expended to equip a laboratory would come from the discoveries which might result from the investigations and which would benefit the country at large. We consider, for instance, that the recent discovery made by Mr. L. W. Page, of the U. S. Public Roads Bureau, on the possibility of making impermeable concrete by simply adding a certain quantity (10% to 15% of the weight of the cement) of heavy non-volatile oil to the mixture, has amply repaid the U. S. Government for the money expended in the up-keep of this Laboratory.

(Signed) GEO. E. PERLEY,
Engineer-in-Charge.

(Signed) ARTHUR SURVEYER,
Supervising Engineer.

(Editor's Note.—The portion of the report of the committee which deals with the "Advisability of Having Laboratories to Determine Effects of Sea Water on Concrete," will be published in the next weekly issue of THE CANADIAN ENGINEER.)

MR. KEEFER: Mr. President and gentlemen, there is very little to add to the report that we have already made. The only report we could make under the circumstances is the report that we have presented. On account of the change of Government and the appointment of a new Minister, it is very difficult for him to do anything, or give his attention to these matters at the moment. In answer to a request from Council that I should see the Minister of Public Works, I did see him some time ago and had a very brief interview with him, as he was very busy at the time, and he asked me to see him later on about it. I wrote him, asking for an appointment, and since then I have received the following letter from the Minister, which, I think, expresses his views of the matter:

"January 9th, 1912.

"C. H. Keefer, Esq., Consulting Engineer, Metcalfe Street, Ottawa.

"Dear Sir,—I have received your letter of the 5th instant, concerning the establishment of a testing laboratory by the Government at Ottawa.

"I am afraid it will be difficult for the Government to take up this important matter during the present session because of our numerous engagements upon assuming office just on the eve of meeting of Parliament. As soon, however, as the Parliament adjourns I will gladly take up this matter with you, and I feel confident that upon a proper examination the Government will favourably consider the establishment referred to in your letter.

"Believe me, dear sir,
"Yours very truly,
"(Signed) F. D. MONK."

It seems to me, Mr. President, from this letter of the Minister that he is in sympathy with us. I think it will take some time, but I think there is every prospect that eventually something will be done towards the establishment of testing laboratories. There is no chance of it being done this session, as nothing, I think, will be put in the estimates of this session, but evidently the Minister will take the matter up after the session, when he has more time at his disposal.

MR. HOLGATE: I would ask in connection with Mr. Keefer's statement, if any definite recommendation has been made by this Society to the Government, or if the committee had made up its mind what to recommend to the Government in the way of a testing laboratory.

MR. KEEFER: What we asked the previous Government for was testing laboratories, which, of course, they would construct and operate themselves. We asked to have a laboratory on the same lines as the laboratories established by the American Government, and we asked to have the Government's engineers go down and examine the American Government's testing laboratories and report on them, and then arrange for the establishment of similar laboratories, of course, not on such a large scale, but along similar lines with a much larger equipment than anything we have at the present time, in the laboratories at present established in Canada. As you will see by our reports the Minister of Public Works in the late Government took the matter up, after we had seen him several times, and he sent an officer of his department to visit the American laboratories, and they have given us full information and made a report, and they recommended or asked to have a certain sum put in the estimates for the establishment of these laboratories, and that I believe has not been done yet, but we have not recommended any special plan ourselves.

MR. HOLGATE: How can this Society assist or promote the establishment of these testing laboratories?

MR. KEEFER: Well, it was simply to draw the attention of the Government to the necessity for them. We thought the Government were using such large quantities of materials themselves in this work that of course they might carry it out on a larger scale than any of our institutions or any individuals, and that the information they would get would be a benefit to the profession at large. That was our object.

MR. DUGGAN: Mr. President, I would like to suggest that if this Society is going to take action in this matter to get the Government to establish a testing laboratory, that it should be a laboratory on a scale that would be of use to Canadian engineers generally. Our universities and a good many large contracting firms have

testing laboratories of one kind or another, the larger universities are well equipped for testing up to 75 tons, and there does not seem to be any occasion for the establishment of a testing laboratory unless it is on a very much larger scale than private individuals or institutions of learning already have. We have instances now before us in connection with the Quebec Bridge, as heavy tests must be made on the other side, and it seems to me if we are to have a testing machine of any use, is should be one of at least 1,000 tons capacity instead of such, as quoted in the report, of 200 tons capacity. In other words, it does not seem to me to be worth while to get the Government to establish a laboratory which would simply duplicate existing laboratories. I think, Mr. President, there ought to be some definite recommendations to the Government rather than a mere request to establish a testing laboratory. (Hear. Hear.)

MR. MOUNTAIN: In reference to this matter I am sure that the Chairman of this committee, Mr. Keefer, will take note of what Mr. Duggan says. Mr. Keefer has certainly done a great deal of hard work in getting this matter brought to the attention of the Government.

MR. KEEFER: I might say, in reference to Mr. Duggan's remarks, that in endeavouring to get the Government to establish such a laboratory, the committee recognized the necessity of having something much larger than existing laboratories, and our idea was to get them to establish a laboratory of as great a capacity as possible; but we did not feel that we could dictate to them exactly, as they were going to spend the money. We did not feel we could tell them what capacity they should establish.

MR. HARKOM: I happened to be in somewhat close touch with the executive of the Canadian Manufacturers Association, and I was going to say that I brought this matter to their attention the other day, with a view that perhaps this meeting might suggest that our Council work in harmony with the council of the Canadian Manufacturers Association. Of course, the laboratory with which this report deals is an exceptional one, but there are a very great number of manufacturers in the country who would be benefited by that and there are also a very great number who would like to see something more general than that. I am able to say, sir, that if this Society sees fit to co-operate with the Canadian Manufacturers Association, that in all probability we will get better results in approaching the Dominion Government in recommending the establishment of a general testing laboratory on such lines, as the laboratory established near Berlin in Germany, which has had a great deal to do with the rapid advancement in German manufactories. There, if a man wants a piece of steel tested, he can get it tested. If a man thinks he has too much sand in his sugar he can get it tested, and if another man is making cotton shirts he can have his cloth tested. This laboratory was established by the Government, and it is looked upon and regarded in the courts as authoritative, and the reports from that laboratory are accepted by the judges of the courts. Now, it so happened that quite recently, in a rather important matter, I had before me for consideration certain reports and there were certain analyses and tests submitted, and I found them varying to such an extent that I was unable to form a really satisfactory opinion on the matter. Now, if this Society can join hands with such an association as the Canadian Manufacturers Association, which is recognized as being an influential one in the country, and if we could also get the co-operation of some other societies, it seems to me we would stand a far better chance of getting what we want, than by approaching the Government single-handed, as we have done in the past.

I understand that Mr. Keefer has seen the Minister, and that the Minister has expressed his appreciation of the recommendation, but I understand they cannot do anything more this year; but it seems to me that in the meantime, if some concerted action were taken, we would have a far better chance of getting what we want, and if it is in order, I would move that the executive or a special committee of this Society be instructed to co-operate with other bodies in bringing the attention of the Dominion Government to the desirability of establishing a National General Testing Laboratory.

MR. SKAIFE: I second the motion.

MR. DUGGAN: I a m afraid I was not very clear in my statements. It seems to me that we already have a number of laboratories, such as Mr. Harkom speaks of. The universities have testing machines for testing cement, and large contractors have testing machines also for that sort of work. There are also commercial concerns who make analyses and tests, but what I supposed this Society had in view, and speaking from my own point of view as a structural engineer, is the installation of testing machines such as are not to be found in this country, and are beyond the reach of any private corporation or institution of learning. The cost of the installation of these machines is much too great for a university to take up, or for any corporation, for that matter, to install. Speaking from my own point of view, we have a 75-ton testing machine, which is about the size of this one, and McGill University has two of about the same capacity, and there is no reason why that class of testing cannot be done in a number of places in Canada, but I think we ought not to have to go to the United States or elsewhere in order to get our heavy testing done, which we have to do now. We have to go to the United States now when we want this heavy testing done.

It was simply to suggest the lines on which we should approach the Government to get it tested that I brought this matter up. My own views are quite opposed to Mr. Harkom's views in this respect. I think we should try to get machines which cannot be got otherwise rather than to establish a general testing bureau.

MR. JAMIESON: As a member of that committee, although I have not taken a great part in it yet, in the beginning when we took the matter up with the Government, I attended meetings that the Government had at Ottawa, and our idea was to impress upon the Government the necessity of putting in large machines—larger than those at present available or owned by the different universities and testing firms in Canada, and in other respects to co-operate with the universities in Canada to utilize their testing appliances wherever possible. We tried to impress them with that fact at the time, but progress, of course, was slow, and they had to go through the ordinary method of appointing somebody to investigate, but it seems to me that unless we can get the Government to realize the importance of this matter and the magnitude of the work that they have to do; namely, the putting in of large machines and a sufficient number of them to make them useful, and the putting of proper men in charge of them, of course, we will not accomplish the object we have in view. I think that now probably it will all have to be taken up again with the new Minister, and I think we might again impress upon him as strongly as possible the points we wish to have taken up, and also those that have been suggested by the other members present at this meeting.

MR. KEEFER: I think if we can get the co-operation of the Manufacturers Association and other bodies to draw the attention of the Government to the necessity of the establishment of a laboratory with very full equipment and the largest possible machines for testing steel and structural materials, and testing all classes of materials, it will be a very good thing and strengthen our position very much.

Mr. JOHN KENNEDY: I think, Mr. President, that Mr. Duggan has touched upon the fundamental question. It seems within the province of this Society to make a recommendation to the Government, not exactly in the way of establishing some sort of a testing laboratory, but to make a definite recommendation as to what is wanted and to point out to the Government what kind of a laboratory to establish, because they do not know what sort of a laboratory is wanted. It seems to me it is within the province of the Canadian Society of Civil Engineers to do that. I cannot recall what this committee was empowered to do. If they were empowered to go to the Government simply and ask for a laboratory, it seems to me their instructions might be enlarged, and that it would be safer for the committee to get information and report to the Society, and then we should make a definite recommendation, either on the lines suggested by Mr. Duggan, or perhaps on a

broader and fuller discussion we could make a recommendation. I think we ought to make some definite recommendation as to what should be done for the engineering profession, and for manufacturers generally.

