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Volume 30. Toronto, February 3, 1916. Contents of this issue on page 5.

The Canadian Engineer

A weekly paper for Canadian civil engineers and contractors

CANADIAN SOCIETY OF CIVIL ENGINEERS

THIRTIETH ANNUAL MEETING AT MONTREAL LAST WEEK GENERALLY DEEMED TO BE THE MOST INTERESTING AND INSTRUCTIVE THAT THE SOCIETY HAS HELD FOR SEVERAL YEARS—IMPORTANT MATTERS DEBATED.

RECOMMENDATIONS for a change in the name of the Society, an appointment of a committee to revise the by-laws, the defeat of the Western amendments to by-laws, and means of meeting financial difficulties, were the chief items of discussion at the thirtieth annual meeting of the Canadian Society of Civil Engineers, held last week at Montreal.

The meeting was called to order at 10.35 a.m., January 25th, with President F. C. Gamble, of Victoria, B.C., in the chair. Prof. C. H. McLeod, secretary of the Society, read the minutes of the last annual meeting.

The first business brought before the members was a resolution expressing great appreciation of the knighting of Sir John Kennedy, Sir Collingwood Schreiber and Sir Alexander Bertram. It was felt that His Majesty had honored not only those three members of the Society, but also, through them, the entire engineering profession in Canada. Sir John Kennedy was present and rousing cheers were given for him, to which he very modestly replied that the honor accorded to him was not at all personal, but was meant for every engineer in Canada.

A telegram of thanks for the contributions to the Engineers' Hospital Fund, signed by General Charles J. Armstrong, chief engineer of the Canadian Army Corps, was read by the secretary. The meeting framed a reply, wishing a speedy and victorious return of all Canadian engineers now at the front. This reply was cabled to General Armstrong.

The president appointed the auditors of the Society, Messrs. Riddell, Stead, Graham and Hutchison, as scrutineers to examine the ballots for officers and for amendments to by-laws. In previous years members of the Society had been appointed scrutineers, and G. A. Mountain questioned the legality of the departure from precedent. An examination of the by-laws showed that the appointment was quite in order.

William McNab wanted to know why the Dominion Government has not accepted the Society's steel bridge specification as standard. The discussion that followed showed that the chief engineer of the Department of Railways and Canals now has the matter under consideration.

The report of the council of the Society was received and adopted, as was also the report of the library and house committee.

The treasurer's report brought on a discussion of the finances of the Society which occupied the remainder of the session. The finance committee made a special report, showing that the income of the Society for 1916 would be considerably less than for 1915 unless many new members should join the Society, and that rigid economy in all matters would have to be the rule. This report, showing exhaustive study of the subject by the finance committee, was appreciated by the members, and they decided to co-operate with the council in every possible way in reducing expenditures consistent with proper service to the membership. For one thing, it was decided to forego printing the list of members this year, and to issue instead a booklet giving the changes in address, additions to membership, etc.

Walter J. Francis, chairman of the papers committee, gave out the following statement, showing that the Society is spending less per member on printing than is any of the other leading engineering societies on this continent, and also that the cost of its printing per page of Transactions is far below that obtained by the other societies:—

TABLE I.—COMPARATIVE STATEMENT OF PRINTING EXPENDITURES.

NAME OF SOCIETY	No. of Members	Cost of Printing	PRINTING			POSTAGE	
			Expense per Member	No. of Pages of Transactions	Cost per page of Transactions	Total Cost	Expense per Member
American Society of Civil Engineers	7,900	$54,676	$6.90	(3,120a) (1,956b)	$21.50	$ 7,338	$0.92
American Society of Mining Engineers	5,000	38,203	7.64	1,569	31.40	—	—
American Institute of Electrical Engineers	7,700	48,103	6.25	2,191	21.95	6,427	0.85
American Society of Mechanical Engineers	7,000	56,938	8.47	1,135	50.15	10,200	1.44
Canadian Society of Civil Engineers	3,060	5,970	1.95	659	9.05	1,887	.62

(a) 1914. (b) 1915

Mr. Francis stated that the above table shows conclusively that the members of the Canadian Society of Civil Engineers are faring very well in proportion to the funds available for printing. He said that it also showed the desirability of making the new printing contract about eighteen months ago whereby the printing was taken out of the hands of Montreal job printers and

entrusted to *The Canadian Engineer* upon a basis most favorable to the Society. The comparisons in Table I. are summarized more clearly in Table II.

TABLE II.

	No. of Members	Cost of Printing	Expense per Member	No. of Pages of Transactions	Cost per Page of Transactions	Cost of Postage	Postage Expense per Member
Canadian Society Civil Engineers.	3,060	$ 5,970	$1.95	659	$ 9.05	$1,887	$0.62
*Other Societies..	6,900	49,480	7.32	1,858	31.25	7,988	1.07

*Average of the four American Societies named in Table I.

Mr. Francis, together with R. A. Ross, chairman of the finance committee, further pointed out that all other disbursements of the Society were equally low. The secretary of the Canadian Society, they pointed out for example, receives a salary less than one-sixth as great as that paid to the secretary of the kindred American Society. Table III. is a statement giving some interesting comparisons along these lines.

TABLE III.—COMPARATIVE STATEMENT OF ALL EXPENDITURES.

NAME OF SOCIETY	No. of Members	CLERICAL STAFF		DISBURSEMENTS		INCOME	
		Total Cost	Expense per Member	Total	Per Member	Total	Per Member
American Society of Civil Engineers --	7,900	$39,311	$5.00	$169,670	$22.00	$160,195	$20.80
American Society of Mining Engrs....	5,000	19,308	3.86	120,969	24.20	115,582	23.12
American Institute of Electrical Engrs.	7,700	28,588	3.60	105,874	13.54	112,775	14.06
American Society of Mechanical Engrs.	7,000	*18,269	2.60	118,847	18.24	147,629	21.09
Canadian Society of Civil Engineers ..	3,060	†45,000	6.43	19,775	6.46	22,079	7.20
		3,768	1.23				

* Printed Statement. † Actual as compiled by Secretary.

The data given in Table III. is even more clearly shown in the summarized form in which it is presented in Table IV.

TABLE IV.

	COST OF CLERICAL STAFF		ALL DISBURSEMENTS		ALL INCOME	
	Total	Per Member	Total	Per Member	Total	Per Member
Canadian Society Civil Engineers	$ 3,768	$1.23	$19,775	$6.46	$22,079	$7.20
*Other Societies.....	29,710	4.24	128,840	19.44	144,045	19.76

*Average of the four American Societies named in Table III.

Mr. Francis said that it had been suggested to him that the American Society of Civil Engineers did not spend as much money when it had 3,000 members as the Canadian Society does now with 3,000 members. He showed annual reports of the American Society for the two years during which its membership approximated 3,000, and they showed that even then the expenditures per member for every item were greatly in excess of the Canadian Society's present expenditures, running from two and a half to four times as great. The income per member was also much larger. It was deemed undesirable, however, to raise the dues of the members of the Canadian Society.

Discussion following upon the presentation of these reports showed that the members were much pleased by the data given, and every expression of confidence was voiced as regards the finance committee and their ability to steer the Society safely through the present strenuous times. The meeting then adjourned till 3 p.m.

E. W. Oliver opened the afternoon session with a discussion on the amendments to by-laws, and the ensuing debate lasted until 5.20 p.m. The best speech of the debate was made by Sir John Kennedy, who said that the main intention of the Society was educational. The Society cannot be a trade union, cannot secure positions for its members, nor hold them in positions. In many other ways the activities of the Society cannot be exerted with dignity. The revision of by-laws is a perennial subject in all societies, and so is the question of smaller units within societies. Engineers are specializing to-day, and each specialty has its own subjects to discuss, and this has at times led to the formation of separate specialized societies in which to discuss them. Such units are more practical than the dividing of a national organization into provincial or district organizations.

But in Canada, thought Sir John, it is better to have one broad national society at present, divided neither by geographical lines nor by specialties, although a certain amount of splitting up of the activities within the Society is inevitable and desirable. The machinery for this exists to-day in the various sections within the Society. At the Montreal meetings, the electrical section has a paper one time on electrical subjects, the mining section another time on mining subjects, etc. This has really kept the Society together, by enabling each to follow out its specialty, yet all meetings have been attended by all members in general, with the result that it has broadened all of our views. It has resulted in a certain amount of overlapping, but even that is good, as it is desirable to interchange ideas. The railroad man, for example, should have some idea of the problems encountered by the waterworks engineer, and vice versâ.

The Society is a centre of information, and while none can expect to be advanced individually by it without his own efforts and worth, yet all can derive much benefit from it. Sir John said he had in his lifetime received a carload of books from the various societies to which he belongs, and that he had obtained a wonderful lot of information of value from them.

He said that he hoped the provincial idea will not grow too strong. The Society's efforts should not be localized too much. For instance, while proud of membership in a national institution like the I.C.E. of Great Britain, he would not care about belonging to a localized society of Irish engineers, or Welsh engineers.

As a result of the discussion, three members submitted conflicting motions regarding the formation of a committee to revise the by-laws, and the president appointed Messrs. Oliver, Conway and Jamieson as a committee to get together and agree upon a motion

which would be satisfactory to all for presentation the following day.

As the hour was late, the reports of branches were received but not read nor discussed. Abstracts from these reports appear on page 204 of this issue of *The Canadian Engineer.*

The report of the Portland cement specifications committee was received, and the specifications they recommended were adopted as the official specifications of the Society, and were ordered to be printed and distributed to members. The report of this committee appeared on page 158 of the January 20th issue of *The Canadian Engineer.*

The meeting then adjourned till 3 p.m. of the following day, Wednesday, January 26th, as Wednesday morning was to be devoted to an inspection trip.

Tuesday evening a smoker was enjoyed at the Society's building, 176 Mansfield Street, where all the business sessions also were held. Several professional entertainers amused the members, and a very pleasant evening was passed. The following morning special cars conveyed the members to the plant of the Canadian Vickers, Limited, where all departments were inspected with great interest.

At the Wednesday afternoon business session E. W. Oliver introduced the joint motion previously mentioned, calling upon council to appoint a committee to decide upon a policy for increasing the prestige of the Society, and for studying the organization and by-laws, and to advise concerning any necessary changes in same; the committee to report to council by September 1st, 1916, and their report to be printed and distributed to all members within thirty days. This was carried with an amendment to the effect that the members of the committee should not be appointed by council, but should be directly elected by the membership, each district electing its own representative. One member is to be elected from each district excepting No. 1, which is to have two members. The branches are to nominate the members, and a ballot is then to be sent out to the members in each district for the election of one of those so nominated.

A letter from J. G. Legrand, of Winnipeg, was read, urging all to do their duty to the Flag at this time.

In a discussion of the above motion, Walter J. Francis thought that insinuations were made that interest in the Society is decreasing. He said that he remembered the time when it had been difficult to get a chairman at the meetings in Montreal. Now there were five or six councillors at every meeting, all willing to preside. He remembered times when only 15 or 20 McGill students and a handful of "old war horses" were the only ones who attended the meetings. Now the assembly room was crowded at meetings, and at times every possible thing that could be sat upon was utilized. Formerly it was often impossible to obtain a quorum at council meetings. During the past year the average attendance at council meetings was much more than a quorum, and some councillors had missed only a few meetings during the whole year. Phelps Johnson had missed scarcely one for years. Did that show decreasing interest in Society affairs?

Mr. Francis had just warmed up to his subject and was "going strong" when members interrupted him and assured him that he had misunderstood certain remarks, and that nobody intimated any lack of interest on the part of the council or the members; so Mr. Francis accepted that statement and did not finish his remarks.

The report of the Committee on Conservation was read by James White. This report was summarized on page 158 of the January 20th issue of *The Canadian Engineer.* Mr. White stated that the figure of $45,000,000 for fire losses per annum in Canada was a clerical error made in his office, and that it should have been $35,000,000, consisting of $10,000,000 forest fires and $25,000,000 other fires.

Conservation means national efficiency, said Mr. White, and perhaps the Commission of Conservation should have been called the Commission of National Efficiency. Mr. White stated that there were 197 delegates from all parts of Canada at the Civic League meeting at Ottawa on January 20th. He stated that within the next month a report on the water-powers of British Columbia would be printed by the Conservation Commission, and he added the following paragraphs to the committee report as originally presented:—

"Substantial progress has been made by the various organizations of the Dominion and Provincial Governments in investigating the water resources of the Dominion. The only province that is not now provided with some form of water resources investigation is New Brunswick, but negotiations, now under way, will probably lead to some satisfactory arrangement in the near future. Manitoba, Saskatchewan, Alberta and British Columbia have permanent systematic hydrographic organizations under the direction of the Minister of the Interior. Ontario is gradually being covered by the hydraulic division of the Ontario Hydro-Electric Power Commission. Quebec is being looked after by the Quebec Streams Commission and the chief engineer of Hydraulic Forces. In Nova Scotia there is a co-operative agreement between the Dominion Water Power Branch of the Department of the Interior and the Nova Scotia Water Power Commission.

The field investigations of these organizations are being published in a very satisfactory form, although there has been some delay in publishing the data promptly, following the completion of the calendar or water year, as the case may be. The chief engineers of the above organizations have had several informal conferences with a view to co-ordinating, systematizing and standardizing their work, and also to facilitate the publication of the data in a uniform way and promptly. The net result of these informal discussions will be that, in the near future, Canada will be completely covered by efficient and effective organizations charged with the responsibility for investigating, in the most complete and comprehensive manner consistent with the dictates of economy, the water resources of the Dominion."

At this juncture Prof. Haultain took objection to Mr. White's report and strongly opposed its adoption by the Society. Prof. Haultain contended that it is still very doubtful whether phosphates have been found in commercial quantities in Rocky Mountains Park; he wanted further information regarding the appointment of a chief inspector of mines, and made certain charges in connection with same; he wished to know what part the Society was asked to take in the affairs of the Civic Improvement League, and why their work should be endorsed; he objected to references to individuals as "the greatest experts in the world," etc.

Mr. White replied in very caustic manner, defending all the statements made in his report. Nevertheless, the meeting decided to receive the report but not to "adopt" it, and this was subsequently made the uniform practice in regard to all committee reports.

The Electro-Technical Committee's report was received and the committee continued.

The Committee on Steel Bridge Specifications made no definite report, but asked to be continued. P. B. Motley, the chairman, wished to have the committee made up of Montreal men only, to facilitate getting them together for discussions, but this was over-ruled. In this connection attention was called to the commendable inauguration during the past year of sub-committees of the Toronto branch, to report to the main committees of the Society and to assist them. The idea of such branch committees was approved of as being likely to give valuable ideas to the main committees.

G. A. Mountain called attention to the advisability of retaining representation of all interests on this committee, so that ultimately its specifications would be adopted by all, resulting in one standard set of steel bridge specifications for the entire Dominion.

The president, F. C. Gamble, then read his address, a brief abstract of which is given on page 205 of this issue. He prefaced his paper with the following remarks:—

"The past year has been one of stress and anxiety. The British Empire has been engaged for eighteen months in the greatest struggle in the history of the world with a nation which for over forty years has been unsparing in preparation for imposing upon the world by force its system of civilization and "Kultur." Notwithstanding the serious handicap of unpreparedness under which the Empire entered upon this war, the British Army, under the unsurpassed guardianship of the Grand Fleet, and supported by contingents from the Overseas Dominions, has withstood the violent attacks of the enemy in Flanders and France with courage and valor.

"It is not too optimistic to say that the ultimate end shall be the triumph of British principles of liberty and justice. To assist loyally in the task thus imposed upon the Empire about three hundred and sixty-three members of our Society (twelve per cent. of the total membership) have given their services freely, of which number thirteen have so far made the supreme sacrifice. We honor those who have died that the Empire may live, and extend to their relatives an expression of our admiration and deepest sympathy. While the memory of their deeds will remain in our hearts as long as we live, it is but fit and proper to commemorate by a tangible token their noble patriotism and unselfish surrender of their lives.

"In one way the Society has already marked its appreciation of this by remitting the annual dues of members actively engaged at the front. This should meet with the unanimous approval of members.

"In the report for the year 1915 the membership of all grades was 3,058. At the commencement of this year (January, 1916), taking into account deaths, resignations and removal from roll for non-payment of dues, the membership is about the same.

