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Contents of this issue on page 279

The Canadian Engineer

An Engineering Weekly

# CONSTRUCTIONAL FEATURES OF A LARGE REINFORCED-CONCRETE DOME.

BY L. R. W. ALLISON

The Second Church of Christ Scientist, Los Angeles, California, was recently erected on West Adams Street at a cost of $300,000, and is probably the finest edifice of its denomination in the west. The structure, shown in Fig. 2, is of reinforced concrete and occupies a ground area of 100 by 150 feet; it was built by a popular subscription building fund. In form it is the arche-type of a Greek cross, offering in treatment many distinctive constructional and architectural features.

The church auditorium proper, 92 by 106 feet, has no column or gallery obstructions, and is surmounted by a hemispherical reinforced concrete dome (Fig. 1) 70 feet in diameter. The crown of the dome is 75 feet above the floor line, and at part way of its periphery, thirty-one stained glass sash are placed to afford an upper source of light.

**Dome Support.**—The supporting structure for the dome, acting as a unit, consists of concrete heavily reinforced with riveted sections. Four columns, as the respective corners of a 70-foot square, carry the load of dome structure and transfer it to the ground. Such columns (Fig. 3) are of concrete section twenty-eight inches square. They are composed of four 3 x 3 x ⅜ inch angles, doubled latticed with 2½-inch flats, and at the outside corners for additional reinforcement 3 x 3-inch T-bars are placed.

At the roof plane of the wings a girder framing is constructed, as shown in plan (Fig. 4). Four large girders "A" form the sides and rest directly upon the columns; at a forty-five degree angle at each corner, smaller built sections "B" are placed, and framing into these latter, as shown, eight small beams "C," approximately 14 feet long, complete a sixteen-sided polygon. This supporting structure is finished flush on top, the smaller girders being carried on brackets, and as a whole sustaining the main base of the dome.

The cross-section (Fig. 5) diagrammatically shows the construction of the main girders "A." The top chord is composed of two 6 x 4 x ⅜ inch angles, placed 12 inches apart and fastened with batten plates. The bottom chord comprises two angles, one 6 x 6 x ⅜ inch and one 6 x 4 x ⅜ inch, similarly spaced and battened. The verticals consist of two 3 x 2½ x 5/16 inch angles at the outer portion of the truss and two 2½ x 2 x 5/16 inch angles at the middle section, while the diagonals are formed of two 3 x 5/16 inch bars at outer end and two 2½ x ¼ inch bars at middle bay, correspondingly. All sections are riveted together at the joints, and the ends of girder riveted to the columns. A system of 1½-inch twisted rods for further concrete reinforcing is employed, as will be noticed.

The smaller girders "B" are of like construction, similarly reinforced with twisted rods, and riveted at ends into the main girders. The built beams "C," (Fig. 4) have top and bottom chord each of two 2½ x 2½ x 5/16 inch angles, battened 12 inches apart. There are two vertical and three diagonals in each constructed beam, the former consisting of two 2½ x 2 x ¼ inch angles, and the latter two 2½ x ¼ inch flats.

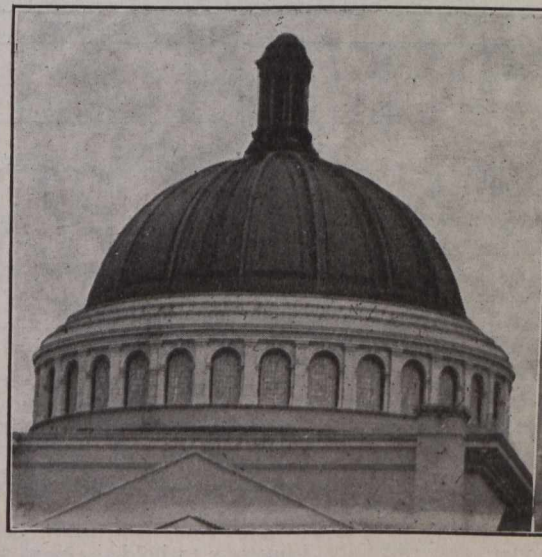

Fig. 1.

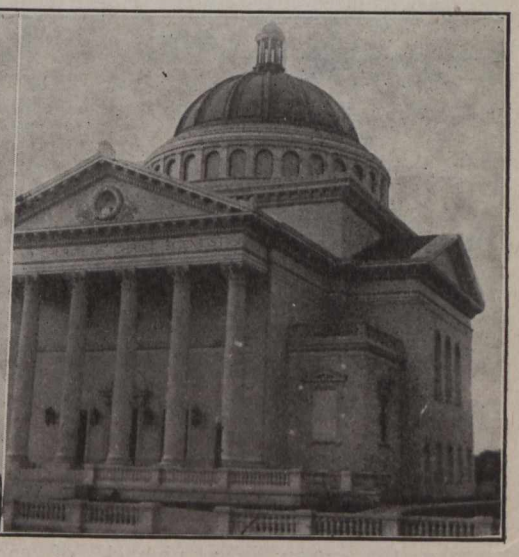

Fig. 2.

This steel supporting structure was erected successively, and then concreted as a unit, the timber form work for the latter being supported by the steel frame.

**Dome Construction.**—The forms for the dome were made in sections and located in position as the work progressed. The base of the timber forms rested upon studs concreted in the girder unit for such purpose. For three feet above the riveted section and concrete support, the dome is 16 inches thick, and is reinforced for such distance with two 1-inch bars at the base and six similar bars through the vertical or outer face.

The following section, about 8 feet in height, consists of thirty-two small posts, spaced equally about the circumference to serve for window jambs. These posts, 12 x 14-inch

in size, are composed of four ¾-inch twisted rods, additionally wrapped with No. 6 wire. The rods extend into the upper and lower bearing surfaces for a distance of about 6 inches to insure proper bonding. For 2 feet above this window area, the dome is of similar thickness, 16 inches, and is reinforced with five 1-inch twisted rods.

As will be noticed in Fig. 2, the remainder of the cupola rests on this 16-inch base, and forms a unit ring in itself. At the base, this dome proper is 8 inches thick and tapers to a 4-inch thickness at the crown. It is reinforced both vertically and horizontally with ¼-inch twisted rods, for the former at 18-inch centres, and for the latter in spaces varying from 6 inches at base to 12 inches at crown.

This complete section of the dome is covered with heavy-gauge copper which, as the crown is approached, assumes the shape shown by the wood frame in Fig. 5, this latter being added after construction was under way to insure a more graceful curve than originally planned. The wood frame consists for the most part of timbers 2 x 10-inch, 1 x 8-inch, or less, and is covered with 1-inch vertical sheeting. Surmounting the crown is a pinnacle of copper covering corresponding to the dome proper, as will be seen in Fig. 2.

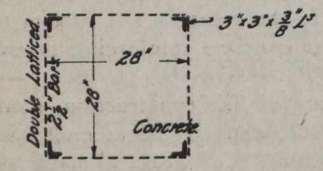


Fig. 3
Column Section.

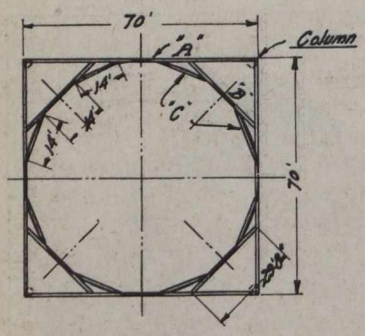


Fig. 4
Plan - Concrete Girder Support.

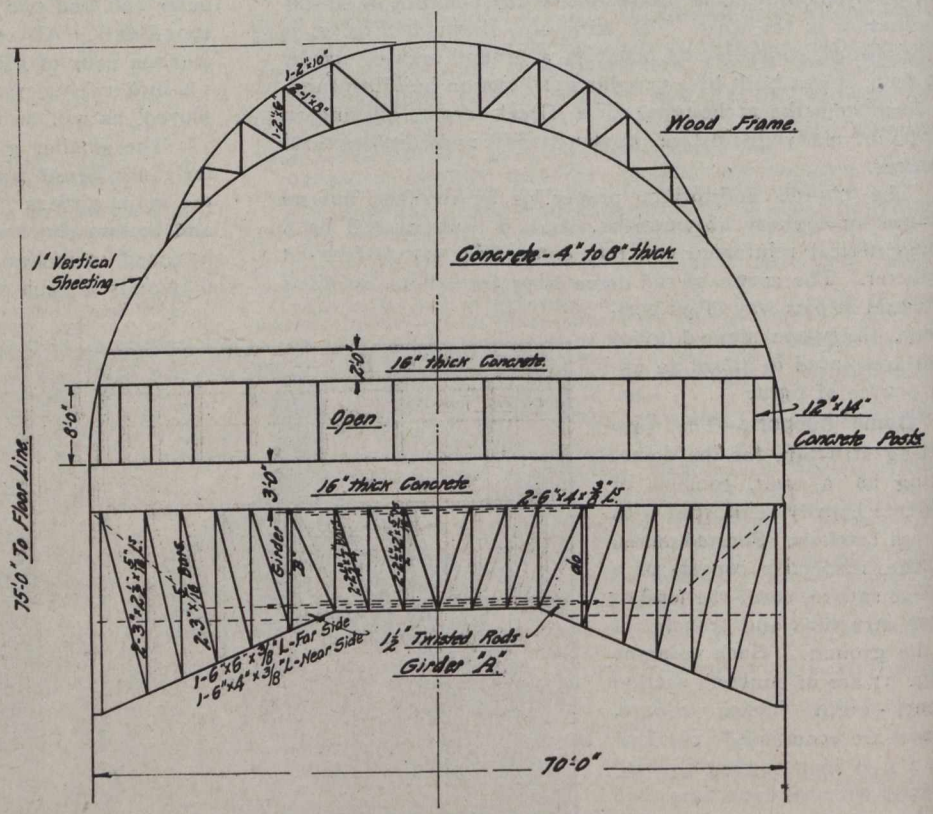


Fig. 5.—Diagram, Typical Section.

All horizontal reinforcing bars in the dome sections were placed near the outer edge of the work. The gravity system of pouring concrete was employed, the mixture was hoisted to a point above the work and conveyed to its respective location by means of a swivel-jointed, sheet-iron pipe. The forms for the dome construction were left in place for about three months.

The exterior finish of the church is a combination of terra-cotta and white enamel brick. This facing is fastened to the concrete body by galvanized wires, placed in position as the concreting progressed.

A. F. Rosenheim and A. C. Martin, both of Los Angeles, were associated as architect and engineer, respectively, of the edifice; the construction was carried out by the C. J. Kubach Company of the same city.

## THE INTERNATIONAL GEOLOGICAL CONGRESS

By H. Mortimer-Lamb.*

Within the last twenty or twenty-five years, the science of geology has developed in a direction that has brought it into direct and serviceable association with those classes of commercial enterprise that are dependent on engineering. While this is especially true in respect of mining, it applies almost equally to railroading, municipal engineering, and other activities of a like nature. The dependence of mining on geology is attested, for example, by the fact that a geologist is now invariably included on the permanent staff of every mining corporation of importance; and the demand in recent years for the services of capable men to occupy such positions has been quite out of the proportion to the supply. It is recognized universally, in short, that the debt of the mining industry to geology is enormous, and the obligation continues to increase steadily. This largely explains the circumstance that the invitation to the International Geological Congress to hold the next meeting in Canada was made, not only at the instance of the Canadian and Ontario Governments, and of the Royal Society of Canada, but at that of the Canadian Mining Institute, an association representative, in a truly national sense, of the mining industry of this country. It is believed that this meeting will immensely benefit mining in the Dominion. From the educational and the scientific standpoints, much is to be expected from the interchange of views on Canadian conditions and problems, by men of international reputations. On purely commercial grounds, the interest and attention that will be directed to the mineral resources and to the opportunities for the investment of capital in mining undertakings in Canada, in themselves fully justified the extensive preparations that are being made and the expense that is being incurred in anticipation of the event. Judging from the character of the attendance in the past, almost every civilized nation will be repre-

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sented at the Canadian meeting by men of recognized eminence, including distinguished government officials, geologists and mining engineers in consulting practice, geographers, great educationalists and writers of text-books. Thus surely never a better, a more effective opportunity has presented itself of providing for the wide-spread dissemination of authoritative information on Canadian resources and potentialities.

On these grounds, a general appeal for sympathetic co-operation is made to all classes and to the mining community in particular. The congress has held many meetings in other countries. In all, it has been welcomed with open arms. That record must be at least maintained.

Meanwhile, before proceeding to recount what progress has been made so far with the arrangements for the meeting and for the instruction and entertainment of the visitors, a word or two should be said concerning the International Geological Congress itself. In the year 1876, at the International Exhibition at Philadelphia, there was displayed a collection of geological maps and sections from both America and Europe. It had the effect of impressing on geologists who saw it the advantage of providing opportunities and means for comparative study; and in consequence, in August, 1876, at the annual meeting of the American Association for the Advancement of Science, at Buffalo, under the presidency of Prof. William B. Rogers, the project of the foundation of the congress was broached, received favorably, and a committee was appointed to arrange for the first meeting, held two years later in Paris. It is worthy of remark that the secretary of the committee in question was that distinguished chemist and geologist, Dr. T. Sterry Hunt, who from 1847 to 1872 was chemist and mineralogist to the Geological Survey of Canada. The objects of the congress may be very briefly and succinctly summarized in the general statement that by means of the periodical meetings the results of knowledge acquired in any one country are given a universal application and significance. The congress endeavors to provide, for example, for the adoption of uniform systems of mapping, nomenclature and classification of rocks, fossils and minerals; and in other directions broadens the boundaries and extends the usefulness of geological science. One achievement, in particular that may be mentioned, is the compilation of a geological map of Europe, shortly to be issued; and it is now proposed to undertake the preparation of a similar geological map of the world.

The records of the meetings, which are usually held every three years, are shown in the following table:—

**Number of Members, Delegates, Vice-Presidents and Countries Represented at Each Congress.**

| Congress | Year | Country | Members | | Delegates | Vice-Presidents | Countries Represented |
|---|---|---|---|---|---|---|---|
| | | | Enrolled | Attending | | | |
| 1st | 1878 | France | | 310 | 7 | 18 | 23 |
| 2nd | 1881 | Italy | 420 | 224 | 23 | 19 | 23 |
| 3rd | 1885 | Germany | 455 | 258 | 15 | 20 | 22 |
| 4th | 1888 | England | 337 | 140 | 68 | 22 | 25 |
| 5th | 1891 | U.S.A. | 546 | 251 | 39 | 31 | 24 |
| 6th | 1894 | Switzerland | 401 | 273 | 18 | 15 | 20 |
| 7th | 1897 | Russia | 1037 | 704 | 139 | 40 | 27 |
| 8th | 1900 | France | 1016 | 461 | 80 | 46 | 31 |
| 9th | 1903 | Austria | 664 | 393 | 39 | 25 | 30 |
| 10th | 1906 | Mexico | 707 | 321 | 83 | 27 | 33 |
| 11th | 1910 | Stockholm | 857 | 650 | 262 | 74 | 36 |

As will be noted, the congress, so far, has met only twice on this side of the Atlantic.

Socially and scientifically, the last meeting in Sweden was notably successful. The opening session was attended by the King of Sweden in person, while at the sessions devoted to the discussion of economic problems, a number of the Cabinet Ministers proved their interest and sense of the importance of the occasion by their presence. The arrangements for the conduct of the meeting, for the entertainment of the visiting scientists, and in connection with the several excursions, were planned and carried out with extraordinary ability and precision; and it will require every effort on the part of Canadians to even equal the standard set by Sweden in these respects. It is scarcely necessary to say, however, that no pains are being spared by an energetic and representative executive committee, to which has been entrusted the task of preparing a programme for the twelfth or Canadian meeting of the congress.

The excursions, more especially on the occasion of recent meetings, have been given special prominence. These have two main purposes; one to illustrate, so far as possible, the subjects discussed; and the other to afford visiting members the opportunity of studying the features of geological interest peculiar to the country in which the congress assembles. In connection with the arrangements for the Canadian meeting, provision has been made for over thirty excursions to mining districts and other localities of geological interest in Canada, between the extreme east and west of the continent, and northward as far as Dawson. It is computed, on the basis of the numbers in attendance at former meetings, that the representation from abroad, at the Canadian meeting, will not be less than, and may exceed, seven hundred. Each excursion will be under the leadership of a duly qualified guide, who will also be competent to point out and discuss the phenomena constituting the point of interest in each instance. Obviously, the planning and effective conduct of a series of excursions on this scale is no light undertaking; but with the assurance of local aid and co-operation, the difficulties should not prove insuperable.

The Swedish meeting was marked especially by the publication of a monumental work on "The Iron Ore Resources of the World," to which reports on the distribution and supply of iron in the respective countries were contributed by eminent authorities. The executive committee of the twelfth congress are to be very heartily congratulated on the decision to emulate this example by undertaking the compilation of a companion work on the "Coal Resources of the World." Incidentally, this report should serve to direct wider attention to the magnitude and value of Canadian resources. The subject of coal resources and supplies will, moreover, form one of the principal topics for discussion at the meeting in Toronto; while other topics of no less economic interest, notably that of the influence of depth on the character of metalliferous deposits, are to be debated.

It is unnecessary here, however, to further discuss details, the purpose of the present notes being to give merely a general idea of the aims and work of the congress and of the significance attaching to its meeting in this country. With a proper realization of the importance of the occasion, the mining men of Canada, no less than the public generally, may be trusted to cordially co-operate with the congress officials in making the Canadian meeting an unqualified success.

Further information may be obtained by applying to the secretary, Twelfth International Geological Congress, Victoria Memorial Museum, Ottawa.

# REPORT OF THE TWENTY-SEVENTH ANNUAL MEETING OF THE CANADIAN SOCIETY OF CIVIL ENGINEERS.

Report of Proceedings of the Twenty-seventh Annual Meeting of the Society, held at 413 Dorchester Street West, Montreal, on Tuesday, January 28th, 1913.

The President, Mr. Wm. Francis Tye, called the meeting to order at 10.30 a.m.

The first business was the reading of the minutes of the last meeting.

The Secretary then read the minutes, which the meeting confirmed.

The President stated that he was requested to call attention to the Introduction or Reception Committee and to its functions. As ordered at the last meeting an Introduction Committee had been appointed, and the members of it are, Mr. Jamieson, Mr. Lewis Skaife and Mr. Francis. If any of the gentleman would like any information or introductions, one of these gentlemen would be glad to do anything for you.

## NOMINATION OF SCRUTINEERS

The following gentlemen were elected scrutineers for the election of officers, etc:—Mr. James Ewing (Chairman), S. Blumenthal, A. R. Ketterson, E. Fiset and Mr. Bates.

## AMENDMENT TO BY-LAWS COMMITTEE

The following gentlemen were elected:—Mr. Openshaw (Chairman), Mr. M. A. Downes, and Mr. G. E. L. Mallory.

## SPECIFICATIONS COMMITTEE

The following gentlemen were elected:—Mr. E. S. M. Lovelace (Chairman), Mr. Shanly and Mr. Oliver.

## REPORT OF COUNCIL

The next business was the reception and adoption of reports. The first was the report of Council. The President asked if it had been distributed.

The Secretary (Prof. McLeod) Stated it had been distributed to the members and that it might be taken as read.

The President said this report of Council was very long and he thought they might take it as read. It would take up too much time to read it, and they all had copies of it. There should be a motion to receive this report. On the motion of Mr. T. C. Irving, seconded by Mr. Hunter the report o Council, as printed, was received.

The President said that they should first take up the report of the Council and afterwards pass on to the report of the Library and House Committee, and the other Committees. That report of Council ends on page fourteen, and the meeting must confine their discussion first of all to that.

The President asked if there were anyone wishing to say anything in regard to this report?

Mr. McNab said that he noticed the third paragraph dealt with the death of twenty-nine members. It seemed to him it would have been well if they had had the names of the departed confreres. Among those who were announced as deceased was one who was also a member of our Society. He referred to the late lamented Mr.Chandler. He would ask the Secretary to read the names of those—there are only twenty-nine—who have gone beyond.

Also, in the third paragraph it says that the number removed from the rolls aggregates forty-five. He would like to know what proportion of those forty-five were removed by straight resignation and what proportion by non-payment of dues, or if the two reasons go together.

The Secretary, answering Mr. McNab's questions as to the sub-division, there was a meeting some three years ago at which a statement was made to the effect that one gentleman had been removed for non-payment of dues and a certain number had resigned. That was taken exception to, and since that date they had been combined.

The Secretary then read the list of those who have died.

Mr. Irving said the name of Mr. C. Beresford Fox of Toronto was not mentioned.

The Secretary stated that he had no information of that. He then read the list of resignations.

Mr. Mitchell asked if these were all resignations.

The Secretary assented and added that they are mostly students.

Mr. Mitchell felt that was rather a large number of resignations.

Could the Secretary give the proportion this year in comparison with former years, say five or six years ago? Was this number of resignations larger than usual, or smaller than usual; also, are these gentlemen those who are engaged actively in engineering work, or are they letting the Society go just out of lack of interest, or do they give reasons, such as having moved away, or having become engaged in other pursuits?

The Secretary stated that he could give detailed information if he referred to the correspondence. Answering Mr. Mitchell's first question, he did not think the number of resignations of corporate members has been as large as usual. The number of students is somewhat large because the Society are continually pressing them for payment of their dues, and they are continually going off into other lines of work than engineering and cannot make the transfer to the higher grade. Perhaps they do not desire to, but in many cases they cannot do so. That accounts for the large number of students who have resigned, but the number of corporate members is small. There are only five of the latter altogether. The actual causes for their resignations can be given, if required.

Mr. Leofred asked if the corporate members resigned because they think the Society is not useful to them, or something like that. They might say something in their letters to that effect. It would be interesting to know what they say.

The President stated that so far as he recollected he did not think they had had that advanced as a reason for any resignations during the year. It would take a very great deal of labour at the present time to produce all the reasons for the various resignations because it would be necessary to go through all the correspondence for the year.

Mr. Vaughan called the meeting's attention to the fact that this year both for non-payment and resignations only two members left, and 27 came in.

The Secretary stated that the actual number of those who were removed for non-payment of dues was 17 associate members, 2 juniors and 27 students. Some of these on the former list would exceed this return because the total right up to the year was now presented and was not available at the time this report was made in the middle of December. This would be corrected.

Mr. Thomson stated that the Society did not charge fees enough to run the society.

Mr. McNab stated that he would like to refer now to page twelve, in which there was a copy of a letter sent by the Secretary as representing the Council, to the Premier of Canada, the Premier of British Columbia, and the Ministers of Public Works and of Railways and Canals of Canada. He would like to ask if the replies to that letter could be read for the information of this meeting?

The President stated that the Council had received several very strong requests, from the British Columbia branch especially, to prosecute this, and that they were pressing it as best they could.

Mr. Robinson then moved that the report of the Council concluded on page fourteen, be accepted.

Seconded and carried.

The President next took up the report of the Library Committee starting on page fifteen and ending on page twenty-two.

Lt.-Col. H. R. Lordly stated that the report of the Library Committee showed that thirteen books were purchased during the year, and fifteen were presented, making a total of twenty-eight. One hundred and twenty-five dollars was expended, of which forty-nine dollars was donated, making a net sum of seventy-six dollars given by the Society. It was possible that owing to the purchase of the new building and expenses incidental thereto the Council had not deemed it advisable to spend any more money, but he believed that there was a connection between this and the number of resignations which were quoted a few moments before. The Library is so poor, the additions to it are so slim, that when you spoke to a young

man, an associate member, and ask why he does not come around and take an interest in the Society, he says, "You have no library, and there is no necessity for my spending fifteen dollars when I get nothing for it." No doubt there were good reasons for the small expenditure this year, but he thought it should be taken up and discussed seriously.

The President stated he thought the library was the best engineering library in the country. (Hear! hear!) Of course, it was not anything like so large as the Society would like to have it, but they had not the money to make it what they thought it should be, and everyone knew the expenses of the Society were mounting up very fast, and in addition to that the Society are moving this year, so the Council thought it inadvisable to buy many more books until they were in the new building.

In response to a question by Mr. McNab, the Secretary stated that as to researches, there have been practically no demands. The Society has facilities for having a research made by the Nelson Bureau of Research, and practically that has not been utilised this year, nor was it last year. There were one or two enquiries last year, so the research feature has not been patronised, although the attention of members has been called to it. There was no record kept of attendance, but he thought the average number of readers would not probably be more than half a dozen a day throughout the year.