MR. JAMIESON: I might say that the committee will welcome suggestions from any members of the Society for any machines, or any testing apparatus that any one might think necessary to recommend. Personally, I think we should go rather further than testing, and that we should get them to put in appliances and men for special research work, that could be carried to much greater extent than any private engineer, or individual, or manufacturer could hope to do. I think that is why such a great degree of success has been attained in other countries, namely, by means of this special research work.

MR. HARKOM: The resolution I have offered is not intended in any way to hamper the committee in the work which it has to do for the Society, but it is simply to authorize them to co-operate with other bodies, which body may be the one I have mentioned or a university. Certainly, I would like to impress upon the meeting that concerted action of that description would be far more likely to lead to good results than individual efforts by the Society itself or by others.

THE PRESIDENT: You have heard the resolution proposed by Mr. Harkom, that the Executive or a Special Committee of the Society be authorized to co-operate with other bodies in bringing to the notice of the Government of Canada the desirability of establishing a Dominion General Testing Laboratory. What is your pleasure, gentlemen?

THE SECRETARY: I suppose Mr. Harkom means the Council when he speaks of a special committee.

MR. HARKOM: Certainly. This is merely a suggestion.

MR. DUGGAN: I would like to move an amendment, Mr. Chairman, to that resolution, namely, that the Committee on Tests be instructed or requested to request the Government to establish a testing machine of not less than one thousand tons capacity, and that they confer with representatives of other bodies to accomplish this, and to establish such other testing machines as may be decided upon, and that they be authorized to co-operate with other bodies.

MR. ST. GEORGE: How long do you think this will take, because the Committee on Testing Laboratories has been established since 1909? I think, if you have some platform to work on in suggesting that the Government establish larger testing machines than we have to-day, of you would give them an estimate of what it is going to cost, the Government will then know something about it.

MR. DUGGAN: The idea was to give the Committee definite lines to work on.

DR. GALBRAITH: Mr. President, I feel a little doubtful at this time about deciding on the size of a testing machine. I think that persons accustomed to make bridge tests and other tests, have very different ideas on the subject, and before we are ready to make a proposition of that kind to the Government, I think there ought to be an opportunity given to the Society to find out its own views.

Now, we know that one of the biggest bridges in the world—the Forth Bridge—was built without any large testing machines being used. I have assisted in making tests on the largest American machines, and I do not feel at all convinced that tests of that magnitude are neccessary. Certainly, if the machines exist it is wisdom to use them. There can be no doubt at all on this point. They are more satisfactory than smaller machines. If you could make a machine that would break a fully constructed bridge, it would give you a good deal more information than you could otherwise have about that bridge. (Laughter.) That, however, is hardly the point. I think that the scientific engineer has to do with the designing of the largest structures from a knowledge of the properties of material and of smaller structures.

Now, while in connection with the Quebec Bridge, our committee received from Australia some very enlightening letters from Professor Kernow, who is connected with the bridge department of one of the Australian states, and we were very much struck by them. He made experiments following the Quebec Bridge fatality, and built up compression pieces made with pasteboard glued together, and he derived from these slight experiments, that could be performed by any one with ordinary weights, and without a testing machine at all, he derived the proportions which seemed to our committee to be far in advance of the proportions that were in the large compression members of the Quebec Bridge.

Sir Benjamin Baker is said to have made experiments with stove pipes in deciding upon the form of the girders for the Forth Bridge. I think, sir, that there is a great deal of work of that kind to be done, and that we should make models of various proportions. We are not doing anything like the amount of work of that kind that we should do, simply because we have these great testing machines in the United States. We should know more about the behaviour of built up compression members if we were forced to make experiments with models—I do not mean models, say, for the Quebec Bridge of one-third size, which was the largest model that could be broken in the machine that was used at the Phoenix Bridge Works, and which, on the other hand, was the largest model that would give a reasonable sized rivet in the rivetting of the machine. It took a very small rivet. I am sure we can do with much smaller machines than a 1,200-ton machine that was used there, and by not attending to the rivetting proportions, but putting in what any engineer would call an over-proportion, so to speak, of strength in the lattice work, we would make experiments that I think most engineers would have a great deal of confidence in. I am sure that while it is convenient to have a big machine, there are many engineers, both in the United States and in Great Britain, and on the Continent, who might not quite agree with the idea that a machine that will break anything of real size is necessary. I should like to see this question discussed a little more fully before we make a proposition to the Government. I think it will be safer to do so. We might come to Mr. Duggan's conclusion. He has come to this conclusion already, but there are a great many others who have not come to it. And I think it is a question that is well worth considering before passing a resolution which practically says that the Civil Engineers Society has made up its mind on the subject.

MR. THOMSON: If you will permit me, Mr. President, Dr. Galbraith has referred to the Quebec Bridge, and I would like to say that if getting very large testing machines is going to result in a repetition of anything like the old Quebec Bridge disaster, we had better not have them. This reference to the Quebec Bridge makes me think of one of our principal engineers' papers, where the stand was taken that the engineers did not know how to design large columns, and that made me a little hot, and I sent them a column they had published some twelve years previously, for some twelve hundred foot span of my own, which I thought would stand the racket. The editors said that while Thomson evidently designed a column that would have stood, they doubted very much if he could say why or how he did it. The only rule I had was to make the column equally strong in every direction.

One objection to these testing machines is that they test a small section of a column and then try to enlarge that, using lattice parts where they have no business to use them. When I had the honour of working under Mr. Duggan, one of the things he always did was to figure out the excess metal in a bridge and keep it down to minimum. I am not like the chap who put a clause in his specification that every full sized member shall be tested to destruction. (Laughter.)

MR. DUGGAN: I am afraid if we go in to the actual necessity of testing members of size, we might continue the discussion all afternoon. Dr. Galbraith, and Mr. Thomson, and I have evidently quite

divergent views on the subject.

I think the statement in the engineering press some time ago, criticizing the designs of large sized columns, has been to some extent borne out by later tests, and that recent tests show we know very little of what large sized columns will stand. We have had our views, but the actual full sized tests, such as have been made, have shown results very different to what we expected would be shown. Now the question of designing or making dimensions from small members has come up and been very carefully considered by engineers, and we have taken into consideration the tests that have been made on miniature members which gave beautiful results, and we decided that those results were absolutely dependable, because the model was, no doubt, made stronger by cold rolling and the manufacture was carried on in the most careful way, using small rivets, less than three-sixteenths diameter; but in every way the conditions of manufacturing those columns were entirely different from the conditions obtained in commercial sizes. A machine that will test a full sized chord of the Quebec Bridge is the kind of a machine we want. I think it is absolutely necessary to have machines that will test commercial sizes of steel that uses not less than five-eighths rivets, or preferably three-quarters rivets, and join the members together the same as they would be in a heavier member—the designs which one would ordinarily use for actual work. We have not had failures of bridges because modern designing allows a very large factor of safety, but when you come to long span bridges you cannot afford it, because the bridge would tumble down of its own weight if we used the same factor of safety as in smaller bridges.

It has been suggested to me that there is a point we know nothing about; that is riveted tension details. We have had tension tests made on three or four sections—on sections 6 x ½, we have had some tests made for a Blackwell Island bridge, but beyond those I do not know of any tests that have been made for riveted joints in tension members for the action of large sized riveted members. There is no use making tests in what we call general members, of three-sixteenths or one-eighth inch rivets because they do not give results comparable with what one gets in practice. The tests made by Talbot, where he took for tests all the way through commercial columns, showed that the columns would not stand what they were expected to stand. He attributes it to errors in the manufacture, to the column not being straight between the lattice bars. No doubt such was the case, but I think all our working formulae ought to be verified by some reasonable tests as if we were going to design for the largest work.

MR. KENNEDY: Supposing we had a thousand ton test about what proportion would the strength of the member which could be tested in that machine bear to the strength of the members in large bridges.

MR. DUGGAN: Well, that is two million pounds. An ordinary column fails at about twenty thousand pounds to the square inch.

MR. KENNEDY: I do not mean that. I mean in a test of a thousand tons, what proportion would that bear to the large members that are used in bridges?

MR. DUGGAN: Well, that would enable us to determine the chords of any railway bridge up to a hundred and fifty feet span. I might say that while I put down one thousand tons, I had no more reason for saying a thousand tons than I had for saying twelve hundred or eight hundred, but I mean a testing machine of very large capacity.

MR. OGILVY: As I understand the motion it is a motion to recommend the matter to Council. Surely our Council has means of getting at this matter in a definite form. It seems to me we are getting beyond the motion. I think there should be a vote on the motion.

MR. HOLGATE: I would say that the more definite the recommendations are at the Annual Meeting, the better and more clearly the Council can deal with them, and it would seem to me that as Mr. Duggan's amendment contains a more definite recommendation, that it would be better for us to have something definite to consider. I understand his amendment leaves it an open question with that object in view, and it would seem to me it would be better to have definite instructions before Council in as a definite a manner as possible.

MR. JAMIESON: Let us understand where we are at. Is this meeting making recommendations to Council, and is Council going to deal with this matter, or the committee?

THE PRESIDENT: Mr. Harkom made a motion and Mr. Duggan made an amendment. Mr. Duggan's amendment is as follows: That the committee be requested to represent to the Dominion Government the need of larger testing machines than now exist in Canada, and that they recommend the establishment of such a machine of not less than one thousad tons capacity. Further that the committee be authorized to co-operate with other bodies in bringing to the attention of the Government the desirability of establishing testing machines and other appliances by the Government.

Now, you have heard the amendment, what is your pleasure?

MR. HARKOM: I am prepared to accept that amendment, and to withdraw my motion. I certainly think there should be some provision made for full sized tests. I have been up against it once or twice myself, and I think that the tests for such work are necessary, because in this country we will have structures containing very large members, and I think there should be some method of testing full sized members and know exactly what they will stand.

I am perfectly willing to withdraw my motion in favour of the amendment.

THE PRESIDENT: You have heard the amendment proposed by Mr. Duggan, what is your pleasure?

Carried.

MR. KEEFER: Is the suggestion that it be limited to one thousand tons?

THE PRESIDENT: Not necessarily. That is for the committee to decide.