"We have to mourn the loss by death during the past year of sixteen members, including juniors and students. Of these, thirteen were killed in action, to which a previous reference has been made. Of the others, special mention should be made of the late Mr. T. C. Keefer, C.M.G., first and tenth president of the Society, and afterwards honorary member, and of Sir Sandford Fleming, who became a member in 1896, and was made an honorary member in 1908. These gentlemen conferred a marked distinction upon the Society, having acquired by probity, eminent ability and usefulness, world-wide reputations. Their careers must be an inspiration to the younger generation.

"There are many Civil Engineers living in the Dominion of marked ability who still hold aloof from us. These can only be induced to join by raising the Society to its proper plane of usefulness and increasing its sphere of influence. Solicitation to join us must be avoided as an undignified and weak expedient. It is quality, not quantity, that is desirable. A most essential factor in bringing about the increase in our membership, attracting to us the most accomplished Civil Engineers, is the firm and courageous carrying out of "The Code of Ethics" adopted by the Society.

"The profession of Civil Engineering, owing to its somewhat uncertain position, having no legal standing, differs from other professions which enjoy the law's protection, and, therefore, there is the more necessity for members to practise the virtue of loyalty to each other and to the profession. If each member realizes his responsibility in this respect public esteem and confidence will increase.

"The Council during the past year has been active in bringing to the attention of governing bodies—Federal, Provincial and Municipal—matters of importance and intense interest to the profession of Civil Engineers practising within the bounds of the Empire. Although no direct beneficial results have been achieved so far, we have no reason to be discouraged. In the coming year, if the past representations are firmly and fearlessly persisted in, some measure of success will without doubt attend our efforts. We are not demanding anything unreasonable or beyond our rights as citizens. We should resent firmly any adverse inference to be drawn from the continued indifferent treatment meted out to the profession by public bodies in Canada. The amelioration of the disabilities under which we labor at present is one of our just demands.

"The Society, through the Council, might well direct its energies towards securing the adoption by governments, for Civil Engineers in the public service, of a standard of qualifications not short of that required by the Society for Associate Members. The Institution of Civil Engineers took this question up with the Imperial Government, meeting with a sympathetic response, and this Society should not hesitate to move in the same direction. It is unfortunately a fact that many positions requiring proper engineering qualifications have been filled by men who have never had either engineering education or experience.

"It would be well also to follow the example of the Institution in another direction. A Civil Engineers Appointment Board, while in no sense to be part of or associated officially with the Society, might be established with the full sympathy of the Council. The Board established in London on these lines has proved useful to engineering employees and younger members of the profession.

"The speaker is of the opinion that this Society, through the Council, should make strong recommendations to the Government of Canada with regard to such of our members who are eminently fitted by age, attainments and experience for commissions in the Corps of Canadian Engineers. There are many whose professional knowledge is more or less wasted in infantry battalions as officers and privates at the present time. In England the Imperial Government has consulted with the Institution of Civil Engineers with regard to members

eligible for commissions in the Royal Engineers, and the recommendations of the Institution have been successful. Why should not this Society and the Government of Canada work together in the same most desirable manner?"

After hearing the president's address the meeting adjourned until 10 a.m., Thursday, January 27th.

In the evening a dinner was given at the Engineers' Club, the visiting members being the guests of the Montreal members. Informal speeches reflected the brotherly feeling underlying the relations between all members regardless of occasional differences of opinion.

On Thursday morning the members received and adopted the following report from the scrutineers:—

AMENDMENTS TO BY-LAWS PROPOSED BY COUNCIL.

		Aye.	Nay.	Not voting
By-law	7	395	52	15
" "	18	386	57	19
" "	27	321	116	25
" "	29	386	44	32
" "	30	334	98	30
" "	36	361	60	41
" "	50	125	17	320
" "	56	326	87	49

AMENDMENTS TO BY-LAWS PROPOSED BY TEN BRITISH COLUMBIA MEMBERS.

		Aye.	Nay.	Not voting.
By-law	7	42	371	49
" "	8	117	229	116
" "	9	119	242	101
" "	10	119	242	101
" "	16	145	218	99
" "	27	97	298	67
" "	30	101	301	60
" "	33	101	264	97
" "	56	96	285	81

There were 462 ballots cast altogether. From the above it will be seen that all of the Western amendments were decisively defeated and all of the Council's amendments were carried excepting that to By-law 50, which result was due to the line "Aye and Nay" under that amendment being accidentally left off the printed ballot.

The election for officers resulted as follows: Vice-president, Thos. H. White, Vancouver. Councillors—Walter J. Francis, Montreal; H. K. Safford, Montreal; H. Donkin, Halifax; A. E. Doucet, Quebec; E. D. Lafleur, Ottawa; J. R. W. Ambrose, Toronto; D. A. Ross, Winnipeg; D. O. Lewis, Vancouver. George Herrick Duggan, Montreal, was elected as president by acclamation.

After the scrutineers' report the newly-elected president took the chair amid applause, and expressed his appreciation of the honor bestowed upon him.

Election of Nominating Committee for 1916 was then held, resulting as follows: E. Brown, G. G. Murdoch, A. Tremblay, G. A. Mountain, A. F. Macallum, J. Chalmers, E. A. Cleveland.

Continuing the reception of committee reports, Andrew F. Macallum was asked to present the report of the Roads and Pavements Committee, abstracts of which were given on page 159 of the January 20th issue of *The Canadian Engineer* and on page 185 of last week's issue.

G. A. McCarthy, chairman of the Toronto branch, called the attention of the members to the honor that had been accorded to a member of the Toronto branch in the election of Mr. Macallum to the presidency of the American Society of Municipal Improvements for the year 1916. The meeting recorded its gratification at this honor paid to one of the Society's members.

F. H. Pitcher, chairman of the Committee on Cast-iron Water Pipe, reported that there is nothing new of sufficient importance to warrant any change in the cast-iron pipe specifications in view of the best practice in the manufacture and use of cast-iron pipe. The meeting authorized the printing of a new edition of the present specifications.

Walter J. Francis, chairman of the Committee on Concrete and Reinforced Concrete, reported that voluminous discussion of the standard specifications for concrete and reinforced concrete had been received from the special committee of the Toronto branch and had been placed in the hands of the members of the main committee.

Henry Holgate, chairman of the Committee on General Clauses for Specifications, reported as follows:—

"Last year's report on general clauses for specifications was referred back to the committee, and the committee was increased in numbers. In the light of subsequent study, the report submitted at the last annual meeting is deemed quite inadequate, and the committee has not yet reached conclusions which can be recommended to the Society for adoption.

"It is doubtful if any set of general clauses can be compiled which can be used as intended under the instructions given to the committee, as the varying demands of contracts for work are so many and the conditions under which they are to be carried out are so various.

"Specifications and contracts for one stated class of work might, perhaps, have standard clauses of conditions, but these might not be applicable to a similar purpose on contracts for work of another variety, and if used, might in all probability lead to disastrous confusion.

"The committee has come to the conclusion that it is not desirable to advise the adoption of one set form of general clauses for specifications, and that if any useful purpose is to be served by standard general clauses, the various classes of work so affected must be separated, and clauses applicable to each class drawn separately, so as to suit the particular class of work.

"Much useful discussion has taken place in the course of the committee's work, which will form the base for further study, but the committee feels it inadvisable to make a report under the existing instructions of the Society, and will await its further instructions." The committee was asked to continue its work.

Prof. H. M. Mackay, chairman of the Board of Examiners, reported that nine examinations were held during the year. Five passed, four failed. The number of examinations is smaller than usual, owing to the recent amendment to By-law 8, which permits of the examination for Associate member to be waived in case of candidates who have had five years' responsible charge of work.

A resolution calling attention to the practice of engineers who are called upon to pass on waterworks and sewerage plans submitted to Provincial Boards of Health being financially interested in special forms of treatment, was submitted to the meeting by Prof. W. Muir Edwards, of Edmonton. After discussion it was decided that this was so fundamental and obvious a feature of business and engineers' ethics that it would be superfluous to call the attention of the Provincial Boards of Health to the matter.

G. R. G. Conway, Toronto, presented the following resolution, seconded by G. A. Mountain:—

"That the Canadian Society of Civil Engineers, assembled at their annual meeting, and including representatives from all parts of Canada, realizing that the work of the trained engineer is becoming more and more of vital importance for the successful termination of the present war, desires to place at the disposal of the Dominion Government its organization for the purpose of assisting and co-operating, by every means in its power, in properly training competent officers for the engineering branches of the service.

"This meeting believes that by the hearty and loyal co-operation of the Society, which its members are anxious to give, the Dominion Government would have available for advice and assistance at all times, the organized services of the best and most highly-trained engineers in Canada.

"The Society would draw attention to the fact that already about twelve per cent. of its membership have volunteered for the defence of the Empire, but feels that the services of these men have not been used to the best advantage, as many of them have been drafted into other branches of service than the engineers. The Society would impress upon the government the importance of requiring that all engineer officers should have had practical engineering training before receiving commissions."

This resolution was adopted unanimously, and the secretary was instructed to mail it to the Prime Minister. The only comment upon it was made by Prof. W. Muir Edwards to the effect that it must not be overlooked that engineering training is the very best sort of training for an infantry officer to have had, as well as an engineering officer.

The Gzowski medal was awarded to E. Brown, H. M. Mackay and C. M. Morssen for paper on "Tests on the Shearing Resistance of Reinforced Concrete Beams." Many members privately expressed their appreciation of the original research work shown by this paper, by Prof. Herdt's paper on "High Voltage Transmission," by the papers on "Decay in Timber," and by other papers presented during the past year, although some others thought there had been an insufficient amount of such research work done during the year.

G. A. Mountain presented a resolution, which was carried unanimously, advising the Committee on Revision of By-laws to consider a change of name of the Society to embody the word "Institution" instead of "Society," on account of the word "Society" calling to mind social affairs mainly, being chiefly used by such organizations as St. Andrew's, St. George's, etc.

Arthur Surveyer, chairman of the Sanitation Committee, reported that the public health acts of all the provinces had been studied and their good points and shortcomings noted. The committee feels that at least two or more of the persons appointed on any public health board should be corporate members of the Society; that all reports, plans and specifications covering sewerage systems, sewage disposal works, water supply or water purification systems, should be prepared, signed and submitted to the public health board by a corporate member of the Society, and that rules covering the filing of plans should be drafted by the health boards, and should be uniform.

The committee also states that the general plans of waterworks systems should show the locations of source of supply, reservoirs, pumping stations, water purification works, and the whole present distributing system, the proposed extensions, and the provisions for future extensions. That these plans should be accompanied by a descriptive report of proposed works.

The plans for sewerage systems and disposal works should include a topographical plan showing main sewer, collecting sewers, location of outfalls, disposal works, elevations of inverts at all important points. That these plans should be accompanied by a report of proposed works, also on the body of water into which sewage is to be discharged.

A section should be inserted, say the committee, in all public health Acts that a municipality cannot submit to the votes of the electors any by-law to raise money for such works as above without having the board of health's approval, based on the plans and reports submitted.

That a section should be inserted in all public health Acts providing that any municipality ordered by the board of health to do any such works as above be authorized to take the necessary amount from its general funds, and, if necessary, to borrow such amount without formality, and even to exceed statutory borrowing powers by 5 per cent. of municipal valuation.

That control of all water purification plants and sewage disposal works be vested in the Board of Health.

That after these recommendations have been fully studied and adopted, the various Boards of Health should be induced to amend their public health Acts accordingly, if possible.

As regards matters which do not affect health materially, such as pumping capacity, pressure at hydrants, etc., it is suggested by the committee that in order to safeguard the credit of the municipalities, the different provinces should each appoint a Provincial Municipal Board, composed chiefly of engineers, all members of the Society, the duty of this Board being to pass judgment upon all important proposed public works and upon the by-laws presented to raise money before these by-laws are submitted to the ratepayers.

Two hundred and eighteen members attended the annual meeting, which is a slightly smaller number than usual, due undoubtedly to the war. The members who attended from outside the Montreal district included the following, the names being given in order of registration:—

John J. McNab, Trenton, Ont.; A. A. Dion, Ottawa; W. Muir Edwards, Edmonton; L. M. Arkley, Toronto; Harry Barker, New York; G. K. G. Conway, Toronto; E. W. Oliver, Toronto; H. E. T. Haultain, Toronto; B. E. Norrish, Ottawa; R. F. Uniacke, Ottawa; Geo. A. Mountain, Ottawa; G. A. McCarthy, Toronto; George Kydd, Campbellford, Ont.; J. R. W. Ambrose, Toronto; E. T. Wilkie, Toronto; Geoffrey Stead, Chatham, N.B.; A. A. Belanger, Ottawa; C. M. Goodrich, Walkerville, Ont.; B. G. Wisser, Carleton Place, Ont.; Geo. E. Roehm, Walkerville, Ont.; F. C. Gamble, Victoria; F. C. Jewett, Campbellford, Ont.; F. De C. Davies, Winnipeg; Alex. J. Grant, Peterboro'; Charles H. Keefer, Ottawa; J. B. Challies, Ottawa; A. St. Laurent, Jr., Ottawa; A. R. Decary, Quebec; Jean T. Claveau, Chicoutimi, P.Q.; F. G. Engholm, Toronto; Gilbert G. Murdoch, St. John, N.B.; Arthur Vincent, Longueuil, P.Q.; Jean Blizard, Ottawa; P. E. Arnat, Chicoutimi; Col. G. S. Maunsell, Ottawa; James Robertson, Lachine; L. A. Amos, Lachine; Harry A. Paquette, Levis, P.Q.; Wm. P. Anderson, Ottawa; James White, Ottawa; R. J. McClelland, Kingston; J. L. Busfield,

Ottawa; B. S. McKenzie, Winnipeg; J. P. Menard, Lac Long; R. L. Dobbin, Peterboro'; J. B. O. Saint-Laurent, Ottawa; D. H. Woollatt, Walkerville, Ont.; A. B. Lambe, Ottawa; T. A. Jardine-Forrester, Quebec; A. F. Smith, Neilsonville, P.Q.; Gordon Grant, Ottawa; Arthur Dick, Quebec; Duncan Macpherson, Ottawa; H. W. Faus, New York; G. H. Blanchet, Ottawa; A. M. Marraway, Ottawa; H. W. McAll, Toronto; C. H. Fullerton, New Liskeard, Ont.; Andrew F. Macallum, Hamilton; T. A. MacLean, Jr., Marble Mountain, N.S.; J. J. Aldred, St. Catharines; Jas. L. F. Millar, Pembroke, Ont.; D. O. Lewis, Victoria; A. Lighthall, Vancouver; H. Bambrick, Winnipeg; J. G. G. Kerry, Toronto; Jos. R. Roy, Ottawa; S. B. Clement, North Bay; A. B. Blanchard, Truro, N.S.; E. A. Forward, Quebec; C. G. Keyes, Ottawa; H. K. Wicksteed, Toronto; B. W. Seton, Toronto; H. T. Routly, Huntingdon, P.Q.; H. W. Read, Stonehaven, N.B.; W. P. Wilgar, Ottawa; A. O. Beauchemin, Quebec.

HIGHWAY WORK IN CANADA.

MR. GEO. A. McNAMEE, secretary-treasurer of the coming Third Canadian and International Good Roads Congress in Montreal, has collected some interesting information regarding recent progress in highway improvement in Canada. We are indebted to him for the following summary:—

In New Brunswick a separate department for roads has lately been created, with Mr. John L. Feeney in charge, and a definite policy of road construction is being formulated. Last year the province subsidized its roads and will again do so this year.

In Prince Edward Island, which is almost altogether an agricultural province, the earth roads are largely repaired and improved each year. The mileage is approximately 3,500 miles. Repairs are made by district road taxes, supplemented by legislative allowances for larger works. The road taxes for 1914 amounted to $36,000 and the legislative allowance was $18,000 for roads and $35,000 for permanent bridges.