Mr. Kennedy stated with regard to the matter of research that he had had occasion to pay quite a considerable sum to the American Society of Civil Engineers because they have a larger library running back a longer time, but if the Society had affiliation with some other concern so they could have such research he thought they would rather have it made through their own library, and it ought to be published and kept before them so they could understand it practically. The American Society have a number of transactions publishing announcements on such matters, and they are put in every time and so kept before the membership.

The Secretary here read from the certificate of membership issued in favor of the Canadian Society of Civil Engineers by the Nelson's Encyclopaedia Library for Research:—"Members are entitled to the educational benefits and privileges of Nelson's Bureau of Research for special information. Upon request, members will be furnished with accurate information on any subject desired, agriculture, astronomy, art, chemistry, electricity, engineering, economics, geography, history, civics, literature, and all allied subjects. All questions will be answered without further charge." The working arrangement is that any question sent in to the Secretary is communicated to the Nelson Bureau for Research. Since this has been posted there have been six or eight enquiries. (Good!)

Mr. Mitchell stated that he was sure the members who are non-residents were delighted to hear of that arrangement.

There was another point which occurred to Mr. Mitchell. The various governments, the Provincial governments, as well as the Federal government, publish various reports throughout the year with reference to their works of an engineering character. The Province of Nova Scotia may publish reports with reference to its road and bridge structures. It may be that members who are living in Saskatchewan would like to know what reports have been published during the year. It is true that those members could write to the Provincial Engineers, but they do not know what is published without writing a letter. It would be a very convenient thing if the Library Committee, through the Council, would publish a list once a year of such publications.

Mr. T. C. Irving asked if it were possible to get the branches of this Society placed on the exchange list of other technical Societies so they might exchange transactions.

The Secretary stated that if they were liberally disposed they might. These exchanges with the Society here have usually been made on the basis of exchange. He supposed some Societies might be willing to send to all the branches. He would be very glad indeed to make the representation.

Mr. Mountain agreed with the last speaker. He thought the Society might ask if other Societies do that, and call their attention to the fact that if any branches of theirs are formed, this Society would reciprocate.

The President thought this a very good suggestion and would refer it to the incoming Council and Library Committee.

On the motion of Mr. Lumsden, seconded by Mr. Blumenthal the report of the Library Committee was accepted unanimously.

The President said that the next order of business was the financial statement which begins at page twenty-three and goes to page twenty-six.

Mr. Mountain moved the adoption of that report.

## REPORTS FROM BRANCHES

The President stated that the next business before the Society was the reception of reports from branches.

Reports were then read from Victoria, Vancouver, Manitoba and Ottawa. The first three were accepted.

Mr. Uniacke, before adjournment, asked if the Ottawa report was open to discussion.

The President stated that the discussion would come. If you want to discuss it you can do so after lunch, and the motion would then be put.

At one p.m. adjourned accordingly.

## AFTERNOON SESSION—JANUARY 28th, 1913

The President said that the meeting had finished reading the report of the Ottawa branch. He understood some members wish to discuss that report.

Mr. Robinson moved in so far as the report deals with matters pertaining to a report of the transactions of the branch of Ottawa, that it be accepted, and that such matters as are contained in that report recommending to this body something to be done, be referred to the heading of "New Business," to come up at that regular time.

The President said that this was satisfactory.

Mr. Mountain asked if it were new business arising out of the adoption of that report. If it was anything to be discussed it seemed to him it should be before the report was finally adopted. The only thing he wanted to refer to was the question of the number of students in the Ottawa branch that have reached their limit of age, and should be transferred. On behalf of the Ottawa branch he would call the attention of the Society to that with a view to its being taken in hand. These men could not be allowed to remain as students and pay one dollar a year, and the branch be out of the receipt of their percentages as corporate members.

The President said that the Secretary had been hammering away at that question as hard as he possibly could. He thought it was also up to the members of the Ottawa branch to move a little in the matter.

Mr. Mountain stated that they could not do that. They had tried to do that and the members of the Society represented that the branch was usurping the powers of the parent Society. It must be done through the parent Society.

The President said that he agreed with that.

The Secretary said that perhaps Mr. Mountain knew that a final circular had been issued to all of the students. There were some six hundred on the list to whom such notices had gone, informing them that unless they make application for transfer to a higher grade, or show that, they are still eligible to remain as students, they will be removed from the list on the first of March. He also said that the Council referred the matter to the Society solicitor in order to ascertain whether it was competent for the Council to transfer such students without their application, and he informed the Council that it was not, that they must make application.

Mr. Mountain said that answered his objection.

The President added he thought the Ottawa branch and the other branches would help along in that matter by urging these student members to make application.

Mr. Mountain said with all due respect to the Chair, that was impossible. They had been called down for attempting to do it.

Mr. Braley, as Secretary of the Ottawa branch, said that they had tried to get these members to transfer, but a certain number of them said they did not have to unless they were forced to. In fact, the question had been brought up that the Society could not force them to transfer because the By-Law for the age limit was passed just lately.

The Secretary said that there was nothing in that.

Mr. Jas. White said that there was another way out of the difficulty. If in accordance with the By-laws it is impossible to force these men to transfer, to change the By-laws. He suggested leaving the matter in abeyance for twelve months, but he did not see any reason why the By-laws should not be changed twelve months hence, and then let the parent association take action. Mr. Mountain had put the matter concisely. He did not know that they could do anything more.

The President said there was no doubt the parent Society was doing everything it could in that matter, and would continue to do so.

Mr. Braley asked if the Society could refuse them the transactions.

The President answered no.

Mr. Irving asked if the Ottawa branch was doing anything to have the very interesting papers read before their branch published in the transactions. They were having great difficulty in getting papers in Toronto, the members seemed to be very busy, and they were rather envious when they heard of Ottawa's success in getting papers.

Mr. Uniacke said it was their endeavor to get all those who have read a paper or given an address before the Ottawa branch to put them in such shape that they could be submitted to the Secretary and to the Committee on papers of the main Society. They had had several cases of papers that had been accepted, and he believed the Committee on papers at present had one or two under consideration. A good many of the papers and lectures had been of such a character that it was very difficult to put them in proper shape for publication. For instance, the paper on wireless telegraphy was a running talk illustrated by apparatus, and several others that were illustrated by lantern slides formed more of a talk, and the discussion brought out almost as much as the paper itself.

The motion that the report be adopted was then put and carried.

Mr. Robinson said he would like to interpolate a request to the Chair to reserve two hours some time during this Convention in which new business could be taken up. He thought the branch at Ottawa would like to bring up some of their suggestions, and he was sure others would like to do the same.

Mr. Braley said he had a few suggestions to bring up later on.

The President said that the next business that was on would give the opportunity desired.

Were there any representatives of Quebec here who could tell the Society anything about their report.

Mr. Leofred said that the Secretary telephoned him yesterday afternoon that he would be there to-day with his report.

The President passed that in the meantime. Kingston was in the same condition. Were there any Kingston gentlemen there?

They would leave those, and if they should get them before the meeting is over they could deal with them.

Regarding the financial report which was referred to the auditors, they say there are some clerical errors in the report as printed. On page twenty-three in regard to receipts the figure $539.72 should read $539.27; and on the next page this $10,000. That $85,141.84 on each side under the head of "Receipts and Expenditures" should be $75,141.84. With those corrections the report is all right.

## FINANCIAL REPORT

The President thought there was a good deal of room for discussion in regard to this financial report, and he would be glad to hear from different members regarding it. The parent Society had reached this point where it had got to do something, it had to increase its receipts and reduce its expenditures, and there did not seem any way of reducing the expenditure, in fact it ought to be increased.

Mr. Braley thought the fees would be considerably increased when they moved the students up to Junior Associate Members.

The President said they would drop a good many students in the process of doing it, and he did not think that would make very much difference.

Mr. Mountain thought if the proposed increase of fees went into force the Society would be in pretty good shape.

The President assented but said that might not pass. Where was the Society going to be then?

Mr. Vaughan said he thought the meeting should talk over this proposed increase of dues, because as had been said it was possible it might not pass. If that increase did not pass it was going to put the Society in rather a serious position.

The Society had had some figures prepared in connection with that which he would like to present to the meeting in order that, should that proposed amendment to the By-law be defeated, the gentlemen from the various branches might be better informed as to the idea of the Council in this matter, as it would certainly have to be submitted again next year. These figures would be printed in the proceedings. They had compared the American Society of Electrical Engineers, the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers, and our own Society, the Canadian Society of Civil Engineers.

The collections per member were: for the American Society of Electrical Engineers, $11.00; the American Society of Civil Engineers, $18.00; the American Institute of Mining Engineers, $9.50; the American Society of Mechanical Engineers, $17.25; the Canadian Society of Civil Engineers, $7.00.

The salaries paid per member are: for the American Society of Electrical Engineers, $2.25; the American Society of Civil Engineers, $5.20; the American Institute of Mining Engineers, $4.70; the American Society of Mechanical Engineers, $9.70; (He was a member of that Society); and the Canadian Society of Civil Engineers, $1.70.

The printing per member was: for the American Society of Electrical Engineers, $3.50; the American Society of Civil Engineers, $5.75; the American Institute of Mining Engineers, $4.60; the American Society of Mechanical Engineers, $10.70; the Civil Engineers of Canada, $2.30.

Those figures show how economically this Society is now being operated.

Another point that he wished to call attention to was the distribution of the $20,000 odd that went into the expenditure as outlined in the annual report. He had divided that into salaries, including legal and auditing expenses, which he considered a general charge very largely, charges of general benefit, such as printing the transactions, etc. He need not go over all these—but he had endeavored to take the charges of general benefit for the year amounting to $9,155. The headquarters expenses proper amount to $3,293.42, contributions to branches $2,810. That worked out about this way: Taking out total expenses, salaries are 24%, general expenses 45½%, headquarter expenses 16½%, branch expenses 14%.

Under the proposed new subscriptions the receipts as nearly as they could approximate from the headquarter expenses would be 23% and from branch members 36%, and from non-resident members 41% of the total. He had pro-rated the salaries equally among the headquarter, branch and non-resident members in proportion to the receipts from them; general expenses in the same way; the headquarter expenses entirely to headquarters, and the branch expenses entirely to the branches. The general result was that headquarters, from whom the receipts are 23%, take 31½% of the total; the branches, from which the receipts are 36%, take 39%; and the non-resident members, from whom the recipts are 41%, take 28½%. In other words, the branches were very nearly as well off, on the assumption that they were simply taking $12 for members and $10 for associates. Under the proposed By-laws the branches could, at their own option, increase that subscription to $15 for members and $12 for associate members, if they wanted the money, which would put them almost exactly on an equality with headquarters, and even then both branches and headquarters were getting more for their money than the non-resident members.

There was no doubt in his mind that this Society did need the headquarters. It was a benefit to the Society to have a headquarters maintained in proper shape. He did not believe they had gone to any unnecessary extravagance in the new quarters. They were the best that could be done with the money, and he did not think they could find them any too elaborate when the members saw them to-morrow. It was going to cost more to keep them up. As somebody said to-day, they should spend more on the library and that sort of thing. He was sure, from the inspection of the balance sheet they would find the increase asked for which simply put the members on an equality with members of other societies was not excessive. It was $15.00 for members. If they joined the American Society of Civil Engineers they would have to pay $25; the American Society of Mechanical Engineers, $15; the American Institute of Mining Engineers, $16.00; the American Society of Electrcial Engineers, $15.00; and the Canadian Society were asking $15.00. He could not compare associates, because their classification of associates was different from the Canadian Society. Their associates were people interested in the different professions, but not actively engaged in them; the Canadian Society Associates were actively engaged, but not of sufficient experience to be in the class of members. But if our associates are compared with the American Society of Civil Engineers associate members it is found that we were asking $15, and they were asking $25 for resident members. So even with this increase the Society were still well below other Societies of anything like an equal status, and it certainly would not give any more income than is necessary to carry on the affairs of the Society properly.

Mr. Vaughan thought that scheme of giving branches the option to increase their branch members to $12 and associate members to $10 so as to provide local funds for the branch would practically put their receipts almost on an equality with those of headquarter members, so far as what they get out of the total revenue of the Society compares with what the

headquarters members get out of the total revenue in proportion to the receipts from two different sources.

In connection with that the Council had recommended that the radius of branches be changed from fifty to twenty-five miles. That was with the idea that if the branch increased its subscription to $15 it might be very unfair to a member who was living thirty or forty miles away from headquarters to pay $15 instead of $10 for a non-resident member. There was no objection whatever to having members join out of the fifty miles radius, but they did not think it was fair to make it compulsory. He thought that was one of the things most criticised, but personally to him it was one of the fairest of the lot. If they get the option of $15 iustead of $10 for a non-resident member the Society should limit the radius so that men who had no opportunity of getting in to the branches to take any interest in them should not be penalised an extra $5 for which they got no benefit.

Both branch and headquarters members were to-day, under this new schedule, getting more out of the Society in proportion to what they put into it than the non-resident members. (Applause.)

Mr. Uniacke said that Mr. Vaughan's schedule of fees and the reason therefor seemed to him to be very logical, but there was one point the speaker laid special stress upon, and that was that the branches at their own option should increase their fees on the same basis as the residents of Montreal, or the resident members. Under the wording of the By-law which had been sent out to be voted upon by the branches, it was a physical, if not a practical impossibility to do that, because it stated that in order to carry that it should be carried by two-thirds of all the members. In an ordinary ballot there was scarcely two-thirds of the ballots cast. So if it had stated "two-thirds of the members present at a meeting, after giving due and timely notice to everybody to attend that meeting," then there might be some chance of the branches carrying such a By-law.

There was one more point he wished to state. In the wording of the by-law several clauses had been lumped together, and a man might have an objection to one or two clauses, but he had to vote "Aye" or "Nay" to the whole. Several had put it up to him that they would vote for this, but they had to vote for the whole thing together. Consequently if the By-law were defeated, it would be in a great measure due to that fact.

Mr. Vaughan thought Mr. Uniacke's point was very well taken about the two-thirds majority. It was a matter of common knowledge that it was almost impossible to get anybody to vote an increase of subscription by letter. He thought that amendment should be accepted and arrange to make a change in that, "that after due and proper notice two-thirds majority at the meeting should carry the change."

Mr. Coutlee thought that strong measures should be taken by the incoming Council to provide that either a larger percentage be given to the branches, or that a loan be made to them so they can put themselves on a respectable footing.

Mr. Irving asked if this were not a case where each branch could work out its own solution. As a matter of fact nearly all the members in Toronto pay thirty dollars to the Engineers' Club there. He thought in the case of Ottawa, Vancouver and Winnipeg, they could start an Engineers' Club and run the local branches of the Society as adjuncts to that Club.

Mr. Uniacke said in that regard that the Ottawa branch had under consideration combination of the three technical societies that were now in Ottawa for the joint use of rooms and lantern. They had a branch of the Mining Association on the same basis as the branch, and also an Association of Officers. They had a Committee on Rooms and the matter was now under consideration. If it went through it would help to put the branch on its feet, provided the members of the Ottawa branch, or the other branches, were a little more prompt in coming to time with their views.

Mr. Harkom said that the discussion was running on the question of headquarter's members and branch members. There had been a great deal said about not getting value for money from membership. He wanted, as a non-resident member, to put himself on record that he thought every member of this Society got full value for every cent he put into it. (Applause.) He thought it was worth $10 to any man to come here and attend these meetings. (Here! here!) For his part he did not think there should be the least little kick about increasing these dues. He had a certain amount of sympathy with these branch members from the fact that he really did not think they got quite enough to carry on their work. The work of the branches, really and truly was going to be, and is largely to-day, the true life of the Society. (Applause.) The branches should, he believed, get a little advance and if the Society was going to raise the dues of the branches two dollars, he thought they should have half of it added to their proportion.

The Secretary here stated that they were getting it all.

And if the fees were raised they would get the difference between the branch allowance for members and the headquarters allowance for members, $3.00. All that would go to the branch.

Mr. Uniacke said that was if the branches could carry that By-law.

Mr. Vaughan stated that he had omitted some information of what this increase would amount to. There would be 135 headquarter's members at $5.00, 400 branch and associate members at $2.00, and 200 headquarters associate members, or a total of $2,175.00 would be the estimated increase to headquarters on the general business of the Society, including all the general expenses. So it was not very much. It would add 12% towards the cost of operating the Society.

Mr. Mountain said that the trouble that had arisen between the branches and the parent Society was from the old By-laws under which they did not get any refund if a man was a year in arrears. He thought that was what started the whole trouble. In his opinion the Society was in a healthy condition, and it was representative of the engineers of Canada practising their profession to-day. He thought the members should keep it there.

Mr. Braley thought everybody would agree that the branches to-day were helping to largely increase the membership. He had been Secretary in Ottawa for three years, and he thought they had pretty nearly corralled everybody there qualified to join the Society. Strong branches throughout the country were one of the greatest assets the Society could have. So long as the branches got a fair proportion of the increase he thought the branch members would be only too willing to increase the dues to the limit if they got a good return for the money.

The President here said this discussion was to a certain extent out of order, but he thought it was very important and he did not want to cut it short.

This question of fees was certainly very important. Canada was growing at a tremendous rate, and the Society wished to keep pace with the growth. The cost of living in every way was going up. It might be the cost of high living, not the high cost of living, but whatever it was it had the same effect on the Canadian Society of Civil Engineers as it had on everybody else and the Society must certainly have more revenue. It would be a calamity if this By-law were not passed. He was glad to have had the views of every man there. Speaking for the main Society, they certainly wanted to do everything they could for the branches, and he thought they could safely say there was no other Society of engineers that was doing anything like, for its branches, what the Canadian Society was doing.

Mr. Vaughan said that the Society might not have as good a branch organization as they ought to have, but they had a better branch organization than any other society he knew of.

Mr. Jamieson said that as the President had stated, the Society would be placed in rather a difficult position if the By-law should not be passed. If it should prove to be the case, he thought it would be well to put it before the members so they would know definitely the condition of affairs and what they were voting on. If that were done he did not think there would be any reasonable fear of its not passing. He did not think the members objected to paying towards ths support of the Society in a proper manner, but they ought to be given some information to base their judgment on.

The Chairman asked if the members were willing to adopt the financial report as corrected.

The motion was then put and carried unanimously.

The next business before the meeting was the reading of the President's address.

Mr. Mountain moved that the Vice-President, Mr. Vaughan, take the chair.

Motion duly seconded and carried.

Mr. Vaughan called upon Mr. Tye to read his address.

Mr. Tye then read his address

# THE ADDRESS OF THE RETIRING PRESIDENT, MR. W. F. TYE.

GENTLEMEN :—

In rising to comply with the time honored custom of reading the President's address, I beg to thank you for the high honor you have conferred on me in electing me to the Presidency of our National Society.

Owing to my residence in Toronto, and to my absence in Europe during the first part of the year, I was unable to attend many of the Council meetings. The affairs of the Society were, however, so well looked after by the Council and our efficient Secretary, that I am sure the absence of the President was not felt.

I have great pleasure in congratulating the Society on its continued growth. Our Membership now amounts in all to over 3,000, and includes almost every engineer in the country. The expansion of the Society is a thing of which we must all feel justly proud. We have grown so rapidly that our old home has become too small for us, and we were very fortunate in being able to dispose of it on such advantageous terms at the very moment when a change had become necessary.

Our thanks are due to the Building Committee for the efficient and expeditious manner in which they have prepared a new residence for us; and I must congratulate the Society on the result of their efforts.

During the year the Council suffered a severe loss in the death of their friend and colleague, Mr. James N. Shanly. Mr. Shanly was a capable, conscientious engineer, and a favorite with all with whom he came in contact. He took a keen and intelligent interest in the Society's affairs. He was Chairman of the Finance and Building Committees, and much of the success of our new home is due to his untiring efforts.

When looking around for a subject on which to address you, my thoughts turn naturally to Railway Location, on which a great part of my professional career has been spent.

Transportation is one of Canada's greatest problems: our country is of vast area, the distances are great, the population sparse, and the traffic light; making the mileage and cost of railways high per head of population. On the other hand the growth of the country is and will continue to be rapid. A great problem is thus presented: how to build our railways that they may not be too expensive for our present requirements, and yet be capable of improvement to fit our future needs. Economics of Railway Location is, therefore, of even more than usual importance to Canada. The subject is so vast that it is only possible in such an address to touch its outer fringe; but it is so important to us all that even a few rudimentary remarks may be interesting.

While railways are built to serve the traffic requirements of the country, the immediate object of the promoters and builders is to make a profit, either on the construction or operation. This is undoubtedly true when built by private parties. When built by a Government, it is with the end in view that the people may make money either directly through the operation of the railway, or indirectly by the reduction of rates. It is, therefore, of prime importance that the engineer, whether he be working for private parties or for a Government, locate and construct the most economic road. The most economic road is not necessarily either the cheapest or most expensive, neither is it necessarily the one which may be operated at the least cost—it is in reality the one which is the most effective commercially or the one which will enable its owners to transport the largest amount of traffic at the lowest cost.

In order to ascertain that a railroad is most effective commercially, the features which underlie its commercial effectiveness should be understood. These are:—Gross Earnings, Operating Expenses, and Fixed Charges; and are of importance in the order named. Gross Earnings, which depend on the amount of traffic handled, is undoubtedly first. It is never advisable to build a railway unless there is or will be sufficient traffic to pay the Operating Eapenses and the Fixed Charges, no matter how cheaply or how well it can be built.

In new countries, such as most Canadian railways are built through, there is rarely sufficient traffic in sight to justify the construction of a road, so the promoters—whether they be a Government or private parties—must have faith in the project and must be able to justify to themselves, and to the investing public, the possibilities of paying dividends.

Engineers are sometimes, though rarely, consulted in the early stages of the project to report on the traffic possibilities of the route. The usual way is for the promoters to decide for themselves that a road between certain terminals is commercially desirable, and that there is or will be sufficient traffic on such a route to justify its construction. Engineers are then employed to survey and construct the road. The question should at once arise with the engineer—how the railway can be so located as to make it the most effective commercially, or how to get for the promoters the most profitable traffic. No matter how this problem is stated, it finally resolves itself into this:—if the promoters be private parties, how can the road be so located and built that the most interest can be earned on the money invested—or if a government, to transport the most traffic at the least cost? The answer in either case would be the same, for, if it is so located that it may handle the most traffic at the least cost, it will, if properly managed, make the most interest on the money invested.

The first problem the engineer has thus to face is how he can so locate the road between the given terminals as to get the most profitable traffic. The route which takes in the greatest number of towns, or which goes through the best land, if the country be unsettled, should be the first examined. A mistake frequently made is to locate the road within a mile or two of an important town in order to decrease distance or avoid expense. The cost of handling traffic is the total cost from the door of the consignor to the door of the consignee, and rates on that basis must be equal. The added charge for cartage is at times so large as to wholly destroy the business of the badly placed line and give it to a competitor more favorably situated, or if it be not wholly destroyed, the additional cartage and delivery charges eat up the profits.

Where traffic is light, and train loads less than the rated capacity of the locomotive, the cost of handling additional traffic is much less than is the ordinary train mile cost. It should be figured in equating the value of a change in location which increases traffic at 50% of the usual train mile cost. In this respect it should be remembered that deviations from the direct route do not always materially add to the length of the line.

In order to locate a railway so that it may be commercially effective it is first necessary to know what the volume of traffic is likely to be, whether it is immediately available, and at what rate it is likely to grow. The best way to ascertain this is by comparison with roads through the same or a similar country. A road through a country most nearly approximating that to be traversed should be selected for examination, and its traffic for previous years studied. If, for any reason business is likely to be materially greater or less than on the road under examination, due allowance should be made.

All railways are now required to make yearly reports to the government, and such statistics should be examined as well as those published in the Railway Companies' Annual Reports. The average train load and the ruling grade should be studied, and finally the average number of trains per day should be ascertained. It must be remembered that though the traffic is rarely balanced, that is, that there is seldom as much tonnage moving one way as the other, the number of trains each way must within narrow limits be the same. It is not always easy for an outsider to ascertain the number of trains over any given railway, as railway statistics are not published in this form, but every effort should be made to arrive at it as closely as possible.

Having obtained this information, and having determined how the traffic on the proposed road will compare with that on the road under examination, some approximation of the ruling grades on the road in view should be arrived at. If different from those on the route with which comparison is being made, the number of trains per day each way on the proposed road should be increased or diminished accordingly.