Now, gentlemen, I don't think we will have time to take up the rest of the papers this afternoon. We will take them up Friday morning. It is getting late, and I understand I have to read the President's address.

MR. GALBRAITH: I beg to move that the President in reading the address vacate the chair, and that Mr. Mountain take the chair.

Mr. Mountain here took the chair and the President read his address, after which the meeting adjourned.

President Rust during the luncheon at the Windsor Hotel Wednesday, stated that in his opinion it would be a good idea if the Society could hold a summer session each year. This suggestion should meet with approval, as it would give more opportunity for visits of inspection to many works of large magnitude. The Society trip to the Pacific Coast a few summers ago was very much enjoyed by the members in attendance.

In 1911 the C.P.R. laid 100,000 square feet of Symmes' Patent Mastic Floor in the Angus Shops, replacing wooden floors

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Report of the Committee on Sewage Disposal.

The Committee has been increased by the addition of the following gentlemen:

H. N. Ruttan, T. Aird Murray,
C. H. Rust, W. M. Edwards.

Last year's report has been carefully considered and the following additions thereto have been agreed upon:

Page 69, insert after the second paragraph the following: "Some system of stand-by tanks should be installed to retain the first foul discharge for the purpose of subsequent treatment. It is evident that in order to provide for efficient sewage treatment the separate system should be adopted."

Page 71, in the first line before the word "travelling," insert "revolving and." On the same page, under *percolating filters*, after the word "matter," in the fourth line, insert "in the form of humus resembling ordinary soil."

Page 72, add to the second paragraph the following: "Percolating filters are being adopted for the cities of Regina, Moose Jaw, Saskatoon, Prince Albert, and Lethbridge, and for several of the smaller towns. In all such cases the filters are covered and provision made for artificial heat, if found necessary." On the same page, in the ninth line from the bottom, after the word "methods," insert "which do not include disinfection."

Page 73, at the end of the second paragraph, insert the following: "In cases where it is desired to disinfect sewage filter effluents, it will generally be advisable to provide sedimentation tanks for the removal of humus and suspended matter, as efficient disinfection is limited to the surface of suspended matters unless long and impracticable periods of contact are provided with an increase in the amount of chlorine otherwise required."

In the summary of conclusions, page 77, seventh line from the bottom, insert after the word "procedure" the following: "It, however, also appears reasonable, in the light of modern information, with reference to disinfection that much more can be done by the sewage producer than heretofore, and that the insistence in certain cases of the production of a sewage effluent as free from disease germs as possible, will go a long way towards maintaining the ordinary standard of purity of surface waters; at the same time the smaller communities, the individual, or the floating summer population, which may not be able to depend upon artificially purified water, and must necessarily use the raw water, will be protected in a greater measure."

The questions as per Appendix I, page 79, in the Report of the Annual Meeting for 1911, have again been submitted to all towns having populations of over 1,000, from which answers were not received last year.

The following additional replies have been received this year:

R. S. LEA,
Chairman.

December 11th, 1911.

Report of the Committee on the International Electrotechnical Commission to the Canadian Society of Civil Engineers.

The Canadian National Committee of the International Electrotechnical Commission held two meetings at its headquarters, Ottawa, during the past year, one in July and the other in October. Considerable correspondence passed between the members regarding the matters of universal symbols, rating of machinery, direction of vector rotation, etc.

The Canadian Committee was represented at the International Electrotechnical Congress at Turin, Italy, in September, by its delegate, Professor L. W. Gill, of Kingston, who made a complete report to the Committee on the work carried out at this Congress. The main accomplishment at this Congress was the adoption of a number of proposals which had previously been referred to the various National Committees, principally as regards matters cited above, and as regards the rating, performance guarantees, method of testing, etc., of electrical apparatus.

Subcommittees have been formed during the year, chief among them is one to study a proposed revision of the Canadian Electrical Units Act.

The Committee desires to acknowledge with thanks donations of $100.00 each from the Canadian General Electric Co. and the Canadian Westinghouse Co., and from your Society.

At the Congress Dr. Budde, of Berlin, Germany, was appointed President of the International Commission, in place of Professor Thompson, whose term had expired.

Montreal, December 11th, 1911.

L. A. HERDT,
Chairman.

Report of the Committee on the Usefulness of the Society and Educational Requirements.

At the several meetings held during the year, the question of educational requirements was fully considered, and the Committee now begs to submit its conclusions.

In its opinion, all applicants for admission into the Society, who have had no training in a technical school, should pass an examination, the nature of which is defined in the amendments to the By-Laws to be voted on at the 1912 Annual Meeting.

If these amendments are adopted, the Society should, without delay, provide the necessary machinery to carry on such examinations.

ERNEST MARCEAU,
Chairman.

ALPHABETICAL LIST OF MEMBERS PRESENT

Allaire, A., Montreal .. 82
Amireault, C., Montreal .. 112
Amos, L. A., Montreal .. 148
Anderson, Wm. P., Ottawa .. 195
Armstrong, J. S., Federicton, N.B. .. 46
Armstrong, C. J., Montreal .. 79
Atkinson, M. B., Montreal .. 158
Auclair, H. L., Montreal .. 226

Baillairge, W. D., Quebec .. 17
Balloch, G. R., Rutland, N.Y. .. 60
Barnett, J. B., Stratford, Ont. .. 71
Bates, H. E., Montreal .. 184
Baulett, N., Montreal .. 162
Beaubien, deGaspe, Montreal .. 93
Belanger, E., Montreal .. 25
Berlinguet, F. X. T., Three Rivers .. 174
Beullac, M., Montreal .. 116
Blais, R., Montreal .. 161
Blumenthal, S., Montreal .. 157
Bonyen, W. A., Montreal .. 216
Borden, H. P., Montreal .. 103
Boyer, A., Montreal .. 169
Breen, Thos., Quebec .. 14
Briercliffe, H. C. D., Montreal .. 189
Brietzeke, E. H., Montreal .. 200
Brown, E., Montreal .. 178
Brown, F. B., Montreal .. 138
Byers, A. F., Montreal .. 86

Cagnat, G. H., Ottawa .. 61
Camp, W. J., Montreal .. 236
Carnegie, J. L., Montreal .. 97
Chadwick, D. M., Montreal .. 89
Chapleau, S. J., Montreal .. 51
Charlton, P., Montreal .. 49
Charlton, R. M., St. Eeleuthere .. 75
Chausse, A., Montreal .. 36
Chipman, Willis, Toronto .. 12
Clement, S. B., North Bay .. 26
Cole, H. F., Ottawa .. 147
Combe, F. A., Montreal .. 233
Costigan, J. B., Montreal .. 133
Cour, de La, P. E., Westmount .. 181
Cowan, W. A., Farnham .. 237
Cowie, F. W., Montreal .. 32
Currie, A., Westmount .. 47

Dakin, F. W., Montreal .. 16
Daniel, W. T., Regina, Sask. .. 34
Daubney, C. B., Ottawa .. 214
Davy, H. M., Montreal .. 50
Day, V. A. G., Montreal .. 143
Delaute, F. J., Ottawa .. 57
Deschienes, A., Montreal .. 153
Desy, J. E., Montreal .. 210
Desy, L. A., Montreal .. 206
Deubelbeiss, H. S., Montreal .. 155
Dietrich, W. H., Montreal .. 225
Drew, W. J. B., Montreal .. 201
Duggan, G. H., Montreal .. 135
Duggan, H. S., Montreal .. 62
Duchastel, J., Montreal .. 120
Duckworth, W. H., Montreal .. 65
Dupont, J., Montreal .. 98

Earle, H., Montreal .. 215
Ewing, J., Montreal .. 105

Fairbairn, J. M. R., Montreal .. 107
Farmer, J. T., Montreal .. 168
Feskin, A. D., Toronto .. 59
Finlayson, J. N., Montreal .. 164
Fisher, S. J., Montreal .. 141
Fleury, P. A., Paris, France .. 167
Forrest, E. J., Montreal .. 127
Francis, W. J., Montreal .. 137
Fredette, J. F., Ottawa .. 85
Fraser, R. J., Ottawa .. 48
Fripp, F. B., Sault Ste. Marie .. 55
Fusey, E., Montreal .. 223

Galbraith, J., Toronto .. 80
Ghysens, A., Montreal .. 111
Girouard, E. C., Ottawa .. 123
Glassco, A. P., Montreal .. 88
Gneadinger, F. T., Montreal .. 209
Gostwyck, G. H. G., Montreal .. 190
Grieve, John, Montreal .. 13
Guillet, G. L, Montreal .. 114

Hammersley-Heenan, J., Montreal .. 179
Hannaford, R. M., Montreal .. 81
Harkness, A. L., Montreal .. 193
Harkom, J. W., Melbourne, Que. .. 18
Haultain, H. E., Toronto .. 63
Hebert, L., Montreal .. 152
Heckman, J. W., Montreal .. 35
Herdt, L. A., Montreal .. 234
Holgate, Henry, Montreal .. 2
Howard, Major Stewart, Montreal .. 159
Howie, G. E., Fredericton, N.B. .. 27
Hogg, T. H., Toronto .. 100
Hunt, R. W., Chicago .. 231
Hunter, J. H., Montreal .. 115

Irving, T. C., Jr., Toronto .. 90

Jackson, J. H., Niagara Falls .. 78
Jacquays, H. M., Montreal .. 175
Jamieson, J. A., Montreal .. 29
Janin, A., Montreal .. 99
Janin, G., Montreal .. 109
Jarman, E. E., Westmount .. 218
Jennings, A. E., Toronto .. 108
Jette, C. H., Montreal .. 154
Jewett, F. C., Campbellford .. 96
Jewett, G. W., Maugerville, N.B. .. 72
Jost, L. G., Montreal .. 134
Johnson, E. V., Ottawa .. 125
Jones, A. M., Ottawa .. 122
Johnson, Phelps, Montreal .. 4

Keefer, C. H., Ottawa .. 77
Kelly, Albert J., Montreal .. 15
Kennedy, John, Montreal .. 45
Kennedy, Wm., Jr., Montreal .. 124
Kerrigan, E. C., Montreal .. 217
Ketterson, A. R., Montreal .. 136
Kirkpatrick, E. C., Montreal .. 207

