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The Canadian Engineer

A weekly paper for Canadian civil engineers and contractors

FOURTH ANNUAL DOMINION GOOD ROADS CONGRESS

REPORT OF SESSIONS HELD IN OTTAWA LAST WEEK—CONGRESS OPENED BY GOVERNOR-GENERAL, ACTING PREMIER SIR GEORGE FOSTER AND SIR WILFRID LAURIER—STATESMEN PROMISE GOVERNMENT'S HELP IN THE GOOD ROADS MOVEMENT

MANY men prominent in road building in Canada and the United States, gathered in Ottawa last week for the Fourth Canadian and International Good Roads Congress and Exhibition.

The exhibits were attractively arranged on the main floor of the Horticultural Building, Lansdowne Exhibition Park, while the meetings were held in a hall which seated about 300, on the second floor of the same building.

The exhibitors were the Canada Cement Co., Canadian Fairbanks-Morse Co., *The Canadian Engineer*, Commission of Conservation, General Supply Co., Imperial Oil Co., T. S. Kirby & Co., Ottawa Valley Motor Car Association, McLaughlin Automobile Co, Paterson Mfg. Co., Sawyer-Massey Co., Trussed Concrete Steel Co., U.S. Steel Products Co. and Warren Bituminous Paving Co.

The features of the exhibits were the very complete outfit of "Case" and "Wettlaufer" road-making machinery shown by the Canadian Fairbanks-Morse Co., Limited, who had no less than twelve large machines of various kinds on view; the pictures and plans exhibited by the town-planning department of the Commission of Conservation; the model bituminous street shown by the Imperial Oil Co.; the power flusher exhibited by the General Supply Co.; the model road sections built for the Province of Ontario; the illuminated photographs by the Paterson Mfg. Co.; the section of concrete roadway built jointly by the Trussed Concrete Steel Co., the Canada Cement Co. and the U.S. Steel Products Co., showing the use of Canada cement, of U.S. steel mesh reinforcement, and of Truscon curb bars, road mesh and armor plates; and the sections of pavements, experiments showing result of filling the voids, and magnified road sections shown by the Warren Bituminous Paving Co.

The Governor-General Opens Congress.

The congress was called to order Tuesday afternoon, April 10th, by the president of the Dominion Good Roads Association, J. Duchastel de Montrouge, city engineer of Outremont, P.Q., who introduced His Excellency the Duke of Devonshire, Governor-General of Canada.

"I have not had very much opportunity to see many roads in Canada," said the Duke of Devonshire, "but those I have seen have filled me with admiration,—not for the roads, but for the skill of the driver and the strength of the vehicle." He looked forward to the time when Canada would be well supplied with good roads as a result of the policy that was being adopted by the provinces from coast to coast.

Reference was made by the Governor-General to the fact that he had presided over a committee, for the discussion of road questions, which had been formed from both houses of the British parliament. He had always been greatly interested in roads and a strong advocate for the extension of good roads in England. He called attention to the permanent beneficial effect which good roads had had upon England, and how they had helped to solve the housing problems of the larger cities. With the improvement of the streets and roads he thought that the trackless trolley would no doubt appear in this country, and he laid stress on the importance of giving due consideration to this method of transportation in the future.

Sir George Foster Represents the Government.

Sir George E. Foster, who is acting as premier during Sir Robert Borden's visit to England, attended on behalf of the Dominion Government. Sir George reviewed the history of the good roads movement from the haphazard methods of half a century ago to the specialized construction of the present day, declaring that the future history of the country would be bound up in its road development. "Good roads are a reflection of the nation's character and the progress it has attained," said Sir George. There was no need to convince him, as an old politician, of the importance of good roads. Sir George gave his assurance that the government would further the cause of good roads to the best of its ability.

To show that there is no politics in the good roads movement, Sir Wilfrid Laurier sat with Sir George Foster on the platform, and followed Sir George with an earnest address advocating better roads. When he was a boy, said Sir Wilfrid, the only road master in Quebec province was the sun. When the sun shone, there were good roads; when it disappeared for the winter, there were no roads; and when it disappeared behind the clouds in the summer on account of rain, there were practically no roads. The people are only beginning to realize that the wealth of the country lies in its good roads.

That good roads throughout the Dominion would have considerable bearing on the economic, industrial and social problems of the country was the opinion expressed by His Lordship Bishop Roper, of Ottawa. He referred to the old Roman roads and the highway by the Euphrates and the Black Sea to Constantinople, and said that roads had always formed a great part in military and international history.

Mayor Harold Fisher, of Ottawa, officially welcomed the delegates to his city, outlining what had been accomplished in Ottawa in the last five years in road-making. He said that more permanent roadways had been laid in and around Ottawa in the last five years than in all previous time in the city's history.