While this method of ascertaining the number of trains per day is only approximate, it is certainly much more accurate than to attempt to make an independent estimate of the gross tonnage on the new road. The rate of growth of traffic should be similarly ascertained, as a railroad should be built not only to take care of the present traffic but also that of the road in the reasonably near future.

Cost per train mile is the basis of all economic comparison, as the effect of the number of trains on the cost of operation is much more direct than

is the actual tonnage handled. The cost per train mile should thus be ascertained with reasonable accuracy. The Annual Reports published by the Railway Companies usually give these figures; if not, the reports of the Inter-State Commerce Commission give this information for every railroad in the United States. From this mass of statistics the train mile cost of the most nearly similar road should be taken and assumed as the train mile cost of the proposed road. It must also be remembered that these costs are increasing rapidly, the average for the whole United States for the year ending June 30th, 1896, being 95 cents, while for the year ending June 30th, 1910, it had increased to $1.49.

Equipped with this information as to the sources of traffic, the estimated average number of trains per day, and the probable cost per train mile, the engineer is ready to make a reconnaissance of the country to be traversed. The reconnaissance should always be of an area rather than a line. An area wide enough to take in any possible line should be examined. All combinations of probable lines should be studied. As the reconnaissance proceeds a map of the country should be made showing the details of the topography by contours ten to fifty feet apart; the elevations of controlling points should be shown with the greatest attainable accuracy. From such a map carefully prepared all lines and combinations of lines can be studied. Approximate condensed profiles can be drawn, and distances, grades and costs can be approximately asscertained. With such information, the choice of routes can usually be narrowed down to one or two, or in rare instances to three lines over which it is necessary to run surveys.

The value of a proper reconnaissance cannot be too strongly insisted upon. It is owing to the lack of it that the graver errors of location are usually due, such as the selection of an improper route or ruling grade, passing of traffic centres, &c. There is no way in which money can be so profitably spent. Great pains should be taken to secure the most expert engineer for this class of work. In engineering and economic importance reconnaissance far outranks location or construction. It is not an exaggeration to say that for every dollar which an engineer can save on construction, he can save five on location, and ten on reconnaissance.

The really essential factor in a location made for freight traffic is the ruling grade. The maximum is not always the ruling or limiting grade, as it might be operated by the aid of a helper engine, in which case it may not limit traffic. A very long grade of a lower rate may, by taxing the boiler capacity, become the ruling grade instead of a shorter steeper one. To ascertain the economic value of any change in grade, or to compare two different grades, the number of round trips per day required to handle the given or estimated traffic should be ascertained. The difference will be the saving in trains each way per day. This multiplied by the ascertained cost per train mile, by twice the length of the Division in miles and the number of days in the year, will give the annual saving. Capitalizing at the proper interest rate will give the capitalized value of the better grade. If the additional cost is not greater than the capitalized value when properly equated for distance, rise and fall, curvature, etc., then the lighter grade is an economic one, and should be adopted.

As many items of expense will not be affected by changes in the number of trains, the saving per train mile for a train eliminated is not as great as the cost per train mile for the entire traffic. The saving is in reality in the neighborhood of 50%, and this percentage of the ascertained total train mile cost should be used in estimating the economy due to a difference in ruling grade.

In figuring on the economics of a grade reduction on an old road where the traffic and the average number of trains per day are known, it is essential that the actual loads hauled by each locomotive be determined and compared with their rated capacities. This difference is due to the inability of the operating officials to get perfect results. This "personal equation" must be taken into consideration in figuring the number of trains per day with the new grades, as they will no more be able to get the best results under the new conditions than they were with the old. In making a reduction from a high rate to a low, for instance, from a 1% to a 0.3% or 0.4%, it must not be forgotten that the proportion of the actual loads to the theoretical rating will be lower on the low grades than on the high. Time is an essential factor. On a 1% grade in good weather, the actual loading may usually be made 90% of the theoretical, while on 0.3% it is unlikely that more than 75% of the rating can be hauled if time is to be made.

The proportionate amount of ruling grade on the Division has also an important bearing on the loading of trains, the greater the proportion its length bears to the length of the Division the lighter the actual train loads must be, and this too must be taken into consideration in determining the average number of trains per day required to handle the traffic on the proposed new grade.

Serious error would undoubtedly arise if the theoretical number of trains required to handle the traffic on the proposed new grade were compared with the actual trains on the present one.

While Fixed Charges—which are largely determined by the "Cost of Construction"—are of lesser consideration than Operating Expenses, they are still of prime importance. No road can pay dividends to stock holders, or afford to reduce freight rates until its Fixed Charges are met. So it is of the greatest importance that the engineer introduce no features that will increase the cost of construction without reducing the Operating Expenses by at least as great an amount as the interest on the added cost. The cost of moving a given tonnage being the sum of the Operating Expenses and the Fixed Charges—it follows that a reduction in the cost which does not increase the Operating Expenses is only of less importance than one which reduces the Operating Expenses without increasing the cost. Such a reduction in cost is a practical improvement to the standard of the road, as it increases the margin between receipts and expenditures, and so permits of an increase in dividends, or has a tendency to permit of a reduction in freight rates, if that be the object aimed at.

In Canada most of the new construction is through districts which at the time of completion furnish but little traffic: much railway has been built on which the traffic did not justify even one daily freight train per day each way. It is a safe statement that 80% of the mileage constructed in Canada would not furnish at the date of completion traffic sufficient for two freight trains each way per day. Under such conditions, the receipts are low and the Operating Expenses high, and it is of the utmost importance that the construction cost be kept low. On the other hand, the country is growing fast, and traffic is increasing rapidly. It is thus necessary that the engineer keep always in view the almost certain necessity of a good road in the future. He should, therefore, so locate and construct his line that the first cost be low, and that the standard may be raised, when necessary, without unduly increasing the total expenditure. In order to get the very best results, the line giving best grades, alignment, etc., should always be first located. From this, as a standard, the engineer should work to the final or economic location. Working from a poor to a better is apt to lead to grave errors.

Where low construction costs are necessary, and it is probable that a high standard will be required in the future, it is much more effective and advisable to use short sections of temporary line with steep grades, sharp curves, etc., on the heavy or difficult sections, maintaining the higher standard for the light or easy portions of line, than it is to adopt a generally lower standard for the whole route. The first cost of the former will probably be less; it may be operated with helper engines as the traffic increases, and may be improved when advisable, while the cost of improving a generally poor road is frequently prohibitive.

The use of sharp curves with short tangents is often a very effective means of reducing cost without materially increasing the Operating Expenses.

The effect of moderately sharp curvature is essentially different from steep grades, inasmuch as it is not limiting in its effect. The use of one sharp curve does not justify the use of another just as sharp—whereas the use of one ruling grade on a division does justify another as steep.

The use of curves up to 14 degrees does not increase the maintenance or operating expenses. A mile of road in which there are 100 degrees of 10 degree curve, the balance being tangent, does not cost any more to maintain and operate than the same length of road with 100 degrees of 2 degree curve—in fact, if there is any difference, it is in favor of the sharper curvature.

## Report of the Annual Meeting of the Canadian Society of Civil Engineers, held in Montreal, Jan. 28, 29, 30, 1913

Unless the curvature is so sharp as to be limiting in its effect, there is no serious objection even on the best class of road to a few sharp curves where the amount saved by their use is sufficient to justify their introduction. The conditions which cause curves to be limiting are when they are so sharp as to prevent the use of the higher grades of modern equipment, and when they limit the haulage capacity of the locomotives, or their speed.

Modern equipment is so constructed as to traverse safely 14 degree curves, and much sharper with guard and hold up rails. The standard compensation for curvature on grades is 0.04 foot per degree. A 10 degree curve is thus equivalent, as far as resistance is concerned, to a 0.4% grade; and a 15 degree curve to a 0.6% grade. On a 0.4% it is only necessary that the grade on a 10 degree curve be made level in order that the resistance be not increased. The same thing applies to a 15 degree curve on a 0.6% grade. It is, therefore, evident that on a road whose ruling grades are 0.4% 10 degree curves are not limiting to the haulage capacity of the locomotives, nor are 15 degree curves on a 0.6% grade.

The easy riding speed is dependent on the amount of the allowable elevation of the outer rail. If the maximum be set at six inches, this speed per hour would be :—

| | | | |
|---|---|---|---|
| on a 3 | degree curve | 60 | miles per hour |
| " 4 | " | 50 | " |
| " 6 | " | 40 | " |
| " 8 | " | 35 | " |
| " 10 | " | 30 | " |

The safe or allowable speeds would be 10 miles per hour greater.

With the track properly elevated, equiped with tie plates kept in good line and surface, and curves provided with proper easements, 10 degree curves are no more disagreeable to ride over at speed of 30 miles per hour than are 3 degree curves at 60 miles per hour.

The reduction in speed for one mile from 50 to 30 miles per hour only means the loss of 0.8 minutes. To take an extreme case—the Twentieth Century Limited runs from New York to Chicago, 980 miles in 20 hours, or at an average of 49 miles per hour. The introduction of one hundred 10 degree curves each one of which required a slacking of speed to 30 miles per hour for a distance of one mile would increase the running time of such a train by one hour and twenty minutes. Such an increase on a road 1,000 miles long would in nine cases out of ten have no ill effect. A 10 degree curve so long as to require the reduction of speed to an average of 30 miles per hour for a mile would in practice be a very rare occurrence.

It is evident the use of curves as sharp as 10 degrees does not prohibit the employment of modern equipment or limit the haulage capacity of the locomotives. It has no effect on the speed of freight trains, or on passenger trains where the average speed including stops is not greater than 30 miles per hour. A few such curves only slightly affect the running time where speeds are high.

It is thus clear that a few curves not sharper than 10 degrees are not objectionable on the very best roads where their use results in large savings. As they are not limiting, the use of one such curve is no justification for a second. The introduction of many of them preventing the employment of high speeds for long distances would certainly be objectionable, but an occasional one where large savings result is justifiable on even the highest class of road.

Wooden trestles to replace heavy rock borrow embankments should be used. Such trestles may be designed to safely carry the heaviest class of equipment. When protected by the installation of the best available water supply they are quite safe, and are good for ten years. Such temporary construction also gives time to ascertain the correct requirements for water ways in new countries where there is frequently a dearth of information as to rainfall, flow of streams, &c., and where unless unduly large water ways are left there is danger of washouts. This danger may be even greater than the danger from fire to wooden trestles. Their use instead of heavy rock borrow embankments is of great importance from an economic point of view. One dollar at 5% compound interest amounts in ten years to $1.63. If rock borrow costs on the original construction say $1.75 per cubic yard it will in ten years time have amounted with interest to $2.85. While, under anything like ordinary conditions train hauled earth embankments on an operated road, made when the trestles require replacement, do not cost over 30 cents per cubic yard, or less than one-ninth of the total cost of a permanent rock embankment made during construction.

Momentum grades are a great source of saving in cost without increasing the operating expenses. The use of momentum in overcoming short stretches steeper than the ordinary ruling grade is almost always justifiable. The exception is where the traffic is so congested that the possibility of a delay due to the failure of an occasional train to surmount the grade is more important than the undoubted saving in interest charges which they insure. It will probably be many years before conditions prohibiting their use prevail on any portion of our Canadian railways.

The foregoing are a few of the more important considerations which the locating engineer should keep in view. He should always remember that railways are commercial enterprises, are built for profit, and that the investors are looking for and are entitled to satisfactory interest on their money; and so far as the returns on their investments depend on location they will for a given traffic be the greatest when the sum of the operating expenses and fixed charges is the least amount.

## A NEW STREET CLEANER.

A new idea in street sweeping by machinery has recently been introduced into England, having been used for some time previously in Milan, the inventor of the machine being an Italian. About the middle of December one of these machines was demonstrated before a number of municipal engineers and other officials from several English cities, picking up satisfactorily the customary assortment of sand, straw, small stones, etc., which are ordinarily scattered for tests of this kind. The machine is propelled and operated by a 20-30 h.p. 4-cylinder motor. Aside from the motor, it consists of a revolving broom carried between the fore and hind wheels, and a double dirt receiver which is carried behind the rear wheels. The revolving cylindrical broom has a diameter of 52½ inches, is 5 feet long, and is built up of twenty distinct small piassava brushes, each five feet in length, arranged along parallel elements of the cylindrical core of the brush.

The cylindrical broom revolves within a sheet iron shell in which it fits closely, at a speed of 120 revolutions per minute; which results in its not only raising the sweepings and carrying them two-thirds of a revolution and passing them through a specially contrived opening into the receivers behind, but the circumferential speed of the broom is said to create a sufficient suction in the cylinder to draw in all the dust and discharge it likewise into the receivers. It is also claimed that the velocity with which the broom revolves throws the refuse into the receivers with such force as to compress it and thus make the capacity of the receiver greater than if the dust merely settled in it.

The rear end of the compartment of the car which contains the two dust receivers is made in the shape of a large door hinged at the bottom which, when opened, forms an incline platform down which the filled boxes are rolled to the ground, each box being furnished with three small wheels or castors. The receivers or collecting boxes are of sheet iron and have a capacity of 50 cubic feet.

The total weight of the car with the receivers empty is 6,450 lbs. It is claimed that the cost per hundred thousand square feet of cleaning with this machine was $1.86, as compared with $11.18 with horse sweepers.

## Report of the Annual Meeting of the Canadian Society of Civil Engineers, held in Montreal, Jan. 28, 29, 30, 1913

# REPORT OF THE COMMITTEE ON CONSERVATION OF THE CANADIAN SOCIETY OF CIVIL ENGINEERS.

The field of conservation, so far as it affects the engineering profession, is so vast that it was deemed inexpedient to deal with more than one phase of it. At the last annual meeting a communication from Mr. Sauder was addressed to the Society and, later, referred to the Committee on Conservation. Mr. Sauder wrote:

"Whereas the water supplies, water powers, navigation of our "rivers, irrigation of our semi-arid lands, drainage of our over-flow "and swamp lands and the sanitary conditions of our streams and "their water sheds generally are a great asset.

"Whereas an accurate knowledge of a flow of water in nearly "all important streams is essential for the solution of many problems "in connection with navigation, water power, irrigation, domestic "and industrial water supplies, mining, bridge building, river channel "protection, flood prevention and storage for conservation of flood "waters.

"Whereas it is the opinion of the Society that the matter of the "topographical and hydrographic surveys to determine the location "and quantity of water supply and the proper methods of conserving "it should be undertaken by the Federal Government.

"Therefore be it resolved: That this Society, while recognizing "the work already done, urges strongly upon the Dominion Govern- "ment the importance of making the necessary appropriations and "providing the necessary staff to undertake in an intelligent and sys- "tematic manner, the gauging of all streams of water supply and the "location and survey of all sites suitable for reservoirs for the storage "of water."

This letter was referred to the members of the Committee and the concluding statements of the report embody the substance of the replies received from them. In view, however, of the importance of the subject it was deemed advisable to take this subject—Water Supply and its Conservation in Canada—as the special subject for this year's report.

When planning to develop a water power or a navigation channel, the first consideration is: What is the minimum flow? The speed of a squadron is the speed of the slowest vessel and, speaking generally, the minimum flow is a determining factor in a water-power or a navigation project. The minimum flow may often be increased by storage in reservoirs but the initial step is to determine its amount and the maximum period that it may be expected to continue.

In arriving at anything approaching a reliable estimate of the minimum flow of a stream, a series of continuous gaugings extending over a considerable period is absolutely necessary. George W. Rafter, in Water Supply Paper No. 80, published by the U.S. Geological Survey, says:

"Further, it can be stated that, for records from twenty years "to thirty-five years in length, the error may be expected to vary "from 3.25 per cent. down to 2 per cent., and that, for the shorter "periods of five, ten and fifteen years, the probable extreme devi- "ation from the mean would be 15 per cent., 8.25 per cent. and "4.75 per cent. respectively."

Rafter says, further, that with less complete records,

"Mr. Henry reached the conclusion that at least 35 to 40 years' "observations are required to obtain a result that will not depart "more than ± 5 per cent. from the true normal. The average vari- "ation of a 35-year period was found to be ± 5 per cent. and for a "40-year period ± 3 per cent."

From the foregoing, it is evident that unless the engineer is in a position to allow a margin on the safe side, he should have continuous gaugings extending over at least ten years. As an example of an erroneous estimate based on insufficient data, the Rainy River at Fort Frances may be cited. Three engineers, reporting separately, estimated the power at 30,800, 33,000 and 34,741 horse power respectively. In the summer of 1911, they were able to generate less than 11,000, and, to do this, it was necessary to keep the stop-logs in all day Sunday, thus stopping navigation. Had gaugings extending over, say ten years, been available, no such over-estimates would have been made and, had they included the very dry season of 1895, they would, probably, have shown as small a flow as in 1911.

Canada is particularly favoured as regards reservoir possibilities. The whole of the northern portion of the Dominion is occupied by a series of granitic rocks, which have a U-shaped form and surround Hudson Bay. This area has been called the Archaean nucleus and, considered in the large, it forms a great plateau. To quote the words of the late Dr. G. M. Dawson,

"It constitutes, moreover, a gathering ground for many large "and almost innumerable small rivers and streams, which, in the "sources of power they offer in their descent to the lower levels, are "likely to prove, in the near future, of greater and more permanent "value to the industries of the country than a great coal-field"

The foregoing was written sixteen years ago, and, with the tremendous strides in electrical engineering, is even truer to-day than then.

The most remarkable features of this Laurentian area are the innumerable lakes which serve as natural reservoirs to regulate the run-off and which can, in many cases, have their storage capacity increased by damming.

In considering the work of stream-gauging in Canada, the provinces have been dealt with in geographical order from East to West.

In the Maritime Provinces, the streams are small and very little gauging has been done except on the St. John River and some of its tributaries. The work on the St. John has been undertaken as a result of differences between Canada and the United States respecting the provisions of the Ashburton Treaty affecting this stream. The St. John above the Allagash and at Fort Kent, the Allagash, St. Francis, Fish, Madawaska and Aroostoock have been gauged. Measurements have also been taken on the St. Croix River which forms the Southern boundary between New Brunswick and Maine. So far as ascertainable, nothing has been done in the way of investigating sites for reservoirs except the reconnaissance surveys made by the Commission of Conservation in 1911.

In Quebec, the more important power companies keep records of the streams on which they are operating. Between lake St. Francis and Sorel, the Department of Public Works has at present nine gauges. Two of these gauges are of the self-recording type and four others of the same type will be in operation next summer.

The Department of Public Works has sixteen gauges on the Ottawa River, and also maintains gauges on its important tributaries. The Engineers of the Georgian Bay Ship Canal, appreciating the importance of stream measurements, made in their report the following recommendation:

"That it is of great importance to continue every year the flow "measurement of the Ottawa, Mattawa and French Rivers, at low, "ordinary and high water stage, in order to have continuous records "of same, which will prove invaluable in the further development "of the canal problem, in case of construction, and a better knowledge "of the water-power possibilities."

On the Richelieu River, the depths on the lock sills of the Chambly canal, at St. Johns, have been recorded daily since 1869 and the level of lake Champlain has been noted daily at Fort Montgomery, N.Y. since 1871. At Montreal, the depths of water on the lower lock sill of the Lachine canal have been measured at noon each day since 1851.

The Province of Quebec has appointed a Commission with the Hon. S. N. Parent, as Chairman. They have recommended the construction of a large dam on the upper waters of the St. Maurice to regulate the flow and have three parties in the field making topographical and hydrographic surveys of various rivers in the Province.

On the St. Lawrence above Montreal the depths on the lock sills have been recorded since 1860. These, therefore, give an excellent series of gauge readings for the river at lake St. Louis, lake St. Francis, Long Sault rapids, Farrans Point, Morrisburg and Cardinal. Similarly, the canal records at Ste. Anne, Carillon and Grenville determine the regimen of the Ottawa since 1870, while the lock depths at Ottawa extend back to 1844. For lakes Superior, Huron and Erie, the records cover the period since 1860, while the Toronto gauge records of lake Ontario extend back to 1854.

In the western portion of Ontario the Departments of the Interior and Public Works have established one gauge on Rainy Lake and five on Rainy River. Next summer five of them will be replaced by self-reading gauges. In connection with the investigation of the water-levels of the Lake of the Woods, the International Joint Commission will establish others on the upper waters of the Rainy River.

So far as work by provincial governments is concerned, Ontario is much the most advanced. Its Hydro-Electric Power Commission has established gauging stations on a great many of the streams of the province and is carrying on the work of stream-gauging in a thorough and systematic manner; possibly the only improvement in this connection would be the establishment of additional stations until all the streams of importance are included in the work.

The powers conferred upon the Commission in this connection may be described as follows:

"It is duly authorized to investigate and report to the Lieutenant-Governor-in-Council upon any and all hydraulic, hydro-electric and other power undertakings, whether developed or undeveloped, throughout the Province."

In connection with the waterpowers of the Winnipeg River, the Water Powers Branch of the Department of the Interior has investigated the water resources of the Lake of the Woods drainage basin. In conjunction with the Department of Public Works, gauging stations have been established on Rainy River and certain important streams falling into Rainy Lake and a study has been made of the outflow from the Lake of the Woods.

While in the Maritime Provinces, Quebec, Ontario and British Columbia, except the Railway Belt and Peace River Block, the water powers are disposed of and are under provincial jurisdiction, in the Prairie Provinces, Manitoba, Saskatchewan and Alberta, they are under the control of the Dominion Government. This right was reserved when the provinces were created with a view of better conserving their waters as a whole and for this purpose a large forest area on the eastern slope of the Rocky Mountains has, recently, been segregated by the Dominion.

In Manitoba, the Water Powers Branch of the Department of the Interior has established stations on the more important rivers where information is required in connection with waterpowers, drainage, navigation, etc. The work is being gradually extended over the whole province to meet the economic conditions.

The Dominion Government has, for some time past, made investigations of the flow of streams in the latter provinces and, although these investigations were more particularly for irrigation purposes, they also have an indirect bearing on waterpowers. The following is an extract from one of the reports on this work:

"The records of stream flow published by the Irrigation Surveys give a fair approximation of the discharge of the principal streams in Southern Alberta and Saskatchewan at the different stages, but do not give the duration of the periods of high and flood discharge. As the water supply in some of the larger streams is apparently almost all recorded, the necessity of carrying on a systematic observance of daily discharge is evident.

"The chief features of the hydrographic work are the collection of data relating to the flow of the surface waters and the conditions affecting this flow. Information is also collected concerning the river profiles, duration and magnitude of floods, waterpower, etc., which may be of use in hydrographic studies."

"In organizing the Hydrographic Surveys it was realized that with the funds available, it would be impossible to make complete investigations of the whole of the water supply in the irrigation tract, but an effort was made to include all the more important streams. Gauging stations had already been established, by the Irrigation Surveys, on a number of the more important streams, and it was important that the observations at these should be continued without interruption. There were, however, many streams of considerable importance upon which there were no gauging stations. It therefore became the policy of the survey to continue the investigations at the stations already established and to establish other stations as soon as possible."

Unfortunately, as the work is being pursued in connection with irrigation, it does not include any figures for the winter season, which additional data would be of great value from a waterpower standpoint; this is recognized in the following quotation also from the report above cited:

"On streams where power is likely to be developed, special attention should be given to the low water flow, which in most cases occurs during the winter. For this reason it is very important that stream measurements should be continued during the winter on a number of the more important streams."

In British Columbia, the Water Powers Branch has a permanent organization known as the Railway Belt Survey. Gauging stations have been established on the important water-power rivers in the Railway Belt and special attention has been given to the streams in the so-called "Dry Belt."

During 1911 and 1912, the Commission of Conservation made reconnaissance surveys of water-powers in southern and central British Columbia and this work will be continued. In 1912, the Department of Lands of British Columbia, recognising the value of this work, appropriated nearly $2,500.00 in addition to the amount expended by the Commission of Conservation and will, this year, make a grant of $5,000.00. This work, however, is only in the nature of a reconnaissance and, wherever the development of the country indicates that the water will be economically usable, it should be followed up by such measurements as the Water Powers Branch of the Department of the Interior is now carrying on.