In Quebec, where rapid strides have been made in the last half-dozen years, 295 miles of water-bound macadam and 140 miles of gravelled roads were built in 1915 by the government as provincial roads, or by municipalities with government assistance, at a total cost of nearly $3,000,000. The Sherbrooke-Derby Line road, 32 miles, is complete. There remain only 14 miles to be done on the Levis-Jackman road, and of 32 miles of uncompleted road on the Montreal-Quebec road, foundation has been laid for 21 miles. These roads are expected to be finished this year. From 17,000 to 18,000 miles of earth, gravelled or macadam roads are regularly maintained by municipal councils, 476 municipalities having by-laws in force for road maintenance. During the past few years Quebec has expended over $14,000,000 on its roads out of the $15,000,000 appropriated, and an authoritative rumor states that $4,000,000 will most likely be appropriated during the present session of the Legislature. This, together with the balance of appropriation on hand, makes $5,000,000 for roads in Quebec. Several provincial roads asked for by different districts are receiving government consideration.

In Ontario, 20 miles of the Toronto-Hamilton concrete highway was completed in 1915, leaving about 16 miles to complete. The total cost will be about $850,000; the provincial subsidy being $4,000 per mile. The construction of a main highway from Toronto to Oshawa, about 26 miles, and from Ottawa to Prescott, about 60 miles, at a cost of $600,000, are the principal main roads under consideration. In addition to these projects for main roads which will ultimately form sections of national highways, there was constructed in 1915 approximately 250 miles of county roads at a cost of $658,000, of which the province paid one-third. The provincial appropriation of $2,000,000 for county aid is exhausted, but a further appropriation is expected at the coming session of the Legislature. The Ontario Government proclaimed the Highways Bill to take effect last month. Instead of 30 per cent., the government will pay 40 per cent. of construction cost and 20 per cent. of maintenance cost, instead of nothing as heretofore. The increased revenue from motor licenses will be devoted to defraying the additional charges on the provincial revenue.

The Saskatchewan Legislature voted the following amounts for road purposes for the fiscal year ending April 30th, 1916: To be expended from income, on roads and bridges, $500,000; to be expended from capital, on steel bridges with concrete foundations, $300,000; to be expended from capital, for highway construction, $1,200,000. Owing to financial conditions arising from the war, however, it was decided to restrict the expenditures, and the amounts spent under the above three heads are respectively $170,000, $163,000, and $328,000. The province has not yet started the construction of hard metal roadways, the work consisting mainly of making passable the dirt roads.

Since its formation as a province in 1905, Alberta has been spending $500,000 annually upon its roads, in conjunction with the municipal organizations, and where there are no municipal organizations, expenditure is made directly through the Public Works Department. As the province, like Saskatchewan, is a new one, no highways have yet been set aside for construction with permanent material, the problem so far having been largely one of assisting the settler to get from his homestead to his nearest railway point.

The above brief survey omits reference to the work done or under way in Nova Scotia, Manitoba and British Columbia. It may be stated that in the Province of Nova Scotia the expenditures for highways and highway structures have been greater for the fiscal year ended September 30th, 1915, than for any previous year, according to recent advice from Mr. Hiram Donkin, provincial engineer, Department of Works and Mines.

In Manitoba the year 1915 saw much rural roadwork accomplished under the direction of Mr. Alex. McGillvray, engineer of highways. In that province log-drag competitions have been of phenomenal value in promoting interest in and in improving roads.

British Columbia is considerably in advance of the other western provinces, both in the matter of its road policy and in actual accomplishments. Along the Pacific Coast are to be found some hard-surfaced roads that vie with any in the east in the matter of service, many of them being of an interurban character and others market roads in thickly settled valleys.

Canada has made rapid progress in recent years in the much-needed solution of her transportation problem. It is to be expected that the Congress in March will add materially to the desire for better roads, and although the provinces must be guided in their financial plans this year by consideration of the conditions created by the war, there is a common knowledge that much can be done toward the improvement of rural highways without entailing the expenditure of large sums of money.

CANADIAN SOCIETY OF CIVIL ENGINEERS REPORTS OF BRANCHES.

SEVERAL items of interest and information of value are contained in the reports of branches submitted last week at the annual meeting of the Canadian Society of Civil Engineers. Following are a few brief abstracts from the reports:—

Vancouver Branch.—A. K. Robertson, secretary. Membership, 119. Thirteen meetings were held during the year, papers illustrated with lantern slides being read at each meeting. The principal engineering magazines are kept on file in the library and reading room of the branch, 1017 Metropolitan Building. F. O. Mills has been appointed assistant secretary, as Mr. Robertson is on military duty during a portion of the time. R. F. Hayward is chairman for 1915-1916.

Manitoba Branch.—A. W. Smith, secretary-treasurer. Seven regular meetings of the branch were held during the year, at which papers were read and discussed. The average attendance was forty. The Electrical Section held six meetings, at which the average attendance was thirty-three. The Mechanical Section also held six meetings, with fifteen average attendance. The membership of the branch is 218, with 27 members at the front or enlisted. A volume of transactions of the branch, including papers read in 1914-15, was printed this year and distributed to branch members. A registration list of unemployed members has been started. Frank Lee is chairman for 1916. The branch has a balance of $721.21.

Regina Branch.—J. N. de Stein, secretary-treasurer. This branch is just concluding the first year of its existence. Joint monthly meetings are now held with the Regina Engineering Society, the conduct of the meeting being vested alternately in each society. There have been three such meetings to date, and three other general meetings for organization. The branch members number 25, with eight on active service. The chairman is O. W. Smith.

Victoria Branch.—R. W. Macintyre, secretary. Twelve meetings were held during the year with an average attendance of 13.6, five papers being read before the branch. The membership is 79, a decrease of two compared with the previous year. Nineteen members have joined the Overseas Forces. Eight receptions were held during the winter, with a good attendance of members and ladies. The fourth annual convention of British Columbia members was held in Vancouver, December 10th. Owing to the formation of a Provincial Division, the report of the annual meeting is incorporated with the proceedings of the Provincial Division, which is a nominal change only, as all past conventions have been provincial gatherings of all British Columbia members. H. W. E. Canavan is chairman for 1916.

Edmonton Branch.—L. B. Elliott, secretary-treasurer. Membership, 50. Four papers were read before the branch during the year. The branch also spent several evenings visiting engineering works of interest in the city. The chairman for 1916 is A. T. Fraser. Informal discussions on engineering problems of the day are now being held. A discussion on spur track regulations in Edmonton was held recently. At the last regular meeting, Hon. Charles Stewart, Minister of Public Works of Alberta, gave an address on provincial highways. The meetings have been held at the University of Alberta, and members are also accorded the use of the university library. These matters have been arranged through Prof. Muir Edwards.

Quebec Branch.—Ivan E. Vallée, secretary-treasurer. Membership, 110. Seven meetings were held during the year. Ten members have volunteered for overseas service and one member has been killed in action. S. S. Oliver is chairman of the branch.

Ottawa Branch.—J. B. Challies, secretary-treasurer. Membership, 254, an increase of 26 compared with 1914. Thirty-one members are on active service. Thirteen papers were read before the branch during the year. The Normal School auditorium, the board room of the Conservation Commission, and the Ottawa Public Library, have been placed at the branch's service for open meetings. The branch is somewhat hampered by lack of permanent quarters, but finances are low. John Murphy is the branch chairman for 1916.

Calgary Branch.—Sam. G. Porter, secretary-treasurer. There have been nine general meetings during the year. Seven suppers were given, and illustrated lectures enjoyed after each supper. A luncheon and other entertainment was also accorded various visiting parties of engineers. The bank balance is $365.95. The membership is 67, eight of whom have enlisted, and one member has been killed in action. The report states that it is felt that "the branch has advanced materially during the past year, and that it is exerting an influence in the community. The fact that the city council gave us a grant for use in entertaining a party of engineers who visited the city, and accepted our offer to investigate and report on the technical matters referred to in Alderman Fawkes' charges regarding the Centre Street Bridge, are evidences of the official recognition we have received." The chairman for 1916 is William Pearce.

Toronto Branch.—L. M. Arkley, secretary-treasurer. Membership, 344, an increase of 49 over 1914. Eighteen corporate members and about 75 students have joined the colors. Standing committees were formed paralleling the committees of the main Society. Eight meetings were held, at which papers were read, and a trip of inspection to the Welland Canal was much enjoyed. The branch's library and lecture-room are those of the Engineers' Club of Toronto. Finances are in a fair condition. The chairman for 1916 is Geo. A. McCarthy. Reports of some of the branch committees are appended to the branch's annual report.

British Columbia Division.—E. A. Cleveland, secretary-treasurer. The report includes the minutes of the first meeting of the committee of the provincial division of British Columbia, held October 23rd, 1915, and also of the first general meeting of the British Columbia division held December 11th. 1915. The by-laws have not yet been completed. The Vancouver and Victoria branches have requested the provincial government to amend the "Interpretation Act" by inserting therein a definition of the word "engineer" as a "member of the Canadian Society of Civil Engineers, or of the Institution of Civil Engineers of Great Britain or Ireland, or of the American Society of Civil Engineers." The request has not yet been granted. A circular letter was mailed to all corporate members of the Society regarding the amendments to by-laws and regarding the circular letter on the same subject that had been sent out to the members by the council of the Society. The first chairman of the division is T. H. White.

DEVELOPMENT OF TRANSPORTATION FACILITIES IN BRITISH COLUMBIA

ABSTRACTS FROM THE PRESIDENTIAL ADDRESS OF FRANCIS CLARK GAMBLE, BEFORE THE CANADIAN SOCIETY OF CIVIL ENGINEERS AT THE THIRTIETH ANNUAL MEETING IN MONTREAL LAST WEEK.

BEFORE the advent of the Canadian Pacific Railway there were in British Columbia three cities, *viz.*, Victoria, Nanaimo and New Westminster, the two first situated on Vancouver Island and the latter on the Fraser River, seventeen miles from the Straits of Georgia; the aggregate population of these cities in 1880 was 9,070. Since then, by reason of the greater facilities for transportation afforded by steamships and railway companies with increased mileage and improvement of highways, the industries connected with the natural resources of the country have prospered and extended their operations. The cities, including Vancouver, the Pacific terminus of the Canadian Pacific Railway, and Prince Rupert, the western terminus of the Grand Trunk Pacific Railway, have increased in number to twenty-five, with a total urban population of 203,689 and a rural population tributary thereto, including those living both in organized and unorganized districts, of 188,796, making the total population of the province, according to the public census of 1911, 392,485.

The principal centres of population and of commercial and mining industries are at present along the Canadian Pacific Railway, which enters the province by way of the Kicking Horse Pass, and between that railway and the international boundary line, a zone which, in consequence of the construction of railways and of its close connection with the United States, has attracted up to this time the greatest degree of attention.

Those portions of the province lying north of the Canadian Pacific Railway, known as the Lillooet, Cariboo and Peace River Districts, rich in agricultural and mineral possibilities, have suffered for want of reasonable transportation facilities other than those offered by highways, no matter how good these may be. Roads are necessary as tributaries to railways for comparatively short distances, but to depend upon them for conveying freight or transporting ore long distances does not encourage economic development.

The remedies for this are now being applied. The Grand Trunk Pacific Railway and the Canadian Northern Pacific Railway, two transcontinental lines, enter the province by way of the Yellowhead Pass. The former, proceeding west from Yellowhead Pass, terminates at Prince Rupert on the coast, about 700 miles north of Vancouver, while the latter, turning south, about forty miles west of the Pass, to the North Thompson River, thence follows that stream, and the main Thompson and Fraser Rivers to Vancouver. The Pacific Great Eastern Railway, in course of construction from Vancouver to Prince George, a distance of 479½ miles, connects at the latter place with the Grand Trunk Pacific Railway. It is the intention to extend it north and east into the Peace River country, as far as the east boundary of the province.

(The enormous resources of the province are then referred to by Mr. Gamble, chiefly the water powers, minerals, fisheries, timber, pulpwood, and the areas of agricultural land.)

Coastal and Ocean Service.—After the commencement of the Canadian Pacific Railway in British Columbia, the railway company, upon its entry into Vancouver in 1887, took over the coast service, which was immediately augmented and improved with boats of a superior class, the "Princess" type, and was extended to other island and northern ports, including Skagway and Seattle. In addition to the passenger and freight boats the company employs tugs to tow car barges backwards and forwards between the city of Vancouver and Ladysmith, on the Esquimalt and Nanaimo Railway, Vancouver Island, whereby through freight is delivered to Victoria and other island points in car-load lots, thus avoiding breaking bulk at Vancouver.

The fleet of 21 vessels, including 12 "Princesses," engaged in this service has a total tonnage of 35,591.42.

The Grand Trunk Pacific Railway have in operation between Prince Rupert, Vancouver, Victoria and Seattle, two large passenger ships of the "Prince" class of 3,372

Mount Robson (13,000 ft.) from the C.N.P. Railway.

and 3,379 tons registered respectively. Three other small boats, aggregate tonnage 4,710, are in commission between Vancouver and the northern ports when business offers.

The Union Steamship Company of Vancouver have nine steamships, total registered tonnage 5,529, calling at British Columbia ports between Vancouver and Stewart, the latter being the most northerly port on the coast of British Columbia, situated on the Portland Canal.

The Terminal Steam Navigation Company have three boats, of a total registered tonnage of 1,355, plying between Vancouver and Howe Sound ports. There are several other boats engaged in the coastwise service, but in number and size they do not call for special mention here.

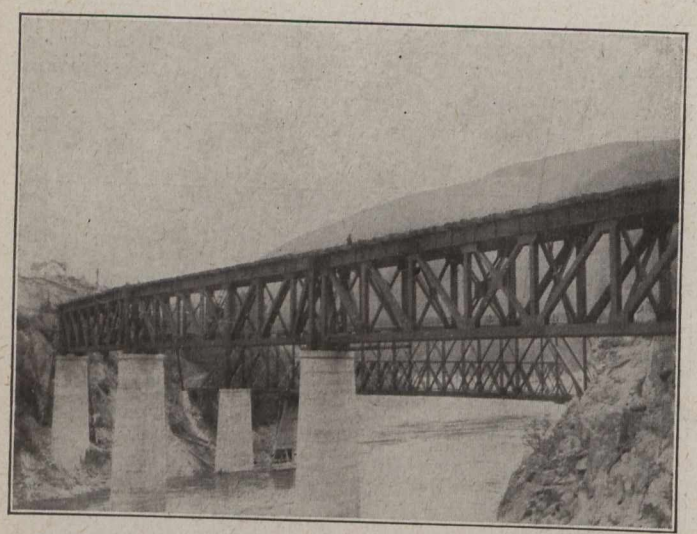
The total number of boats and the registered tonnage thereof, as outlined above, engaged in the coastwise service of the province, are 38 and 43,936 respectively.

The trans-Pacific trade is of great interest. There has been a notable advance since 1880, when the tonnage was insignificant. In 1887, following the opening of the railway between the Atlantic and the Pacific, the Canadian

Pacific Railway established a line of steamships between Vancouver and oriental ports, consisting of three ships, approximately of a total gross tonnage of 10,000. The service was every three weeks both ways. In 1889 three ships of the "Empress" class entered the service, replacing those first mentioned; in 1893 two larger "Empresses" were put in service. Had it not been for the war there would now be five large steamships of a gross tonnage of 51,720 tons running between Vancouver and Yokohama and Hong Kong.

The Canadian-Australian line was established in 1893, with two steamships of a gross tonnage of 6,421, augmented, at this date, to 21,490 tons. One of these boats leaves Victoria, B.C., and Sidney, Australia, every twenty-four days for Sidney, Australia, and Vancouver, B.C., respectively, calling en route at Honolulu, Suvo, Fiji and Auckland, and New Zealand.

Two other lines of steamships, the Blue Funnel and Harrison lines, freight carriers principally, make voyages between the ports of Great Britain and those of the province, via the Suez Canal or by way of Cape Horn, or by the Panama Canal, when again open to traffic, calling both at Vancouver and Victoria.



Bridge No. 3 Over Thompson River at Lytton, B.C., C.N.P. Railway.

Two lines of steamships, one called the Asaka Shosen Kaisha, with four boats of 12,000 tons each, and two boats of 18,000 tons each displacement, totalling 84,000 tons; and the Nippon Yusen Kaisha, with three boats of 13,000 tons each and three boats of 12,500 tons each displacement, totalling 76,500 tons, call about every two weeks at Victoria on the voyage from Yokohama to Seattle.