Labelle, J., Montreal .. 197
Laberge, F. C., Montreal .. 119
Labrecque, H., Montreal .. 150
Lalonde, J. A., Montreal .. 140
Lamb, H. J., Windsor .. 211
Lamb, H. M., Montreal .. 212
Lariviere, A., Montreal .. 229
Larocque, A., Montreal .. 235
Lawrence, W. D., Montreal .. 43
Leech, C. S., Montreal .. 139
Lefebvre, H., Montreal .. 53
LeGrand, J. G., Winnipeg .. 38
Leofred, A., Quebec .. 39
Lesage, R., Montreal .. 42
Lesage, T. W., Montreal .. 110
Lindsay, V. G., Belleville, Ont. .. 118

Linton, A. P., Montreal .. 194
Loudon, T. R., Toronto .. 58
Lordly, H. R., Montreal .. 20
Mackay, H. M., Montreal .. 177
Malvern, E. E., Montreal .. 156
Marceau, Ernest, Montreal .. 9
Mauer, E., Montreal .. 33
Maunsell, Lt.-Col. G. S., Ottawa .. 56
Mattice, E. S., Montreal .. 91
Meadows, A., Lachine .. 40
Meadows, J. O., Montreal .. 170
Menard, J. P., Quebec .. 204
Mercier, P. E., Montreal .. 185
Meyers, A. J., Montreal .. 180
Mitchell, C. H., Toronto .. 74
Monsarrat, C. N., Montreal .. 84
Morkill, J. M., Sherbrooke .. 126
Morris, T. P., Montreal .. 208
Motley, P. B., Montreal .. 104
Mountain, G. A., Ottawa .. 5
Munro, G. R., Peterborough .. 83
Murdock, G. G., St. John, N.B. .. 52
Murray, T. A., Toronto .. 67
Murray, W. A., Montreal .. 192
Murray, W. P., Lachine .. 199
MacBean, T. L., New York .. 94
MacGowan, A. R., Moncton, N.B. .. 76
MacLean, T. A., Marblemountain, N.S. .. 113
MacKenzie, W. B., Moncton, N.B. .. 132
McAllister, W. J., Montreal .. 142
McConnell, S. B., Montreal .. 238
McCoulson, C., Montreal .. 232
McLean, W. B., Montreal .. 41
McLeod, C. H., Montreal .. 11
McKillop, R., Montreal .. 173
McRae, J. B., Ottawa .. 144
McRae, J. P., Ottawa .. 145

Nelles, D., Ottawa .. 101
Nichols, J. R., Montreal .. 228
Norton, Ch., Latchford, Ont. .. 30

Odell, C. M., Glace Bay .. 64
Ogilvy, R. F., Montreal .. 121
Openshaw, J. R., Montreal .. 37
Osler, C. H., Montreal .. 176
O'Sullivan, E., Montreal .. 130
O'Sullivan, Henry, Indian Lorette, Que. .. 22
O'Sullivan, Patrick, Indian Lorette, Que. .. 23
O'Sullivan, Owen, Indian Lorette, Que. .. 24
Oxley, A. C., Montreal .. 187
Oxley, J. Morrow, Toronto .. 205

Papineau, G. L., Montreal .. 151
Parent, P. E., Quebec .. 6
Parezeau, H. D., Victoria, B.C. .. 69
Pitcher, F. H., Montreal .. 131
Porter, G. F., Westmount .. 160
Porter, J. B., Montreal .. 128

Read, H. W., Stonehaven, N.B. .. 19
Reid, W. M., Westmount .. 191
Reynolds, G., Montreal .. 213
Robinson, A. W., Montreal .. 106
Rolphe, H., Lachine .. 166
Roy, A., Montreal .. 163
Rust, C. H., Toronto .. 1

Sandover-Sly, R., Campbellton, N.B. .. 172
Saunders, R. G., Moose Jaw, Sask. .. 68
Scott, A. N., Montreal .. 221
Seens, J. W., Montreal .. 202
Shanley, J. M., Montreal .. 102
Shearwood, F. P., Montreal .. 92
Shuter, R., Graham .. 224
Skaife, Lewis, Montreal .. 28
Smaill, A. E., Ottawa .. 117
Smith, A. Bronley, Montreal .. 149
Smith, Stanley M., Westmount .. 183
Smith, W. Roy, Westmount .. 182
Spelman, J., Montreal .. 165
Spencer, A. T., Montreal .. 188
Spencer, R. A., Montreal .. 196
St. George, P. W., Montreal .. 54
Stead, G., Chatham, N.B. .. 31
Stewart, W. J., Ottawa .. 7
Stuart, H. B., Montreal .. 171
Sullivan, A. W., Valleyfield .. 146
Surveyor, A., Montreal .. 44
Sutherland, C. H., Montreal .. 129
Sweezey, R. O., Quebec .. 70

Tennant, D. C., Lachine .. 198
Thomson, T. K., New York .. 95
Thomson, W. Chace, Montreal .. 87
Trigon, H., Montreal .. 186
Tye, W. F., Toronto .. 3

Vaughan, H. H., Montreal .. 8
Vincent, A., Montreal .. 222

Walker, A., Montreal .. 239
Wallis, H., Montreal .. 73
Warnock, Ch., Montreal .. 230
Warren, E. C., Montreal .. 219
White, James, Ottawa .. 10
Williams, D., St. Johnsbury, Vt. .. 227
Wilson, J. M. Moose Jaw, Sask. .. 66
Wilson, L. R., Montreal .. 220
Wolff, M., Quebec .. 21