W. A. McLean, C.E., Deputy Minister of Highways of the Province of Ontario, referred to the gratification that it gives to good roads enthusiasts to know that every province in the Dominion has created special departments to deal with the questions incidental to construction of public highways.

S. L. Squire, Hon. President of the Ontario Good Roads Association, expressed the hope that the federal government would take a tangible interest, and not only a passing interest, in the work of the Roads Congress. "I welcome you to Ontario," said Mr. Squire, "to a province first in population; first in agriculture; first in manufacturing; first in wealth; and first in good roads possibilities, but unfortunately not first in good roads progress. We hope soon, however, to lead the Province of Quebec instead of being second to her as now."

A. Dion, president of the Ottawa Valley Motor Car Association, said that the association had been the projectors and pioneers of the Ottawa-Prescott Highway proposition which will link Ottawa with the highways of New York State and with the inevitable Toronto-Montreal Highway. He hoped for the early construction of the Ottawa-Prescott Highway.

Ben Michaud, Deputy Minister of Roads of the Province of Quebec, referred to the complete accord in the Province of Quebec between the ratepayers and the government in connection with good roads policies. "At the beginning," said Mr. Michaud, "a trial had been made with some county councils by giving them aid to buy stone-crushers. Then another attempt was made with local municipalities, helping them to purchase road graders. The crusher was left idle in a neighboring field and in one instance the road grader was the subject of a boisterous meeting at which a resolution was passed prohibiting the use of the implement.

How the Movement Grew in Quebec.

"We set our men to work to find out what was the matter, and why, since we were not Greeks, our presents were refused. We soon realized the truth of the old French saying to the effect that you cannot get anything unless you pay for it. We granted certain subsidies and obtained good results, but we saw that it would be a slow affair if we did not do more.

"The trend of opinion showed a general desire to have good roads and the government was anxious to give to the province the much-needed improvement. The only question to be settled was of the necessary funds. The government decided to borrow millions and to furnish the ratepayer with the money required to pay the cost of construction. It is realized that the construction of good roads is just as important as the construction of all kinds of public works, not excepting railroads. The idea was that the time had come to put good roads on a proper footing and to invest in their construction all the money available, provided that it would not interfere with sound administration.

"The government asked from the municipalities a contribution of $1,000 a mile towards provincial roads and this contribution was readily granted. As regards local roads, the government offered to pay 50 per cent. of the amount expended on macadam or gravel roads. Then the government offered all the money necessary for road construction at two and then at three per cent. interest without sinking fund. The dollars have not ceased to pour in and with such a continuity that in five years joint action of the people and of the government has given to the province over 300 miles of trunk roads, nearly 2,000 miles of improved roads, and has done away to a large extent with statute labor and has created a new spirit which will no longer suffer trails to be called roads."

Dominion Good Roads Annual Meeting.

The annual meeting of the Dominion Good Roads Association was held at Chateau Laurier Tuesday evening and it was decided to incorporate the association. Temporary by-laws were adopted and application to parliament will be made for a Dominion charter. This will place the association upon a more business-like basis and will mean a more equitable distribution of the support of the movement. Instead of the expenses of the congress being met almost entirely by the manufacturers who take space in the exhibition, the expenses of the propaganda work of the association will now be met by regular annual dues from members all over Canada. There will probably be three classes of membership, with fees ranging from $1 to $100 per annum, similar to the scheme adopted by the American Highway Association.

Wednesday's Business Sessions.

The three days' business sessions of the congress opened Wednesday morning, April 11th. Paul D. Sargent, chief engineer of the State Highway Commission of Maine, was on the programme for the first paper, but unfortunately Mr. Sargent was unable to be present and his place was taken by Jas. H. MacDonald, of New Haven, Conn. Mr. MacDonald was for many years State Highway Commissioner of Connecticut, and is now a consulting paving engineer.

He told of the small beginning of the road movement in his native state, which movement had grown to great proportions, six and a half million dollars now being the appropriation in Connecticut for this work, and his state has previously spent sixty-eight million dollars in constructing highways. Forty states in the union have been committed to a permanent good roads policy.

"Of the 200,000 miles of roadway in the United States, half that mileage will have to be overhauled and redressed," said Mr. MacDonald. "Drainage and foundation are the two necessities of good roads. Broadly speaking, the surface would almost take care of itself if the road were properly drained and had a proper foundation."

George Hogarth, chief engineer of the Ontario Public Highways Department, presented a paper on "Drainage and Foundations." In the discussion which followed, emphasis was laid on the difficulty of building roads across swamps. Mr. MacDonald spoke highly of the English rubble drain and the Telford base, which he had never known to fail.

In the afternoon W. A. McLean gave an address on the highway laws of Ontario, emphasizing the importance of preparation being made to provide public works for the employment of the thousands of men who will return from France.