It is interesting to note the number and tonnage of ships entering inwards and outwards from the ports of the province, in 1880, 1889 and 1915, a period of 35 years:

	Ships.	Registered tonnage.	Foreign.
In 1880:—			
Inwards:	471	356,649	71%
Outwards:	465	353,687	74%
In 1889:—			
Inwards:	1,261	1,312,988	84%
Outwards:	1,313	1,175,567	85%
In 1915:—			
Inwards:	4,453	4,578,405	45%
Outwards:	4,448	4,582,982	44%

It is encouraging also to note by the above figures that while vessels of foreign origin were largely in excess of those of British origin in 1880 and 1889, the position in 1915 has been reversed, British ships outnumbering the foreign.

The Dominion Government, aided by the Imperial Government to the extent of £50,000 granted with the condition that the fleet should have the preference in docking over any other ships, constructed in the 80's a graving dock at Esquimalt. The dimensions are:

Length, with gate at outer invert	481 feet
Width at entrance	65 "
Depth on sill (extreme)	30 "
Least water on sill at low tide.....	17 " 6 inches

As shipping increased the necessity for greater facilities for making repairs arose, and to meet this, marine railways or slips were constructed from time to time.

One of these is situated at Esquimalt, lately acquired by Yarrows, Limited. The dimensions are:

Total length on keel blocks	55 feet
Dead weight capacity	2,500 tons

Another was built in Victoria harbor by the Victoria Machinery Depot, of which the dimensions are:

Length	280 feet
Width	50 "
Dead weight capacity	3,000 tons

In Vancouver harbor, south side, the B.C. Marine, Limited, has a slip of the following capacities:

Length of vessel	250 feet
Width of slip	52 "
Dead weight capacity	1,500 tons

On the north side of Burrard Inlet the Wallace Ship Yards have two marine railways of the following capacities:

(a)	Length of vessel	260 feet
	Width of slip	52 " approx.
	Dead weight capacity	2,000 tons
(b)	Length of vessel	150 feet
	Width of slip	52 " approx.
	Dead weight capacity	1,000 tons

The Grand Trunk Pacific Railway Company lately built at Prince Rupert a floating dry dock. It is in three sections, of which the dimensions are as follows:

Centre Section: Length 270′ x 100′ in width.
Lifting capacity ..... 10,000 tons
Each end Section: 165′ each,
Length 330′ x 100′ in width,
Total length ..... 600′

Lifting capacity, 5,000 tons each ..... 10,000 tons

Total lifting capacity ..... 20,000 "

It is equipped with twenty-four 12-inch centrifugal electrical pumps.

The Dominion Government have now in contemplation the construction of another graving dock at Esquimalt of much greater dimensions than the first one.

Mr. Gamble then prefaces his consideration of land transportation by taking up the natural divisions by mountain ranges and by rivers, outlining physical features and pointing out the leading resources of each division.

Early Land Routes.—Before the Canadian Pacific Railway began operating through British Columbia as a transcontinental railway (the first in Canada) in 1885, there were no commercial railways in the province. Supplies were transported to the interior of the mainland over trails, by pack trains of mules or horses, and sometimes on men's backs; and afterwards by freight wagons hauled by bull, mule or horse teams, over the wagon road from Yale to Barkerville in Cariboo, a distance of about 432 miles.

The construction of the Cariboo Road was commenced through the canyon above Yale by royal engineers in 1862, who built about eight miles. After this, the work was given out by contract by the Crown Colony Government, and the road completed to Barkerville.

When navigation on the Fraser River was possible, freight was transferred to steamers at Soda Creek and carried to Quesnel, a distance of about 54 miles.

The suspension bridge over the Fraser River (220-ft. span) was built by contract in 1863, the contractor being allowed to collect tolls. The cables of this structure, made of black iron wire brought from San Francisco, were laid together on the ground covered with canvas and painted. The towers were of timber resting on masonry. It was in use for forty-seven years.

There was an alternative route into Cariboo, in the early days before the Yale-Cariboo Road was built, by way of the Fraser River, Harrison River, Harrison Lake, Douglas Portage, Lillooet Lake, Portage to Anderson Lake, through the latter and Seton Lake by boat, and thence by road to Lillooet and up the Fraser River over Pavilion Mountain, over 5,000 ft. altitude, to Clinton, where a junction with the Cariboo trail was made. This route was abandoned after the completion of the Yale-Cariboo Road, on account of the excessive cost, the consequence of many unavoidable delays due to necessary transhipments.

A branch stage road was built in 1866 from the Cariboo Road at Cache Creek to Savona on Kamloops Lake, through Kamloops to Okanagan Mission, situated on the east side of Okanagan Lake, and in 1869 a stage line was established between Clinton and Lillooet.

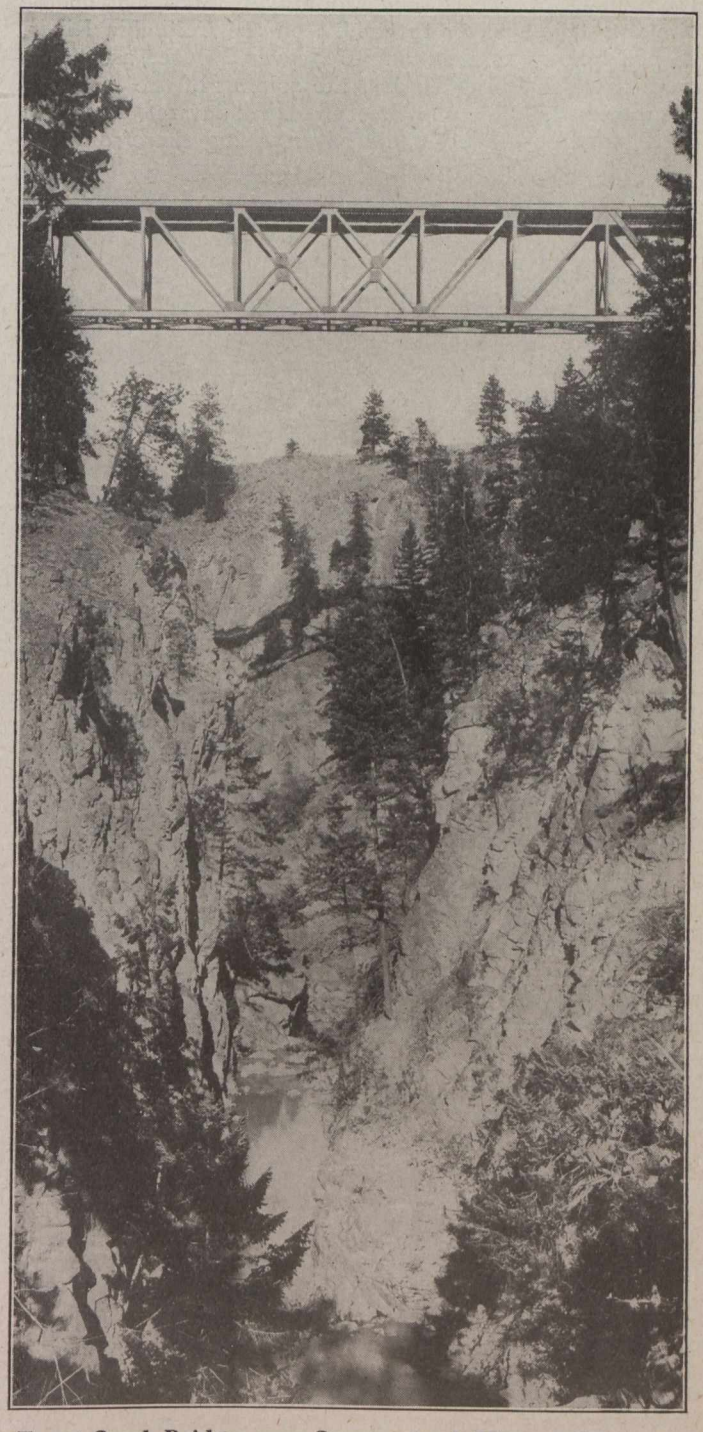
To assist in the construction of the C.P.R. the government of British Columbia transferred to the Dominion Government a strip of land called the Railway Belt, 40 miles in width (20 miles on each side of the centre line of the railway), from a little east of the 123rd meridian to the summit of the Rocky Mountains, containing about 11,050,000 acres, together with a block of land in the Peace River country bordering on the 120th meridian, the east boundary of the province, between north latitudes 55·38 and 56.40 containing 3,500,000 acres.

Since May, 1880, when the construction of the Canadian Pacific Railway was commenced in British Columbia by the Government of Canada, over 2,000 miles of railway have been completed and put in operation in the province, including Vancouver Island; 411 miles are now under construction and 949 miles projected.

The Canadian Pacific Railway.—It has never been definitely explained why the Kicking Horse Pass was selected in the first instance by the Canadian Pacific Railway Company in preference to the Yellowhead Pass, some 1,479 ft. lower, but whatever the reason the fact remains that it has proved a wise and fortunate one for the country through which the railway now passes. Mining districts have been prospected and many mines opened up, and fertile valleys settled and developed that otherwise would have remained untouched for very many years.

The Dominion Government in 1880 let the contract for the construction of that portion of the railway lying between Emory Bar, about four miles below Yale, through the canyon of the Fraser, to Savona at the lower end of Kamloops Lake, a distance of about 123 miles. Work began in May of that year. A contract was let subsequently to the same contractor to build from Emory Bar west to Port Moody, the statutory terminus, a distance of about 105 miles. The track between Port Moody and Savona was laid first with 56-57-lb. steel rails in 1884-5. These two portions were handed over upon completion to the company.

The railway company entered upon construction in British Columbia probably in the fall of 1883, working east from Savona and west from the summit near Field. The last spike closing the connection between east and west was driven near Craigellachie, in Eagle Pass, 351 miles west of Vancouver, by Mr. Donald Smith (afterwards Lord Strathcona), on the 7th November, 1885.



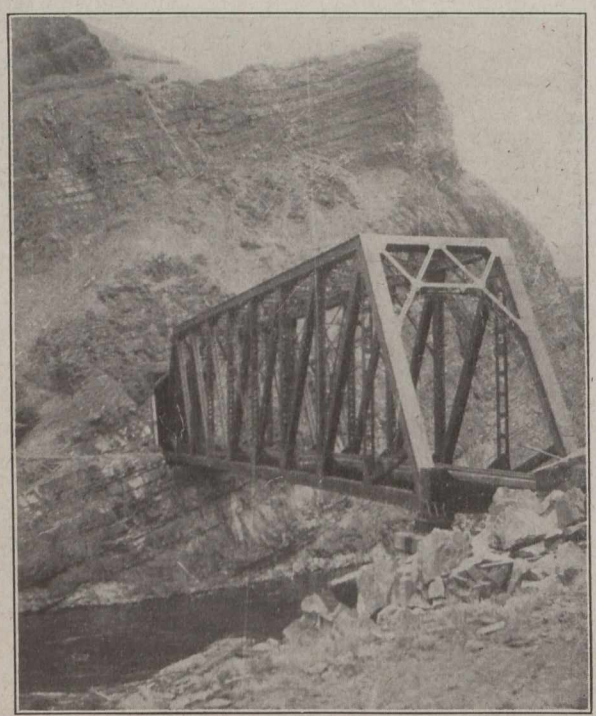
Trout Creek Bridge, near Summerland, West of Okanagan Lake. Centre Span, 250 ft.; Maximum Height, 236 ft.

The railway company extended the line west from Port Moody along the south shore of Burrard Inlet to Coal Harbor, the first through train arriving in Vancouver on the 23rd May, 1887.

From the year 1886 the Canadian Pacific Railway Company has steadily pushed into the territory tributary to, and south of, the main line by constructing branches

or by leasing and absorbing the provincial charters of other railways, whereby fertile valleys and mineral resources lying between the main line and the international boundary line have been developed. The company between Vancouver and Ruby Creek has 92 miles of double track.

The transcontinental line of the railway company enters the province by way of the Kicking Horse Pass at the summit of the Rocky Mountains, follows down the Kicking Horse River to Golden on the Columbia River, thence follows that stream to Beaver Mouth, ascending from there to Roger's Pass, the summit of the Selkirks, descending again following the Illecillawaet River to Revelstoke on the Columbia River, rising therefrom, the line passes through Eagle Pass, descending to Shuswap Lake, and thence following the valleys of the Thompson



Canadian Northern Pacific Railway Bridge No. 5, Over Thompson River, at Ashcroft, B.C.

and Fraser Rivers to Burrard Inlet and Vancouver, a distance of 521 miles.

The weight of rails first laid from Kicking Horse summit to Revelstoke was 70 pounds, from Revelstoke to Savona, 60 pounds. These have all been replaced with 85-pound rails with improved angle bars, and tie plates.

The ruling grades are as follows:—

East Bound:—

Cascade Section:—
- Port Moody, 2 miles east 1.1%
- Katz Landing to Hope, 3 miles 1.2%
- Sailor Bar to Spuzum, 4 miles 1.2%

Thompson Section:—
- Salmon River to Keefer, 4 miles 1.1%

Shuswap Section:—
- Stormont to Notch Hill, 9 miles 1.1%
- Craigellachie to Clan William, 10 miles..... 1.1%

Mountain Section:—
- Revelstoke to Albert Canyon, 20 miles 1.2%
- Albert Canyon to Rogers Pass, 20 miles..... 2.2%
- Golden to Linchoil, 15 miles 1.7%
- Otter Tail to 2 miles west of Field, 4 miles... 2%
- Field to Tunnel, 2 miles 2.2%
- Tunnel to Kicking Horse Lake, 5 miles 4.5%
- Kicking Horse Lake to Hector, 2 miles 2%

West Bound:—

Mountain Section:—
- Field to 2 miles west 2%
- Beaver Mouth to Rogers Pass, 23 miles 2.2%

Shuswap Section:—
- Revelstoke from Columbia River Bridge to Clan William, 8 miles 1.3%
- Tappin Siding to Notch Hill, 8 miles 1.3%

Thompson Section:—
- Penny's Grade, 3 miles 1.1%
- Cisco, 2 miles 1.1%
- Salmon River west, 2 miles 1.1%

Cascade Section:—
- 2 miles east to Spuzum 1.1%
- 1 mile east to Yale 1.1%
- 1 mile east of Hope 1%

One notable betterment is the great reduction which has been carried out on the hill between the tunnel and Kicking Horse Lake, whereby the 4.5% grade has been reduced to 2¼% grade, but lengthening the line four miles with the assistance of two spiral tunnels.

Another very important improvement in the location of the line is at present in progress at Roger's Pass, whereby the 2% grade, compensated, ascending westwards to, and descending from the summit of Roger's Pass, will be very greatly reduced, the line shortened by 4.3 miles and about five miles of snow sheds avoided. This change entails a tunnel, double tracked in anticipation of future needs, five miles in length, one of the longest, if not the longest, on the continent. The grade reduction is the difference in elevation between the summit of the Pass and that of the highest point in the tunnel near the west portal, namely, 552.6 ft.

Entering the east portal the grade rises .95% for a distance of 4¾ miles, then follows a quarter of a mile of level grade to the west portal, the grade therefrom falls for three-quarters of a mile at the rate of .50% and thence at 2% compensated, to connection with the original main line where the grade is the same.

The diversion commences 76.55 miles west of the divisional point at Field and terminates at 87.05 miles.

The bridge erected by the Dominion Government over the Fraser River at Cisco, 152 miles east of Vancouver, was a cantilever type designed by Mr. Snider, of New York, fabricated at Birmingham, England, shipped to Esquimalt and erected in place by the San Francisco Bridge Company in 1884. It was the first bridge of this kind designed for railway purposes.

Previously to being shipped, it was put together at the shops and was there seen by some engineers who ordered a similar structure for the Niagara River below the Falls. It was manufactured of iron and shipped, and was erected before the Cisco bridge, so that although the latter was the first railway cantilever bridge made it was not the first erected.

The total length of the bridge was 529 feet, ballast wall to ballast wall of abutments, the centre span being 315 feet centre to centre of piers.

The traffic becoming heavier, the weight of the locomotive was increased from 100 to 200 tons. It was thereupon decided to replace the cantilever bridge with a steel through truss centre span and deck shore spans. This replacement was carried out without any interruption to traffic by the Dominion Bridge Company. The old bridge has been re-erected over a deep ravine on the Esquimalt and Nanaimo Railway within a short distance of Victoria.