The great importance of systematic stream gauging in Canada cannot be over estimated. On the information furnished by the Government will depend to a great extent the development of water-power. Very often, before designing a development, the hydraulic engineer has to spend a year or more in making observations which in many cases are practically useless, because they do not cover a sufficiently long period, and the result is that the possible development is either much over-estimated or, in other cases, much under-estimated.

Although most of the waters of Canada are under provincial control, this matter of stream gauging is not only important to the different provinces but it is of national importance, and the Federal authorities should undertake the gauging of Interprovincial and International rivers to collect this all-important data in a systematic and uniform manner.

The Provincial Governments could make a beginning by devoting their attention altogether to the establishment of stations where the water levels only would be read, leaving, if necessary, for future years the systematic observations required to convert these water heights to discharges. It was in this manner that it has been possible to calculate the different discharges of the Ottawa River since 1844; water-levels only had been kept since that date by the lockmasters of the canal at Ottawa and it was only comparatively recently that observations were taken to convert these water-levels into actual discharges.

For the present, of course, it would be out of the question to have these stations on all of our streams, but a start might be made on the more accessible ones or those on which storage and conservation will become a necessity or a natural outcome at some future date. At present, there are very few streams in Canada on which artificial storage or conservation is being practised, because it has not yet become commercially economical or necessary to do so. When the power possibilities of a stream under natural flow have been exhausted at one site, other sites, nearby, on the same or other streams have been found and developed, this requiring less outlay per h.p. than would have been required to conserve the flow of the stream. But this cannot go on forever, and a time will come when the last site within an economical radius will have been secured and the conservation of the stream will have to be resorted to in order to satisfy the increasing demand for power. When this time comes, in order to develop a conservation scheme on any stream intelligently, it will be necessary to possess a complete history of the flow of the stream under consideration for a period of at least from ten to fifteen years previous, and, unless a beginning is made now on the history of flow of some of these streams, when the time comes to conserve them the data at

## Report of the Annual Meeting of the Canadian Society of Civil Engineers, held in Montreal, Jan. 28, 29, 30, 1913

hand will be found very meagre and the conservation scheme will have to be designed in a more or less haphazard manner.

With federal co-operation, the system now practised in Ontario could probably be continued and extended to comprise other streams and establish new stations more rapidly.

In Quebec and the Maritime provinces, much data on this subject could no doubt, first of all, be collected from private parties or large hydraulic plants where records of river heights have been kept, and a system similar to that of Ontario or a modification to suit local conditions could be started at once and the returns from the different stations throughout Canada sent to their provincial authorities as well as to Ottawa, where they could be tabulated in a uniform manner and printed for easy access to the public.

Other countries with less water-power possibilities than Canada have devoted a great deal of attention to systematic observation of stream flow, namely: Italy, Switzerland, Bavaria, France and other European countries. In the United States, the Geological Survey has, for years, devoted a great deal of attention to the subject of stream measurement and has developed an excellent system, both of carrying out the work in the field and of reporting and tabulating the data obtained.

In Canada, one of the greatest difficulties to be overcome in connection with this work is the taking of observations during the winter season, as practically all our streams are then frozen over. These difficulties, however, can be overcome and they are always more than balanced by the importance of obtaining complete and reliable data during the very time when the rivers are in this condition.

In a report on "Stream Flow during the Frozen Season," Messrs. H. K. Barrows and R. E. Horton of the U.S. Geological Survey say in part—"There is not even an approximate relation between the snow-fall and the stream flow, so that the failure to obtain winter records of flow at a gauging station means a considerable percentage of uncertainty as to the total run-off as well as its distribution. In the Northern states droughts are apt to occur in the late summer or fall and during the winter. At times this condition of drought may be nearly or quite continuous between these two periods, with its culmination in January or February. If there is no melting of snow during the winter, the inflow to streams that freeze is chiefly derived from springs, ground water, and lake storage and in a long, cold winter, especially if it succeeds a period of low water, the minimum flow for the year may be reached and continue for some time. Estimates of flow, therefore, to be of conclusive value on streams utilized for water-power, must embrace these winter periods of low water."

It is needless to add that the winter conditions which occur in Northern United States rivers are found even in a more marked degree in Canadian rivers, and it follows that the statement just quoted applies with a proportionately greater force to Canada.

Summing up, the Committee on Conservation is of the opinion that, while the work recommended by Mr. Sauder, viz., topographical and hydrographical surveys to determine the situation and quantity of water supply, should be undertaken by the Dominion Government, and is of great importance, it is probable that the Government is, at the present time, carrying on more extensive and detailed investigations of this nature than is generally appreciated. That, while a certain amount of concentration to avoid duplication and overlapping of work is necessary, the scale upon which the work has been initiated indicates that the needs of the country in this respect will be met.

That the work already done is of great value but that much of it is not, in its present form, available to the engineers and

That steps should be taken to secure such publication and distribution of this information as will bring it within the reach of each and every engineer in Canada.

COMMITTEE—

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

JAMES WHITE
Chairman

# REPORT ON THE VISIT OF MEMBERS OF THE INTERNATIONAL CONGRESS OF NAVIGATION TO CANADA IN JUNE, 1912.

On March 6th, 1912, Col. W. P. Anderson, Chief Engineer of the Department of Marine and Fisheries, acting for the Department, addressed the Council of the Society to the effect that the members of the International Congress of Navigation had been invited by the Canadian Government to visit Canada on the conclusion of the sessions of the Congress to be held in Philadelphia in May, 1912. Col. Anderson intimated that the Dominion Government had voted $20,000 to provide for the expenses of the delegates and that of this sum $5,000 would be required for the necessary official publications, the remaining $15,000 being available for transportation and incidental charges. He also stated that Major G. W. Stephens, Chairman of the Montreal Harbour Commission, who had been officially nominated by the Government to represent Canada at the Congress, had recommended that the Canadian Society of Civil Engineers should be invited to organize the proposed visit to Canada, and asked if the Council would be willing to undertake the work of outlining a programme and make the necessary arrangements for carrying out the excursion.

At a meeting held on March 9th the Council acquiesced in the proposal and appointed a Committee consisting of Messrs. H. Holgate and H. H. Vaughan, Vice-Presidents of the Society; Mr. Ernest Marceau, Past President; Messrs. C. N. Monsarrat, J. N. Shanly, W. J. Stewart and P. E. Parent, Members of Council; Mr. A. St. Laurent, Department of Public Works, Ottawa; and Professor C. H. McLeod, Secretary of the Society, to confer with Major Stephens and report. This Committee met Major Stephens, and as a result of various conferences with him and with the Department of Marine and Fisheries through Col. Anderson, the following programme was outlined and received the approval of the Council of the Society and of the Department of Marine and Fisheries on behalf of the Government of Canada. It was understood that the Society, represented by its Council and special Committee, would act for the Government in receiving the foreign guests and conducting them to the various places named and works of engineering and commercial interest of the Dominion. It was further arranged that in addition to the central Committee of the Council above mentioned, the Society's Branches at Toronto and Ottawa should be asked to formulate the programmes in these cities and be responsible for the completion of the same. In Ottawa the departmental officials were to take in hand, especially, the organization of the banquet to be tendered to the delegates by the Dominion Cabinet.

## CANADIAN EXCURSION

June 12th P.M.—Leave Sault Ste. Marie.

June 13th A.M.—Arrive Port McNicoll.
The terminal facilities of this Port will be inspected and a special train will convey the party to Toronto.
P.M.—Arrive Toronto.
The afternoon will be spent in sight-seeing.

June 14th A.M.—A short excursion on the Lake and Harbour.
The Toronto programme will be in charge of a local Committee of the Toronto Branch of the Canadian Society of Civil Engineers.
P.M.—Leave Toronto (by steamer).

June 15th A.M.—Arrive Prescott.
Before reaching Prescott (about 10 A.M.) the Thousand Islands of the St. Lawrence River will have been passed through.
A.M.—Leave Prescott.
P.M.—Arrive Ottawa.
The arrangements at Ottawa will be in charge of a Committee of the Ottawa Branch of the Canadian Society of Civil Engineers. A very interesting programme has been prepared, including a banquet to the gentlemen of the party by the Dominion Cabinet, and some special entertainment for the ladies.

June 16th A.M.—Leave Ottawa (by train).
A.M.—Leave Coteau Landing (by boat).
P.M.—Arrive Montreal.
On this trip the lower lock of the Soulanges Canal will be inspected.
June 17th —At Montreal—Inspection of Harbour and tour of City.
June 18th A.M.—Leave Montreal by Government Steamer.
P.M.—Arrive Quebec.

The Council at a subsequent meeting appointed Professor McLeod as the representative of the Society to the Congress in Philadelphia, in order chiefly that he might have an opportunity of ascertaining the names and becoming acquainted with those members who desired to visit Canada and of organising the various features of the excursion in Canada.

Immediately on the adoption of the programme, transportation arrangements were made with the C. P. Ry. Co., the R. & O. Navigation Company and the G. T. Ry. and with the Department of Marine and Fisheries for the use of a special steamer from Montreal to Quebec, and the necessary hotel accommodation was reserved at Toronto, Ottawa, Montreal and Quebec. The following is the list of those who registered at Philadelphia for the Canadian Excursion.

REPRESENTING THE ARGENTINE REPUBLIC

Mr. Figueroa, O., Civil Engineer, London, Government Delegate.

REPRESENTING BELGIUM

Mr. Vander Vin, H., Chief Engineer of Bridges and Roads, Antwerp, Government Delegate.
Mr. Bogaert, M., Engineer, Brussels.
Mr. Bonnel, J., Builder, Brussels.
Mr. Bosquet, Albert, Brussels.
Mr. Bosquet, J., Brussels.
Mr. Cleuren, G., Brussels.
Mr. Colin, E., Brussels.
Mr. Colin, E., Jr., Brussels.
Mr. de Beukelaer, F., Merchant, Brussels.
Mr. de Koninck, L., Brussels.
Mr. Delbove, L., Brussels.
Mr. de Meulenaere, O., Brussels.
Mr. Dillies, C., Manufacturer, Brussels.
Mr. Fichelin, G., Brussels.
Mr. Medaets, A., Contractor of Public Works, Brussels.
Mr. Mertens, Chas., Clerk of Bridges, etc., Brussels.
Mr. Piron, Expert, Brussels.
Mr. Van der Houte, J. F., Contractor.
Mr. Vandeuren, J., Contractor, Brussels.
Mr. Verganwen, Brussels.

REPRESENTING BRAZIL

Dr. M. E. de Souza Bandeira, Government Delegate.
Miss Marie de Souza Bandeira.

REPRESENTING CANADA

Lt.-Col. Anderson, W. P., Chief Engineer, Dept. of Marine, Ottawa, Government Delegate.
Mr. Lamb, H. J., Engineer of Public Works, Windsor, Government Delegate.
Mr. McLeod, C. H., Professor, Montreal, Corporation Delegate.
Mr. de Bray, Dr. of Science, Montreal.
Mrs. Anderson, Ottawa.
Mrs. de Bray, Montreal.

REPRESENTING CUBA

Mr. Guastella, S., Chief Engineer, Havana, Corporation Delegate.

REPRESENTING DENMARK

Mr. Hummel, C. M., Chief Marine Engineer, Copenhagen, Government Delegate.
Mr. Schonweller, G., Prof. i. Wasserbau, Copenhagen.

REPRESENTING EGYPT

Mr. d'Epantchine, N., Engineer, Cairo.

REPRESENTING FRANCE.

Mr. Charguerand, State Councillor, General Inspector of Bridges and Roads, Paris, Government Delegate.
Mr. de Joly, G., Chief Engineer of Bridges and Roads, Paris, Government Delegate.
Mr. Barrillon, P., Engineer of Bridges and Roads, Bordeaux, Government Delegate.
Mr. Bouvaist, General Inspector of Bridges and Roads, Government Delegate.
Mr. de Pulligny, Chief Engineer of Bridges and Roads, New York, U.S., Government Delegate.
Mr. Voisin, J., Chief Engineer of Bridges and Roads, Boulogne sur Mer, Government Delegate.
Mr. Batard-Razeliere, A., Chief Engineer of Bridges and Roads, Marseilles, Government Delegate.
Mr. Ducrocq, Chief Engineer of Bridges and Roads, Le Havre, Government Delegate.
Mr. Dreyfus, S., Chief Engineer of Bridges and Roads, Paris, Government Delegate.
Mr. Le Trocquer, Engineer of Bridges and Roads, Paris, Government Delegate.
Mr. Perrier, L. C., Chief Engineer of Bridges and Roads, Ismailia, Egypt, Government Delegate.
Mr. Farjon. F., President, Chamber of Commerce, Boulogne sur Mer, Government Delegate.
Mr. Brancher, A., Engineer, Paris.
Mr. Narcy, P. J., Notary, Le Havre.
Mrs. Voisin, Boulogne sur Mer.

REPRESENTING GERMANY

Dr. Freiherr von Coels von der Brugghen, Under Secretary of State, Public Works Dept., Berlin, Government Delegate.
Mr. Lusensky, F., Ministerial Director for Trade and Commerce, Berlin, Government Delegate.
Mr. Tincauzer, E., "Geheimer Oberbaurat," Public Works Dept., Berlin, Government Delegate.
Mr. Thoholte, R., "Geheimer Baurat," Dept. of Lands and Forests, Berlin, Government Delegate.
Mr. de Thierry, G., "Geheimer Baurat" and Professor, Berlin, Government Delegate.
Mr. Hedde, P., Kais. Marine Architect, Berlin, Government Delegate.
Mr. von Haag, Ph., Ministerial Director, Dept. of the Interior, Stuttgart, Government Delegate.
Mr. Ehlers, P., Member of Board of Works and Professor, Danzig, Government Delegate.
Mr. Schulze, F. W. O., Professor, Danzig, Government Delegate.
Mr. Wulle, K., Government Architect, Dirschau, Government Delegate.
Mr. Frentzen, K., Government Architect, Dorsten (Lippe), Government Delegate.
Mr. Gugenham, M., "Oberbaurat," Stuttgart, Government Delegate.
Mr. Mayburg, Government Architect, Dusseldorf, Government Delegate.
Mr Apelt, President, Chamber of Commerce, Bremen, Corporation Delegate.
Mr. Hoffmann, A., Editor, Leipzig, Corporation Delegate.

## Report of the Annual Meeting of the Canadian Society of Civil Engineers, held in Montreal, Jan. 28, 29, 30, 1913

Mr. Schmidt, G. H., Harbour Director, Dortmund, Corporation Delegate.
Mr. Brinzinger, A., Architect, Esslingen.
Mr. Bueren, H., Merchant, Munster.
Mr. Ebelt, O., Government Architect, Essen-Ruhr.
Mr. Heiser, B., Government Architect, Pillau-Konigsberg.
Mr. Jungel, J., Government Assessor, Stuttgart.
Mr. Landsberg, G., Government Architect, Berlin
Mr. Lehmann, F., Member Municipal Board of Works, Osnabruck.
Mr. Lisse, L., "K. Bergassessor," Charlottenburg.
Mr. Lobbecke, E., Doctor of Law, Hildesheim.
Mr. Meck, B., Manufacturer, Nurnberg.
Mr. Schinkel, M., Government Architect, Kiel.
Mr. Speer, T., Assessor, Heilbronn.
Dr. Zimmerman, E. W., New York.
Mrs. Else Landsberg, Berlin.
Mrs. Schmidt, G., Dortmund.
Mrs. Thoholte, Berlin-Steglitz.

REPRESENTING GREAT BRITAIN

Lt.-Col. Yorke, H. A., R.E., C.B., London.
Mrs. H. A. Yorke, London.

REPRESENTING HUNGARY

Mr. de Kohanyi, Z., Chief Marine Inspector, Budapest, Government Delegate.
Mr. Posa, Chas., Technical Adviser, Budapest, Government Delegate.
Mr. de Szabo, N., Chief Engineer, Budapest, Government Delegate.

REPRESENTING ITALY

Mr. Sandjust di Teulada, E., Chief Civil Eng. Inspector, Rome, Government Delegate.
Mr. Luiggi, L., Chief Civil Eng. Inspector, Rome, Government Delegate.
Mr. Valentini, C., Chief Civil Engineer, Bologna, Government Delegate.
Mr. Dondonna, Ph.. Naval Captain, Pittsburgh, U.S., Government Delegate.
Mr. Brunati, P., Engineer, Milan.
Mr. Castiglioni, C., Engineer, Milan.
Mr. de Chantal, E., Engineer, Venice.
Mr. Fontana, P., Engineer, Milan.
Mr. Gullini, A., Engineer, Rome.
Mr. Pain, A., Engineer, Venice.
Mr. Rava, G., Engineer, Venice.
Mr. Allegri, M., Army Doctor, Venice, Corporation Delegate.
Mr. Vianello, F., Naval Captain, Venice.
Mrs. Allegri, Venice.

REPRESENTING MEXICO

Mr. Mateos, J., Mexican Consul, Port Arthur, Texas, Government Delegate.

REPRESENTING NORWAY

Mr. Kristensen, I., Director of Maritime Works, Kristiania, Government Delegate.
Mr. Johnsen, J. P., Kristiania.

REPRESENTING ROUMANIA

Mr. Botez, E., Naval Captain, Soulina.

REPRESENTING RUSSIA

Mr. de Timonoff, V. E., Engr., State Councillor, St. Petersburg, Government Delegate.
Mr. de Hoerschelmann, E. F., Engr., State Councillor, Tsarskoie Selo, Government Delegate.
Mr. Merczyng, C. K., Engr., State Councillor, St. Petersburg, Government Delegate.
Mr. Tsionglinsky, M. F., Engr., State Councillor, St. Petersburg, Government Delegate.
Mr. de Rummel, L., State Councillor, Reval, Government Delegate.
Mr. Olkhine, A. S., State Councillor, Director of Commerce, Government Delegate.
Mr. Ivanovsky, A. V., Engineer, Government Delegate.
Mr. Bakhmetief, J. A., State Councillor, Government Delegate.
Mr. Rojdestvensky, A. K., Engineer, Government Delegate.
Mr. Chovgenoff, Court Councillor, Government Delegate.
Mr. Kortschynsky, Engineer, Moscow.
Mr. Laknisky, V. E., Engineer, St. Petersburg.
Mr. Martinowsky, M., Engineer, Cherson.
Mr. Schmakoff, W., Moscow.
Mr. Zwetaieff, Moscow.
Miss Kortschynsky, Moscow.

REPRESENTING SWITZERLAND

Mr. Hilgard, K. S., Prof. Consulting Engineer, Zurich, Corporation Delegate.

REPRESENTING THE UNITED STATES

Lt.-Col. Sanford, J. C., Corps of Engineers, Philadelphia, Government Delegate.
Col. White, H. K., U.S. Marine Corps, Southport.
Mrs. J. C. Sanford, Philadelphia.
Mrs. H. K. White, Southport.

The meetings of Congress were concluded on May 28th, and a large number of the delegates made a trip to Washington, Pittsburg and other Southern points and returning, one party by way of Hudson River, the other through Cape Cod and Boston, united at Albany whence an excursion was made along the line of the New York State barge canal with stops at Syracuse and Buffalo. At Buffalo, the party, numbering about three hundred, embarked on the steamer "Northland" and visited Cleveland, Detroit and Sault Ste. Marie. At Sault Ste. Marie the Canadian party separated from the other excursionists and began the trip in accordance with the above programme.

The following members of the Canadian Society of Civil Engineers welcomed and took charge of the foreign visitors:—Col. Anderson, Past President of the Society; Dr. J. Galbraith, Past President of the Society; Mr. J. Morkill, Member of Council; Mr. H. J. Lamb, Member; and Mr. C. H. McLeod, Secretary. On account of various unforeseen causes several of the gentlemen, who had booked passage at Philadelphia, were unable to make the Canadian excursion, and it was especially regretted that amongst these was Professor de Timonoff, the President of the Congress. Some time was spent at Sault Ste. Marie examining the locks and shipping facilities on the American and Canadian sides, and the voyage down the Lake and Georgian Bay commenced at 3 P.M., Wednesday, June 12th.

Messrs. J. G. Sing and T. R. Loudon, representing the Toronto Branch of the Canadian Society of Civil Engineers, came to Port McNicol for the purpose of distributing hotel assignments and making other arrangements with the managers of the Excursion. At Toronto the party was welcomed by the Committee of the Toronto Branch of the Society named below, and under their direction the following local programme was carried out in a most successful manner.

TORONTO COMMITTEE

Chairman—T. C. Irving, Jr.
Secretary—T. R. Loudon
G. G. Powell
H. E. T. Haultain

## Report of the Annual Meeting of the Canadian Society of Civil Engineers, held in Montreal, Jan. 28, 29, 30, 1913

J. Galbraith
E. T. J. Brandon
Parker Kemble
F. F. Longley
Allan Garrow
E. L. Cousins
J. G. Sing

The special thanks of the Society are also due to the Mayor of Toronto Mr. Reginald Geary, to Commodore Aemilius Jarvis of the R.C.Y. Club, and to Mr. L. H. Clarke, Chairman of the Harbour Commissioners. The following gentlemen also contributed in a wholehearted manner toward the success of the visit to Toronto:—Messrs. E. L. Cousins, Engineer of the Harbour Board; A. L. Lewis, Secretary of the Harbour Board; J. C. Eaton, whose magnificent yacht was put at the disposal of the visitors; Alderman Alf. Maguire, who was associated with the Mayor in representing the City; Lt.-Col. J. B. Miller, Mr. Carl Allen of the R.C.Y. Club, and others for many courtesies. The ladies of the party were entertained under the direction of the following Committee:

Mrs. Galbraith
Mrs. Kemble
Mrs. Sing
Mrs. Cousins
Mrs. Loudon

TORONTO PROGRAMME

"Special train is due to arrive Toronto about 1.15. Party will detrain at North Parkdale station, and take special street cars waiting on Dufferin Street which will run direct to King Edward Hotel. Headquarters of the party will be King Edward Hotel.

Tickets will be found herewith showing room assigned to each member of the party. Please present these tickets at King Edward Office for keys.

Baggage will continue by train to Union Station and will be conveyed from there to the hotel. Each piece of baggage should have a tag attached showing room number of owner at King Edward Hotel.

Luncheon will be served at King Edward Hotel at 1.30 and ticket for same will be found herewith.

Through the courtesy of the Toronto Board of Harbour Commissioners, and the Commodore and Members of the Royal Canadian Yacht Club, the party will be tendered a trip around Toronto Island. The Royal Canadian Yacht Club's launch leaves the R.C.Y.C's. city station at the extreme end of the East side of Yonge Street dock at 2.45, 3.15 and 3.45, for the R.C.Y.C. Club House, Toronto Island, where the yachts will be boarded.

At 7 o'clock a Dinner will be tendered by the Harbour Commissioners and the Royal Canadian Yacht Club in the Club House, Toronto Island. Dress will be informal.

Friday, June 14th. A breakfast ticket will be found herewith.

At a quarter to ten, through the courtesy of the City Council and a number of Citizens of Toronto, automobiles will be placed at the disposal of the visitors for a ride around the city. The party will leave the King Edward Hotel sharp at 10 o'clock and will proceed to the City Hall, where His Worship, the Mayor, will receive the party in the Council Chamber, after which automobiles will be taken for a drive, visiting points of interest, including the Provincial Parliament Buildings and the University of Toronto. The drive will terminate at McConkey's where a luncheon will be tendered by the City Council.

Richelieu and Ontario Navigation Co's. boat leaves the East side of the foot of Yonge Street sharp at 2.30, and the members of the party should be on board not later than 2.15. All baggage should be ready not later than 12 o'clock noon and each piece should have a ticket showing the number of the owner's stateroom on the R. & O. boat."

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Passage was taken from Toronto at 2.30 p.m., on Friday, June 14th, on the S.S. Kingston. It was, unfortunately, necessary for several of the members, on account of their business arrangements and dates of sailing from New York to leave the party at Toronto. Those on board the steamer numbered in all 131. The party landed at Prescott early on Saturday morning, where they were met by Mr. D. MacPherson, Member of Council, representing the Ottawa Branch of the Society. At Ottawa the delegates were received by the following Committee, under whose direction the local programme outlined below was observed.

OTTAWA COMMITTEE

Chairman—S. J. Chapleau
Hon. Secy.-Treas.—H. V. Brayley,
Noulan Cauchon
R. de B. Corriveau
F. J. Delaute
John Murphy
R. F. Uniacke

The Ottawa banquet was given in the new and magnificent Chateau Laurier Hotel and was presided over by Mr. Hazen, Minister of Marine and Fisheries. The following Cabinet Ministers were also present, adding thereby eclat to the occasion.