"Township councils in the earlier history of Ontario," said Mr. McLean, "depended largely on statute labor for road improvement. At the present time townships in Ontario are spending annually over $1,400,000 in cash, and 1,100,000 days in statute labor, having a total estimated value of $2,500,000 annually. The mileage of roads assumed by a county is usually from 12 to 18 per cent. of the total mileage of the county."

Replying to a question by Mr. Michaud, Mr. McLean agreed that the Provincial Highway Act in Ontario is coercive to a certain extent, but that in fact it works out harmoniously, the province and the municipality agreeing as to the wisdom of building a road.

W. L. Squire expressed himself as being in favor of autocratic legislation in connection with location, standardization and assessment of cost of roads.

C. A. Mullen, of Montreal, questioned whether it was not advisable to use concrete foundations more extensively for highways, and Col. Sohier agreed that it is a good

thing where possible. Mr. Jarman, of Westmount, spoke of the tar-sand-grout roads, and Prof. Crandall, of the Barrett Co., commented on the fact that the tar and sand mixed method was invented in 1835 and then was seemingly lost until it was rediscovered by Mr. Brodie, of Liverpool, in 1900.

"Bituminous Roads and Pavements" was the title of Col. W. D. Sohier's paper. Col. Sohier is chairman of the Massachusetts Highway Commission. An abstract of his paper appears on page 333 of this issue.

T. Harry Jones, city engineer of Brantford, Ont., delivered a paper on "Cement Concrete Roads and Pavements," abstract of which is published on page 338 of this issue.

Good Speeches at the Banquet.

The annual dinner of the Dominion Good Roads Association was held Wednesday evening at Chateau Laurier. Col. Sohier, State Highway Commissioner of Massachusetts, ex-Commissioner MacDonald of Connecticut, and Sir Geo. Foster, made the principal speeches of the evening. Mr. MacDonald, who delivered an excellent address, witty and stirring in patriotism, touched but lightly upon good roads problems, but Col. Sohier's speech bristled with valuable facts and definite instances of the increased values that have accrued to the rural districts of Massachusetts through the building of good roads. The facts that he related were really startling, and showed the very great benefit of an adequate system of highways. His speech was an inspiration to road-makers and engineers generally.

Sir George Foster called attention to the fact that the benefits of good roads are not all monetary and material benefits, but that good roads are upon a higher plane, and are chiefly useful in the human uplift which results from them.

Hon. W. G. Mitchell, treasurer of Quebec Province, said that the $20,000,000 set aside by the provincial government for aid to good roads is insufficient to meet the demands. The farmer has merely to be shown where his interests are benefited, and he takes hold of the road proposition vigorously.

Mr. Mitchell said that there are 1,175 rural municipalities in Quebec with 30,000 miles of roadways, and there are towns with another 2,000 miles, making 32,000 miles of highway to maintain, in addition to numerous colonization roads. All told, there are 45,000 miles of roadways in the Province of Quebec, while the population is but about 2,000,000, and the revenue only nine or ten million dollars.

Sir Sam Hughes considered that improved highways are more important than railways because they reach a greater area of agricultural industry. He looks forward to a system whereby the federal government will provide a main trunk road across the continent, the provinces providing the subsidiary highways.

More Papers Discussed on Thursday.

Jas. H. MacDonald opened Thursday's session with a talk on the construction and maintenance of gravel and macadam roads.

A. Fraser, engineer of the Roads Department of the Province of Quebec, read a paper on "The Correction of Alignments and Grades in Existing Highways."

The paper on "Highway Bridges and Culverts," by W. G. Yorston, Assistant Road Commissioner of the Province of Nova Scotia, appears on page 331 of this issue.

D. T. Black, town engineer of Welland, explained the various methods for laying brick pavements. His paper aroused much discussion among the delegates.

W. H. Connell, chief of the Bureau of Highways, Philadelphia, gave an illustrated talk on "Granite Block Pavements," showing interesting slides. "Many streets in Philadelphia have been laid with these blocks, which, from the standpoint of durability, give very good service under heavy traffic if properly laid," said Mr. Connell.

L. Reinecke, of the Department of Mines, Ottawa, delivered a paper on "Methods Employed for Making Road Materials Surveys. "The Geological Survey," said Mr. Reinecke, "has made records of the rock formations in many parts of the Dominion, and samples from each source of supply have been investigated and recorded. In taking the census of Canada's stone supply, the surveyors have even included field stone fences, so that these could be used in case of shortage of supply."

R. B. Morley, general manager of the Ontario Safety League, delivered an address on "Safety on the Public Highway," explaining what his league has done toward making the roadways safe for both pedestrians and drivers.

Canadian Automobile Association Meeting.