The paper then reviews the history of the construction, and of the development resulting therefrom of the various branch lines and extensions of the C.P.R. in British Columbia, with particular reference to the Kootenay Central Railway; the Revelstoke-Arrowhead-

Nakusp-Kalso system; the Shuswap and Okanagan Railway; the Crow's Nest extension, the Kettle Valley Railway, the Esquimalt and Nanaimo Railway, and others.

The Canadian Northern Pacific Railway.—The Canadian Northern Pacific Railway Company was incorporated by an Act of the Legislature of British Columbia in 1910. By a previous Act an agreement confirmed by an Act had been entered into whereby the government of the province agreed in consideration of the company building 500 miles on the mainland, and 100 miles from Victoria on Vancouver Island, to guarantee the company's bonds to the extent of $35,000 per mile, 600 miles in all. The guarantee of bonds for the 500 miles on the mainland was afterwards increased by $10,000 per mile. Further undertakings by this company received assistance from the province in the shape of guaranteed bonds as follows: 339 miles of branch lines and extensions at $35,000 per mile; 11 miles Westminster Bridge to Vancouver, at $10,000 per mile; 6 terminals, Port Mann, Westminster, Vancouver, Patricia Bay and Victoria. Lump sum, $10,000,000.

The line on the mainland has been completed and is now in operation from Yellowhead Pass to Westminster bridge, and thence over the tracks of the Great Northern Railway Company to Vancouver.

The Canadian Northern Pacific Railway enters the province of British Columbia through the Rocky Mountains at Yellowhead Pass, from thence paralleling the Grand Trunk Pacific Railway, on the south side thereof, it follows the Fraser River, Mt. Robson to the right, to Tete Jaune Cache for a distance of about 42 miles, thence turning south, it passes over Albreda Summit—there are seven steel bridges between Yellowhead and this summit—to the North Thompson River, which it follows to Kamloops, crossing the same in its course four times. From Kamloops paralleling the Canadian Pacific Railway generally on the opposite side of the river it continues down the Thompson River, crossing it seven times, and the Fraser River, crossing it at two points, to New Westminster, thence over the Provincial Government bridge at that place, it proceeds to Vancouver, as before stated, over the tracks of the Great Northern Railway, a total distance of 511 miles. All the bridges over the Thompson and Fraser Rivers have steel superstructure resting on concrete piers and abutments. One span on the North Thompson River above Kamloops has a vertical lift span.

The Pacific Great Eastern Railway.—The Pacific Great Eastern Railway, now under construction between Vancouver and Fort George, where it will form a connection with the Grand Trunk Pacific Railway, has a length of 479.6 miles. Its initial point is on the north short of Burrard Inlet, where it will connect with the proposed bridge over the Second Narrows of that sheet of water.

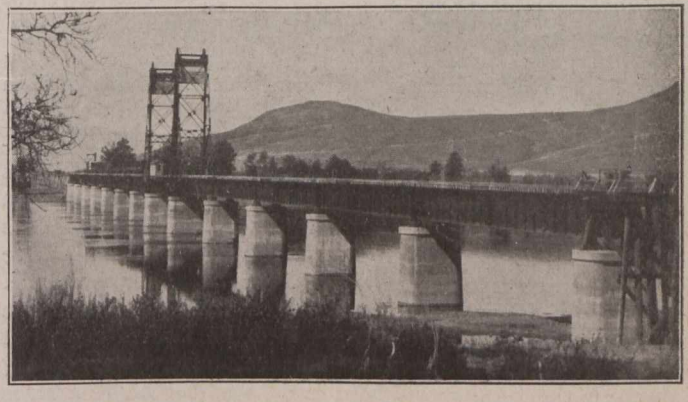
At the present time it is constructed between Lonsdale Avenue, in the city of North Vancouver, and a point called Whytecliffe, 13 miles west of the shores of Howe Sound. Between Whytecliffe and Squamish (a distance of 27 miles), the present terminus of the railway, no work of construction has been performed. From Squamish the line follows up the Cheakmus River to the summit at Green Lake. From Mons or Green Lake the line descends to the Lillooet River, Pemberton Meadows, 58 miles from Squamish dock. From the Lillooet River the line ascends over Birkenhead Summit, then descending to Anderson Lake, skirting its north shore and that of Seaton Lake, to Lillooet on the banks of the Fraser River. From Lillooet the line follows up the east side of the Fraser River on a grade of 2% and 2.2% for about 28 miles to Kelly Lake summit, and thence on to Clinton, a distance of 167 miles from Squamish. From Clinton, to which point the line is now being operated from Squamish dock the direction is northeasterly to Horse Lake summit. From Horse Lake summit the line turns to the northwest and skirts the shores of Lac la Hache on the south side to the divisional point at Williams Lake, thence passing Quesnel, returning to the Fraser River it continues on the east side thereof to the Grand Trunk Pacific bridge on the Fraser River opposite Prince George. The Pacific Great

Yellowhead Pass from the Summit of Mount Resplendent (8,000 ft.), Showing C.N.P. Lines on Extreme Left; G.T.P. Parallel to it and Fraser River on Right.

Eastern Railway, when finally finished, will open up one of the most desirable sections of British Columbia.

From Prince George it is proposed to extend this railway northwards and westerly to the Peace River country, where it is anticipated connection will be made with one of the roads in the northern part of Alberta.

Grand Trunk Pacific Railway.—The Grand Trunk Pacific Railway (transcontinental line) enters British Columbia by way of Yellowhead Pass paralleling the Canadian Northern Pacific Railway down the Fraser River to nearly Tete Jaune Cache, a distance of 42 miles, from this point it continues down the Fraser, which it crosses, into Prince George, thence running up the



Bridge No. 10 Over Thompson River at Kamloops, B.C., C.N.P. Railway. Note Vertical Lift Span.

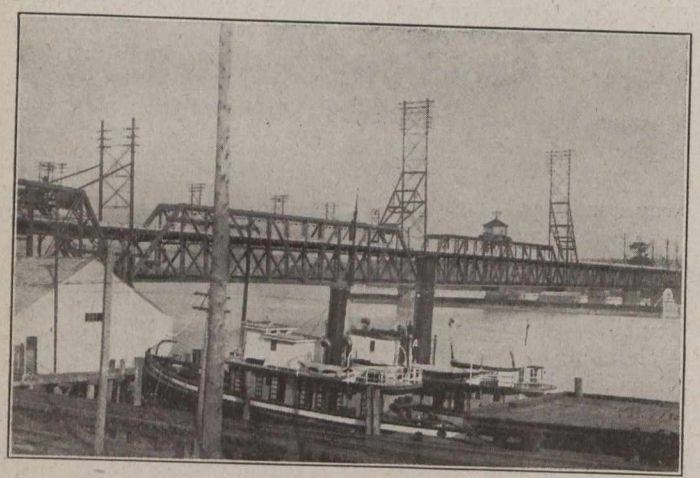
Nechacco River to Fraser Lake it passes through the Bulkley Valley to the Skeena River, about Hazleton, thence down that river to its estuary which it follows along the north shore line to the terminus of the railway at Prince Rupert, a distance of 703.4 miles.

The ruling grade westbound is .4 of 1%. The maximum grade is the same. The ruling grade eastbound is the same; the maximum grade eastbound is 1%, 20.15 miles in length, and designed as a pusher grade. Outside

of the 20.15 miles mentioned all eastbound grades are .40 of 1% or less. The maximum curve in British Columbia is 6 degrees.

At Prince George, where connection will be made with the Pacific Great Eastern Railway, another transcontinental road will be admitted into Vancouver.

Great Northern Railway.—The Great Northern Railway Company, incorporated in the United States, controls in the province of British Columbia all the lines constructed under charter guaranteed by the Provincial Legislature to the Vancouver, Victoria and Eastern Railway and Navigation Company; the Crow's Nest Southern Railway; the Victoria and Sidney Railway; the Victoria Terminal Railway & Ferry Company, and the New Westminster Southern Railway; the Red Mountain Railway which is a branch of the Spokane Falls & Northern Railway from a point south of the boundary line to Rossland in British Columbia; the Fort Shephard and Nelson Lake Railway from the boundary line to Nelson, B.C.; the Vancouver, Westminster & Yukon Railway, approximately 420 miles in length. The terminus in this province is Vancouver. With the exception of the Victoria and Sidney Railway, all the lines mentioned above lie between the Canadian Pacific Railway and the international boundary line. This railway system brings the northern portion of the province into close touch with the United States.



Bridge Over the Fraser River at New Westminster, Built by the British Columbia Government.

The most easterly point of the Great Northern Railway Company in British Columbia is Michel on the Crow's Nest Southern Pass. From Michel the line proceeds down the Elk River, passing Fernie and paralleling the Crow's Nest line of the Canadian Pacific Railway to Elko, where the latter line crosses under the one now under reference. From Elko this road proceeds in a southwesterly direction to Kootenay River and crosses into the United States at a place called Gateway. Thence, after meandering through the States of Idaho and Washington it returns to Canada: (1) At Waneta on the east side of the Columbia River at the boundary line; (2) at Paterson on the east side of the Columbia River; (3) at Laurier. From Laurier it runs on the north side of the boundary line through British Columbia, passing Grand Forks, with the branches to Granby and Phœnix, leaving the province again at Carson, returning to the north side of the boundary line at Midway and leaving it again about Bridesville, returning to the north of the boundary line at Chopaka on the Similkameen River, thence following up the Similkameen River to Princeton and on to Otter Summit. From Otter Summit the V. V. & E. Railway and Navigation Company (Great Northern Railway Company) has running rights over the Kettle Valley Railway to Hope on the Fraser River, then having the same rights over the Canadian Northern Pacific Railway to Sumas, and thence through the southern part of New Westminster district to the bridge over the Fraser River at New Westminster, and then on to Vancouver.

The bridge over the Fraser River was built by the province of British Columbia and was operated for traffic in the year 1904. It gives access to Vancouver for three transcontinental railways, namely, the Great Northern Railway, the Northern Pacific Railway, and the Canadian Northern Pacific Railway.

British Columbia Electric Railway.—The British Columbia Electric Railway Company has also running rights over this bridge. This company was incorporated in 1897, and immediately took over the operation of electric tramways and light and power services in the cities of Victoria, Vancouver and New Westminster, and the adjoining territory. The present mileage of single track, including city and suburban lines, is 281 miles, in details as follows:

Vancouver Island	51 miles
Mainland	230 "
	281 "

The above-mentioned bridge is a steel structure resting on solid masonry piers consisting of the following spans:

1 through fixed span of 225′
1 " " " " 380′
1 " swing " " 380′
5 " fixed spans of 159′ each.

The approaches to the spread span on the north side:

East Railway Approach:

1 deck-plate girder skew span 90′
2 through plate girder skew spans of 53.5′ each
1 deck-plate girder skew span 41′

West Railway Approach:

1 deck-plate girder skew span 71.5′
1 through plate girder skew span of 43′
1 " " " " " " 38′
1 deck " " " " " 32′

The highway floor is on the upper chords of the bridge. On the north side the approach consists of three deck plate girder spans of 57.5 ft. each.

Steel bents are used to support all railway spans that cross railway tracks of the Canadian Pacific Railway and the Great Northern Railway; and also the three highway spans at the north end of the structure. The clear roadway for both the railway and highway is 16 ft.

The approach on the south side is by means of a wooden trestle crossing over the Great Northern Railway line, and makes all necessary connections.

In our issue of January 20th there appeared an article on the Welland Ship Canal, in which it was stated that certain excavation work had been done by "an 85-Ton Marion-Osgood Shovel." As the corporate name of Marion-Osgood Company was some time ago changed to The Osgood Company, this should have read "an 85-Ton Osgood Shovel."

IMPORTANT CANADIAN WATER POWER QUESTIONS.

At the recent meeting of the Commission of Conservation, Mr. Arthur V. White, consulting engineer to the Commission, reported, in part, as follows concerning water interests of Canada. Last year's annual report contains a comprehensive statement respecting certain very important water problems with which the Commission is especially concerned; as, for example, the proposed development of power on the St. Lawrence River at the Long Sault Rapids; the unauthorized diversion of water from the Great Lakes system by means of the canal of the Sanitary District of Chicago; and the hydro-electric power developments at Niagara Falls.* A brief reference may here be made to the present state of affairs in connection with such problems.

Long Sault Rapids, St. Lawrence River.—As is known, the Long Sault Development Company, of New York, has had its charter, granted by the State of New York, declared, by the governor and by the attorney-general of the State, to be unconstitutional. The company has filed application with the Supreme Court of the United States, with the object of having its case reopened before that tribunal, in order, if possible, to secure a re-establishment of its status with respect to its former charter. It was expected that the case would be tried at Washington, D.C., in the October term of 1915, however, it will probably not come up for hearing until March, 1916. The Commission of Conservation is keeping informed upon this matter.

Water Diversion by Chicago.—The Sanitary District of Chicago, it may be recalled, has been diverting from the Great Lakes system into the Mississippi River, more than double the quantity of 4,167 cubic feet of water per second—the amount authorized by permit of the United States Secretary of War. The attorney-general of the United States has brought a suit against the Sanitary district, which action is being tried in the District Court of Chicago.

This action has been referred to, by some persons in the United States, as a "friendly suit," the signification of the phrase as thus used being: that inasmuch as it was anticipated such suit would involve the taking of a great deal of technical testimony, it was considered desirable, in order to finally save time in the Supreme Court, to develop the case and have the testimony submitted in one of the lower courts and then, subsequently, the case could be submitted largely in printed form for the consideration of the higher court.

As the quantity of water, which is being diverted by the Sanitary District, is avowedly a transgression of its permit from the United States War Department, many Canadians who have been interested in this matter have been perplexed when trying to understand why it has been necessary to develop such a prolonged and extensive technical case, when the fundamental fact at issue, *viz.*, the diversion of the water in direct violation of the government permit authorizing same, is so outstanding a fact that it can scarcely be made more cogent by technical or other special evidence.

With regard to the additional carrying capacity of the newer canal, known as the Calumet-Cutoff, it has been understood that the United States Secretary of War authorized the construction of this new canal, subject to the provision that as a result of such construction, the total diversion of water through both the Chicago and Calumet rivers together, should not be greater than would otherwise be diverted, or become legal to divert, through the Chicago River alone. In view of the fact that the Chicago Drainage Canal has been designed so that, from the physical standpoint, it could carry from two to three times the quantity of water authorized by the permit of the United States Secretary of War, it would appear that there could scarcely be satisfactory justification for constructing a large additional channel like the new Calumet-Cutoff. Once such large channels are actually constructed, the requests for additional water may be expected to become more and more insistent, or the water may even again be taken in defiance of authority. Obviously there will always be greater danger of having water diverted with consequent danger to the interests entitled to use it in its natural channels, than would be the case if channels admitting of such diversion were not created. Consequently the construction of such channels as the Calumet-Cutoff can hardly be considered as other than a serious additional menace.

Diversions from St. Croix River, New Brunswick.—Speaking of diversions from boundary waters, it may be stated that the Commission of Conservation, in 1915, had brought to its attention an actual diversion of boundary waters, without proper authority, on the St. Croix River, which, as is known, constitutes, for a portion of its length, the international boundary between the Province of New Brunswick and the State of Maine.

Briefly stated, the facts are as follows: United States financial interests controlling the St. Croix Paper Company of the State of Maine, and operating through two allied companies—one the St. Croix Water Power Company, chartered in 1899 by special act of the Legislature of the State of Maine, and the Sprague's Falls Manufacturing Company, Limited, chartered in 1902 by special act of the Parliament of Canada—secured control of the two most valuable power sites on the St. Croix River; one at Sprague's Falls, the other at Grand Falls. The electric energy capable of development aggregates some 25,000 horse-power and is to be used entirely on the United States side for the operation of pulp and paper mills located at Woodland, Maine, where a thriving community, claiming a population of 1,500 to 2,000 has, as a result of this power, already been built up.

At Sprague's Falls the rated capacity of the power plant is about 12,000 to 14,000 horse-power. Another plant situated near Grand Falls, about ten miles above Woodland, has recently been completed with an additional rating of 12,000 to 14,000 horse-power, which is to be transmitted to Woodland in order to increase the capacity of the company's plant there located. It has been stated that the property of the St. Croix Paper Company, exclusive of their extensive timber holdings, represents an investment of over $3,500,000. The average net earnings of the company during recent years is stated to be over $300,000 per annum.