WHO'S WHO

1. C. H. Rust, Toronto.
2. Henry Holgate, Montreal.
3. W. F. Tye, Toronto.
4. Phelps Johnson, Montreal.
5. G. A. Mountain, Ottawa.
6. P. E. Parent, Quebec.
7. W. J. Stewart, Ottawa.
8. H. H. Vaughan, Montreal.
9. Ernest Marceau, Montreal.
10. James White, Ottawa.
11. C. H. McLeod, Montreal.
12. Willis Chipman, Toronto.
13. John Grieve, Montreal.
14. Thos. Breen, Quebec.
15. Albert J. Kelly, Montreal.
16. F. W. Dakin, Montreal.
17. W. D. Baillairge, Quebec.
18. J. W. Harkom, Melbourne, Que.
19. H. W. Read, Stonehaven, N.B.
20. H. R. Lordly, Montreal.
21. M. Wolff, Quebec.
22. Henry O'Sullivan, Indian Lorette, Que.
23. Patrick O'Sullivan, Indian Lorette, Que.
24. Owen O'Sullivan, Indian Lorette, Quebec.
25. E. Belanger, Montreal.
26. S. B. Clement, North Bay, Ont.
27. G. E. Howie, Fredericton, N.B.
28. Lewis Skaife, Montreal.
29. J. A. Jamieson, Montreal.
30. Ch. Norton, Latchford, Ont.
31. G. Stead, Chatham, N.B.
32. F. W. Cowie, Montreal.
33. E. Mauer, Montreal.
34. W. T. Daniel, Regina, Sask. k
35. J. W. Heckman, Montreal.
36. A. Chausse, Montreal.
37. J. R. Openshaw, Montreal.
38. J. G. LeGrand, Winnipeg.
39. A. Leofred, Quebec.
40. A. Meadows, Lachine.
41. W. B. McLean, Montreal.
42. R. Lesage, Montreal.
43. W. D. Lawrence, Montreal.
44. A. Surveyor, Montreal.
45. John Kennedy, Montreal.
46. J. S. Armstrong, Fredericton, N.B.
47. A. Currie, Westmount.
48. R. J. Fraser, Ottawa.
49. P. Charton, Montreal.
50. H. M. Davy, Montreal.
51. S. J. Chapleau, Montreal.
52. G. G. Murdoch, St. Johns, N.B
53. H. Lefebvre, Montreal.
54. P. W. St. George, Montreal.
55. F. B. Fripp, Sault Ste. Marie.
56. Lt.-Col. G. S. Maunsell, Ottawa.
57. F. J. Delaute, Ottawa.
58. T. R. Loudon, Toronto.
59. A. D. Fiskin, Toronto.
60. G. R. Balloch, Rutland, N.Y.
61. G. H. Cagnat, Ottawa.
62. H. S. Duggan, Montreal.
63. H. E. T. Haultain, Toronto.
64. C. M. Odell, Glace Bay.
65. W. H. Duckworth, Montreal.
66. J. M. Wilson, Moose Jaw, Sask.
67. T. A. Murray, Toronto.
68. R. G. Saunders, Moose Jaw, Sask.
69. H. D. Parizeau, Victoria, B.C.
70. R. O. Sweezey, Quebec.
71. J. B. Barnett, Stratford, Ont.
72. G. W. Jewett, Maugerville, N.B.
73. H. Wallis, Montreal.
74. C. H. Mitchell, Toronto.
75. R. M. Charlton, St. Eleuthere.
76. A. R. Macgowan, Moncton, N.B.
77. C. H. Keefer, Ottawa.
78. J. H. Jackson, Niagara Falls.
79. C. J. Armstrong, Montreal.
80. J. Galbraith, Toronto.
81. R. M. Hannaford, Montreal.
82. A. Allaire, Montreal.
83. G. R. Munro, Peterborough.
84. C. N. Monsarrat, Montreal.
85. J. F. Fredette, Ottawa.
86. A. F. Byers, Montreal.
87. W. Chace Thomson, Montreal.
88. A. P. Glassco, Montreal.
89. D. M. Chadwick, Montreal.
90. T. C. Irving, Jr., Toronto.
91. E. S. Mattice, Montreal.
92. F. P. Shearwood, Montreal.
93. deGaspe Beaubien, Montreal.
94. T. L. MacBean, New York.
95. T. K. Thomson, New York.
96. F. C. Jewett, Campbellford.
97. J. L. Carnegie, Montreal.
98. J. Dupont, Montreal.
99. A. Janin, Montreal.
100. T. H. Hogg, Toronto.
101. D. Nelles, Ottawa.
102. J. M. Shanly, Montreal.
103. H. P. Borden, Montreal.
104. P. B. Motley, Montreal.
105. J. Ewing, Montreal.
106. A. W. Robinson, Montreal.
107. J. M. R. Fairbairn, Montreal.
108. A. E. Jennings, Toronto.
109. G. Janin, Montreal.
110. T. W. Lesage, Montreal.
111. A. Ghysens, Montreal.
112. C. Amireault, Montreal.
113. T. A. MacLean, Marblemountain, N.S.
114. G. L. Guillet, Montreal.
115. J. H. Hunter, Montreal.
116. M. Beullac, Montreal.
117. A E. Smaill, Ottawa.
118. V. G. Lindsay, Belleville, Ont.
119. F. C. Laberge, Montreal.
120. J. Duchastel, Montreal.
121. R. F. Ogilvy, Montreal.
122. A. M. Jones, Ottawa.
123. E. C. Girouard, Ottawa.
124. Wm. Kennedy, Jr., Montreal.
125. E. V. Johnson, Ottawa.
126. J. M. Morkill, Sherbrooke.
127. B. J. Forrest, Montreal.
128. J. B. Porter, Montreal.
129. C. H. Sutherland, Montreal.
130. E. O'Sullivan, Montreal.
131. F. H. Pitcher, Montreal.
132. W. B. Mackenzie, Moncton, N.B.
133. J. B. Costigan, Montreal.
134. L. G. Jost, Montreal. i
135. G. H. Duggan, Montreal.
136. A. R. Ketterson, Montreal.
137. W. J. Francis, Montreal.
138. F. B. Brown, Montreal.
139. C. S. Leech, Montreal.
140. J. A. Lalonde, Montreal.
141. S. J. Fisher, Montreal.
142. W. J. McAllister, Montreal.
143. V. A. G. Day, Montreal.
144. J. B. McRae, Ottawa.
145. J. P. McRae, Montreal.
146. A. W. Sullivan, Valleyfield.
147. H. F. Cole, Ottawa.
148. L. A. Amos, Montreal.
149. A. Bronley Smith, Montreal.
150. H. Labrecque, Montreal.
151. G. L. Papineau, Montreal.
152. L. Hebert, Montreal.
153. A. Deschenes, Montreal.
154. C. H. Jette, Montreal.
155. H. S. Deubelbeiss, Montreal.
156. E. E. Malvern, Montreal.
157. S. Blumenthal, Montreal.
158. M. B. Atkinson, Montreal.
159. Major Stuart Howard, Montreal.
160. G. F. Porter, Westmount.
161. R. Blais, Montreal.
162. N. Baulet, Montreal.
163. A. Roy, Montreal.
164. J. N. Finlayson, Montreal.
165. J. Spelman, Montreal.
166. H. Rolph, Lachine.
167. P. A. Fleury, Paris, France.
168. J. T. Farmer, Montreal.
169. A. Boyer, Montreal.
170. J. O. Meadows, Montreal.
171. H. B. Stuart, Montreal.
172. R. Sandover-Sly, Campbellton, N.B.
173. R. McKillop, Montreal.
174. F. X. T. Berlinguet, Three Rivers.
175. H. M. Jaquays, Montreal.
176. Osler, C. H., Montreal.
177. Mackay, H. M., Montreal.
178. Brown, E., Montreal.
179. Hammersley-Heenan, J., Montreal.
180. Meyers, A. J., Montreal.
181. Cour, de La, P. E., Westmount.
182. Smith, W. Roy, Westmount.
183. Smith, Stanley M., Westmount.
184. Bates, H. E., Montreal.
185. Mercier, P. E., Montreal.
186. Trigon, H., Montreal.
187. Oxley, A. C., Montreal.
188. Spencer, A. T., Montreal.
189. Briercliffe, H. C. D., Montreal.
190. Gostwyck, G. H. G., Montreal.
191. Reid, W. M., Westmount.
192. Murray, W. A., Montreal.
193. Harkness, A. L., Montreal.
194. Linton, A. P., Montreal.
195. Anderson, Wm. P., Ottawa.
196. Spencer, R. A., Montreal.
197. Labelle, J., Montreal.
198. Tennant, D. C., Lachine.
199. Murray, W. P., Lachine.
200. Brietzeke, E. H., Montreal.
201. Drew, W. J. B., Montreal.
202. Seens, J. W., Montreal.
204. Menard, J. P., Quebec.
205. Oxley, J. Morrow, Toronto.
206. Desy, L. A., Montreal.
207. Kirkpatrick, E. C., Montreal.
208. Morris, T. P., Montreal.
209. Gneadinger, F. T., Montreal.
210. Desy, J. E., Montreal.
211. Lamb, H. J., Windsor.
212. Lamb, H. M., Montreal.
213. Reynolds, G., Montreal.
214. Daubney, C. B., Ottawa.
215. Earle, H., Montreal.
216. Bonyen, W. A., Montreal.
217. Kerrigan, E. C., Montreal.
218. Jarman, E. E., Westmount.
219. Warren, E. C., Montreal.
220. Wilson, L. R., Montreal.
221. Scott, A. N., Montreal.
222. Vincent, A., Montreal.
223. Fusey, E., Montreal.
224. Shuter, R., Graham.
225. Dietrich, W. H., Montreal.
226. Auclair, H. L., Montreal.
227. Williams, D., St. Johnsbury, Vt.
228. Nichols, J. R., Montreal.
229. Lariviere, A., Montreal.
230. Warnock, Ch., Montreal.
231. Hunt, R. W., Chicago.
232. McCoulson, C., Montreal.
233. Combe, F. A., Montreal.
234. Herdt, L. A., Montreal.
235. Larocque, A., Montreal.
236. Camp, W. J., Montreal.
237. Cowan, W. A., Farnham.
238. McConnell, S. B., Montreal.
239. Walker, A., Montreal.

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 PENDING

In Addition to Those in this Issue.

Further information may be had from the issues of The Canadian Engineer referred to.

Place of Work.	Tenders Close.	Issue of.	Page.
Arcola, Sask., schoolhouse	Feb. 1.	Jan. 18.	75
Brantford, Ont., schoolhouse	Jan. 27.	Jan. 18.	75
Calgary, Alta., bridge	Feb. 10.	Jan. 18.	86
Chesley, Ont., public wharf	Jan. 31.	Jan. 18.	75
Grandview, Man., scrapers	Feb. 1.	Jan. 18.	75
Lion's Head, Ont., lighthouse tower	Feb. 5.	Jan. 18.	75
Ottawa, Ont., supply of coal	Jan. 29.	Jan. 18.	75
Ottawa, Ont., iron posts	Jan. 31.	Dec. 21.	68
Ottawa, Ont., contracting machinery	Feb. 26.	Jan. 11.	59
Ottawa, Ont., armory, Fernie, B.C.	Jan. 24.	Jan. 11.	59
Petewawa, Ont., improvements to wharf	Jan. 31.	Jan. 18.	75
Saskatoon, Sask., pavements	Feb. 16.	Jan. 18.	86
Saskatoon, Sask., concrete sidewalks	Feb. 16.	Jan. 18.	86
Toronto, Ont., bridges	Jan. 31.	Jan. 18.	75
Vancouver, B.C., supplies for 1912	Jan. 27.	Jan. 18.	75
Victoria. B.C., schoolhouse	Jan. 31.	Jan. 18.	75
Walkerton, Ont., bridge, Saugeen River	Jan. 23.	Jan. 4.	59
Winnipeg, Man., electric vehicle.	Feb. 1.	Jan. 18.	75
Winnipeg, Man., drawings for government buildings		Dec. 21.	68

TENDERS.

Calgary, Alta.—Plans are being prepared for the building of a new school for South Calgary. The building will be 200 x 140, fireproof, hollow tile and concrete floors. Estimated cost, $150,000.

Fredericton, N.B.—The St. John and Quebec Railway Company contemplate making their first call for tenders for construction work on the St. John Valley Railway about the middle of February.

Galt, Ont.—Tenders will be called for waterworks, 250 k.v.a., 2,200 volts motor, direct connected to centrifugal pump. Specifications prepared by the Hydro-Electric Commission, Toronto.

Hamilton, Ont.—Tenders will be received until February 6th, 1912, for supplying the corporation of the City of Hamilton with the following: Works Supplies—sewer pipe, line, sewer brick, castings, asphalt, creosoted wooden blocks, Portland cement, road oil, gravel, lumber, lead pipe, pig lead, iron pipe, valves, hydrants, and extension boxes. Specifications for above can be obtained at the office of the city engineer, S. H. Kent, city clerk, City Hall, Hamilton.

Hamilton, Ont.—S. H. Kent, city clerk, City Hall, will receive tenders for the various trades in alterations to the City Hall, until January 31st, 1912. Full information obtained at the office of Mills & Hutton, architects, Room 804, Bank of Hamilton Building.

Lajord, Sask.—Tenders will be received until Saturday, February 10th, 1912, for the construction of a two-room two-storey and basement brick school building. Plans and specifications may be obtained from the secretary-treasurer of the Prairie Flower School District No. 989, Mr. A. W. Rogers, Lajord, Sask.

Ottawa, Ont.—Tenders will be received until January 30th, 1912, for the supply of some 210,000 barrels of cement, more or less, required for the construction and maintenance of the various canals of the Dominion, and to be delivered in such quantities at such places and at such times as may be directed. Specifications, etc., can be obtained from the Purchasing Agent of the Department of Railways and Canals, Ottawa. L. K. Jones, Secretary Dept. of Railways and Canals.

Ottawa, Ont.—Tenders will be received by the Dept. of Public Works until February 14th, 1912, for the construction of a wharf at Little Lameque, Gloucester County, N.B. Plans, specifications, etc., can be obtained at the offices of Geoffrey Stead, Esq., Dist. Engineer, Chatham, N.B.; E. T. P. Shewen, Esq., Dist. Engineer, St. John, N.B.; the Postmaster at Lameque, N.B., and at the office of R. C. Desrochers, Secretary Dept. of Public Works, Ottawa.

Ottawa, Ont.—Tenders will be received at the Dept. of the Interior, until noon of the 31st day of January, 1912, for the furnishing of iron posts for use on the survey of Dominion Lands, to be delivered as follows:—At Winnipeg, five thousand small and one hundred and fifty large posts; at Edmonton, one hundred and fifty large posts. Forms of tender and detailed information may be obtained from the Surveyor-General of Dominion Lands, Ottawa. P. G. Keyes, Secretary Dept. of the Interior.