Col. Hon. Sam Hughes, Minister of Militia and Defence.
Hon. C. J. Doherty, Minister of Justice.
Hon. Martin Burrell, Minister of Agriculture.
Hon. F. D. Monk, Minister of Public Works.
Hon. T. W. Crothers, Minister of Labour.
Hon. G. H. Perley, Minister without portfolio.
Hon. J. A. Lougheed, Minister without portfolio.

OTTAWA PROGRAMME

"The visiting members will arrive at the Central Station at noon. They will be met by representatives of the Ottawa Branch, Canadian Society of Civil Engineers.

Informal Lunch will be served at the Chateau Laurier.

During the afternoon, automobiles will convey the party, accompanied by members and ladies of the Ottawa Branch, through picturesque Ottawa, and the following itinerary, so far as possible, will be followed:—

2.15 P.M.—Leave Chateau Laurier for Parliament Hill. Attention is directed to: (1) The Locks of the Rideau Canal, built in the year 1832, overcoming the 80 feet difference in levels between the Ottawa River and the Rideau Canal, (2) the Limestone face of Major Hill Park, along which the C.P.R. line approaches, (3) the Interprovincial Bridge crossing the Ottawa River and connecting the Provinces of Ontario and Quebec, (4) the City of Hull with (5) the Laurentian Hills in the background, (6) the Chaudiere Falls and (7) the Timber Slides.

2.30—3.00 P.M.—Thirty minutes will be devoted to an inspection of the Parliament Buildings, including the Parliamentary Library, the Senate Chamber and the House of Commons. The Corner Stone of these buildings was laid in 1860, by the Prince of Wales, who afterwards became King Edward VII., and the buildings were completed about 1866.

3.00—3.30 P.M.—From Parliament Hill a visit will be made to Rockcliffe Park, passing through Rideau Hall grounds, the official residence of His Royal Highness the Duke of Connaught, Governor-General of Canada.

3.30—4.10 P.M.—From Rockcliffe Park to the Dominion Government Experimental Farm via the Driveway.

4.10—4.40 P.M.—Inspection of the Dominion Government Experimental Farm and the Astronomical Observatory.

5.00—5.40 P.M.—From the Experimental Farm the drive will be continued to the Chaudiere Falls on the Ottawa River. Inspection of the Water Power Dam controlling 50,000 horse-power will be made, also the Hydraulic Power Plants, Electric Stations, Saw Mills, Pulp and Paper Mills.

## Report of the Annual Meeting of the Canadian Society of Civil Engineers, held in Montreal, Jan. 28, 29, 30, 1913

6.00 P.M.—The return trip will be through the City of Hull in the Province of Quebec, and over the Interprovincial Bridge. Attention is again directed to the view from the bridge of the Parliament Buildings, Chaudiere Falls and the lower Ottawa River.

In the evening at eight o'clock, the members of the International Congress of Navigation will be tendered a dinner at the Chateau Laurier by the Government of Canada. At the same hour the ladies, accompanying the members of the International Congress of Navigation, will be tendered a dinner at the Chateau Laurier by Mrs. R. L. Borden, and the wives of the Members of the Government of Canada."

Mrs. R. L. Borden very kindly received and presided over the entertainment of the ladies of the party in Ottawa.

A special steamer through the Coteau and Cedar rapids afforded opportunities for seeing the navigation of the rapids, and the party was enabled to inspect the lower portions of the Soulanges Canal.

At Montreal, which was reached on Sunday evening June 16th, the excursionists were met by a Committee of the Council of the Society and conducted to the Place Viger Hotel. The following local programme was observed in Montreal, and opportunities given for inspection of the city and especially of the shipping facilities of the harbour of Montreal were greatly appreciated by the visitors.

MONTREAL PROGRAMME

FOR MEN

9.00—10.30 A.M.—Drive on Mount Royal, to terminate at Wharf for Harbour Commissioners' excursion.

10.30 A.M.–1.00 P.M.—Excursion on Harbour. Landing to be made at Wharf adjacent to Place Viger Hotel. Lunch at Hotel privately.

3.00 P.M.—6.00 P.M.—(a) Visit to Angus Shops by street cars, or (b) Automobile drives to various points.

Provision will be made for persons who desire to visit the Universities or other places in which they are specially interested.

8.00 P.M.—Complimentary dinner by the Harbour Commissioners at Montreal Club, Dominion Express Building, St. James Street.

FOR LADIES

10.00 A.M.—Drive on Mountain.

1.00 P.M.—Luncheon by Ladies' Committee at Windsor Hotel.

3.00 P.M.—6.00 P.M.—Automobile drive. Dinner at Forest and Stream Club.

June 18th 9.00 A.M.—Board Government steamers Lady Grey and Sir Hugh Allan for Quebec."

The banquet by the Chairman and his associates of the Harbour Commission was an important occasion and these gentlemen deserve the heartiest congratulations and thanks for their assistance in entertaining the guests.

On Tuesday morning, the greater portion of the party, accompanied by a number of Montreal gentlemen and ladies, embarked on the Government steamer "Lady Grey" for the trip down the river. The remainder of the party took passage as the special guests of the Montreal Harbour Commissioners on the steamer "Sir Hugh Allan." The trip down the river was in every way a successful one and the party was safely landed at Quebec in the early evening and conducted to the Chateau Frontenac Hotel. On Wednesday an unofficial programme was observed in Quebec with the assistance of members of the Society resident there.

It was in a large measure owing to the very courteous and substantial assistance given by the Corporations and Associations named in the foregoing and to the efficient co-operation of the officers and members of this Society that the visit of this important body of gentlemen and ladies to Canada was so successfully carried out. The very liberal contributions made to the entertainment of our guests materially reduced the necessary expenditure on Government account and made it possible to carry out the enterprise within the amount of the grant.

On behalf of the Society,

C. H. McLEOD

Montreal August 1st, 1912

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The foregoing Report was transmitted to the Honourable Minister of Marine and Fisheries on November 1st last in accordance with instructions of the Council and was acknowledged as follows:—

Ottawa, November 5th, 1912

Sir,—

I have to acknowledge the receipt of your letter of the 1st instant, covering your very interesting report on the excursion of members of the twelfth International Congress of Navigation through Canada in June last.

From it, as well as from reports received from Col. Anderson, Government Delegate from the Department, I learn of the great assistance rendered to the Government by the Canadian Society of Civil Engineers, and I would now ask you to convey to the Council of the Society my sincere acknowledgment of and the thanks of the Government of Canada for the valuable services rendered gratuitously by your Society, by the several local branches, and by yourself as Secretary, and which contributed in so great a degree in making the Canadian excursion a very signal success.

Yours sincerely.

(Signed) J. D. Hazen.

Prof. C. H. McLeod,
Sec. Can. Soc. Civil Engineers,
Montreal, P.Q.

## SUBWAY AND BRIDGE COSTS.

A reinforced concrete highway bridge spanning two railway tracks, waterproofed, paved with vitrified brick and designed for a moving weight of 100 lbs. per square ft. of floor area, or a 10-ton road roller, can be built for $1.65 per sq. ft. of floor, including the spans, supports and ordinary foundations, according to a statement made by H. N. Rodenbaugh, assistant engineer, Southern Railway, Atlanta, Ga., in a paper read before the Engineering Association of the South. Such a structure is only slightly higher in first cost than the typical steel girder bridge of similar capacity with a wooden floor, which costs about $1.50 per sq. ft. of floor area complete. A very satisfactory wooden Howe truss bridge of modern design has been built by one railway at a total cost of $45 per sq. ft. of floor area, and as between the latter two structures, Mr. Rodenbaugh very much favors the wooden bridge. Commenting on shallow floors, which are very common in subway design, he states that a typical open floor—that is, one having ties resting on steel stringers without ballast—will have a depth from base of rail to under clearance of about 3 ft. 4 in., and will cost about $1.20 per sq. ft. of floor area. A transverse steel I-beam construction with ballasted deck on flat plates will have for the same span a depth of 3 ft. 1 in., and will cost about $1.90 per sq. ft. of floor area.

## NEW INTAKE PIPE, OTTAWA, ONT.

By L. McLaren Hunter.*

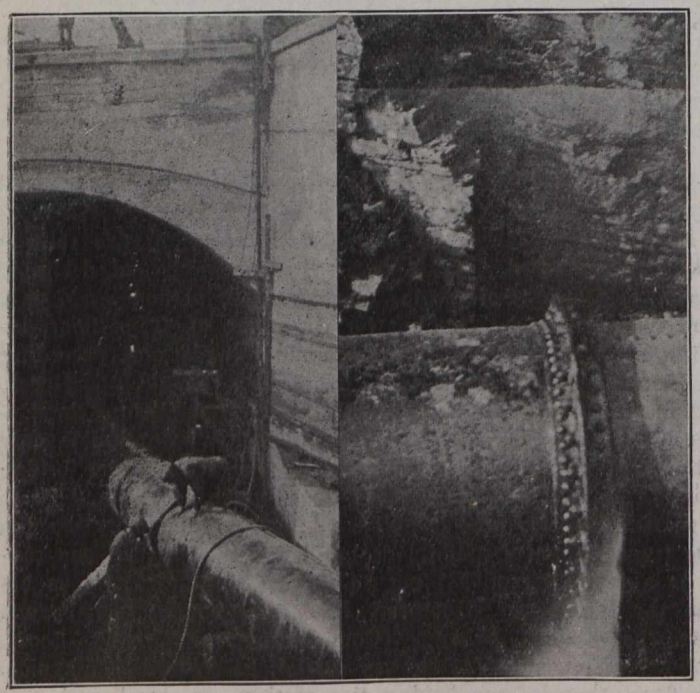
A new intake pipe was necessary to supply water to Ottawa, owing to the condition of the old pipe which, after the last typhoid epidemic, was investigated, thoroughly examined, and proved to be in a very leaky condition.

Tenders were called and the contract was awarded to Messrs. Laurin and Leitch, of Montreal, who contracted to finish the aqueduct section of the intake by December 1st, 1912. The council offered a bonus of $200 for every day that the pipe was completed before the specified day for completion, and a fine of $200 for every day over the specified date.

The new intake is a forty-two-inch lock-bar steel pipe, one-quarter inch thick, made by the East Jersey Pipe Company, of Paterson, New Jersey. The length of the intake is twenty-four hundred feet.

In connection with the pipe, three twelve-million Imperial gallons per day, electrically driven pumps of the Rees Roturbo type, and run by Canadian General Electric motors, were placed at Lemieux Island—the mouth of the intake. These pumps have a lift of twelve feet, thus throwing the whole line of the 42-inch steel pipe, supplying the city, under a head of water sufficient to insure the pressure being outwards all along the pipe line.

The pipe thus far has proved very satisfactory, and during the hydraulic test withstood the guaranteed pressure without a leak being noticed.



Pipe Entering Tunnel of Aqueduct.

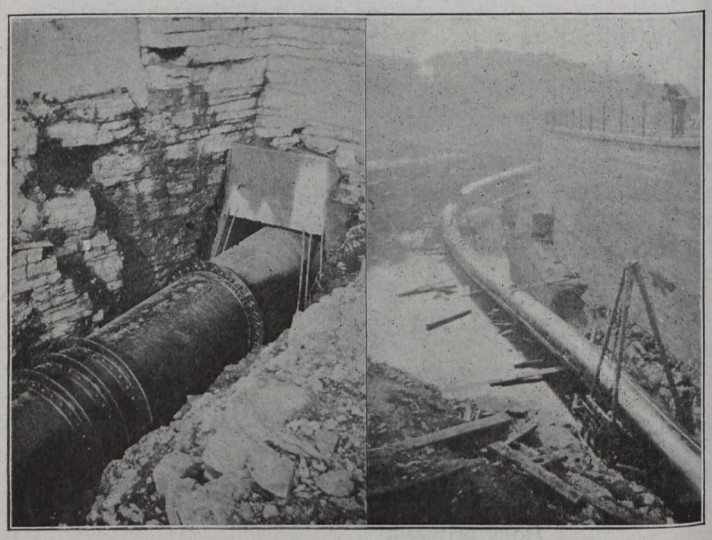
Detail Photograph of Joint Between Old and New Intake.

The construction of the pipe was in the charge of Mr. William Storrie, A.M.Inst.C.E., and was carried out in a very expeditious manner, the contract being let on October 2nd, 1912, and completed by November 21st. The city was being supplied with water through it on the 27th of the same month.

* Of the City Engineer's Department, Ottawa.

## TIN PLATE PRODUCTION AND CANADA.

During 1912 the United States have largely extended their exports, and Britain has been meeting their serious competition in neutral markets, such as Canada and Japan, state Messrs. Sims and Coventry, in their report on the tinplate market during 1912. British exports to the former country are considerably smaller than they were some years ago and so long as the American makers choose to supply the Canadians with tinplates regardless of whether it pays them or not they will no doubt secure the business. The Canadians are getting the benefit and the Americans seem satisfied with the "honor



Joining of the Old Intake and the New One.

New 42-inch Steel Pipe in Aqueduct.

and glory." At the time of writing there are no exact figures available as to the American output for the year, but as the American mills have been running much more fully during the year there is sure to be a considerable increase over 1911 and there is little doubt that their make will have exceeded that of Britain. In the last report a doubt was suggested as to the American foreign trade being on an economically sound basis.

Germany lays claim to having been the original home of the tinplate industry, having, so it is said, begun the manufacture in the fourteenth century. They are now turning out some 50/60,000 tons a year, the figures for three years at intervals of ten being:—

| | Tons. 1890. | Tons. 1900. | Tons. 1910. |
|---|---|---|---|
| German manufacture ..... | 21,300 | 30,705 | 57,136 |
| Imports into Germany ..... | 4,296 | 18,158 | 46,973 |

It will be noticed that the imports are increasing more quickly than the home production and a proposal for a considerable extension of the German manufacture has received powerful advocacy. At one time (in the nineties) the German makers supplied 96 per cent. of their home consumption, whereas in 1910 it was only 55 per cent. In 1907 it fell as low as 51 per cent. Now, the advocates of German extension look forward to making a bid for the export trade, and a number of new mills are already at work in Westphalia. The American manufacture has increased by rapid steps. In 1910 their output was 722,770 tons. British exports in that year of tinplates, tenneplate and blackplate for tinning were 538,870 tons, and if Britains export trade takes about two-thirds of British make, this would give 808,305 tons as Britains total ouptut for 1910. In 1911, the American make was 783,360 tons and on the same method of computation Britains was 816,630.

# The Canadian Engineer

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JAMES J. SALMOND, MANAGING DIRECTOR

T. H. HOGG, B.A.Sc., MANAGING EDITOR — A. E. JENNINGS, ADVERTISING MANAGER — P. G. CHERRY, B.A.Sc., CIRCULATION MANAGER

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## CONTENTS OF THIS ISSUE.



## A NATIONAL ENGINEERING SERVICE.

In these columns, in the issue of January 23rd, we published an editorial on "A National Engineering Service." In another part of the same issue were published two articles which had secured the prizes offered in the competition held under the auspices of the Royal Military College Club and the Canadian Society of Civil Engineers.

We inadvertently stated in that editorial that Mr. T. Chase Casgrain, chairman of the International Joint Commission, had offered the prizes for these essays on the formation of a National Engineering Service. Our attention has been drawn to the error by Mr. Casgrain.

Mr. Charles A. Magrath, and not Mr. Casgrain, was responsible for the offering of the prizes in this competition, and we are extremely sorry that the error should have occurred in our previous editorial. The fact that they are both members of the International Joint Commission was the reason for the mistake. The fact that Mr. Magrath has interested himself in the discussion of the formation of a National Engineering Service is sufficient to convince those who know him that some result will be achieved. As a member of the engineering profession in the past, his work has always been marked by accuracy and efficiency, and it is, no doubt, due to his intimate knowledge of the profession that he has appreciated more fully the necessity for a change in the method of administration of engineering service for the federal government. This move on the part of Mr. Magrath is but the forerunner of some plan of concentration and co-operation in the government service.

The matter was discussed at the annual meeting of the Canadian Society of Civil Engineers, held in Montreal last week, and, while no decision was arrived at, it is plain to see that the feeling of the members is strongly in favor of some such system as is outlined in the two essays by Evolu and Observer, printed in the issue of January 23rd.

We would again express our regret that Mr. Magrath was not given the credit for initiating this movement and that the error of ascribing it to another man occurred.

## LIABILITY OF CANADIAN RAILWAYS

During the year ended June 30th, 1912, $21,251,664 was added to the stock liability of Canadian railways and $38,996,661 on account of funded debt, representing a total addition of $60,248,325. That increase over the figures of 1911 brought the total capital liability of Canadian railroads up to $1,588,937,526. These figures in themselves are of interest, but more so because considerable railroad construction has yet to be undertaken in the Dominion. The railroad stocks last year totalled $770,459,351 and the funded debt $818,478,175, so that stocks and bonds are about equally divided. It is interesting also to examine the division of the funded debt. This is set forth in the excellent volume of railway statistics compiled by Mr. J. L. Payne, Comptroller of Statistics of the Department of Railways and Canals, at Ottawa. The figures are as follow:—

| Funded debt. | 1912. |
|---|---|
| Bonds ..... | $772,532,108 |
| Miscellaneous obligations ..... | 12,608,718 |
| Income bonds ..... | 17,119,466 |
| Equipment trust obligations .... | 16,217,883 |
| | $818,478,175 |

The constant call of the Canadian roads for new equipment is reflected in the equipment trust obligations for the past few years. The amount for 1910, 1911 and 1912 exceeded $42,000,000. The Grand Trunk Railway for the first time adopted this form of financing last year.

Mr. Payne calculates the capitalization per mile of our railways. If the total capital liability of $1,588,-937,526, as given above, be divided, he says, by the 26,727 miles of operating line shown on a preceding page, the result would be $59,454 per mile of line. It would be quite misleading, however, to make such a calculation. Neither the divisor nor the dividend is correct. The mileage, for example, includes Government owned and operated lines, to which no capital liability attaches. On the other hand, the capital figures embrace the liability of unfinished lines, such as the Grand Trunk Pacific, which do not appear in the mileage column. The deductions under this head amount to $134,321,020. Then there is considerable duplication. It has not been practicable to ascertain the exact amount thereof, created chiefly by the issue of stocks and bonds for the purchase or control of smaller roads by the larger, but it is known to be not less than $210,000,000. Joining these two sums, and subtracting the total from the $1,588,937,526 already indicated, the remainder is $1,244,616,506. For immediate statistical purposes that might be regarded as the proper capital liability of Canadian railways.

The elimination of Government owned lines, and such other lines as should not figure in the mileage column, reduces the total to 24,485. Using these factors, it will be seen that the capital liability of railways in Canada amounts to $50,832 per mile. This is a relatively low figure.

The net capitalization per mile of line in other countries is as follows:—

| Country. | Net capital per mile. |
|---|---|
| United States | $ 59,345 |
| United Kingdom | 275,166 |
| France | 94,933 |
| Germany | 111,737 |

The cost per mile of the government owned railways in Canada has varied considerably. The Intercolonial with 1,463 miles of line has a cost per mile of $64,761; the Temiskaming and Northern Ontario Railway, $58,-495; the Prince Edward Island, $32,296; and the New Brunswick Coal and Railway, $33,398.

The capital liability of Canadian railways has grown enormously in the past few decades. In 1876 railway stocks totalled $181,000,000 and the funded debt $76,-000,000, an aggregate of $257,000,000. In 1900 the stock indebtedness had expanded to $410,000,000 and funded debt to $373,000,000, a total of $784,000,000. In 1908 the funded debt for the first time exceeded the stocks, the figures being respectively $631,000,000 and $607,000,000, or a total sum of $1,238,000,000. Last year, as mentioned above, the stocks had reached $770,-000,000 and funded debt $818,000,000. The growth in stocks since 1876 has been $589,000,000, or 325.4 per cent.; in funded debt $742,000,000, or 976.3 per cent.; in total capital liability $1,331,000,000, or 517.9 per cent.

The relationship of dividends and net earnings to share capital have shown some interesting fluctuations during recent years. In 1907, the percentage of dividends paid to share capital was 2.17, and this percentage changed year by year as follows: 1908, 2.11 per cent.; 1909, 2.97; 1910, 3.16; 1911, 4.08; 1912, 4.04. The percentage of net earnings to share capital in 1907 was 7.30. In 1908 it declined to 6.51, and in the following year to 6.24. In 1910 it increased to 7.78 per cent.; next year it declined to 7.70 and last year rose to 8.91. Of the total dividends paid in 1912 amounting to $31,164,791; on common stock, $18,487,000 was paid; and $12,677,791 on preferred stock.

## LETTER TO THE EDITOR.

Sir,—We notice on page 901 of your issue for December 19th, 1912, that the Stereophagus Pump and Engineering Company, Limited, control the Canadian rights of the Hon. R. C. Parson's pump. Permit us to point out that this is liable to give a wrong impression, as we made the earliest pumps and hold the license for this pump in every part of the world. We are, therefore, in a position to supply to Canada.

Yours faithfully,

THE PULSOMETER ENGINEERING CO., Limited.

Reading, England, January 21st, 1913.

## MONTREAL'S BOARD OF TRADE

The annual meeting of the Montreal Board of Trade brought out some remarks by the retiring president, Mr. Robt. W. Reford, on a point of much economic interest and importance. He referred to the selling to industries on the other side of the international boundary line of power generated in Canada. He questioned whether it was wise to permit the export of power developed near Montreal as the growth of the city depended to such an extent upon cheap power. He also regretted the failure of the provincial government to appoint a hydro-electric commission for the purpose of fixing electric power rates. He asked the members of the board to consider whether the manufacturers were not paying too much for power by generating it by steam when a great heritage in water power lay at the very doors. He said that notwithstanding all the water power at the doors of the city the companies which had acquired he powers had been selling the power out at a price apparently governed by the cost of power when generated by coal.

Mr. Reford also referred to the high cost of living, saying that one of the factors was the permission enjoyed by the public utility companies to issue as much capital as they saw fit or as they had prospective power to pay dividends upon at the rate of five or six per cent. All this was increasing the cost of living. Cheap electrical power, cheap transportation and other public utility services would place the manufacturers in a better position to compete and to pay higher wages. After all the capitalizing and re-capitalizing had taken place, the stock eventually found its way into the hands of shareholders who would be the sufferers when the power to charge high rates was curbed. Meantime, the promoters were left to enjoy their illegitimate profits without any interference whatever.

The British Columbia Electric Railway Company plans the construction of additional repair and car-making shops in Burnaby municipality, in addition to the shops they already have at New Westminster. The shops will employ about 500 men.

The new line to Eburne over Oak Street is now in operation. This line runs directly south from Broadway to the Fraser River, Oak Street being five blocks east of Granville. The ultimate plan is to have a double track down Granville to Eburne, when a belt line will be run around Oak, Broadway, Granville and Eburne.

## THE MOUNT ROYAL TUNNEL OF THE CANADIAN NORTHERN RAILWAY.

Headings aggregating over a mile in length have already been driven for the Mount Royal Tunnel of the Canadian Northern Railway. A summary of the general scheme and the construction methods was given on page 812 of The Canadian Engineer for January 16, 1913, and the reader is requested to turn to that article, as the points brought out therein need not be repeated.

In view of the rapid progress made since Chief Engineer Brown prepared his excellent paper for the Canadian Railway Club, some photographs and additional notes regarding the work may be of interest.

Four headings are being driven simultaneously—one eastward from the West Portal, one westward from the Dorchester shaft, and one each way from the Maplewood shaft. All four are bottom centre headings. The headings have advanced approximately two thousand feet from the West Portal, sixteen hundred feet from the Dorchester shaft, and a thousand feet each way from the Maplewood shaft. A temporary heading has also been driven eastward from Dorchester shaft nearly to Lagauchetiere Street.

The approach to the West Portal is through a cut about a half mile in length and twenty feet deep at the portal. This cut is through the Model City and will be bridged at the street crossings. Just west of the portal it passes under the Canadian Pacific Railway tracks. Fig. 2, looking west through the site of the Model City, shows the steam shovel making the cut. Fig. 3 shows the West Portal. The compressor house, repair shop, etc., are in the background.