Now, in order to develop this power at Grand Falls, the company constructed a large canal lying, and extending for nearly a mile, entirely within the State of Maine. By means of a dam erected across the international boundary at Grand Falls, an artificial lake has been created so as to enable the water of the St. Croix River to be diverted, by the canal, into the United States for the development of power at the Grand Falls power house. At its lower stages the total flow of the St. Croix River—an international boundary stream—will be diverted into the United States.

The Commission of Conservation being requested to report upon this diversion, the assistant to chairman, Mr. James White, appeared before the International Joint Commission and presented, on behalf of the Commission

* See *The Canadian Engineer* for February 11th, 1915, page 238.

of Conservation, a memorandum objecting to the diversion; also requesting that the use of Canada's share of the waters of the St. Croix River be only permitted on such terms, including time limit, as would ensure that the Province of New Brunswick or the Dominion of Canada would receive reasonable compensation for the use of Canada's waters; and, further, that Canada's equity in the waters, *per se*, be inalienably preserved.

The time will come when Canada will have uses for her share of all such water powers. One element of danger which the Commission of Conservation emphasized in connection with the diversion of waters like those of the St. Croix River into the United States, was that while the International Boundary Waters Treaty contemplates the possibility of certain "temporary" diversions, yet, unless the terms and conditions of such temporary diversions are explicitly understood and specified, and means taken to render the diversion only a "temporary" one with respect to time, there may be an effort later, on the part of interested parties, to claim that the diversion had resulted in the establishment of vested interests, and should *now* be regarded as of a more or less permanent, rather than a temporary character.

Niagara Power Development.—A year ago it was pointed out in connection with power development that a complex situation exists along the Niagara River, more particularly in the vicinity of the Falls.

Attention was drawn to two Bills—the Cline Bill and the Smith Bill—presented to the United States Congress, both of which measures contain features which, if enacted into law, would have an important effect upon Canadian interests.

In last year's report attention was drawn to the opinion delivered by the Public Service Commission of the State of New York, and quoted the Commission as representing:

> That there is a large shortage of electric power in western New York, with a strong demand for greater supply which is not being met by existing companies. . . . We are using all the power made on the New York side, and all that has been brought from Canada, and the demand for more power in western New York is insistent and being urged with great force.

And it was also stated that it had been urged; if the importation, into the United States, of power from Canada were prohibited it "would plainly amount to a great public calamity."

All these facts indicate that the time has arrived when the strongest possible efforts will be made to secure more and more use, for power purposes, of the waters of the Niagara River.

In the United States there are a number of public organizations already actively interested in securing additional development of Niagara power.

The Joint Legislative Water Power Investigating Committee, appointed by the Legislature at Albany, under the chairmanship of Senator George F. Thompson, has recently (December, 1915) been holding power hearings in New York City and elsewhere.

At these hearings, the president of the American Civic Association, as reported in the daily press, stated that "the Thompson committee were looking for testimony which could be distorted into an excuse for a development of vast importance to the city of Niagara Falls, at the expense of the State and nation."

The Hydro-Electric Association of Niagara Falls has been holding meetings and drafting proposed legislation which, it is stated, will be presented to the New York Legislature for approval early in 1916. This organization seeks the use of the 4,400 cubic feet of water per second available in the United States under the International Boundary Waters Treaty, but which has not yet been apportioned.

New York financial interests have had engineers exploiting and making representations to government departments in the United States, respecting schemes for the proposed development of power by means of dams in the lower Niagara River.

The Federal Light and Power Company, of Detroit, it has been stated, have just secured a permit from the United States Federal Government permitting the importation of Niagara power via Canada to Detroit.

Hearings respecting Niagara power have been held before the United States House of Representatives Committee on Foreign Relations. Bills such, for example, as the Smith Bill and the Cline Bill, have been under discussion by this important committee.

Hydro-Electric Power Commission of Ontario.—The growing market for Niagara power in Canada is strikingly emphasized by the success of the undertakings directed by the Hydro-Electric Power Commission of Ontario. Recently the chairman of the Commission, Sir Adam Beck, in drawing attention to the fact that the government transmission lines now carrying from Niagara a load of 110,000 horse-power, said that he could not help recalling the time when the late premier, Sir James Whitney, told him that "the Commission would not require 10,000 horse-power." As a matter of fact, the markets for the Commission's power have developed so rapidly that the Commission itself has been compelled, earlier than was anticipated, to seek diligently for new sources of power.

The chairman of the Commission has stated that there can be made available some 6,000 to 6,500 cubic feet of water per second out of the unappropriated portion of the 36,000 cubic feet per second allotted to Canada under the Boundary Waters Treaty. The Commission proposes that this surplus be utilized by it under a head of some 300 to 305 feet, resulting, in round figures, in the development of some 200,000 horse-power. The water would be conveyed from the vicinity of Chippewa Creek to, and discharged near, Queenston.

All the electric companies developing at Niagara Falls have found that their market demands have exceeded their expectations. Over 100 Ontario municipalities are now supplied by the Hydro-Electric Power Commission; and in January, 1916, another reduction was made in electrical rates, resulting in the saving of from 3 to 20 per cent. to consumers in about 60 municipalities.

Rural customers—not necessarily meaning in every case farmers, but rather small rural consumers—being supplied, now number some 700 to 1,000.

Last fall the Hydro-Electric Commission placed in operation its new plant at Eugenia Falls, Ontario, having a possible capacity of 8,000 horse-power, half of which is already installed. Ten or twelve municipalities are being supplied from this plant. Other municipally owned plants are to be constructed.

During the past year the first government-owned electric railway in Canada, known as the London and Port Stanley Railway, was placed in operation by the Commission. A summary of the first half year's operation ending December 31st, 1915, shows a gross revenue of $145,737.84, a net expenditure for operating expenses and fixed charges, etc., of $136,460.20, making the net earnings for the half year of $10,277.64. Freight appears to be the important factor in ensuring profitable returns for such roads.

In the municipal elections held in January, 1916, all the larger municipalities concerned, including the cities of Toronto and London, passed a by-law involving a possible expenditure of some $14,000,000 to provide a government-

owned systems of hydro-radial railways, the trunk line of which will run from Toronto to London. Such railway systems will require much additional power.

These facts just cited are offered by way of further emphasizing the great economic importance to Canada of power like that obtained from Niagara. The larger portion of southwestern Ontario is now dependent for power and lighting on the hydro-electric developments at Niagara.

Problems corresponding to those associated with these Niagara developments, involving as they do the question of the exportation of electrical energy, are of vital importance to the whole Dominion, and are worthy of the best statesmanship which Canada can bring to bear upon them.

Investigation by International Joint Commission at Lake of the Woods.—What is known as the Lake of the Woods investigation is being conducted by the International Joint Commission, under the Boundary Waters Treaty, of 1909, between Great Britain and the United States. The chief purpose of the investigation is to secure the most advantageous use of the waters of the Lake of the Woods and of the waters flowing into and from that lake on each side of the boundary for domestic and sanitary purposes; for navigation and transportation purposes; for fishing purposes, and for power and irrigation purposes; and also to secure the most advantageous use of the shores and harbors of the lakes and the waters flowing into and from the lake. This object is sought to be attained by means of regulating the lake between certain desired and yet-to-be-determined levels.

Through the courtesy of the Commission of Conservation, and upon request by the Canadian Commissioners of the International Joint Commission, arrangements were made for the writer to have whatever time would be necessary to fully attend to the duties of this important investigation.

The total area of the territory which drains its waters into the Lake of the Woods is 26,750 square miles, of which 15,565 square miles, or 58.2 per cent. are in Canada, and 11,185 square miles, or 41.8 per cent., are in the United States. Of this 26,750 square miles, 3,960 square miles, or 14.8 per cent., is water area, of which 70 per cent. is in Canada, and 30 per cent. in the United States.

Comparatively few persons have any adequate appreciation of the extent and value of the great inland water resources of portions of Canada. In this connection a few brief statements, having the Lake of the Woods watershed in mind, will doubtless be of interest.

The extent of the area of the Lake of the Woods watershed, 26,750 square miles, may be appreciated when it is understood that it is only about 5 per cent. less than the area of the Province of New Brunswick. It is greater than the combined areas of the States of New Hampshire, Massachusetts, Rhode Island, Connecticut and Delaware. Its water surface, at 3,960 square miles, is, if we except the Great Lakes system, larger than the water area of any individual State in the United States; the State of Minnesota being probably the nearest approach, with 3,824 square miles of water out of a total area for the State of 84,682 square miles.

The area of the Lake of the Woods, including Shoal Lake, with 107 square miles, is 1,485 square miles. The area of Rainy Lake is 345 square miles.

The waters of the Lake of the Woods eventually discharge into Hudson Bay. Important water power development has already taken place at the outlet of the Lake of the Woods, and also on the Winnipeg River. At the outlet there are located the plants of the Lake of the Woods Milling Company, having an installation of about 6,000 horse-power, and flour mills with a capacity of 9,000 barrels per day. The municipality of Kenora has a power plant at the outlet of the Lake of the Woods, which has an installed capacity of about 3,600 horse-power.

On the Winnipeg River at the present time, below the outlet of the Lake of the Woods, there is an installation of about 75,000 horse-power. It has been stated that there is about 290 feet of utilizable fall between the Lake of the Woods and the Winnipeg River with a potentiality under controlled outflow, exceeding 400,000 horse-power.

In order to convey some idea of the volume of water corresponding even to one foot of depth on some of these lakes, it may be stated that on the Lake of the Woods a depth of one foot is equivalent to 41.4 billion cubic feet, while the corresponding volume for one foot of depth on Rainy Lake is 9.6 billion cubic feet. Speaking in other terms, a depth of one foot on the Lake of the Woods would supply 1,313 cubic feet per second for one year, while one foot depth on Rainy Lake would supply 305 cubic feet per second for the same period.

It will be perceived, therefore, how the storing of the run-off from the Lake of the Woods watershed in Rainy Lake, Lake of the Woods and elsewhere, may be made to exert a marked beneficial influence upon water powers receiving supply from this watershed. The International Joint Commission, in making its recommendations respecting a proposed regulation of the Lake of the Woods, will consider the advantage which would result to power interests, and also take into account any disadvantages that may result to riparian owners living in the State of Minnesota or elsewhere, whose lands, bordering on the lake, may, under certain regulation of levels, be subjected to damage by flooding.

Lake Winnipeg is one of the lakes lying upon the water course which connects Lake of the Woods with Hudson Bay. As stated, comparatively few people appreciate the extent of some of these waters, and are surprised when, for example, they are informed that Lake Winnipeg has an area of some 9,400 square miles, which is about 2,000 square miles larger than the area of Lake Ontario.

Water Powers in British Columbia.—Although we have not been able to complete the report relating to the water powers of British Columbia, upon which we have been engaged, nevertheless all possible effort has been, and is being bestowed upon this work. It may not be amiss to remark that the other work, which has necessarily taken so large a part of our time, involves matters of great national importance, and which affect all the provinces of Canada.

With the continued kind co-operation of various government organizations which have hitherto greatly assisted by contributing data, it is planned that the hydrographic data shall, wherever possible, be brought up to the end of 1915. It will be appreciated, therefore, that while the British Columbia report has necessarily been delayed, it will be up to date when published, and it is believed that when the report is issued it will be of considerably more permanent reference value than could otherwise have been the case.

The Alaska Engineering Commission has completed the new water system at Anchorage, ending a water shortage which began with the freeze-up last November. During the shortage merchants and householders paid a dollar a barrel for water taken from holes chopped in the ice on Ship Creek and water peddlers sold the precious fluid at 15 cents a bucket.

OILING OF EARTH ROADS.*

By B. H. Piepmeier,
Maintenance Engineer, Illinois State Highway Department.

THE oiling of earth roads has been practised on a small scale in a number of places for the past fifteen years. California has done more of this work than any other state, primarily on account of its natural resources and climatic conditions. It has used a large amount of oil and has successfully maintained many of its roads by this method, largely on account of the oil that is available at a very low cost, and also on account of the sandy condition of the soil and the light winters that prevail.

All localities cannot expect to accomplish the same results in oiling earth roads. The black, loamy soil, the low and poorly drained conditions of many roads, together with the severe winters and springs, make it a fallacy to expect anything like a permanent road to result from the use of road oil.

It should be kept in mind that continued oiling will not make an earth road entirely satisfactory for all localities or for all conditions of traffic. The oiling of earth roads, like dragging, is a maintenance proposition. The intelligent use of oil, like the continued use of the road-drag, will maintain the earth road so that it will materially improve the present conditions existing on many of the earth roads.

The oiling of earth roads should not be practised promiscuously, but used only where the roads are suited to such work. The intelligent use of oils on many earth roads is unquestionably a justifiable expense. It is the purpose of the following to present as many facts concerning the use of oil as it is possible to secure at this time; also to describe what is shown by experience to be the best method of preparing the road and applying the oil, together with a few suggestions that may be of some assistance to the contractor or individual who has such work under consideration.

The Selection of Roads for Oiling.—Roads should not be oiled until they have a permanently established grade; that is, all hills should be cut down, hollows filled, embankments widened, and all drainage structures established. Low, flat, undrained roads should not be oiled until proper drainage has been attended to. The oiling of a mudhole will not remedy the trouble, but often aggravates it.

Roads that have a preponderance of heavy hauling should not be selected for oiling. The oiling tends to waterproof the road, but it is readily understood that continued heavy hauling, even on perfectly dry earth roads, will eventually rut and dig them out in pot holes. The mixture of oil and earth lacks stability to meet all the requirements of traffic. If something could be mixed with the oil and earth to give it stability and aid it to resist the wear of traffic, it would more nearly meet all traffic conditions.

On moderately travelled roads where there is a greater amount of pleasure travel, the oiled earth roads will give better service.

The Purpose of Oiling.—It should be kept in mind that the main purpose of oiling earth roads is to suppress the dust and aid in maintaining a smooth and waterproof surface. If it is possible to prevent dust from forming, the surface of the road will remain much smoother and there will be less mud form during rainy weather. By reducing the mud nuisance it is possible to use the road a larger portion of the year. By keeping the surface of an earth road smooth, the traffic is distributed more uniformly over the road, thereby making it wear much longer. The suppression of the dust not only makes the road wear longer, but prevents a portion of the road from blowing into the adjoining fields, washing away, etc. The oil also prevents the encroachment of weeds and sod upon the travelled portion of the highway, thus improving the appearance and producing a more thoroughly compacted road.

The suppression of dust makes an earth road more sanitary and desirable for pleasure traffic. The expense of oiling many roads is in many cases justifiable from the standpoint of the increased comfort to pleasure drivers.

A road that is oiled systematically for a series of years gradually acquires an oil-soaked crust which is more or less impervious to water. The heavy oil-soaked crust, however, will rut if the traffic is not distributed uniformly over the road and it will break through during the continued freezing and thawing of a severe winter and spring. This is particularly true if the road is used by heavy traffic. However, when such roads rut and cut through, they may be reshaped by use of the road-drag at a very slight expense.

The purpose of the oiled earth road, therefore, is not to replace what is generally recognized as a hard-surfaced road, but to keep the moderately travelled earth road in a suitable condition for ordinary traffic a larger portion of the year.

Preparation of the Earth Road.—The mistake is often made of attempting to improve a road without first grading and draining it. When a road is graded for oiling, gravelling, or any other form of surfacing, a permanent grade line should be established. Money spent in properly grading an earth road is not wasted, but has practically its full value when such a road is designated for later improvements. The great advantage of establishing a permanent grade and cross-section before the road is oiled is to utilize the oil soaked crust of earth as a foundation for later improvements, such as gravel, stone, brick or other hard road surfaces. If oil, gravel, or other surfacing material is applied to an improperly graded road, a very large portion of the material will be disturbed and practically wasted when later improvements are demanded. In other words, any money that is spent upon the public highways should be spent with a view of further improvements that will naturally be required as traffic increases.

The Road Surface Preparatory to Oiling.—As the prime objects of oiling an earth road are the suppression of the dust and the maintaining of a smooth waterproof surface, it is very important that the road surface be oiled when it is smooth, free from dust, and in a condition to absorb the oil.

Oil applied on dust will not penetrate the road surface, but will merely mix with the loose material to make an oiled-dust surface that is apt to fly readily and become a nuisance. The surface should be perfectly smooth and free from low places that will retain water. If water is allowed to stand upon an oiled earth surface, a bad mud hole will soon result. A moist subsoil preparatory to oiling is not serious, though best results may be expected when the road is reasonably dry for about two inches on the surface.