Ottawa, Ont.—Tenders will be received until February 15th, 1912, for the construction of a dam and sluiceways below the outlet of Lake Quinze at the head of Maple Rapids, in the Townships of Guerin and Baby, County of Pontiac, Que. Plans, specifications and forms of tender can be obtained at the offices of J. G. Sing, Esq., Dist. Engineer, Confederation Life Bldg., Toronto; J. L. Michaud, Esq., Dist. Engineer, Merchants Bank Bldg., St. James St., Montreal; on application to the Postmaster at Haileybury, Ont., and at the office of R. C. Desrochers, Secretary Dept. of Public Works, Ottawa, Ont.

Ottawa, Ont.—Tenders will be received until February 7th, 1912, for the erection of a public building at Lloydminster, Sask. Plans, etc., may be obtained at the offices of Mr. J. E. Cyr, Supt. of Public Buildings for Manitoba; Post Office Bldg., Winnipeg, Man.; at the Post Office at Lloydminster, and at the office of R. C. Desrochers, Secretary Dept. of Public Works, Ottawa.

Ottawa, Ont.—Tenders are being invited by the Department of Public Works for the construction of a pier at Upper Salmon River, Albert County, N.B. Received until Wednesday the 14th of February, 1912. Plans, etc., at the offices of E. T. P. Shewen, district engineer, St. John, N.B.; Geoffrey Stead, district engineer, Chatham, N.B.; the Postmaster at Alma, N.B., and at the office of R. C. Desrochers, secretary, Department of Public Works.

Regina, Sask.—Tenders will be received until Feb. 16, 1912, for the several trades required in the erection and completion of a theatre in the town of Swift Current, Sask. Plans, etc., at the office of Messrs. Sharon & Darrach, Architects, Regina.

Saskatoon, Sask.—Tenders will be received by the City Commissioners until February 23rd, 1912, for the construction of the sub-structure for a subway under the Canadian Northern Railway Company's tracks at 23rd Street, in the City of Saskatoon. (See adv. elsewhere in the Can. Eng.)

Toronto, Ont.—Tenders are being called by the chairman of the Board of Control, City Hall, Toronto, until Tuesday, February 20, 1912, for the supply of track intersections and other special work layouts. (See advertisement elsewhere in The Canadian Engineer.)

Toronto, Ont.—The Temiskaming & Northern Ontario Railway Commission will shortly be in a position to call for tenders for the construction of the extension into the Elk Lake District.

Toronto, Ont.—Tenders will be received, addressed to the Chairman of the Joint Building Committee of the Y.M.C.A. till noon, Monday, February 5th, for the various trades required in the erection of the Central Building, Nos. 30-40 College Street and 35-47 Grenville Street. Burke, Horwood & White, Architects, 25 Toronto St.

Toronto, Ont.—Tenders will be received until Jan. 31st, 1912, for the construction of concrete abutments and a steel bridge, 100 feet clear span, and also for a reinforced concrete truss bridge, 50 feet clear span, over the Burnt River in the Village of Haliburton, Municipality of Dysart. Frank Barber, Civil Engineer. (Adv. in the Can. Eng.)

Toronto, Ont.—Tenders will be received by the Chairman of the Board of Control, City Hall, until noon, Tuesday, Jan. 30th, 1912, for the construction of sewers. (See adv. elsewhere in the Can. Eng.)

Victoria, B.C.—Tenders will be received until the 31st day of January, 1912, for the erection and completion of a gymnasium for the Provincial Normal School, Vancouver, B.C. Plans, specifications, etc., at the office of the Timber Inspector, Vancouver, B.C.; the Government Agent, New Westminster, B.C.; and the Dept. of Public Works, Parliament Buildings, Victoria.

Winnipeg, Man.—The date for delivery of preliminary plans in connection with competitive drawings for the new Parliament Buildings, to be erected in the city of Winnipeg, is extended to March 31st, 1912. Colin H. Campbell, Minister of Public Works. (Adv. in the Can. Eng.)

Winnipeg, Man.—Tenders will be received until February 16th, 1912, for the supply of steel casement sash, linen chute doors and elevator doors, for the King George Isolation Hospital. Plans and specifications may be obtained at the offices of Mr. H. B. Rugh, Architect, 928 Union Bank Bldg. M. Peterson, Secretary Board of Control Office, Winnipeg.

Winnipeg, Man.—Tenders for the supply and installation of a five million gallon horizontal turbine pump driven by an induction motor, direct-connected, will be received until March 1st, 1912. M. Peterson, secretary, Board of Control Office, Winnipeg. (See advertisement elsewhere in The Canadian Engineer.)

Winnipeg, Man.—The Winnipeg Public School Board are open to receive tenders until February 8, 1912, for two motor generator sets and two rotary transformers and generators required in connection with the Kelvin and St. John's Technical High Schools. Specifications, etc., at the office of J. B. Mitchell, commissioner of supplies, School Board Office. R. H. Smith, secretary-treasurer, W.P.S.B.

CONTRACTS AWARDED.

Calgary, Alta.—Messrs. Gorman, Clancy & Grindley, of this city, have closed contracts with the city of Moose Jaw for the supply of upwards of 20 miles of 18½-inch steel pipe for the new gravity water system, to be installed by that city very shortly. The same firm also have a contract with the city of Lethbridge for the supply of 14 miles of rails, together with specials and poles for the Lethbridge Street Railway.

Hamilton, Ont.—The Hamilton Bridge Company has secured the contract for the erection of the new buildings for the Steel Company of Canada. Total cost, $140,000.

Lethbridge, Alta.—The contract for street car equipment has been awarded to United States Steel Products Co., 706 McArthur Bldg., Winnipeg. City Engineer, A. C. D. Blanchard.

Montreal, Que.—The contract for offices and stores on Notre Dame and St. Sulpice Streets, has been awarded to Mr. C. E. Deakin, 11 St. Sacrament Street. Cost, $147,000.

Toronto, Ont.—The Electrical Development Company have awarded the contract for the completion of the power house at Niagara Falls, to Messrs. Page & Co., Toronto. Exclusive of equipment, the power house cost over $500,000, and the new addition will cost between $200,000 and $300,000.

Victoria, B.C.—The contract for the completion of the warehouses and other buildings on the new provincial wharf at Prince Rupert, has been awarded by the provincial minister of works to the Westholme Lumber Company, of this city, the successful tender for the work being at a price of $12,550.

Westmount, Que.—Messrs. Mussens, Limited, Montreal, have the contract for the supply of one steam road roller, at a cost of $3,110. Other tenderers were: Messrs. Brennan & Cairnie, Westmount, $2,900; Messrs. F. Hankin & Co., Montreal, $2,600; Messrs. Chambers & Simpson, Toronto, $2,930. Arch. Currie, City Surveyor.

RAILWAYS—STEAM AND ELECTRIC.

Montreal, P.Q.—The estimates of the Canadian Pacific for 1912 are placed at $20,000,000.

Ottawa, Ont.—During the recent investigation into the telegraph department of the Canadian Pacific Railway lines, it was brought out that the total cost was $6,696,421.40, of which $3,897,238 was for line equipment. This was spread over 12,108 miles of poles, making the average cost $321.87 per mile.

Ottawa, Ont.—It is reported that the Grand Trunk Pacific Railway will seek legislation at the present session of parliament empowering the company to issue additional debenture stock perpetual or terminal, up to a total of $25,000,000. The company needs an additional $15,000,000 to complete its railway, to purchase rolling stock and construct branch lines, etc. Mr. Hays preferred to get the money by way of a government loan, as they got $10,000,000 three years ago, but the new government being found to be less indulgent than the old, the company finds a further issue of debenture stock necessary.

Ottawa, Ont.—The Dominion Railway Commission are preparing a measure to eliminate several level crossings or install certain safety devices.

Ottawa, Ont.—It is reported that a deputation representing an English syndicate has asked for consideration of the charter of the Hudson Bay Pacific Railway Company. This charter was granted in 1906 for the building of a road from Prince Albert to Churchill, but no work was done; the charter, it is understood, has now fallen into the hands of English capitalists, who are asking for the guarantee of their bonds for the carrying out of the project.

Port Arthur, Ont.—The council will apply for legislation to extend the street car system to districts outside the city boundaries.

Toronto, Ont.—Toronto is to be the head office of the Mexican Interurban Electric Traction Company, Ltd., which has been incorporated with a capital stock of $5,000,000. A number of Toronto men are associated with Dr. Pearson, of New York, in the enterprise, among whom are Mr. Z. K. Lash, K.C., vice-president of the Mexico Tramways Company.

Vancouver, B.C.—Property owners are to appeal the offer of the Great Northern Railway for their lots on False Creek. The property owners were given $1 each for their property. The owners first sought a total of $57,000 damages, or an average of $3,000 per lot. The award of the arbitrators of $1 apiece is declared to be far from equitable.

LIGHT, HEAT AND POWER.

Brantford, Ont.—The committee appointed to investigate the possibility of a reduction in the cost of electrical energy, have decided to extend an invitation to the hydro-electric engineers for a report. The contract with the Ontario Power Company does not expire for 27 years yet. A rough estimate from the hydro-electric states that a transforming station to supply 1,500 horsepower, could be erected at a cost of $70,163.

Galt, Ont.—Galt will soon be calling for tenders for a cynchronous motor 250 K.V.A. 2,200 volts, 750 R.P.M., to be used on the waterworks. J. H. Radford, Chairman Waterworks Commission.

Long Sault Rapids, St. Lawrence River.—It is reported that Mr. W. J. Westley, of Morrisburg, has gone to Washington in an effort to overcome certain difficulties in connection with this development.

Niagara Falls, Ont.—A representation from Buffalo, Niagara Falls, N.Y., and Detroit have urged the house of foreign affairs at Washington, D.C., to change the limit of diversion of water on the American side from the present, 15,600 cubic per minute, to the maximum of 20,000 feet as

Charles Street, Stratford, Ontario, showing "Tarvia Modern Pavement."