Fig. 4 is a photograph taken from a high cliff on the mountain showing the location of the Maplewood shaft, which is about a mile east of the West Portal and about two and a fifth miles west of the Dorchester shaft. This shaft is almost exactly at the centre of the photograph. The Maplewood shaft is 250 feet deep, the Dorchester shaft 55 feet deep.

**Fig. 2.—Steam Shovel Making the Cut at the West Portal**

Illustration No. 5 was obtained while the Dorchester shaft was being sunk. The Dorchester shaft is so named because it is immediately alongside of Dorchester Street, almost opposite the old headquarters of the Canadian Society of Civil Engineers. The Maplewood shaft is near Maplewood Avenue, Outremont.

The headings are 9 feet high by 12 feet wide at present. The full size section will be 20 feet high by 28½ feet wide. The work of enlarging to the full size is just being started. Average progress from the Dorchester shaft has been 12 feet a day, although there have been 20-foot days. No shooting is allowed between 11 p.m. and 6 a.m. At the west end, where shooting is allowed at night and stronger blasts possible without public annoyance, the average has been 20 feet per day.

Chief Engineer Brown says that the photograph from which illustration No. 1 was made is one of the best tunnel photographs that he has ever seen. It shows clearly the face of the heading with the four drills mounted on the horizontal bar. Immediately back of the point from which this photograph was obtained, is a large pile of muck from which the laborers shovel off slick sheets into low cars.

**Fig. 1.—Face of Leading, Showing Rock Drills Mounted on Horizontal Bar.**

Illustration No. 6 shows the cap and post system of timbering which is being used. In his paper before the Railway Club, Engineer Brown said: "The cap and post system is very similar to the segment system, except that the segments are not self-supporting. This system is used in very heavy ground and posts and rakers are used similar to those in the crown bar system. The crown bar system consists of bars (usually of wood) set up parallel to the axis of the tunnel and poling boards driven outside them, almost tangentially to the surface of the tunnel excavation. The crown bars are supported by posts and rakers, so arranged as to best suit the nature of the ground and the methods of excavation and lining.

"The segment timbering system—used in lighter ground—consists of a series of timbers cut in segments, approximately to fit the form of the tunnel cross-section, when set up in a plane vertical to the tunnel axis. The poling boards are driven outside the segments nearly parallel to the axis of the tunnel. The segment timbers are ordinarily self-supporting. This system is often used where only the roof is soft and the segments can be sprung directly from plates on the rock walls"

The Montreal tunnel will not likely require much timbering during construction and as the rock will likely be safe, much of the tunnel may be left permanently unlined. The character of the rock is principally limestone and volcanic in-

trusion. Up to the present time, the headings have gone through Essexite, Trenton limestone and dykes of trap rock, and the engineers expect to strike considerable Nepheline syenite. The engineers do not expect to find any faults in the rock. If they do, they will deal with the emergency as it arises. If they strike water in the headings going up, they will drain it out; if in the headings going down they will pump it out, for which purpose several pumps of the centrifugal type have been provided. They do not expect to strike much water, however.

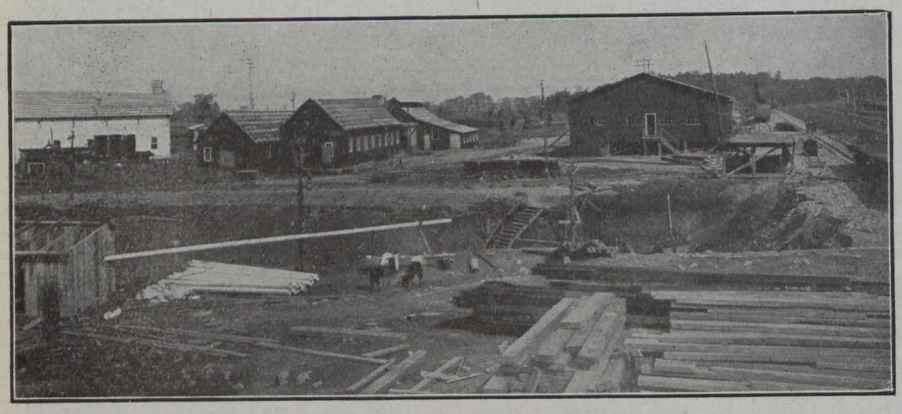


**Fig. 3.—Western Approach to the Tunnel.**

The tunnel will be lined with concrete. The cement gun method of depositing concrete through pipes with compressed air, like grout, is being investigated, and may be used.

The final designs for the tunnel are not yet decided upon, but it is likely that it will be a twin tube throughout, with a concrete centre wall to facilitate ventilation. In single tube tunnels, where the cross-section is small compared with the bulk of the trains, the piston action of the trains themselves gives excellent ventilation if the portals or openings are free.

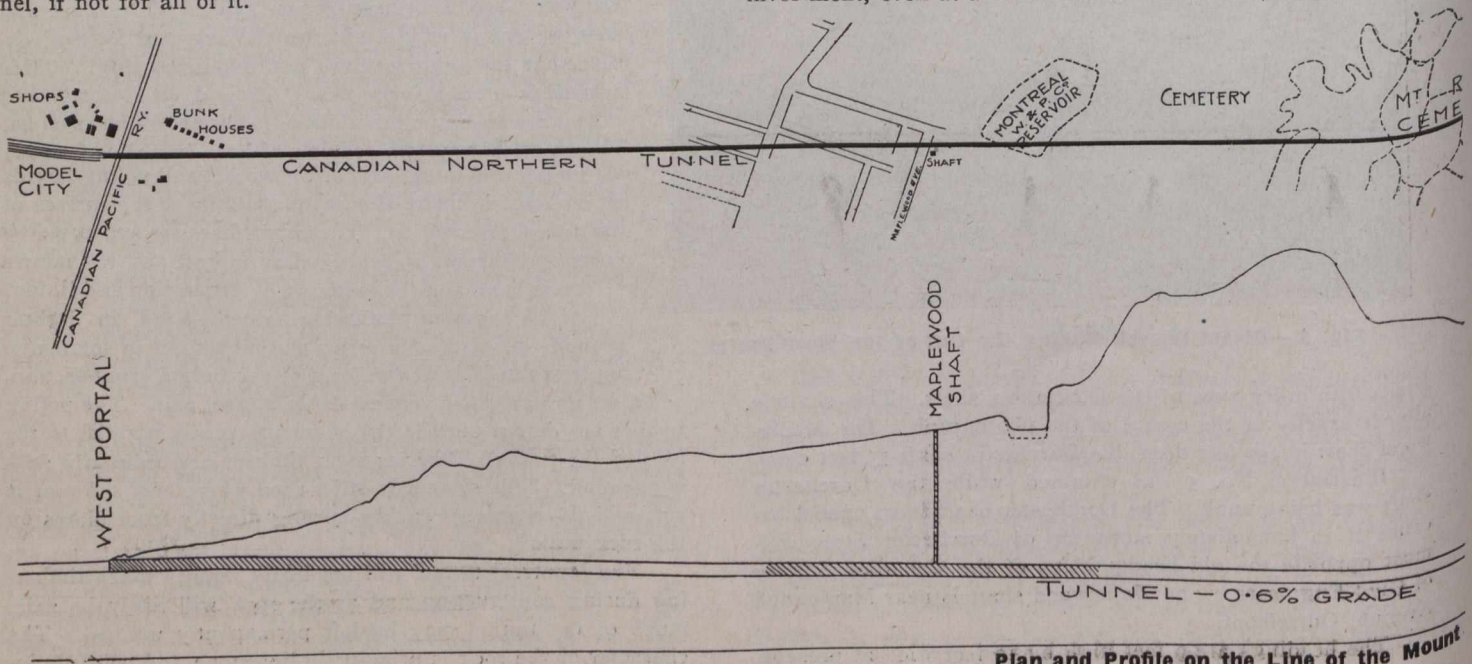
The permanent track in the tunnel will probably be constructed on a concrete base, with creosoted wooden blocks set in the concrete, on which tie plates and screw spikes are used. With this type of construction, a gutter in the centre affords splendid drainage, and the grade and alignment are fixed perfectly. The wooden blocks can be easily removed and renewed. While the engineers favor this type of construction at present, a track laid in rock ballast is also being given consideration and may be used for portions of the tunnel, if not for all of it.

All the very latest signaling devices applicable to this type of tunnel and proven efficient by trial in tunnels in New York City and elsewhere, will be installed in the Mount Royal tunnel. The track will be divided into sections or blocks, the length of which will depend on the grade, curvature, speed and weight of trains, etc.

At the end of the block section an insulated joint is inserted between the ends of the rails, with this type of signal installation. A source of electric current is connected at one end and a track relay at the opposite end, at which end the signal is also installed. The connections are so made that the electric current passes through the rails and relay when there is no train in the block, the relay holding the signal at clear position. When a train enters the block the current takes the path of least resistance through the wheels and axles and is thus cut off from the relay which then allows the signal to fall to "danger" by gravity. If the electric current should fail for any reason, or if the rail should be broken, the signal would go to "danger," just as though a train were occupying the block.

When a block signal is set at "danger" it must be passed, so if only one signal were placed at each block station it would be necessary to approach each signal at a speed which would permit stopping the train at each signal, in case it were found at "danger." To avoid this difficulty, a second signal, called the "distant signal," is installed, which follows the movements of the other, called the "home signal." The distant signal is located so that the train can be easily stopped at the home signal, in case it is in the danger position, as indicated by the distant signal. This signal is usually placed on the same mast with the home signal of the next block, and immediately below it. Within the tunnel lights are substituted for the semaphore arms, the red light being "danger," the yellow for stop position of the distant signal or "caution," and green for the clear, of "proceed" position of both home and distant signals. A safety latch is so placed that if the train runs by a signal set at "danger," the brakes are automatically set and the train stopped.

Engineer Brown is a firm believer in buying good quality of machinery for his plant, as he says it is usually the best investment, even at a material increase in cost, since its sale-




**Plan and Profile on the Line of the Mount**

able value at the end of the job will be so much greater. Also standard, advertised machinery is easier to dispose of than special equipment. As the plant is only temporary, however, expensive fuel and labor-saving devices cannot usually be installed, as they would not have time to pay for themselves, unless the saving is very large. Duplicate machinery is installed in critical places, so that if a unit gets out of order, the job will nnt be shut down.

Illustration No. 7 shows the compressor house at the

**Fig. 4.—Showing Location of the Maplewood Shaft. The Shaft is Almost Exactly at the Centre of the Photograph.**

Dorchester shaft. It is duplicated exactly at the West Portal. There are three belt-driven, cross compound compressors, 1,100 cubic-feet per-minute capacity, with induction motors, 225 h.p., 170 r.p.m. These can be seen in the background of the illustration, while in the foreground can be seen parts of a direct-connected, cross compound unit which has since been erected, having a capacity of 2,160 cubic feet per minute, compressing to 100 pounds. This compressor is driven by a synchronous motor, 400 h.p., 170 r.p.m. The power is three-phase, 62½ cycles at 2,200 volts.

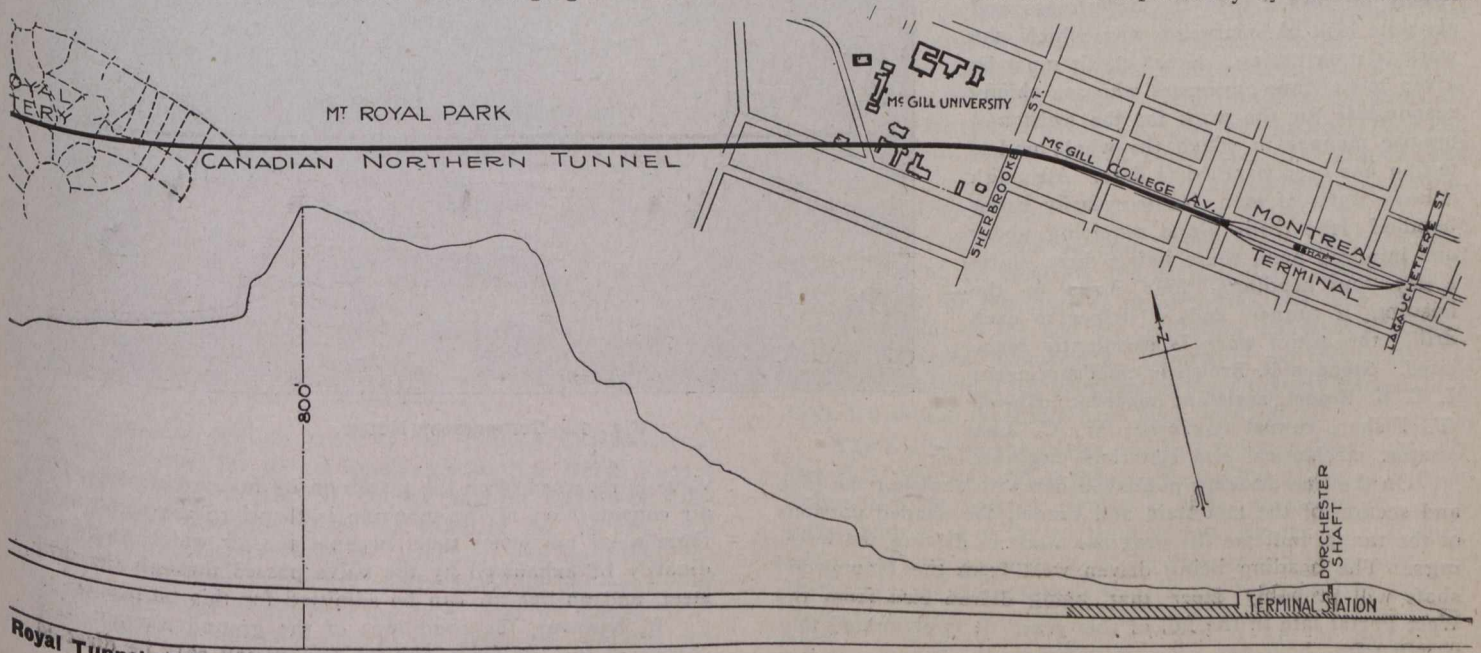
24-inch gauge, V-shaped muck trucks were used at first, but the muck cars now being used are 3-foot gauge, very low and narrow, so that a mucker can shovel into them at maximum efficiency. The wheel base is short. Axle springs reduce the number of derailments resulting from poor track. Gasoline locomotives are used at the West Portal, horses at the Maplewood shaft, and storage battery electric locomotives at the Dorchester shaft. Facilities for recharging the batteries have been provided at the shaft. It is said to be the intention to use storage battery locomotives in the near future at the West Portal and the Maplewood shaft also.

The tunnel is ventilated by forcing fresh air through pipes into the working areas under pressure from blowers driven by motors near the portals. The exhaust from the drills also aids ventilation materially.


**Fig. 5.—The Dorchester Shaft.**

There is a hospital plant at the West Portal, though its services have been needed but little as yet. Up to the present time the city hospitals have been relied upon in connection with the Dorchester and Maplewood shafts. A well-equipped repair plant has been erected, as even in the city of Montreal, where shops are readily accessible, it was deemed wise to have a complete repair shop on the job, as delays were apt to occur in outside shops over which the tunnel engineers would have no control. As all money spent in tunneling is dead capital until the tunnel is completed, every moment counts, and it was estimated that a few days' delay would cost more than the shop.

Illustration No. 8 shows the engineering corps making precise measurements. Tunnel Engineer Fisher succeeded in throwing a base line directly over the obstacles under which the tunnel passes and in the vertical plane of the tunnel tangent axis. The tapes were calibrated to a standard measure and temperature at a given tension. Readings and measurements were taken independently by each instrument




**Royal Tunnel of the Canadian Northern Railway.**

man and rod man of the baseline party, and the result summarized by the chief of party to eliminate the personal element.

In this work the tape was anchored at one end to a heavy weight, so that when stretched ahead it passed over a spider with a brass cross hair plate on it. This spider marked the

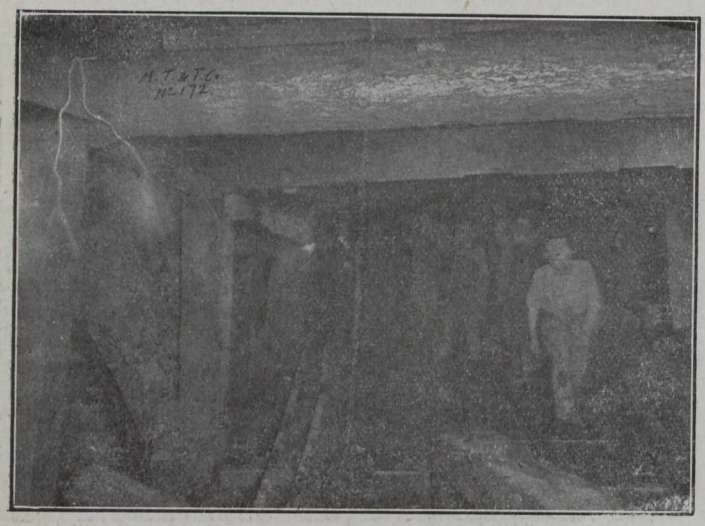


**Fig. 6.—Showing Cap and Post Method of Timbering**

last station measured to. The other end of the tape was attached to a standard weight by a chord passing over a vertical bicycle wheel, thus keeping the tape at the standard tension, and the next measuring spider was set close to this end. The tape was supported at regular intervals and thermometers enabled it to be corrected for temperature. Level readings on the spiders gave the correction for inclination and, as the spiders were set up on transit lines, the final result was a very accurate transverse.

The baseline was extended down the shafts by plumb lines consisting of heavy weights suspended on piano wire. From these plumb lines the engineer's line was projected into the tunnel. Permanent points and centre line stations were marked by wooden plugs with steel spads.

A visitor to the Mount Royal tunnel is chiefly impressed with the orderliness and absolute lack of confusion with which the work is progressing. Great credit must be given to the four engineers who are chiefly responsible for the work for the swift and precise manner in which the whole undertaking has been handled to date. Although a large gang of men is necessarily being handled (the drills alone requiring about one hundred men, there being three shifts a day, four headings, four drills to the heading, a runner and a helper to each drill), the entire work is excellently regulated. Stephen P. Brown is chief engineer; J. C. K. Stuart, assistant engineer; Howell T. Fisher, tunnel engineer; W. C. Lancaster, mechanical and electrical engineer.

On the line drawing published herewith showing the plan and section of the mountain and tunnel, the shaded portions of the tunnel indicate the progress made in driving the headings. The heading being driven west from the Maplewood shaft will probably meet that being driven east from the West Portal late in the fall of this year. It is estimated that it will take about two years to complete the tunnel. It will be noted that the tunnel curves under McGill University grounds and follows the centre line of McGill College Avenue, as where the covering is light the engineers did not wish to go under a portion of the city where somebody might desire to put up a skyscraper with deep foundations.

The scale to which this drawing was made was one inch to 200 feet horizontally and one inch to 50 feet vertically. The engraving for the illustration was then made about one-seventh the size of the drawing. The straight portion of the tunnel is 76 degrees 33 feet 55 inches N.W.

A few notes concerning the mechanical arrangement of the drills now being used on the work may also be of interest. Essentially the drill is an ordinary rock drill of the reciprocating type with a piston and rifle bar bored out to permit the insertion of a small tube, adjustably secured in the back head of the machine. Water under pressure is conducted by a hose line and fittings to the mouth of this tube, through which a constant jet passes into the pollow piston rod and thence into the hollow drill steel, held in the chuck of the machine. The hole through the drill piston is enlarged for a certain distance from the point at which it ends in the counterbore for the rifle bar, and the function of this opening or secondary counterbore is to connect an impulse of exhaust air from the rear of the piston chamber down through the hole in the piston, when it withdraws from the lower end of the tube, which happens at the instant of reverse on its forward stroke. This action causes a charge of mingled air and water to pass through the hollow drill steel to the cutting face of the bit, which, with the water which passes through when the piston is lifting, has the effect of ejecting the cuttings in the form of sludge from the drill hole. It also insures a clean rock surface for the bit to strike and prevents the hole from mudding up regardless of its direction.

When working under normal conditions, air from the cylinder is not admitted to the hollow piston until after the

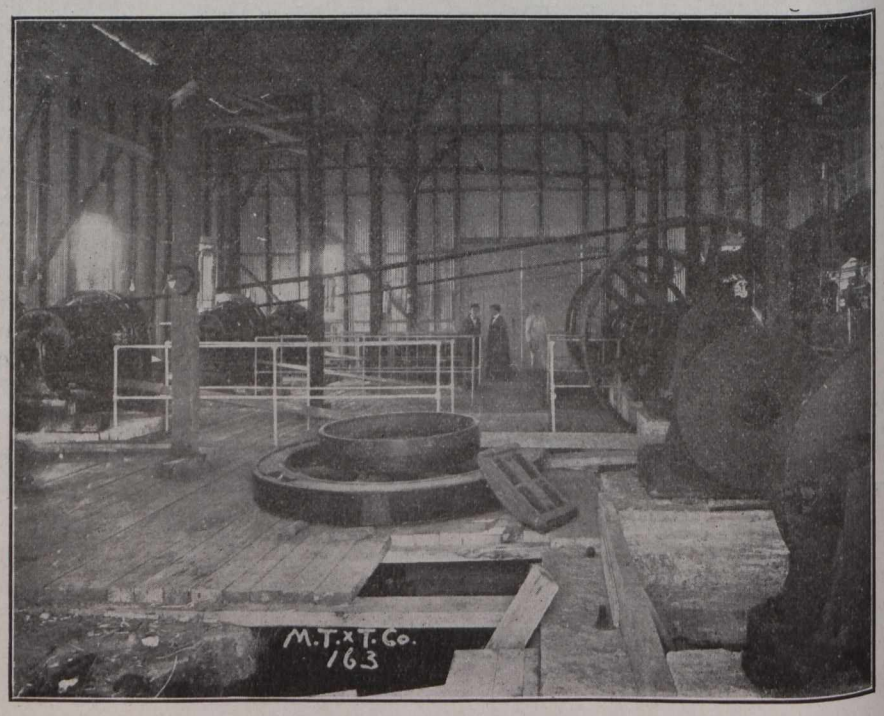



**Fig. 7.—Compressor House.**

valve is reversed, with the piston on its forward stroke. The air consumption of the machine is therefore the same as if there were no water tube, because the air which would ordinarily be exhausted by the valve passes through the drill steel, and no live air can be admitted for this purpose.

If, however, the conditions of the ground warrant it, a charge of live air from behind the piston may be directed

into the drill steel, and this will be followed by the impulse of exhaust air as the piston nears the forward end of its stroke. This may be accomplished by pulling the tube farther back into the head and then securing it by screwing down the lock plug upon the rubber sleeve. By thus manipulating the water tube a varying proportion of air and water may be admitted to the drill hole to handle to the best advantage the particular kind of rock that is being drilled.

The water tube is secured in the back head by the rubber sleeve and gland or lock plug just mentioned. Water is introduced through a water elbow and hose fittings, which include a spud, containing a screen to prevent foreign matter from entering the tube, and a screw cap to keep out dirt when

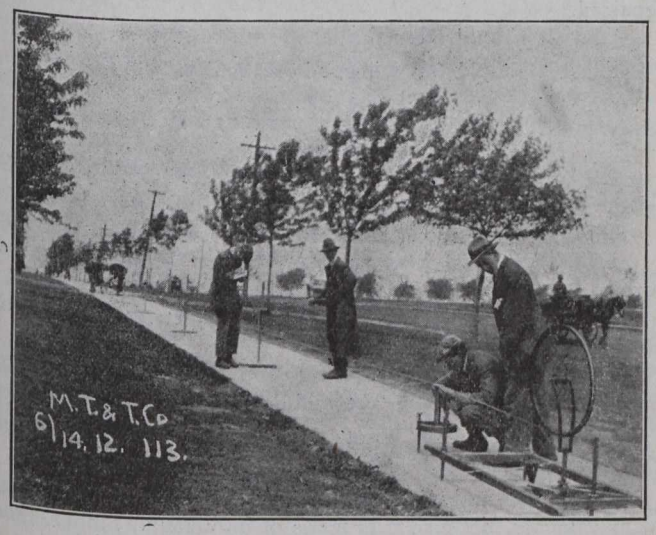



**Fig. 8.—Precise Measuring Engineer Corps.**

the hose is disconnected. A removable plug is provided to limit the amount of water admitted.

Water under a pressure of from 50 to 100 lb. per square inch is required for clearing the hole of its cuttings. Round, hollow steel is used and requires no shanking. The bit is the regular cross shape similar to that commonly used with solid steel.