*Extracts from Bulletin No. 11, Illinois State Highway Department.

Applying Oil.—After the road has been prepared as heretofore described, the oil should be applied at the rate of one-fourth to one-half gallon per square yard of surface. If the road has never been oiled, or if more than a season has elapsed since a previous oiling, it will be found that about one-half gallon per square yard will be required. If the road or street has been oiled regularly, one-fourth to one-third gallon per square yard will usually be satisfactory. It is much better to apply a small amount of oil twice each season rather than to put on the full quantity in one application. When too much oil is applied, it is not only wasted, but is often very disagreeable to traffic.

After a road has been oiled for several years, one light application each year may be sufficient, or at least equal in results to two applications per year on a new oiled road.

The time for oiling will necessarily vary considerably, depending upon the season. Favorable times for applying the oil will be about April and September.

The uniform distribution of the material is one of the essential requirements for success. An ordinary street sprinkler or a home-made device attached to a thresher tank wagon or similar tank may be utilized for distributing the oil. An expert using such equipment can ordinarily get the required amount of oil on the road rather uniformly. Much better results, however, can be secured by the use of some specially designed apparatus made for the purpose, such as pressure distributor tank wagons.

There are a number of specially designed pressure distributing wagons on the market that vary in the price from $400 to $6,000. The horse-drawn distributors have a capacity of from 450 to 600 gallons and can be purchased at from $400 to $600. Such distributors are usually equipped with some form of heating device so that hot oil may be applied when required.

Some of the auto distributors hold 1,000 gallons and are equipped with oil heaters for heating the oil quickly; also, special oil pumps for filling the distributor and for spraying the oil upon the road in the desired quantities. Such trucks cost from $5,000 to $6,000 complete.

Shipping and Handling Oil.—Road oil is usually shipped in 8,000 or 10,000 gallon tank cars. Some companies are able to furnish 4,000 and 6,000 gallon tank cars, but such cars are very few and usually hard to get. The railroad tank cars are equipped with steam heating coils so the material may be heated in the tank by attaching a steam pipe or hose. Small quantities of oil may be purchased in molasses barrels, but when delivered in barrels there will be an additional cost of two to three cents per gallon. The tight barrels will ordinarily hold about 50 gallons. If the barrels are handled with care they can be sold at 50 to 65 cents each when empty. Heavy oil shipped in this manner is usually very difficult to remove from the barrels. In such cases the barrels are dumped into an open heating kettle and broken. After the oil is warm the staves and hoops may be removed by a large hoe or rake and used as kindling. The hot oil can be pumped from the heating kettles to the distributor and, while still hot, applied on the road.

Where there is no heating kettle on the job and there are but a few barrels of heavy oil to apply, they may be emptied direct into the distributing wagon by first placing the barrels in a very warm room or close to a fire for several hours.

Where there is but a small quantity of oil desired, say, 3,000 or 4,000 gallons, it is usually cheaper and much more economically handled if shipped in a large tank car. Freight will have to be paid on a full tank car of 8,000 or 10,000 gallons, but this will ordinarily be compensated for by the saving in barrels and in the economy effected in handling the oil on the job.

Pumping Oil.—There are a number of special oil pumps on the market that can be purchased at from $15 to $30 that will readily pump hot or cold oil. The rotary pump is the one most commonly used. It may be driven by a gasoline engine or a steam engine, in case the latter is needed at the tank car for supplying steam heat. A 1½-inch or 2-inch rotary pump will fill a 600-gallon distributor in from ten to fifteen minutes.

The ordinary water tank pump may be used for pumping cold oil. A 2-inch suction tank pump will fill a 600-gallon tank in 30 to 40 minutes. Such pumps cannot be used for hot oil, as it will soon burn out the valves.

All of the above-named pumps work best attached to the bottom of the railroad tank car by means of a hose or pipe. However, it is well to eliminate hose connections as much as possible as some oils and tars eat them out very rapidly.

A 3-inch or 4-inch lift pump may be used to an advantage in pumping oils. Such pumps are set in the tank car at the top, and one man will readily pump a 600-gallon tank in 20 minutes. This kind of pump can be purchased for $20 to $25. It has many advantages, as there is no mechanical power needed nor any pipe or hose connections.

After the pump is connected at the bottom of the tank car and everything is ready to receive the oil, the cap on the dome of the car should be unscrewed and the discharge valve opened from the inside. This valve has a stem projecting up to the dome. It is well to have a cut-off valve in the hose or pipe connection at the bottom so the tank car valve may be left open during the day that oil is being used.

If there is an elevated siding or switch eight or ten feet high at the station, the tank can be spotted thereon and the oil allowed to flow by gravity into the distributing wagon from the tap in the bottom of the tank car.

Heating Oil.—Where oil must be heated before being applied, it is often convenient to spot the car on a spur near some steam plant, such as a mill, creamery, or electric light plant. Where such arrangements can be made, a ¾-inch or 1-inch steam pipe line may be connected from the plant to the tank car. If no steam plant is accessible, an ordinary steam tractor or roller can be connected with the tank car. Where a steam connection is made for supplying the heat, from 12 to 24 hours are required to bring the oil up to 150 to 175 degrees F., which is about the maximum temperature that can be reached with the steam heat. This temperature will permit the oil to be pumped readily. Its temperature may then be increased the desired amount in the distributor.

The steam connection with the tank car is made at one of the 2-inch pipes that projects beneath the tank; the other 2-inch pipe that projects should be supplied with a valve so the amount of steam passing through the coils may be regulated.

It is advisable to have a thermometer on the job so that the temperature of the hot oil may be tested from time to time.

Some road oils have a very low flash point, and extreme care should be taken to prevent any oil from coming into contact with a flame. An analysis of an oil always shows the flash point, so it is well to keep the temperature somewhat lower to prevent burning and to be on the safe side.

The presence of a slight amount of water in heating oil will cause the oil to foam and give a great deal of trouble. Where the oil tends to foam it should be heated very slowly. In such cases every precaution should be taken to prevent accidents.

Sanding Oil Surfaces.—Better results can be secured from sanding the road slightly after either hot or cold oil has been applied. Clean, hard sand is much better on a road surface than dust or the sweepings from the road. A hot oil application should be followed with a light dressing of sand, or the traffic will likely pick up the oil and make the surface of the road very uneven. Sand may be applied at the rate of one cubic yard to each 100 to 150 square yards of road surface. It may be applied by shovels from a wagon or from a special apparatus for distributing the sand.

The application of sand gives an oiled earth surface more stability. The sand retains the oil, assists in preventing wear, and aids in keeping down the dust. The light application of sand is a justifiable expense on a majority of oiled earth roads.

Oiling Sandy Roads.—There are many sections of roads that are very sandy and have to be handled differently than the ordinary earth road. Where it is possible to mix clay or loam with the top four or five inches of sand before oiling, much better results may be expected. A suitable clay or loam can usually be secured at a reasonable distance from the sandy section. Where possible the sand and clay should be thoroughly mixed and allowed to compact under traffic before the oil is applied. The sand-clay road will permit a slightly heavier oil than the ordinary earth road.

If there is no clay or loam within reasonable distance of the sand road, it may be materially improved by mixing a heavy oil (70 to 90 per cent. asphaltic product) with four or five inches of the top layer of sand. This can best be done by applying about three-fourths gallon of oil and then covering it with about one inch of the sandy soil from the road side, then applying about one-half gallon of oil and another layer of sand. By building up successive layers of oil and sand it is possible to get from one and one-half to two gallons of oil per square yard of surface. This amount of oil mixed with four or five inches of the sandy soil will form a solid oil and sand crust that will hold up light traffic. The cost of such applications will vary from $800 to $1,500 per mile of road fifteen feet wide.

The cost of applying a four or five-inch layer of clay or loam that may be secured within one mile of the road, and mixing it with the sand, will be about the same. It is generally recognized that the mixture of sand and clay is more serviceable than the mixture of oil and sand.

The Cost of Surface Oiling.—The cost of preparing a public road for an oil treatment may vary from $100 to $2,000 per mile. However, the grading and preparation of an earth road should not be charged against the cost of oiling. The oiling or dragging of an earth road is a maintenance proposition and should be estimated separately from the building or preparing of the road. The road should be kept well shaped regardless of whether it is to be oiled or not. However, some cleaning is almost always necessary prior to the first application of oil, and this cost will vary from $25 to $50 per mile of road.

Road oil can be purchased for from three to seven cents per gallon, depending upon the quality. It may be applied on the surface of the road at the rate of one-fourth to one-half gallon per square yard. So the cost of oil alone may vary from $75 to $275 per mile of road 15 feet wide, depending upon the quality and quantity of oil applied.

The cost of applying the oil will vary, depending upon the length of haul and the kind of equipment used. This cost may be estimated at from $50 to $150 per mile of road 15 feet wide.

The above figures show the cost of oiling to vary from $150 to $475 per mile of road. With average conditions and with a medium priced oil, the average cost of oiling alone per application may be from $200 to $250 per mile of road 15 feet wide.

It is understood that the above figures are only an approximate estimate. A complete record of the cost of oiling, together with the quality and quantity of oil used each year over a period of years is not available. The above figures, however, are based on the best information available in this and other similar states.

It is predicted by some enthusiastic users that a road will not require oiling after it has been oiled for two or three years and the surface has become thoroughly saturated with the oil. The writer has visited some twenty different towns that have oiled their streets for a period of more than five years, and the present condition of such streets indicates that the oiling will have to be repeated each year indefinitely to secure the desired results. The quality or quantity of oil used in the twenty towns referred to is not known. It may be that if a high grade of asphaltic oil is used that some annual applications may be omitted after a few years of treatment. With the best oil, however, it is hardly expected that more than one year could elapse without some attention.

Some experiments have been made along the line of thoroughly saturating the top six inches of earth and then compacting it with a petrolithic roller. The saturating of the earth with the first application of two and one-half to three gallons of oil was intended to resemble somewhat the continual oiling of the surface over a period of four or five years. The experiments referred to were made in 1908 and 1909 on three different sections of road of one-half to three-fourths of a mile in length. Two of the sections were considered failures, and were within three years covered with a more desirable wearing surface. The third section still remains; however, it shows very few signs of having such a treatment. This section seems to rut in the winter and spring almost as badly as the other portion of the road; in midsummer the surface of the road pulverizes and forms a dust that flies almost the same as dust from other portions of the road.

In view of all the information that is available on oiled earth roads, indications are that the treatments must be made each year, or at least every other year, to get the desired results. On this basis, $150 to $200 per year for five to ten years may be a basis for estimating the cost of surface oiling.

Editorial

THE DEVELOPMENT OF BRITISH COLUMBIA.

Lack of space in this issue precludes more than a cursory review of Mr. Gamble's address to the members of the Canadian Society of Civil Engineers assembled in Montreal last week. It is doubtful if the Province of British Columbia has in course of preparation, or already in its archives, a more interesting historical sketch of the growth of its transportation facilities. It is unlikely that the subject has previously received more thorough consideration and study than the retiring president of the Society must have given it in the preparation of his paper. He has enriched the literature of engineering by a volume of information that will be frequently turned to in future years, not only by his associates in the profession, but by many in other walks of life. His address is a most comprehensive resumé of the development, by land and sea, of transportation in British Columbia, and of the industries encouraged and increased thereby.

Mr. Gamble "goes back to the first," and his history of early days, earlier traditions and stories or hardship and adventure are in all probability as authoritative as they are interesting. His portrayal of the white man's awakening of inland solitudes, in search of the livelihood the world owed him, when roads were trails and railways were a myth, is indicative of the optimism and perseverance that have been potent factors in the development of the West. His references to early freight rates of 15 to 18 cents per pound between Yale and Barkerville, to hay as high as $250 per ton and oats 35 cents per pound, signify that in 1867, as now, money in British Columbia persisted in having its say.

He deals with Pacific transportation in its initial stages, reviving our knowledge of the achievements of early navigators and explorers along the coast, notably Capt. Bering in 1741, Joan Perez in 1774, Capt. Jas. Cook in 1778, Capt. George Vancouver in 1792 and Alexander MacKenzie, who crossed the continent, reaching the coast in July, 1790. The establishment of trading posts by the Hudson's Bay Company, of Forts Vancouver and Victoria; the introduction into Pacific waters of the first steam vessel "Beaver" in 1836; the dangers to shipping along the treacherous coast and the establishment and growth of the present excellent system of safeguards to navigation, are subjects of extreme interest. The development within the province of the various railway systems and of coastal and oceanbound commerce is presented and, unconsciously perhaps, the manner of its presentation following a brief reference to the remarkable resources of the province is a thorough justification of the rapid expansion of facilities to trade and commerce in British Columbia.

CANADIAN WATER POWERS FOR CANADIAN NEEDS.

As one of the wealthiest countries of the world in water power resources, it is natural that Canada holds the attention of other countries as to the manner in which her water interests are investigated, controlled and utilized. We have made frequent reference in *The Canadian Engineer* to the extensive investigations of hydrographic and hydrologic nature that have been under way during recent years in practically every province. Too much attention cannot be called to the valuable work of the engineers of the Water Power Branch, Department of the Interior; the Commission of Conservation, Canada; the Hydro-Electric Power Commission of Ontario; the International Joint Commission; the Quebec Streams Commission and the Nova Scotia Water Power Commission. To a certain extent the enormous amount of water power data which these organizations have accumulated toward the economic development and proper utilization of power, is a measure of what is being done by them for the direct benefit of the nation. Study and observation are unending, however, and increase in scope and responsibility with each succeeding year. Progress is slow, as stream flow data are necessarily years in attaining dependable value. Further, there are always questions demanding prompt attention regarding the water interests of the country, requiring, perhaps, special and detailed investigations; inquiries from individuals, corporations, government departments or from the governments of other countries, often demanding an intensity of research not anticipated by the applicant.

The report of Arthur V. White, consulting engineer to the Commission of Conservation, calls our attention to the administration of some very important problems at the present time. Presented at the recent annual meeting of the Commission in Ottawa, this report, which appears in part elsewhere in this issue, brings out a phase of water-power investigation which men are often apt to forget—the safeguarding to Canada of water power resources that are Canadian. Many of the questions referred to are those relating to waters along the boundary between Canada and the United States. It is worthy of note that these questions of international importance, upon a subject that is commanding great attention in both countries, are being, one by one, settled to the general satisfaction of both. The International Joint Commission is rendering a great service to the English-speaking nations of America, a service that will not be fully appreciated in a single decade or generation.

The same applies to the other forces mentioned above. Their work is highly important, for while Mr. White points out that the time will come when Canada will have uses for her share of all boundary water powers, the time will also come when there will be use for all her water powers. To safeguard them against incompetent and improper methods of utilization should be the aim of one and all.

NIAGARA RIVER POLLUTION.

The report of the International Joint Commission concerning the pollution of boundary waters will be presented this spring, in all probability. Investigations have been under way for several years, references to which have appeared from time to time in these columns. The findings and recommendations of the Commission with respect to the Niagara River will be awaited with much interest. At Niagara Falls, Ont., for instance, there are four sewer outlets, all of them discharging into the river. They are at Bender, Seneca, Park and Orchard Streets. It is to be expected,, therefore, that a considerable readjustment of the city's disposal system may be required.

It is to be expected, therefore, that a considerable recollect the discharges from the Seneca, Park and Orchard outlets and to convey the sewage to a projected disposal plant, presumably near the Orchard Street outlet. This plant would consist of sludge beds, sedimentation tanks and chlorinating apparatus. The Bender Street outlet is too low to discharge its sewage into such an interceptor as the one suggested, and a small disposal plant may be required at its terminus. If the large intercepting sewer is recommended and constructed it will probably be a mile or more in length, with the large disposal plant in the vicinity of the Whirlpool Rapids. The interceptor will necessarily have a heavy gradient and may be not more than three feet in diameter.

Of course, no work of this nature will be undertaken before the Commission makes its report, but it is probable that the city will be required to go ahead with some such scheme as soon as the report has been made.

The Niagara River water pollution question involves also the towns of Fort Erie and Bridgeburg, on the Canadian side, as well as a number of towns and cities bordering the river in New York State. All of these municipalities will be effected by the recommendations of the Commission and in all probability adequate means to put an end to river pollution will be required in each case, similar to that described above.