Stratford's Experience with Tarvia

STRATFORD, Ontario, did some thorough and successful work with Tarvia X in 1910 and the accompanying photograph shows a section of Charles Street in that city built by the Tarvia Modern Pavement Method.

Tarvia X was used as a binder throughout the road on a Telford base. Although the job was done by the somewhat primitive barrel-and-kettle method, the total cost was only $1.32 per yard.

The Tarvia, filling the voids of the stone, acts as a plastic matrix, keeping the stone in position, preventing all internal movement, resisting water and frost, protecting the road against automobile traffic and preventing the formation of dust.

After its first year of use, the street is in excellent condition and is giving perfect satisfaction. It has been visited by various engineers, all of whom agree as to the success of the work.

This is only one of thousands of instances of successful Tarvia construction.

We will be glad to send to any inquirer a booklet showing many other cases.

The Paterson Manufacturing Co., Limited
Montreal Toronto Winnipeg Vancouver

The Carritte-Paterson Manufacturing Co., Limited
St. John, N.B. Halifax, N.S.

authorized by the treaty. They also seek the removal of the present limitation of 160,000 horse-power, that may be imported from Canada.

North Toronto, Ont.—The Water, Fire and Light Committee have recommended that the town council install a motor generator and storage battery system for the fire alarm system. This is to cost $2,000. Mr. E. A. James, Engineer.

Port Stanley, Ont.—It is expected that the hydro-electric line into Port Stanley will be completed in a few days.

Quebec, P.Q.—A new power company, capitalized at $1,000,000, has been formed in Quebec, with Hon. L. P. Pelletier as president. It will be known as Stadacona Light, Heat and Power Company.

Toronto, Ont.—A legal decision of interest to engineers and power house managers, was handed down by Mr. Justice Riddell and two other judges. Their decision allows the Canadian Niagara Power Company to pay for excess power, besides the yearly rental of $15,000, on an average basis, instead of on the individual excess, or "peak load" basis, without regard to times when the power used might be under the limit.

SEWAGE AND WATER.

Calgary, Alta.—The city engineer has recommended that the reservoir be lined along the bottom and sides.

North Toronto, Ont.—The Water, Fire and Light Committee have recommended to the council the sinking of a well to cost $1,500, also that weeping tiles be placed, in order to increase water supply. Mr. E. A. James, engineer.

Ottawa, Ont.—The new intake pipe will be coupled up in from three to four weeks, according to the city engineer. There is about 120 feet to be laid as yet.

Ottawa, Ont.—The engineering firm of Siemen Brothers, London, England, are sending a representative to Ottawa to prepare a report on the water supply question.

Port Arthur, Ont.—The question of securing a municipal water supply from Loch Lomond is again before the council.

Richmond, B.C.—This municipality is preparing a by-law to borrow the sum of $50,000 for the construction of waterworks.

Regina, Sask.—The municipal council intend to make a test within the next few days to ascertain just what water pressure can be maintained and to find out if the supply of water is sufficient for the requirements of the city.

Saskatoon, Sask.—A private corporation which enjoys the privilege of supplying the outlying districts of Saskatoon with water have raised their price to 25c. per barrel. The council are investigating for a reason.

Victoria, B.C.—The city council on the recommendation of the water commissioner decided to purchase 10,000 feet of ten-inch pipe, 10,000 feet of eight-inch pipe, 50,000 feet of six-inch pipe, and 50,000 feet of four-inch pipe at a cost of $55,000. In addition there will be purchased 1,220 water meters of the Trident type at a cost of $17,670. Angus Smith, city engineer.

Weston, Ont.—The council has decided to go ahead with installation of sewage disposal plant. T. Aird Murray of Toronto has been called in as consulting engineer.

BUILDING.

Brantford, Ont.—The Dominion Government have purchased a site on Dalhousie Street on which to erect a $200,000 post office.

Calgary, Alta.—A report states that the Swift Packing Plant of Chicago will erect a branch in Calgary.

Calgary, Alta.—The city engineer, Mr. J. F. Childs, has drawn up an estimate of the cost of providing the city with an asphalt plant, which would be in the neighborhood of $20,000.

Calgary, Alta.—The Canada Malting Company will begin construction work at an early date. This plant will have a capacity of 750,000 to 800,000 bushels per year. They will erect a large elevator, which will have a capacity of 400,000 bushels. The estimated cost is $250,000.

Coquitlam, B.C.—Messrs. Brown & McKay, an eastern firm, are reported to have arranged the purchase of a site for the construction of a steel works to cost $100,000. They have bought a site for a woodworking plant.

Fort William, Ont.—Certain technicalities in connection with the granting of warehouse sites have been overcome. Some of the concerns contemplating building operations in 1912-13 are: The Cameron Heap Company, Fort William; The McLaughlin Biscuit Mfgs., Fort William; The Fife Hardware Company, Fort William; The Fitzsimmons Fruit Company, Fort William; Matthews Pork Packing Company, Fort William; Tees and Peiss of Winnipeg.

Galt, Ont.—A new lighting system is to be installed in the Baptist Church. Mr. S. Misner is financial secretary.

Montreal, P.Q.—The British-Canadian Canners, Ltd., have secured sites for five factories and plan to erect factories this year. The sites are located at Merlin, Highgate, Port Robinson, Bowmanville and Cobourg. Contracts for buildings and machinery, it is reported, will be called for at an early date. The directors of the British-Canadian Canners, Limited, comprise Sir Henry N. Bate, of Ottawa, and J. P. Black, H. A. Lovett, K.C., and R. Brutinel, of Montreal.

Moose Jaw, Sask.—The Jensen Tanneries, of North Dakota, U.S.A., are negotiating with the municipal council for a site on which to erect a $15,000 plant.

Nanaimo, B.C.—The $50,000 School Loan By-law to sanction the borrowing of a sum of money not exceeding $50,000 for the erection of a new school was carried.

North Vancouver, B.C.—The Vancouver Safe Works, Ltd., are considering establishing a plant on the North Shore. The company contemplate taking out a 10 to 20-year lease on two acres of land for the erection of a plant and equipment to cost approximately $50,000, which would give employment to about fifty men.

Oshawa, Ont.—The government have decided to construct an armory, providing the town council supply a suitable site.

Port Arthur, Ont.—The congregation of St. Paul's Presbyterian Church have decided to erect a building to cost $40,000 or $50,000. A committee consisting of L. Walsh, M. Hood, M. W. Bridgman, A. M. Long, F. Urry and L. J. McCutcheon have been appointed to undertake the preliminary work of getting out plans, etc.

Port Arthur, Ont.—Acting for Mackenzie & Mann, and a British syndicate, J. M. Fraser, of the Atikokan Iron Co., submitted to the city an application for the establishment of a $5,000,000 steel plant. The city will give a site of 400 acres at Bare Point and a fixed assessment for twenty years of $50,000 except for school and local improvements.

Port Arthur, Ont.—Mr. D. K. Campbell will erect a 4-story hotel on Arthur St. at a cost of $50,000.

Regina, Alta.—The Rock City Tobacco Company of Quebec, P.Q., have decided to construct a new warehouse in this city, providing a suitable site may be secured. Mayor Drouin of Quebec is president of this company.

St. Catharines, Ont.—The Dominion Government have increased the estimates for this locality by $6,000 for repairs to a bridge at Lock 4, old canal. The estimates for the Welland Canal in addition to the above are: $3,000 for a bridge over the feeder canal, $10,000 for heavy repairs, $8,000 for installing Gowan Safety devices, and $15,000 for the repairing of foundations of locks on the old canal.

Toronto, Ont.—Mr. P. J. Mulqueen, proprietor of the Tremont House, has obtained a permit to erect a hotel structure to cost $80,000. Work is to start about April 1st, 1912.

Toronto, Ont.—The estimates for the property and street cleaning department include $85,000 for firehalls at Wright and Roncesvalles, at Greenwood Avenue, and at St. Clair and Hendrick Streets; $30,000 for a bath house on a site to be acquired from the Harbor Commission, and $26,000 for lavatories. The increase in maintenance over last year is $32,000.

Vancouver, B.C.—There is considerable likelihood of a new city hall being erected. The cost of this is to be $750,000.

The aldermen suggest that competitive plans be sought from architects. The intention is to construct a permanent city hall of architectural beauty, and so laid out that wings could be added to it if necessary later on, as the site is ample for city hall needs for many years.

Victoria, B.C.—It is reported that the estimates of Hon. Thomas Taylor, provincial minister of public works, contain an item of $7,000,000 for new roads and public bulidings throughout British Columbia.

ROADS AND PAVEMENTS.

Ottawa, Ont.—Premier Borden is to receive a deputation from the Ontario Motor League, who will urge on the Federal Government the necessity of maintaining good roads in the Province of Ontario and of making grants towards the same.

CURRENT NEWS.

Esquimalt, B.C.—Twelve carloads of steel plates and tank material have arrived for use in the alterations being made to the G.T.P. liner Prince George. The steamer is being equipped to burn fuel oil at the British Columbia Marine Railway Company's yards. It was necessary to construct special tanks in the steamers to contain the supply of oil.

Latchford, Ont.—An acetylene explosion occurred in the rear of the King Edward Hotel. Considerable damage to property resulted.

Ottawa, Ont.—The Dominion Government have decided to restore the bounties on pig iron.

Ottawa, Ont.—A deputation representing the iron and steel industry waited on the government in an effort to obtain from the new government the restoration of the iron and steel bounties and further encouragement for the iron industry.

Ottawa, Ont.—The statement of the municipal treasurer shows a deficit of $78,085. The treasurer's statement is as follows:—

Deficit in city general account, excluding $12,500 for extra land for Lady Grey Hospital, for which debentures are to be issued		$68,163.72
Deficit, interest and sinking fund account		1,705.45
Deficit, street watering		5,071.11
Total deficit		$74,940.28
Less surplus in hospital account	$ 3,882.70	
Net deficit, exclusive of waterworks	$71,057.58	
Waterworks deficit	7,028.00	
Total net deficit		$78,085.58

Province of British Columbia.—The penalties imposed by the timber branch of the Department of Lands for the year 1912 amounted to $13,199. The total timber branch revenue for the province for 1911 amounted to $2,297,452.25.