The general operation of the drill is the same as that of the ordinary reciprocating or so-called piston machines. The water drills are mounted on horizontal 11-foot heading bars, with a leg or support in the centre to secure stiffness. Four drills are used at once on each bar. When the rock is unusually hard, three double screw mining columns are used instead of the bar. Two drills are mounted on arms on each of the two outside columns, and a fifth drill on the centre column. In one heading the drills have cut as high as 20½ feet per hour per drill. This does not include setting up, but does include changing steel, lining up holes, etc. The average depth of holes is 5½ feet and the average speed per drill hour 16½ feet. In sinking a shaft with 7-foot cut holes and 5-foot line holes, an average of 8.6 feet per hour per drill was maintained (total drilling time). In another heading, where the rock is harder, the four drills cut 13 feet per drill hour, or eighteen 5½-foot holes in two hours.

Application will be made to the Ontario Legislature at its next session for an act amalgamating the North Lanark Railway Company with the Ottawa and St. Lawrence Electric Railway Company under the name of the Ottawa and St. Lawrence Electric Railway Company, and increasing the capital stock from $1,000,000 to $5,000,000 by the creation of 40,000 additional shares of $100 each; and for power to issue bonds and borrow money to the extent of $30,000 per mile of the railway.

## INTERNATIONAL ROAD CONGRESS, JUNE, 1913.

Although over six months have still to elapse before the opening of the Road Exhibition in the Royal Horticultural Hall, the preliminary arrangements have all been completed and over half the available stands have been already applied for.

The exhibition will be attended by representatives of highway authorities from all parts of the world. It will be unique in its character, and will bring together for the first time a representative exhibition of road-making materials and appliances, including heavy road machinery.

The organization of the exhibition is in the hands of a committee of which the Right Hon. Earl Beauchamp, K.C.M.G., is president. Other members of the committee are Sir Maurice Fitzmaurice, C.M.G., Colonel R. E. Crompton, C.B., Messrs. Alfred Dryland, Howard Humphreys, T. Richards, Wallace E. Riche, Gibson Thompson, J. Walker Smith, John Willmot and Rees Jeffreys. The honorary secretary is Mr. H. P. Maybury, and the assistant secretary and manager Captain L. A. Kingston.

The exhibition committee is assisted by an advisory committee of traders and exhibitors. The members of this committee are Messrs. H. Pitts (chairman), H. Beadle, H. D. Blake, F. E. Bristowe, E. B. Chittenden, D. G. Comyn, W. Penrose Green, F. W. Manuelle, and H. L. Wettern.

The following table shows the position of the letting of stands at the present time. It is to be regretted that the limitations of space will preclude all the firms who desire to do so from exhibiting.

| No. of Stands. | In Hall. | In Machinery Section. |
|---|---|---|
| Let | 26 | 7 |
| Under negotiation | 14 | 6 |
| Reserved for foreign exhibitors | 10 | 4 |
| Unlet | 16 | 8 |
| Total | 66 | 25 |
| Grand total | — | —91 |

Among the exhibitors in the Horticultural Hall (for small exhibitors) will be found Messrs. J. and P. Hill-Galloways, Limited; The Anglo-Mexican Petroleum Products Company, Limited; The Limmer Asphalte Company, Limited; Taroads, Limited; The Neuchatel Asphalte Paving Company, Limited; Roadamant, Limited; Tarmac, Limited; The Gas Light and Coke Company, Limited; Rocmac, Limited; Roadite, Limited; The Canadian Mineral Rubber Company, Limited; The Enderby and Stoney Stanton Granite Company, Limited; F. E. Bristowe and Company; Krupka and Jacoby; Ellis and Everard; Iliffe and Sons; J. Hutchinson; Crompton and Company; Good Roads; Roads Improvement Association, and The Surveyor, etc.

The exhibition will be open daily from 9 a.m. to 8 p.m. to members of the congress and their friends, and in view of the fact that the meetings of the congress will take place in close proximity to the hall the exhibition will form a rendezvous for informal discussions. Afternoon tea will be provided at the exhibition for members of the congress immediately after the formal meetings have been concluded.

The executive committee will be glad to welcome any offers of assistance, and at present the matter of laying out the footpath of the exterior section is under consideration. The paths, which are of the width of 12 feet throughout and cover some 750 square yards, could be apportioned in sections to road surfacing and other firms who desire to make a display of their various specialities in paving. Applications for further particulars can be obtained from Mr. W. Rees Jeffreys, honorary secretary, local organizing committee of the

International Road Congress (London, 1913), 72 Queen Anne's Chambers, Westminster, S.W.

## MAINTENANCE ENGINEERING IN RAILROAD WORK.*

The chief enemy of the maintenance engineer is water in some form or other. Drainage should not be forgotten in the early stages of an engineering work. Do not dip a road to get under a railway, or a railway to get under a road, without some thought as to the possibility of draining the depression proposed.

In dealing with steel bridge floors there are three courses open to the designer: (1) To make the floor as open as possible, with no place for water to lodge, and every facility for its getting away quickly; (2) to protect the steelwork floor so thoroughly that water cannot get to it; (3) a compromise course. Even the worst drained bridge, however, does not suffer so much as one over a railway, with a floor so designed that steam and gases from locomotives cannot escape freely.

When a structure fails, it is important that a correct diagnosis should be made. Otherwise the treatment may be all wrong, and may lead to large expenditure, when something quite simple and inexpensive would have met the evil equally well.

One instance is recalled where an intelligent inspector, climbing among the girders of a viaduct 140 feet high, found that there were signs of movement where the girders rested on the piers. The first thing to find out was whether the girders were moving on the pier, or the pier moving under the girders; and observations extending over some time were necessary to settle this point. There was then no doubt that it was the pier that was moving and getting increasingly out of plumb. Fortunately, the next pier was an unusually massive one, and it was possible with a system of tie rods attached near the base of it to get hold of the faulty pier near the top, and entirely stop the movement. From the date of the first observations to the tightening up of the tie rods, there had been a movement of 1¼ inches.

Similarly, if one is called upon to deal with an abutment which is bulging and out of plumb, the first thing to find out is, to what the failure is due; is it, for instance, the result of (1) bad foundations? (2) of colliery workings (and old workings which nobody knows much about are sometimes very troublesome)? (3) of excessive pressure from swelling clay or defective drainage behind? or (4) of imperfect building and want of proper bond, or sufficient section in the wall itself? The treatment will entirely depend on the diagnosis. For instance, it would simply be waste of money to rebuild or reface if colliery workings were the cause of the trouble, unless indeed the settlement due to them had quite ceased.

In the design of new works the consideration of the likelihood of future alteration has a bearing on the materials to be used. If it is likely to come soon, one does not build with the some solidity adopted if the structure is to be one of real permanence. In designing bridge work, some of our predecessors in days gone by have added large margins to the calculated strengths of their structures, remembering the effect of corrosion and the tendency to increase the weights of locomotives, etc. We are now reaping the benefit of this liberal policy; for had things been calculated more closely, our maintenance expenditure would now be largely increased.

*Abstract of article in the "Journal" of the Junior Institution of Engineers, London, England, by A. Clifford Swales, Secretary.

## HOW NEARLY DOES THE MODERN YELLOW PINE BLOCK PAVEMENT APPROACH TO THE IDEAL PAVEMENT AND WHAT IMPROVEMENTS CAN WE SUGGEST?

**By H. L. Collier.**

To intelligently discuss the matter let us get forth the cardinal points of an ideal pavement.

1st. It should be sanitary.

2nd. It should be durable.

3rd. It should be reasonable as to first cost.

4th. It should be easily, economically and effectually repaired.

5th. It should offer the least resistance to traffic.

6th. It should furnish good foothold to horses.

7th. It should be easily cleaned.

8th. It should be noiseless.

9th. It should possess elasticity, which would care for the horse.

10th. It should be dustless.

11th. It should have a smooth surface and wear uniformly.

12th. It should not be easily affected by climatic changes.

Finally. This being the automobile age, the ideal pavement should care for the automobile as well as for the horse.

As to the cardinal points, what claim can we make for the modern creosoted yellow pine block pavement?

First. We unhesitatingly say it is the most sanitary of all pavements, because it is made of only sound timber, thoroughly seasoned under a temperature of at least 240 degrees Fahr. in an air-tight cylinder; subject to a vacuum of from 22 to 26 inches of mercury, and under pressure of from 100 to 200 pounds per square inch; creosote oil, a distillate of pure coal tar, free from all adulterants whatsoever, is forced into the blocks until the pores are filled with the oil at a temperature of 240 degrees Fahr.

The heavy oil of creosote, a pure coal-tar distillate, free from adulterations, is not only a wood preserver, but also a most effectual disinfectant; a sure exterminator and preventative of germs, microbes, fungi and all other seeds of disease or decay.

The pores of the yellow pine blocks being thus filled under pressure will not absorb impurities, and creosote being ever present no germ can exist on the surface of the pavement.

Again, the blocks are manufactured to exact dimensions, rectangular in form, and are laid so closely and fitted around manholes, water keys, catch-basins, frogs, switches, etc., so snugly that the interstices are too small to admit any impurities.

Again, there is nothing about a wood block pavement to grind into dust, and no dust can appear thereon except that carried to the pavement; and as dust is not only a disease producer and also a disease distributor, and as all other pavements are at least ninety (90) per cent. dust producing materials, we say creosoted yellow pine block pavement is the most sanitary of all pavements.

Dr. Floyd W. McRea, of Atlanta, one of the most noted surgeons in the south, who served his city on the Board of Health, after a most careful examination of creosoted yellow pine block pavement, not only in this country but also in Europe, pronounced it the most sanitary and the best of pavements.

*Abstract of paper read before American Wood Preservers' Association.

Mr. H. Wheeler Bond, health commissioner of St. Louis, under date of March 2nd, 1911, wrote:

"In our opinion the creosoted yellow pine block pavement is not only sanitary in nature, but also considered the best street pavement in St. Louis."

Mr. James C. Travilla, street commissioner of St. Louis, under date of March 6th, 1911, wrote:

"The modern creosoted block is the most sanitary form of paving material on the market. The reason for this is evident, since the creosote used in treating the wood contains a large percentage of highly antiseptic ingredients, namely, Phenol, or carbolic acid, and Naphthalene. These ingredients are the lighter, more volatile portions of the preservative oil and continually come to the exposed surface of the blocks, the only portion of which collects germs, and thus keeps the street in a healthy, sanitary condition."

Second. We say also that creosoted yellow pine block pavement is the most durable of all pavements, even under heavy traffic. Tested side by side with granite on Hudson Street, New York, it was proven to be more durable. In U. S. Circular No. 141 we find in the above test, "one wood-block pavement outlasted three granite-block pavements under identically the same climatic and traffic conditions."

Williamsburg Bridge, New York, gives proof that wood block pavement is more durable than Medina sandstone.

On Michigan Boulevard, Chicago, asphalt blocks wore out in five years and wood blocks in same location under the same traffic were good at the end of nine years, certified to by Mr. Lynn White, engineer for South Park Commissioners, Chicago. On Holliday Street, Baltimore, after a test of six years, sheet asphalt, asphalt blocks and several different makes of vitrified brick pavements wore out and had to be removed, while wood blocks were perfectly sound and showed only a compression of ⅛ of an inch in the six years. At the present time, after twelve years' service, the wood blocks look as when new and no cost of repairs. All of these tests are described also in U. S. Circular No. 141.

On Tremont Street, Boston, in 1900, the test was made with asphalt by paving from centre to curb on one side with the very best quality of asphalt paving, and on the other side from centre to curb with the best quality of creosoted yellow pine blocks—all on six inches Portland cement concrete foundation. After nine years' service the asphalt was practically worn out, after having been many times repaired, while the wood blocks, according to the superintendent of streets, "seem in as good condition as when first laid; by actual measurement I find that they have been reduced ⅛ of an inch, but the surface is so regular the reduction in thickness of ⅛ inch must be from compression rather than wear. The wood blocks on Tremont Street have not received or required any repairs caused by either wear or decay in the nine years."

Messrs. Dow and Smith, experts of New York, in making their report to the Merchants' Association of Philadelphia looking to the paving of Market Street in said city, made this comment on Tremont Street pavement in Boston:

"To all appearances these blocks, although subjected to severe traffic for the past nine years, are practically as good as the day they were put down. There has been no maintenance cost whatever during the nine years the pavement has been in place."

In the same report Dow and Smith stated:

"Where laid along side of street car tracks the present wood blocks have outworn two sets of granite blocks similarly placed."

"Wood block paving down under heavy traffic from 10 to 12 years shows less than ¼ inch wear or compression, and none as yet having cost anything worth considering for repairs, while the life of all other pavements under heavy traffic is from 8 to 12 years—all requiring extensive repairs in three or four years. Therefore, we say creosoted yellow pine block pavement is the most durable of all pavements."

Third. While wood block pavement is slightly more expensive as to first cost than asphalt, bitulithic or brick, its wonderful durability and ease of repairs soon enable it to overcome any saving as to first cost by other pavements.

In New York, Chicago, Cincinnati. Philadelphia, St. Louis, Detroit, Minneapolis, Indianapolis, Atlanta and Boston wood block paving costs from 33⅓ to 50 per cent. more than asphalt, brick or bitulithic paving, yet in the business districts wood block paving is used almost to the exclusion of the other pavements named.

If, in ten years, the other pavements are worn out and have to be replaced with some other pavement, and under the same climatic and traffic conditions at the end of ten years, the creosoted yellow pine blocks show no wear and are as good as when first put down, would they not be cheaper and more desirable as an investment were the first cost double that of the other pavements?

Constant repair of pavements is a fearful nuisance to the business men of a city, and holes in a pavement are productive of a multitude of damage suits, the expenses of which should be charged to the faulty pavement.

Fourth. We say creosoted yellow pine block pavement is the easiest and most economical of all pavements to repair and is the only pavement that can be effectually repaired and made to look as well after repairs as before. And to repair wood block paving requires no expensive outlay—only a laborer, a hatchet and a few blocks necessary for any wood block repair.

The blocks are more easily trimmed to fit than are bricks. Square cuts have to be made for brick repairs, while wood blocks can easily be made to dovetail into the pavement and the pavement made as good as when new. Therefore, we say creosoted yellow pine block pavement is the easiest and most economically repaired of all pavements.

Fifth.—On account of its smooth surface, elastic and yet unyielding so far as impeding traffic, it offers the least resistance to traffic of all other pavements the year round. Asphalt and bitulithic paving, when of smooth and regular surface, in winter offer as little resistance to traffic as wood blocks, but in summer, when yielding, the tires sink in and considerable resistance is encountered.

Sixth. Wood block paving offers a sure footing to horses when dry or wet, as shown by the long, easy strides they take on said pavement. When slightly damp from a heavy dew or light frost or heavy fog, when the pavement is not clean, like asphalt and bitulithic pavements, is slightly slippery for a short while early in the morning under those climatic conditions, but no more slippery than other smooth pavements under the same conditions.

Seventh. Wood block pavement, made of perfectly rectangular blocks, can be laid with a smooth surface and the wear or compression is perfectly regular. The interstices soon iron-out (weld together), leaving no receptacle to hold dust or impurities and is easily swept and, there being nothing to produce dust, we say wood block pavement is the cleanest and easiest kept clean.

Eighth. Wood block pavement is known as the "silent pavement." Wood does not reflect sound, has elasticity and yields under the horse's tread, does not give forth the metallic sound common to all other pavements.

This noiselessness has transformed the down-town districts of all our large cities. With wood block paving even the busy marts of London, Paris, Berlin, New York and Chicago are free from noise and clatter, which before proved so nerve-wracking.

First, second and third stories of buildings which have been abandoned as offices and sales rooms, after improvements of the streets with wood blocks become the choice office locations.

Ninth. Wood is the only material out of which a road surface can be made which possesses elasticity at all times.

On a wood block pavement a horse would never become "stove up." Examine your city horses and see the effect of all other pavements on them. You will find that in three or four years on asphalt, bitulithic, brick or granite blocks paving horses become stiff—"stove-up."

The saving on horses and vehicles on wood block pavement would, in a few years, amount to a sum sufficient to pave with wood blocks all the down-town streets in our cities.

Tenth. We have already stated that there is nothing about a wood pavement that can grind into dust under the erosion of wheels or the impact of horses' hoofs; while all other pavements, except brick, are made of materials which are ninety (90) per cent. dust producing, and brick we know to be of 100 per cent. dust producing materials.

Eleventh. We say it can be laid with a smoother surface than any other pavement, and the experience the past twelve years has proven, under heavy traffic, the wear or compression is uniform and the surface continues smooth.

As example, for instance, Tenth Street, Minneapolis; Tremont Street, Boston; Washington Avenue, St. Louis—the latter is so very smooth the children make it, after ten years' service under a heavy traffic, a skating rink; and of Tremont Street the street commissioner of Boston, late in 1912, wrote: "After twelve years' wear it looks as smooth as when first laid." Of Tenth Street, Minneapolis, Mr. George S. Harper, of said city, wrote: "The pavement on Tenth Street has been down ten years and it is in as good condition now as when laid." So with all our creosoted yellow pine block pavements; not so with any other pavement—all, without exception, wear unevenly into ruts and chuck-holes.

Twelfth. It is the least of all pavements affected by heat and cold; neither does moisture seriously affect it. In Minneapolis more than 60 per cent. of all the pavements are creosoted wood block paving. Altogether there are 61 miles, and every yard doing nicely, and some down ten years. In Chicago, Detroit, Indianapolis, Toledo, Cincinnati, Boston, New York, Atlanta, Mobile, Pensacola, Beaumont, Dallas, Kansas City, Mo., also in all the large cities of Europe, the pavements have given entire satisfaction; geographical locations or climatic conditions seem in no wise to affect it. We have testimonials from street officials in every city sustaining this declaration.

Finally. As before stated, the elasticity and smoothness of the wood block pavement cares for the horse, fully doubling his years of usefulness over any other pavement, and in turn the horse does no harm to the wood block pavement.

The same reciprocity exists between the creosoted yellow pine block pavement and the automobile.

The smooth surface of the wood block pavement does not whet out the tires; neither is there found on a creosoted yellow pine block pavement chuck-holes or ruts to bend the axles or throw out of adjustment the delicate parts of an automobile; nor are there slivers to puncture the tires—in fact, on a creosoted yellow pine block pavement, properly constructed, an automobile should last almost forever.

In turn, under automobile traffic, a wood block pavement should last almost forever. The friction between the tires and the pavement in no wise hurts the surface of the wood blocks.

The automobile is a machine of destruction to all other pavements, and in turn all other pavements wear out rapidly the automobile—the grit cuts the tires like an emery wheel; the chuck-holes and ruts bend the axle and throw out of adjustment and shake to pieces all the delicate parts of the machine.

If the creosoted yellow pine block pavement possesses all these good qualities, and in a superlative degree, why is it not an ideal pavement?

What is it lacking?

How can it be improved?

What is said against it?

Our competitors say "It is slippery." "It bleeds." "It buckles." "It is unsanitary," and "While creosoted yellow pine block pavement can be made a better pavement than any other, it is so hard to make right, and so easy to make wrong, that is is seldom a city gets a first-class job." And in their extreme lamentations they say, "It requires an army of carpenters to keep it in order."

As to these criticisms, let us see how many are real and how many can be remedied:

First. The bleeding is exuding of the heavy oil injected in the blocks under pressure for two purposes—to prevent decay and to lessen the absorptive power of the wood. The bleeding is positive proof that the blocks have been impregnated with the oil which the engineer said should be, and the inspector declares has been injected. No one has charged that bleeding is injurious to the pavement, except as a temporary nuisance which almost always begins and ends in the first hot season, and which can be made unobjectionable by whipping a thin coating of sand over the pavement two or three times during that period, which labor and expense fall upon the contractor, who is "both ready and willing."

The bleeding is not without its benefit; it helps to form a mastic coating around the blocks, which aids in preventing absorption.

Up to 1908 creosoted wood block paving did not bleed; blocks laid prior to 1908 were treated with oil of light specific gravity and treatment—1.04 to 1.08 specific gravity, and about twelve pounds of oil to the cubic foot of timber.

Since 1908 a heavier oil and treatment have been largely used—from 1.10 to 1.14 specific gravity, and from 16 to 20 pounds to the cubic foot of timber.

Whether about 1908 there was any material change in the mechanical treatment of the blocks we do not know.

The question of seasoned or unseasoned timber for blocks before treatment is an unsettled question.

Since every pavement made of creosoted yellow pine blocks, impregnated with from 10 pounds to 22 pounds of creosoted oil, the distillation, or the product of pure coal tar, with specific gravity from 1.04 to 1.14 has proven successful, and "not one has cost any amount worth considering for repairs," declared by every city engineer during their long service under heavy traffic, some more than twelve years, many miles more than ten years—who can say whether light or heavy oil, light or heavy treatment, seasoned or unseasoned woods, is the best and will be the most durable. We who have spent years studying the pavement have our preferences on all these points, yet none of us can prove our ideas are best. Since the blocks show no perceptible wear, no decay for twelve years under heavy traffic, on what are we to base our arguments?

If I am asked my preference on these points, I would say:

Let the oil be a pure coal-tar distillate, unadulterated by any other material whatever, with specific gravity not lighter than 1.06 and not heavier than 1.08; on distillation not to show more than 5 per cent. up to 210 degrees C. and not less than 45 per cent. nor more than 60 per cent. up to 315 degrees C.

For light traffic, 18 pounds; for medium heavy traffic, 16 pounds; for heavy traffic, 14 pounds to the cubic foot of timber.

Second. As to buckling. This has been a most awfully over-ridden hobby-horse. There is nothing that can happen to any kind of pavement so inexpensive and so easy to repair.

Either lay the blocks with tight joints, both longitudinal and transverse, as has been the practice in New York, with ample longitudinal expansion joint at the curbs, filled with a bituminous filler so compounded as not to melt below 175 degrees Fahr. or become brittle above 15 degrees Fahr.

This method will prevent bleeding, buckling and slipperiness and will make waterproof the pavement.

Third. As to slipperiness. Creosoted yellow pine block pavement is, as are all other smooth pavements, slippery under certain climatic conditions. If the pavement is not clean (covered with a film of dust or soot), and the morning is mucky, heavy fog or heavy dew, or very light sprinkle of rain, or light frost or snow, the pavement will be, for two or three hours, slippery. This condition will probably exist for two or three hours one day in every week the year through, and not more than that in any section of the United States. All of which can be overcome by an occasional whipping of coarse sand on the surface.

If the engineer will make the crown of his wood block pavement as light as the grade of the street will admit, and if above 4½ per cent. grade, will separate the blocks transversely with a creosoted strip ⅝ x 1 inch and fill the joint above the strip (the strip to be set up on the concrete base), with the bituminous filler, already described, and pebbles, there will be very little, if any, slipperiness, not any more than on asphalt, bitulithic, concrete or brick with cement grout filler under the same conditions.

Fourth. All creosote plants buy their oil in large quantities, and as fully 90 per cent. of the treating of timber and paving blocks is done under expert supervision, selected by those who pay for the work, the danger of imposition is reduced to the minimum.

As to the quality of the wood, any novice can tell whether it conforms to the engineer's specifications.

As to the construction work of the pavement, it is practically the same as that of several other pavements—so, where can the deception be practiced?

Fifth. As to the sanitation of the pavement, proof sufficient has already been given.

Sixth. As to the extent of repairs, we have shown that no expensive plant or gang of trained laborers are necessary to be maintained for said purpose, but the only thing needed is a laborer, a hatchet and a few new blocks.

**What Improvements Can We Suggest?**—I think we are on the "right line,"—will only mention a few points which, after long experience, much study and many critical inspections, have impressed me as essentials.

First. Be careful in making the Portland cement base. Have the ingredients carefully selected and well mixed; proportion depth to traffic, and always finish the concrete base with a template and straight-edge, exactly parallel to the contour and grade of the finished pavement.

As to cushion for the blocks, I prefer the mortar bed—of one part cement and three parts screened sand, mixed dry, struck off with a template and dampened with a hand-sprinkler just in advance of the paver.

Lay the blocks close-jointed sidewise and with one-eighth inch joint between ends of the blocks, carefully spaced.

At the curbs provide an inch expansion joint for a thirty-foot street, between curbs, and 1½ inches for a 50-foot street.