ESTIMATES OF MATERIAL AND HAULAGE COSTS FOR GRAVEL ROADS.

Some useful tables relating to the matter of estimating both hauling cost and material quantities for gravel road construction appear below. The figures are derived from actual results recorded on many different projects and in different localities by the Iowa State Highway Commission. Some items of cost, as of the price of sand and gravel available, freight charges, expense of labor and teams, will vary to a certain extent in different localities, but nevertheless the tables will be of great help in striking a general average close enough for an intelligent estimate.

Table I.—Number of Linear Feet of 9-ft. Road a Load of a Given Size Should Cover for Various Loose Depths.

Weight of load Granite, lb.	Weight of load Limestone, lb.	Size of load, cu. yd.	Length spread for loose depth in inches, 3-in.	4-in.	5-in.	6-in.
2,800	2,500	1	12 ft.	9 ft.	7.2 ft.	6 ft.
3,500	3,125	1¼	15 ft.	11.25 ft.	9 ft.	7.5 ft.
4,200	3,750	1½	18 ft.	13.5 ft.	10.8 ft.	9 ft.
4,900	4,375	1¾	21 ft.	15.75 ft.	12.6 ft.	10.5 ft.
5,600	5,000	2	24 ft.	18 ft.	14.4 ft.	12 ft.
6,300	5,625	2¼	27 ft.	20.25 ft.	16.2 ft.	13.5 ft.
7,000	6,250	2½	30 ft.	22.5 ft.	18 ft.	15 ft.
7,700	6,875	2¾	33 ft.	24.75 ft.	19.8 ft.	16.5 ft.
8,400	7,500	3	36 ft.	27 ft.	21.6 ft.	18 ft.

Table II.—Number of Cubic Yards of Material Per Mile to Make Given Loose Depth for Various Widths of Road.

Depth of loose material in inches.	Width of surfacing 9-ft. Cu. yd.	14-ft. Cu. yd.	15-ft. Cu. yd.	16-ft. Cu. yd.	18-ft. Cu. yd.
1¼-in. (screenings	180	280	300	325	367
3-in.	440	684	733	782	880
4-in.	587	913	979	1,043	1,174
5-in.	734	1,141	1,222	1,304	1,468
6-in.	880	1,369	1,466	1,565	1,760
Sq. yds. of surface per mile	5,280	8,213	8,800	9,387	10,560

Knowing the cost of gravel in any community, the cost of the material for the road can be easily determined.

The cost of hauling the gravel varies also between rather wide limits but the following may be considered as average prices where teams cost forty cents per hour and where ordinary earth roads are hauled over:

Table III.—Average Cost for Hauling Gravel Based on 40 Cents an Hour for Teams.

Length of average haul.	Cost per cu. yd.
One-quarter mile	21 cents
One-half mile	28 "
One mile	40 "
Two miles	63 "
Three miles	86 "

SYPHON LOCK ON BARGE CANAL.

THE New York State Barge Canal is an interesting piece of engineering construction with many features that are noteworthy in a comparison with the Panama Canal, the Welland Ship Canal, and others of similar rank. On it there are 440 miles of constructed canals and 350 miles of intervening natural waterways. There are 57 locks, with one flight of five locks in a distance of 1½ miles near Waterford, N.Y., the latter providing a lift of 169 feet.

The works in their original state date back to 1817, when the original Erie Canal and the old Champlain Canal were both commenced. The Oswego Canal was begun in 1825 and the original Cayuga and Seneca Canal in the following year. Enlargements have been made from time to time in these canals until in 1905 the four were incorporated into the Barge Canal system, and since that time a canalization of numerous lakes and rivers has been

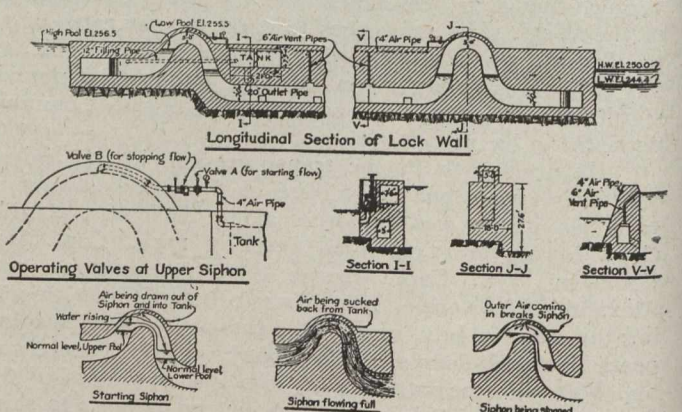


Fig. 1.—Diagram Showing Method of Operating Syphon Lock.

under way. The present design provides a channel 200 feet wide and 12 feet deep through rivers and lakes, and land lines of 75 feet bed width and 125 feet width at water line, and of 12 feet depth. There is a clearance of 15½ feet between water-line and bridges, etc.

Among the many interesting features throughout its length, there is, at Oswego, N.Y., a syphon lock of particularly notable design. It is the only lock on the system employing the syphon principle. Fig. 1, for which we are indebted to the General Electric Company, is a diagram illustrating the method of operating this syphon lock. The flow of water is started in the syphon by means of tanks. To perform an operation the tank is first filled with water, then the intake valve is closed and the outlet valve opened. There results a body of water suspended by its weight, but tending to escape into the lower pool, thus producing the necessary vacuum. On opening the air valve, air from the syphon rushes into the vacuum and water begins flowing over the crest.

COAST TO COAST

Stratford, Ont.—Mr. John Roger, county road engineer, reports a total expenditure in the county of Kent last year of $26,884.

Chatham, Ont.—The need of a county good roads system was voiced at a recent meeting of the county council and the matter received considerable discussion in view of the participation by the government in the cost of construction and maintenance under the new Highways Act, which came into force on January 18th.

Montreal, Que.—The board of control is considering a recommendation involving the construction of a barrier to prevent water from the St. Lawrence River backing up into the Little St. Pierre River, referred to in another paragraph. The proposal includes also the construction of a pump house and the total cost is placed at $120,000.

Guelph, Ont.—The annual report on county roads shows an expenditure last year, under the Highway Improvement Act, of about $25,000, of which about 25 per cent. was for bridges. The superintendent recommends the use of road oil on these county roads, as it has been found in Wellington to give good satisfaction.

Victoria, B.C.—Construction is now in progress on the Patricia Bay branch of the C.N.R. on Vancouver Island. Plans have been prepared for car ferry slips and docks at Patricia Bay for the transfer of passengers and freight from the mainland, and it is expected that a start will soon be made on the construction of terminal facilities.

Toronto, Ont.—In a recent interview Mayor Church intimated that the city would be willing to bear its share of the cost of an improved highway from Toronto to Lake Simcoe. A proposal is under way to extend the scope of the York County Highway Commission to include the roads of North York, and this main thoroughfare is receiving paramount attention.

Belleville, Ont.—According to the annual report of Mr. J. W. Evans, city engineer, 11,771 sq. ft. of sidewalk was constructed during 1915 at a cost of 35c. per sq. ft., including cost of labor, material and rent of concrete mixer. New pavements were laid on Florin Street and Victoria Avenue and about 24,000 sq. yds. of macadam were laid on various streets.

Moncton, N.B.—The Intercolonial Railway management has been working on a project involving a division between telegraph lines for railway use and commercial purposes, the desire being to obtain exclusive use of its own lines for railway business. The work has been under way for over a year, and it is expected that the new arrangement will be completed in a few weeks.

Edmonton, Alta.—The Edmonton, Dunvegan and British Columbia Railway, the head office of which is located in this city, announces that the main line reached Spirit River on January 22nd, this completing for the time being the main line programme of the company and connecting Spirit River and Edmonton by 357 miles of railway. Construction will now be proceeded with on the Grande Prairie branch, which leaves the main line near Spirit River. Steel is expected to reach Grande Prairie City in March.

Victoria, B.C.—Steel work has been completed for the new observatory which the Dominion Government is constructing on Little Saanich Mountain. Mr. C. H. Topp is in charge of the work. The building will house a 70-inch telescope, expected to be delivered not later than June, and the structure will likely be completed by that time. Water mains will be laid to the top of the mountain during the next few months and the road leading thereto will be resurfaced early in the spring.

Vancouver, B.C.—The annual report of the Vancouver and Districts Joint Sewerage Board shows an expenditure of about $787,600 on trunk sewers in Burrard Peninsula during 1915. The sewer accounts were made up of the following items: Brunette River improvement, $17,640; Balaclava trunk sewer, $129,449; Bridge Street sewer, $40,750; Central Park sewer, $565; China and Canoe Creek sewer, $69,297; China Creek extension, $187,886; Clark Drive sewer, $212,304; Clark Drive sewer, No. 2, $56,038; Hastings Park sewer, $66,987; Kaye Road sewer, $126; general plant and stores, $578.

Montreal, Que.—A report has been submitted concerning the conversion of St. Pierre River into a covered sewer. The board of control has the matter at present under consideration. This small river rises in Cote St. Luc and empties into the St. Lawrence below the city waterworks. It receives sanitary and storm sewage from the municipalities of Lachine, Ville St. Pierre, Montreal West, and Government properties, etc., and also waste water from the Lachine Canal. With the exception of about 700 ft. already covered, it is practically an open sewer. The report of the investigating commission recommends a project estimated to cost $610,000.

Ottawa, Ont.—It is expected that the International Joint Commission will conclude at least two very important investigations before the close of the present year. These are the extent and prevention of pollution of international waters and the effects of power development upon the level of the Lake of the Woods and tributary waters. Upon this latter question the commission has done an immense amount of investigatory work and is now in possession of detailed reports and of a large amount of data bearing upon the effects of lake and river levels. Meetings were held recently at Detroit and Winnipeg for the discussion of this important question.

Montreal, Que.—The following is an extract from the recent address of Mr. G. F. Benson, retiring president of the Montreal Board of Trade: "I would particularly call attention to the matter of the opposition of the Canadian Society of Civil Engineers to the present aqueduct scheme and the letter sent by our council to the Board of Commissioners. This is a question that I think needs the very careful attention of your new council, and of the members of this board. The statement is made that as a scheme for the development of power by the city, the enlargement of the aqueduct, as now proposed, is not an economic commercial proposition. It would seem to be leading to a cost of development that will greatly exceed that of any modern hydro-electric development, and the figures would indicate that it will result in a cost per horse-power to the city higher even than the cost of development by steam power, and considerably higher than the present contract price that the city is now paying for electric power. The question also arises as to whether it is in any case wise to make the city dependent upon one source of hydro-electric power, in view of the well-known troubles from frazil and backwater during the winter season, referred to in the letter addressed by your council to the Board of Commissioners."

PERSONAL.

D. A. GRAHAM has been appointed resident engineer at Vancouver for the Canadian Northern Pacific Railway.

C. B. GORDON, of Montreal, has been appointed deputy chairman of the Imperial Munitions Board of Canada.

J. L. COTE, M.L.A., was elected president of the Alberta Land Surveyors' Association at its recent annual meeting.

MARK WORKMAN is the new president of the Dominion Steel Corporation, in succession to Mr. J. H. Plummer.

T. J. McMULKIN has been recommended for the position of chief engineer at the city of Toronto high level pumping station.

E. H. HAMILTON has been appointed consulting metallurgist for the Consolidated Mining and Smelting Company at Trail, B.C.

WM. ALDERSON, formerly with the Timmins Co., in Northern Ontario, has been appointed superintendent of the Hollinger Gold Mines Co.

D. H. WILLIAMS has been appointed assistant general manager of the Canadian Government Railways, with headquarters at Moncton, N.B.

Capt. JOHN McHUGH, engineer in British Columbia for the Department of Naval Service, Dominion Government, is adjutant of the 104th Battalion.

C. H. FOX, formerly assistant division engineer at Winnipeg for the Canadian Pacific Railway, has been appointed resident engineer of District No. 2, Manitoba Division.

GEO. HOGARTH, B.A.Sc., O.L.S., of the engineering staff of the Department of Public Works, Ontario, has been appointed Chief Engineer of Highways, to succeed Mr. W. A. McLean, now Deputy Minister of Highways.

FRED RICKETTS has been appointed road superintendent in the municipality of Esquimalt, B.C., to succeed Mr. E. Williams, who is on active service. Mr. Ricketts was formerly in the employ of the provincial government upon similar work.

Lieut. GEO. K. WILLIAMS, B.A.Sc., formerly on the engineering staff of the University of Toronto, and a graduate of the Curtiss Aviation School, has been appointed mechanical superintendent of the Air Training School at Detling, Kent, England.

P. LeCOINTE, one of the engineers in the roadways department, city of Montreal, has returned to his position after having been on active service since the beginning of the war. He was in some of the heavy fighting in Northern France, and has been the recipient of recognition for gallantry in rescuing comrades under fire.

M. O. ROBINSON, who has been manager of the Port Arthur Street Railway for the past 5½ years, has submitted his resignation. Prior to the separation of the electric railway lines of Port Arthur and Fort William, which took place in 1914, Mr. Robinson was joint manager of both. He was formerly in charge of the electrical plant of the Canadian Pacific Railway in Fort William.

OBITUARY.

The death occurred last week at St. John, N.B., of Mr. John A. Wheatley, at the age of 78. The deceased was a prominent railway contractor in Eastern Canada. He built the northern section of the Intercolonial Railway, and also the Inverness and Richmond Railway.

The death occurred recently of Mr. Charles C. Schneider, for many years consulting engineer of the American Bridge Co. The deceased was a member of the Quebec Bridge Commission which investigated the collapse of the Quebec Bridge in 1907 at the request of the Dominion Government. In 1911 he was made a member of the Board of Engineers, under whose supervision the new Quebec Bridge is being built. Mr. Schneider was closely associated with bridge building in the United States and Canada. In the early 80's he designed the Fraser River cantilever bridge for the Canadian Pacific Railway, for which company he was afterwards for many years a consulting engineer. He was president of the American Society of Civil Engineers in 1905.

On January 24th Mr. John Alexander Hill, president of the Hill Publishing Co., New York, died suddenly, a victim of heart failure, at the age of 57. He had been an editor and a publisher for over 30 years. The success of the Hill publications bespeak his worthy achievements in engineering journalism, each being a recognized authority in its field. Of Engineering News, American Machinist, Power, Engineering and Mining Journal, and Coal Age, it may be safely said that they owe their distinction to the combination of broad and sound editorial judgment and keen business acumen possessed by the deceased.

COMING MEETINGS.

AMERICAN ELECTRIC RAILWAY ASSOCIATION.—To be held in Chicago, Ill., February 4th, 1916. Joint dinner that evening with American Electric Railway Manufacturers' Association.

NINTH CHICAGO CEMENT SHOW.—At Chicago, Ill., February 12th to 19th. R. F. Hall secretary, 208 South La Salle Street, Chicago, Ill.

NATIONAL CONFERENCE ON CONCRETE ROAD BUILDING.—Second National conference to be held at Chicago, Ill., February 15th to 18th, 1916. Secretary of the Advisory Committee, J. P. Beck, 208 South La Salle Street, Chicago, Ill.

AMERICAN CONCRETE PIPE ASSOCIATION.—Annual Convention to be held in Chicago, February 17 and 18, 1916. Secretary, E. S. Hanson, 538 S. Clark Street, Chicago, Ill.

CANADIAN LUMBERMEN'S ASSOCIATION.—At Ottawa, February 18th, 19th and 20th, 1916, annual convention. Frank Hawkins, secretary, Ottawa.

NATIONAL PAVING BRICK MANUFACTURERS' ASSOCIATION.—Meeting to be held in Cleveland, Ohio, February 21st and 22nd. Will P. Blair secretary, Brotherhood of Locomotive Engineers' Building, Cleveland, Ohio.

AMERICAN ROAD BUILDERS' ASSOCIATION.—Thirteenth Annual Convention to be held at Pittsburgh, Pa., February 28th to March 3rd. E. L. Powers secretary, 150 Nassau Street, New York, N.Y.

CANADIAN MINING INSTITUTE.—Eighteenth annual meeting to be held at the Chateau Laurier, Ottawa, March 1, 2 and 3. Secretary, H. Mortimer-Lamb, Ritz-Carlton Hotel, Montreal.