Province of New Brunswick.—A deputation from New Brunswick are at Ottawa seeking to have an experimental farm established in that province.

Province of Alberta.—The use of a common drinking cup in this province is now against the law.

Province of Manitoba.—At the next session of the legislature there will be inaugurated a "Public Service Commission" for the province. Under this commission will be placed all the public services of the province, including steam and electric railways, gas and electric lighting, telegraphs, telephones, grain elevators and any other public utility.

St. Boniface Man.—A plan to reclaim certain lands now occupied by the River Seine is being prepared for discussion by the municipal council. The plans show a cutting off of the Seine south of the city boundary, and a short cut to the Red River about opposite River Park. An alternate plan shows a cutting of the stream at the St. Boniface Road, which is the southern boundary of the city. Here it is proposed to run the water through a flume in the centre of the road to a point in the Red River shore opposite Bartlett Avenue, Fort Rouge. The ground thus saved is desirable for railway purposes, as yards, and the filling in of the creek would obviate the necessity of bridges. All the railways will be able to use the territory, and new tracks laid east from Winnipeg will be opposed by no such difficulties as are now to be met. The lands are valued at approximately $3,000 per acre.

Toronto, Ont.—The Works Committee have recommended the municipal council to discontinue its policy of insuring laborers against accident, as premiums have amounted to $7,191.73 per annum, and accidents have been fortunately few.

Vancouver, B.C.—Amongst the suggestions made by Mr. Lea, the engineer preparing the plans for the sewage system, was that the city should provide him with an assistant resident engineer to secure data regarding surfaces, make the further investigations as to areas, and report to him. The commission passed a resolution authorizing the chairman to consult with Mr. Lea as to the selection of an engineer.

Winnipeg, Man.—It is the intention of the municipal authorities to construct a submarine telephone cable across the Red River.

Winnipeg, Man.—The faculty of the University of Manitoba has arranged a series of lectures to be given during the month of February. The syllabus is as follows: "The Pitch and Quality of Musical Sound," "Experiments on Flame," "The Mineral Resources of Manitoba," "Water Purification."

Winnipeg, Man.—The Minister of Public Works announces that the time for receiving competitive drawings for the new parliament buildings has been extended to March 1st, 1912.

BUSINESS.

Dauphin, Man.—Fire did considerable damage to the Canadian Northern Railway station at this point. The telegraph office was destroyed.

Kenora, Ont.—Fire destroyed the fire hall, police station and a business block. The damage is placed at $50,000.

Kingston, Ont.—The municipal council are about to consider the installation of a heating system for the city hall, to replace the box stove method now in use.

Medicine Hat, Alta.—There is a probability of the Ogilvie flour mill coming to this city, and negotiations are in course of progress between the municipality and a representative of the company. The head office of this company is in Montreal, P.Q.

Montreal, P.Q.—$125,000 damage was caused by fire to the building and contents of the Richelieu and Riendeau hotels, and the Hobb Glass factory.

Port Stanley, Ont.—It is stated that the Dominion Government will erect a fish hatchery at this point in the near future.

Port Arthur, Ont.—The fire, water and light committee have been instructed to purchase a new fire engine of not less than 600 gallons capacity.

St. Mary's, Ont.—$10,000 damage was caused by fire to the plant of the St. Mary's Wood Specialty Company. The sawmill and part of the main building were destroyed.

Shoal Lake, Man.—A loss of $25,000 was caused to the business district of Shoal Lake.

St. Boniface, Man.—The plant of the Winnipeg Steel Granary and Culvert Company, in the outskirts of St. Boniface, was totally destroyed by fire with a loss of $15,000.

Sudbury, Ont.—The Canadian Copper Company's hospital was destroyed by fire. The loss is estimated at $50,000.

Toronto, Ont.—Fire damaged the R. D. Fairbairn & Company and the Allen Manufacturing Company's building to the extent of $250,000.

Toronto, Ont.—The Dominion Foundry at 400 East Front Street, owned by Messrs. Blatchford & Trelour, was damaged to the extent of $10,000 by fire.

Winnipeg, Man.—$100,000 damage was caused by fire to the plant and building of the Winnipeg Cold Storage Co.

Winnipeg, Man.—Damage of $20,000 was caused by fire to the Lightfoot furniture storage warehouse.

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

Each week on this page may be found summaries of orders passed by the Board of Railway Commissioners, to date. This will facilitate ready reference and easy filing. Copies of these orders may be secured from The Canadian Engineer for small fee.

15748—January 4—Authorizing C.N.O. Ry. to cross public road, Twp. of Nelson, County of Halton, Ontario.

15749—January 3—Authorizing City of Winnipeg to extend Ellice Avenue across C.P.R. Pembina Branch.

15750—January 3—Approving location of South Ontario Pacific Ry. station at Progresston, mileage 5.32, Twp. of East Flamboro, Ontario.

15751—December 14—Directing that G.T.R. employ watchman from May 1 to October 1 of each year at crossing just east of Grimsby Beach, Ontario; 15 per cent. by Twp. of Grimsby, remainder by G.T.R.

15752—January 3—Extending until June 1, 1912, time for making changes by G.T.R. to water standpipes at Alexandria, Ont.

15753—January 11—Approving plans for spur track to property of W. H. Haight, Piper's Siding, B.C., G.N.R.

15754—January 8—General Order re Freight Rates Western Canada.

15755—January 8—Authorizing C.P.R. to construct spur for Bardsley and Peterson in N.E. ¼ Sec. 4, Twp. 2, R. 7, W. 2 M.

15756—January 8—Authorizing G.T.R. to construct spur for Lautz Co., village of Bridgeburg, Ontario.

15757—December 28—Directing Atlantic, Quebec & Western Ry. to provide farm crossing for Arsene Lelievre, Little River East, joint crossing with A. Shannon. See No. 15456, November 22, 1911.

15758—January 8—Authorizing C.N.O. Ry. to construct its line from present tracks of Central Ontario Ry. at Stanley Street, Trenton, Ont., to railway bridge across Trent River.

15759—January 8—Naming express collection and delivery limits for City of Strathcona, Alta.

15760—January 4—Authorizing C.P.R. to divert road allowance in Twp. of Mara, County Ontario, mileage 41.56 from Victoria Harbor.

15761-62—January 4—Authorizing C.N.O. Ry. to take of Geo. W. Burgess and John Penny, in City of Belleville, Ont.

15763—January 8—Authorizing G.T.P.B.L. Co. to cross with its Melville-Regina Line public road at mile post 42, Lebret, Sask.

15764—January 9—Directing that crossing over Yonge Street, Simcoe, Ont., G.T.R., that when watchman is not on duty that crossing be protected by flagman for all switching movements.

15765—January 5—Directing C.N.R. to complete by February 15, 1912, under penalty of $10 per day to erect wind breaks, etc., just east of Melfort, Sask. Complaint L. I. District, 428 South Melfort, Sask.

15766—December 13—Approving plans for new station by G.T.R. at Stoney Point, Ont., station at new location.

15767—January 3—Authorizing C.P.R. to cross with its Swift Current to Brooks Branch twenty-three highways in Saskatchewan.

15768—January 11—Authorizing C.P.R. to construct sidings into Union Stock Yards, at Toronto, Ont.

15769—January 9—Authorizing C.N.O. Ry. to open for carriage of traffic its line from Harrowsmith to Sydenham, mileage 160.50 to 163.50 from Don Junction, Ont.

15770—January 11—Authorizing Government of Saskatchewan to divert highway and cross C.P.R. at Foam Lake, Sask.

15771—January 9—Authorizing G.T.P.B.L. Co. to cross with its Melville-Regina Branch highways and to divert same at mileage 85.9 and 58.9, Saskatchewan.

15772—January 9—Authorizing T., H. & B. Ry. to discontinue operation of its interlocking appliances at crossing of Hamilton Street Ry. Co. at Barton Street East, Hamilton, until May 1, 1912, crossing to be protected by flag during passage of trains.

15773—January 11—Authorizing C.P.R. to operate spur into premises of Lowe Bros., Sorauren Avenue, Parkdale, Toronto, Ont.

15774-75—January 10—Extending until March 31 and May 31, 1912, time for completion by C.P.R. of subways at point in Sec. 34, Twp. 24, R. 2, West 5, M. and at Jane Street, West Toronto, Ont.

15776—January 12—Approving Lachine, Jacques-Cartier & Maisonneuve Ry. Co. location 400 feet west of C.P.R. crossing at Iberville Street to terminal at St. Catharine Street, Montreal, through lands of C.P.R., subject to agreement between the two companies.

15777—January 8—Directing that before June 15, 1912, the C.P.R. provide an interchange track with G.T.R. in town of Goderich, Ont.

15778—January 9—Naming express collection and delivery limits for town of Brigthon, Ont.

15779—January 10—Directing Canadian Express Co. to file tariff before January 25, 1912, abolishing extra charge between Pictou, N.S., and Charlottetown, P.E.I., except where it shall be necessary (owing to weather conditions) for traffic to be carried to Georgetown, P.E.I.

15780—January 4—Directing C.P.R. to not later than February 10, 1912, institute by providing two passenger trains a day each way between Ottawa and Prescott. Complaint Hon. J. D. Reid.

15781—January 8—Authorizing C.N.R. to cross with its Vegreville-Calgary Branch over tracks of C.P.R. McLeod Branch in S.W. ¼ of Sec. 11, Twp. 24, R. 1, West 5 M., Alta., by means of overhead bridge.

15782—January 9—Authorizing N.Y.C. & H.R.R. to reconstruct interlocking plant at crossing of G.T.R. at Cecile Jct.

15783-84—January 8—Granting certificate correcting omissions and errors in plan of G.T.P.B.L. Co. location, Regina-Boundary Branch.

15785—January 10—Authorizing C.P.R. to construct its Wilkie to Anglia Branch across twelve highways, mileage 0 to 19.37, Saskatchewan.

15786—January 10—Authorizing G.T.R. to construct siding into premises of International Varnish Co., Ltd., and Pinchin, Johnson & Co. (Canada), Ltd., Toronto, Ont.

15787—January 10—Authorizing T., H. & B. Ry. to construct five spurs in City of Brantford, into lands of Verity Plow Co., Ltd., through lands of the New England Co.