Have no transverse expansion joints on the pavements.

Trim the blocks to fit neatly around manholes, catch-basins and all permanent fixtures; provide necessary expansion joints around same.

Let the blocks be brought to a firm bearing by means of a hand-rammer in the hands of an active, careful laborer, or quickly rolled with a light tandem roller, from three to five tons.

After the blocks have been spaced, inspected and low blocks brought up to grade, the surface should be swept broom clean and a bituminous filler, so compound as not to melt below 175 degrees Fahr. or become brittle above 15 degrees Fahr., heated until as thin as water, should be poured on the surface and worked back and forth with a squeegee until all cracks, interstices and expansion joints are three-quarters full, using sufficient force on the squeegee to leave only a thin coating on the surface of the blocks, into which, while hot, sprinkle a layer of pebbly sand.

Traffic should be excluded for at least four days, and longer if necessary, for the mortar bed to properly harden.

If a sand cushion is used, let it be only one-half inch in depth, made of screened sand not too fine.

This plan should be used universally on bridge floors.

**What Should Not Be Done.**—Blocks should not be loosely laid on a sand cushion, varying from ½ inch to 2 inches in depth and a sand filler used—remember, wet sand is as unyielding as granite. You could with equal propriety each day drive steel wedges between the blocks. As the blocks shrink the sand trickles down to fill the space made and keeps the blocks hugged in this narrowest limit. When the blocks are wet so also is the sand, and when the blocks want to expand to their natural sizes, the wet sand will not yield and a buckle of the block occurs.

If sand is to be used as a filler, lay the blocks close-jointed both longitudinally and transversely, and place a half-inch layer of coarse, pebbly sand on the surface.

Neither should a paving pitch filler be used unless specially made for the purpose, guaranteed not to melt below 175 degrees Fahr. or become brittle above 15 degrees Fahr.

Ordinarily paving pitch on a wood block pavement is a nuisance in hot weather, and below 50 degrees Fahr. it is absolutely unyielding. Wood blocks will want room for expansion below 30 degrees Fahr.

**As to Treatment.**—The period should not be too short—making haste is dangerous; gradual heat, not at any time to exceed 240 degrees Fahr., rapid vacuum up to 22 to 26 inches of mercury—slowly increasing pressure not to exceed 200 pounds.

Better retain 150 pounds pressure longer than hasten the work by applying 250 pounds pressure for a shorter time.

**As to Timber.**—Like the specific gravity of the oil, too much of a bugaboo is made of the amount of heart lumber to require. We have diligently searched for evidence to prove that sap in creosoted wood blocks wear more rapidly than heart, and not in one instance have we found such evidence.

The blocks, if laid level on a concrete foundation with close joints, the compression or wear has been perfectly regular, as much on the heart side as on the sap side.

The treatment seems to toughen the timber, making the heart and the sap of equal wearing surface in paving.

Therefore, we say there is no good accomplished in calling for 66 per cent. or 95 per cent. of heart. Such requirement adds considerably to the cost of the timber. Our mill men are anxious to sell heart lumber, but they greatly increase the price charged therefor.

Square-edged and sound Virginia southern yellow pine, free from all defects which would injuriously affect the timber for the uses intended, are all that is needed in an up-to-date, first-class timber specification for paving blocks.

With these precautionary suggestions as to timber classifications, treatment and construction observed, we will have in the creosoted yellow pine block pavement the ideal pavement.

## COAST TO COAST.

**Vancouver, B.C.**—The contract for the building of the new police headquarters has been awarded to Mr. C. F. Perry, his tender being for $250,000.

**Montreal, Que.**—Canada has now 26,727 miles of railroad in operation, and 3,466 miles under construction. Gross earnings of Canadian railroads in 1912 increased 16.2 per cent.

**Winnipeg, Man.**—A report issued by the highways commissioner for the province of Manitoba shows that a sum of over $1,000,000 will be spent during 1913 on the highways of the province.

**Montreal, Que.**—The Montreal Trust Company estimate the total output of the Cedar Rapids plant, when completed, to be 100,000 horse-power. This would mean an annual revenue of $3,500,000.

**Montreal, Que.**—Mr. George Janin, in his report to the Board of Control, estimated that it will cost three and a half million dollars to pave streets and sidewalks that are not paved now within a radius of two miles of the city hall.

**Minneapolis, Minn.**—The Minneapolis, St. Paul and Sault Ste. Marie Railroad will spend $25,000,000 in building 725 miles of new road, which will cross Montana and strike the Canadian Pacific road somewhere near the Montana-Idaho boundary line.

**Hamilton, Ont.**—The council has decided to contribute $25,000 towards the construction of the proposed concrete highway between Hamilton and Toronto, provided the Ontario government builds and maintains the new road starting where the asphalt pavement ends at the cemetery gate.

**Guelph, Ont.**—County Road Superintendent J. M. Young reported that the amount of money spent under the Highway Improvement Act for road and bridge construction from November 16th, 1911, to December 31st, 1912, was $33,597.38, of which $13,242.38 was for bridges and $20,355 for roads.

**Sault Ste. Marie, Ont.**—The H. E. Talbott Company of the Soo, have been awarded the contract for the construction of a 1,500 foot dam and the installation of a complete hydro-electric system at Grand Mere, Que. The contract involves a sum of over a million and a half and 1,000 men will be employed on the work.

**Vancouver, B.C.**—The province of British Columbia stands third among the provinces in the Dominion in amount of articles manufactured, producing $65,204,235 worth of goods; and fifth in the cities of the Dominion in the rate per cent. of increase of values of products with 695.16 per cent. for 1910.

**Victoria, B.C.**—Mr. W. Fleet Robertson, provincial mineralogist, has completed a preliminary review and estimate of the mineral production of the province of British Columbia for the year 1912, which sets the total value of the production for the past year at $32,606,000, or $9,106,928 in excess of the production for 1911.

**Calgary, Alta.**—Mayor Sinnot has submitted an estimate to the city council, providing for a $10,000,000 pipe line from Bow Island to Calgary and neighboring points, to be controlled by the municipalities and retailed at cost to manufacturers and other consumers. The Bow Island town council is preparing to operate municipal gas wells and furnish this natural fuel free to manufacturers locating here.

**Hamilton, Ont.**—Jas. Bain, electrical engineer, in his report shows that during the four months the two electrical pumps were in operation the cost per million was $6.35, while during the eight months coal was used the cost was $7.01. With the combined use of electrical power and coal, however, the average cost per million gallons was $5.23, the net saving by the use of steam to keep down the peak load being $1.11 for every million gallons.

**Sarnia, Ont.**—The Huron Lake Shore Railway, with a capital of one million, are seeking a charter to construct not only a railroad from Sarnia to Seaforth, but also a line of steamboats is contemplated by the company, which will mean the building of wharves, warehouses and other adjuncts of marine shipping. Telegraph and telephone service will also follow the line of the railroad. It is understood that hotels, pleasure resorts along the proposed route are possibly to be included in the plans of the company.

**St. Thomas, Ont.**—The City Council have awarded the contract for the construction of the new Just Wright shoe factory to Albert E. Ponsford, his tender for the complete work being $33,953. Other contracts in connection with the work are as follows: Sprinkling system, to cost $3,100, the General Fire Equipment Company of Toronto; vault doors, costing $56.25, Ford & Fetherston, of Hamilton; electric elevator, $520, will be supplied by the Otis-Fensom Company. The factory, complete, will cost $37,629.25.

**Hamilton, Ont.**—Articles incorporating the International Harvester Corporation, with an authorized capital of $70,000,000, was filed with the secretary of state at Trenton, N.J., the incorporators being connected with the International Harvester Company, a concern already chartered under the laws of New Jersey with an authorized capital of $140,000,000. The new corporation has been formed for the purpose of taking over the business and properties of the International Harvester Company in foreign countries, including the manufacturing plants in Canada, France, Sweden, Germany and Russia.

## VANCOUVER BRANCH OF THE CANADIAN SOCIETY OF CIVIL ENGINEERS.

At the annual meeting of the Vancouver branch of the Canadian Society of Civil Engineers, held on 20th January, 1913, the following officers were elected for the ensuing year: Chairman, G. E. G. Conway; vice-chairman, L. G. Robinson; secretary-treasurer, F. Pardoe Wilson; executive, C. E. Cartwright and W. A. Clement. Secretary's address, 422 Pacific Building, Vancouver.

## ALBERTA ARCHITECTS' ASSOCIATION.

The annual convention of the Alberta Architects' Association was held January 23, 24 and 25, at the Edmonton Board of Trade Rooms, Edmonton, Alta. The following officers were elected for the coming year: President, R. W. Lines, Edmonton; hon. president, G. M. Lang, Calgary; 1st vice-president, Jas. Henderson, Edmonton; 2nd vice-president, J. J. O'Gara, Calgary; hon. secretary, W. D. Cromarty, Edmonton; hon. treasurer, G. H. McDonald, Edmonton. The following is the newly elected council: R. P. Blakey, Edmonton; L. Gibbs, Edmonton; Geo. Fordyce, Calgary; W. S. Mayor, Calgary, and R. P. Barnes, Edmonton.

## MEETING OF THE SOCIETY OF CHEMICAL INDUSTRY.

A largely attended meeting of the Society of Chemical Industry was held last week in Montreal. Prof. R. F. Ruttan was in the chair. The lecturer of the evening was Mr. James O. Meadows, superintendent of the filtration plant of the Montreal Water and Power Company, who spoke on "Water Purification," with special reference to rapid sand filtration. In the course of his lecture he described various forms of chemical and mechanical filtration, and referred to the systems being installed for Montreal and suburbs. The lecture was followed by an interesting discussion.

## PERSONAL.

SETON PORTER has been admitted as a member of the firm of Sanderson & Porter, consulting engineers, New York.

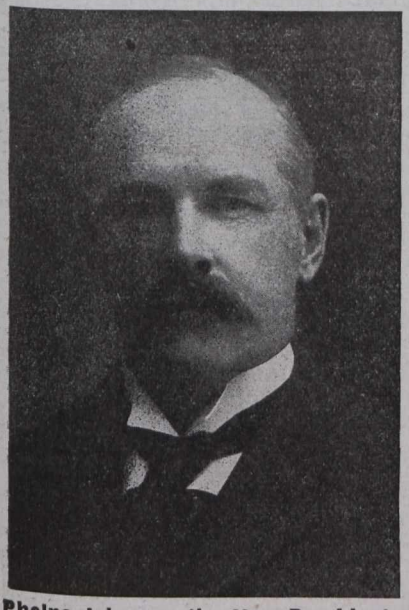
RICHARD S. BUCK has retired from the firm of Sanderson & Porter, of New York, and has become chief engineer of the Dominion Bridge Company, of Montreal.

GEORGE CRAIG, assistant city engineer of Omaha, Neb., has been appointed city engineer of Calgary at a salary of $5,000 per annum.

W. A. OSTROM, chief engineer of the power house, Saskatoon, Sask., has resigned his position and will become general erecting superintendent of the General Electric Company west of Winnipeg.

LEE MURRAY, M.C.E. (Melb.), M.Inst.C.E., M.I.E.E., M.I.Mech.E., who recently retired from the position of general manager of Messrs. Bruce Peebles & Company, Limited, engineers, Edinburgh, has started business on his own account in London as engineering representative (buying, inspecting, etc.) for firms and corporations in the colonies and abroad. Mr. Murray's address is 10 Norfolk Street, Strand, London, W.C.

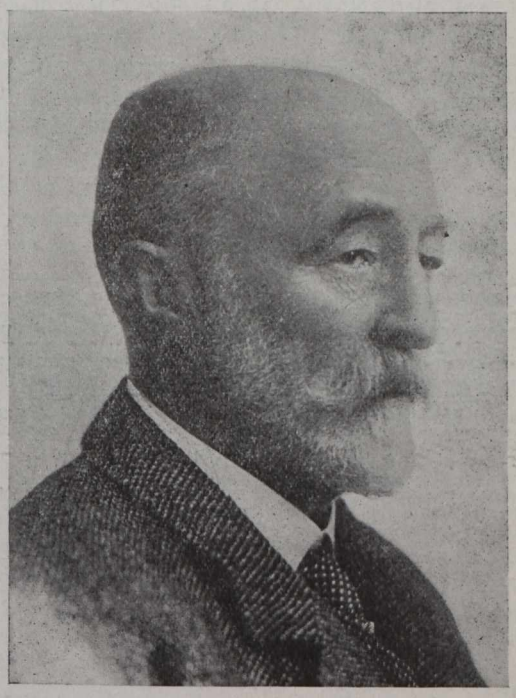
PHELPS JOHNSON was born in Orange County, U.S. From 1872 to 1879, Mr. Johnson was engineer for the Hawkins Iron Works, at Springfield, Mass. In 1879 he became assistant engineer for the Wrought Iron Bridge Company, of Canton, Ohio. In 1882 he came to Toronto as engineer and manager of the Toronto Bridge Company, which afterwards became the Dominion Bridge Company. In 1888 he became chief engineer of the Dominion Bridge Company, at Lachine, P.Q., which position he retained until 1892. In 1892 Mr. Johnson was appointed general manager of the Dominion Bridge Company, which position he holds to-day. Mr. Phelps Johnson is also president of the St. Lawrence Bridge Company, which company was formed to construct the steel superstructure of the new Quebec bridge. Mr. Johnson is a member of the St. James Club, the Engineers' Club and the Royal St. Lawrence Yacht Club of Montreal. Last year at the annual meeting of the Canadian Society of Civil Engineers he was elected a member of the council.



**Phelps Johnson, the New President of the Canadian Society of Civil Engineers.**

RAY R. KNIGHT has received the appointment of city engineer of Fort William. Mr. Knight, who is an associate member of the Society of Civil Engineers and associate of the Institution of Municipal and County Engineers, is at present chief designing engineer in the sewer department of the city engineer's office, Toronto. During the two years he has held this position he has been responsible for the design and planning of sewerage schemes and storm sewers to the value of nearly $4,000,000. In addition to this he was called upon to report and give estimates for the disposal of the house refuse of Toronto involving an expenditure of $900,000. Before coming to Canada, a little more than two years ago, Mr. Knight was deputy town engineer of Bromley, England, and for five years previously held a similar appointment at Wood Green, London, England. Special street railway and sewerage work occupied his time before this at Folkestone, England. He was articled to the town engineer, Carnarvon, North Wales. For nearly sixteen years Mr. Knight has been engaged in municipal engineering in every phase, including many large sewerage, street railway, roadway and waterworks undertakings.

FRANCIS C. GAMBLE, the new vice-president of the Canadian Society of Civil Engineers, is the second son of the late Clark Gamble, K.C. He was born in Toronto, on



**Mr. Francis C. Gamble. Vice-President of the Canadian Society of Civil Engineers.**

October 23rd, 1848. His early education was received in Upper Canada College and by private tuition. He began his engineering career on the Intercolonial Railway in 1869. In 1872 he was assistant engineer on the Canadian Air Line (Great Western Railway), subsequently he became resident engineer for the contractors on the P.E. Railway. He was assistant engineer for the Intercolonial Railway, the Q.M. & O. Railway, and the Canadian Pacific, at Rat Portage, during construction. In 1880 Mr. Gamble was sent to British Columbia as assistant engineer on Government work above Yale, B.C. He was afterwards transferred to the Department of Public Works of Canada in British Columbia. In 1887 he was appointed resident engineer in the province which position he resigned in 1897 to become public works engineer and inspector of dykes for the province of British Columbia. In 1911 he became chief engineer and inspecting engineer of Railways for British Columbia. Mr. Gamble was elected a member of the society in 1887. He is also a member of the Institute of Civil Engineers, of London, Eng., and of the American Society of Civil Engineers.

S. BRUCE McCONNELL, Assoc. M. Can. Soc. C.E., formerly assistant division engineer of the Canadian Pacific Railway, at Montreal, Que., has been promoted to be assistant engineer. His headquarters will remain at Montreal. Mr. McConnell entered the railway service in 1898 as a transitman on the location of the Midland Railway of Nova Scotia.

Later he was transitman and resident engineer on construction of the Great Northern Railway of Canada, and resident engineer of a railway in Cuba. He joined the engineering staff of the Canadian Pacific in 1902, as assistant engineer in charge of yard construction at North Bay, Ont.

MAJOR W. W. CROSBY, M.Am.Soc.C.E., chief engineer to the Maryland Geological Survey, and consulting engineer, Baltimore, Md., on January 31st delivered an illustrated lecture on "Engineering Duties and Responsibilities," before the graduate students in Highway Engineering at Columbia University.

## OBITUARY.

JULIAN THORNLEY, M. Am. Soc. C.E., died in the Masonic Hall Building, New York City, December 28. He was 44 years old, was formerly an engineer with the New York State Water Supply Commission, and was at one time resident engineer on the construction of the plant of the Electrical Development Company at Niagara Falls, Ont.

## COMING MEETINGS.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Fourth Regular Meeting, Toronto Section, will be held at Engineers' Club, 96 King Street, West, 8.15 p m., Friday, February, 7th, 1913. Secretary, H. T. Case, 611 Continental Life Building, Toronto.

UNIVERSITY OF TORONTO ENGINEERING SOCIETY.—Meeting on Wednesday afternoon, Feb. 12th. Illustrated lecture by Mr. David Molitor of Engineering Staff of the Panama Canal. H. Irwin, Secretary.

ILLINOIS WATER SUPPLY ASSOCIATION.—The Fifth Annual Meeting of the Association will be held at the University of Illinois, Campaign-Urbana, Ill., March 11th and 12th, 1913. Secretary, Edward Bartow.

THE CLAY PRODUCTS EXPOSITION.—To be held in the Coliseum, Chicago, Feb. 26th to Mar. 8th.

NATIONAL PAVING BRICK MANUFACTURERS' ASSOCIATION.—Annual Meeting will be held March, 3, 4 and 5, 1913, in the Green Room, Congress Hotel and Annex, Chicago, Ill. Secretary, Will P. Blair.

THE INTERNATIONAL ROADS CONGRESS.—The Third International Roads Congress will be held in London, England, in June, 1913. Secretary, W. Rees Jeffreys, Queen Anne's Chambers, Broadway, Westminster, London, S.W.

THE INTERNATIONAL GEOLOGICAL CONGRESS.—Twelfth Annual Meeting to be held in Canada during the summer of 1913. Secretary, W. S. Lecky, Victoria Memoriam Museum, Ottawa

## ENGINEERING SOCIETIES.

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

KINGSTON BRANCH—Chairman, A. K. Kirkpatrick; Secretary, L. W Gill; Headquarters: School of Mines, Kingston.

OTTAWA BRANCH—
177 Sparks St. Ottawa. Chairman, R. F. Uniacke, Ottawa; Secretary, H. Victor Brayley, N.T. Ry., Cory Bldg. Meetings at which papers are read, 1st and 3rd Wednesdays of fall and winter months; on other Wednesday nights in month there are informal or business meetings.

QUEBEC BRANCH—Chairman, W. D. Baillairge; Secretary, A. Amos; meetings held twice a month at room 40, City Hall.

TORONTO BRANCH—96 King Street West, Toronto. Chairman, E. A. James; Secretary-Treasurer, A. Garrow. Meets last Thursday of the month at Engineers' Club.

VANCOUVER BRANCH—Chairman, G. E. G. Conway; Secretary-Treasurer, F. Pardo Wilson. Address: 422 Pacific Building, Vancouver, B.C.

VICTORIA BRANCH—Chairman, F. C. Gamble; Secretary, R. W. MacIntyre: Address P.O. Box 1290.

WINNIPEG BRANCH—Chairman, J. A. Hesketh; Secretary, E. E. Brydone-Jack; Meets every first and third Friday of each month, October to April, in University of Manitoba, Winnipeg.

### MUNICIPAL ASSOCIATIONS

ONTARIO MUNICIPAL ASSOCIATION—President, Mayor Lees, Hamilton. Secretary-Treasurer, Mr. K. W. McKay, County Clerk, St. Thomas, Ontario.

SASKATCHEWAN ASSOCIATION OF RURAL MUNICIPALITIES.—President, George Thompson, Indian Head, Sask.; Secy-Treasurer, E. Hingley, Radisson, Sask.

THE ALBERTA L. I. D. ASSOCIATION.—President, Wm Mason, Bon Accord, Alta. Secy-Treasurer, James McNicol, Blackfalds, Alta.

THE UNION OF CANADIAN MUNICIPALTIES.—President, Chase. Hopewell, Mayor of Ottawa; 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. S. MacMillan, Warden, Antigonish, N.S.; Secretary, A. Roberts, Bridgewater, N.S.

UNION OF SASKATCHEWAN MUNICIPALITIES.—President, Mayor Bee, Lemberg; Secy-Treasurer, W. F. Heal, Moose Jaw.

UNION OF BRITISH COLUMBIA MUNICIPALITIES.—President, Mayor Planta, Nanaimo, B.C.; Hon. Secretary-Treasurer, Mr. H. Bose, Surrey Centre, B.C.

UNION OF ALBERTA MUNICIPALITIES.—President, F. P. Layton, Mayor of Camrose; Secretary-Treasurer, G. J. Kinnaird, Edmonton, Alta.

UNION OF MANITOBA MUNICIPALITIES.—President, Reeve Forke, Pipestone, Man.; Secy-Treasurer, Reeve Cardale, Oak River, Man.

### CANADIAN TECHNICAL SOCIETIES

ALBERTA ASSOCIATION OF ARCHITECTS.—President, R. W. Lines, Edmonton; Hon. Secretary, W. D. Cromarty, Edmonton, 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.

BRITISH COLUMBIA SOCIETY OF ARCHITECTS.—President, Hoult Horton; Secretary, John Wilson, Victoria, B.C.

BUILDERS' CANADIAN NATIONAL ASSOCIATION.—President, E. T. Nesbitt; Secretary-Treasurer, J. H. Lauer, Montreal, Que.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.—President, Wm. Norris, 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, A. A. Dion, Ottawa; Secretary, T. S. Young, 220 King Street W., Toronto.

CANADIAN FORESTRY ASSOCIATION.—President, John Hendry, Vancouver. Secretary, James Lawler Canadian Building, Ottawa.

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

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

THE CANADIAN INSTITUTE.—198 College Street, Toronto. President J. B. Tyrrell; Secretary, Mr. J. Patterson.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President, Dr. A. E. Barlow, 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, Dr. Charles A. Hodgetts, Ottawa; General Secretary, Major Lorne Drum, Ottawa.

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, Patrick Dubee, Montreal; 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 and August.

DOMINION LAND SURVEYORS.—President, Mr. R. A. Belanger, Ottawa Secretary-Treasurer, E. M. Dennis, Dept. of the Interior, Ottawa.

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

ENGINEERING SOCIETY, TORONTO UNIVERSITY.—President, J. E. Ritchie; Corresponding Secretary, C. C. Rous.

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

ENGINEERS' CLUB OF TORONTO.—96 King Street West. President, Willis Chipman; 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 ASSOCIATION OF ARCHITECTS.—President, W. Fingland, Winnipeg; Secretary, R. G. Hanford.

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

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

ONTARIO ASSOCIATION OF ARCHITECTS.—President, C. P. Meredith, Ottawa; Secretary, H. E. Moore, 195 Bioor St. E., Toronto.

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, Major. T. L. Kennedy; Hon. Secretary-Treasurer, J. E. Farewell, Whitby; Secretary-Treasurer, G. S. Henry, Oriole.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, T. B. Speight, Toronto; Secretary, L. V. Rorke, Toronto.

TECHNICAL SOCIETY OF PETERBORO.—Bank of Commerce Building, Peterboro. General Secretary, N. C. Mills, P.O. Box 995, Peterboro, Ont.

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.

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ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—President, H. C. Russell, Winnipeg, Man.; 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.—Wallace P. Cohoe, Chairman, Alfred Burton, Toronto, Secretary.

UNDERGRADUATE SOCIETY OF APPLIED SCIENCE, McGILL UNIVERSITY.—President, W. G. Mitchell; Secretary, H. F. Cole.

WESTERN CANADA IRRIGATION ASSOCIATION.—President, Duncan Marshall, Edmonton, Alta. Permanent Secretary, Norman S. Rankin, P.O. Box 1317, Calgary, Alta.

WESTERN CANADA RAILWAY CLUB.—President, R. R. Nield; Secretary, W H Rosevear, P.O. Box 1707, Winnipeg, Man. Second Monday, except June, July and August at Winnipeg.