The annual meeting of the Canadian Automobile Association was held Thursday evening at Chateau Laurier. W. D. Edenburn, of Detroit, delivered an illustrated lecture on the Indiana-Pacific-Transcontinental tour, which helped to locate the Lincoln Highway. He incidentally showed some pictures of the present condition of the Ottawa-Prescott Highway, showing how necessary is the proposed improvement of this road.

W. A. McLean declared that the Ottawa-Prescott Highway is simply a matter of time and will surely be improved in the near future. He defended the present roads of Ontario, declaring that at least 40 per cent. of them are well-surfaced, serviceable roads and, though not of the best, they are capable of enduring for several years. Prophesying that gradually the main centres of Ontario and Quebec would be linked up by permanent highways, intersected with a network of town and county roads, he declared that the time was not far distant when the dreams of the good roads promoters would be an accomplished fact.

Closing Sessions on Friday.

Wimund Huber, assistant engineer of the Ontario Public Highways Department, opened the last day's sessions with a paper on "Modern Road Machinery, Its Selection, Use and Care."

"Road Organization," a paper by Geo. S. Henry, M.P.P., Ontario, was extensively discussed by S. L. Squire, of Waterford, Ont., R. S. Henderson, of Winnipeg, and others.

C. A. Mullen, director of the paving department of the Milton Hersey Co., Montreal, discussed "The Contract and Specifications for Paving." Abstract of his paper appears on page 328 of this issue. A. F. Macallum, works commissioner of Ottawa, led the discussion, agreeing with Mr. Mullen that sheet asphalt pavements can successfully be laid by cities by day labor, and also agreeing that the guarantee clause is unnecessary in contract paving work. Mr. Near, city engineer of St. Catharines, Ont., called attention, however, to the fact that a 5 or 10-year guarantee is wise in Ontario towns and cities where the property owners pay for the pavement but not for its maintenance, and through the guar-

antee clause they are really made to pay part of the maintenance, as they pay the insurance on the life of the pavement or on part of its life.

"Sheet Asphalt Pavements," by T. Linsey Crossley, of J. T. Donald & Co., consulting chemists, Toronto, discussed the essentials of this type of pavement, the preparation of the specifications and the tests of the materials. An interesting article on these points, by Mr. Crossley, was published in *The Canadian Engineer* for February 22nd, 1917.

Arthur H. Blanchard, professor of Highway Engineering at Columbia University, New York City, was unable to be present, but forwarded his paper on "Road Oils and Tars," so it was read by Mr. Huber. Among those who took part in the discussion on this paper were Paul Mercier, city engineer of Montreal; Richard McClelland, city engineer of Kingston; F. C. Askwith, assistant city engineer of Ottawa; and W. H. Connell, chief of the Bureau of Highways, Philadelphia. Mr. Connell's discussion was particularly thorough and instructive. He told how traffic mats can be constructed to the best advantage with asphalt or tar oils.

The last paper read before the congress was "The Highway in Relation to Land Development," by Thos. Adams, town-planning adviser to the Commission of Conservation, Ottawa. During the ensuing discussion H. Brad Billings, of Billings' Bridge, Ont., who is one of the most enthusiastic good roads supporters among the wealthier Ontario farmers, having constructed many a mile of county road at his own expense so that he can motor to and from his estates, called serious attention to the fact that Mr. Adams, in his plans for highways and towns, provides no public green, or parking area, for aeroplane landings. The time is rapidly approaching, prophesied Mr. Billings, when aeroplanes will be more popularly used, and in any far-sighted and comprehensive town-planning scheme an area should be assigned where the machines can safely alight, the area being suitably indicated by markings distinguishable from the air by day, and by signal lights at night.

Next Meeting Probably at Hamilton.

A business session of the Dominion Good Roads Association was held Saturday morning at the Chateau Laurier. An invitation was received from the Hamilton Board of Trade, asking that the fifth session of the congress be held in that city. The invitation was accepted subject to the condition that favorable arrangements can be made.

The 1916 board of directors of the association was re-elected for 1917. A few additional directors will be added at the next meeting of the association. The old board was continued in order to allow it to perfect its work of incorporating the association under Dominion charter. The officers are now as follows:—

President, J. Duchastel de Montrouge, city engineer, Outremont, P.Q.; vice-president, S. L. Squire, Waterford, Ont.; secretary-treasurer, Geo. A. McNamee, Montreal; honorary presidents, U. H. Dandurand, Montreal; W. A. McLean, Toronto; B. Michaud, Quebec; and O. Hezzlewood, Toronto.

The directors of the association are the above officers and Thomas Adams, Ottawa; A. L. Caron, Montreal; E. A. Cunningham, Lethbridge; Dr. E. M. Desaulniers, St. Lambert, P.Q.; A. C. Emmett, Winnipeg; R. S. Henderson, Winnipeg; Geo. Hogarth, Toronto; J. W. Levesque, Montreal; A. F. Macallum, Ottawa; P. E. Mercier, Montreal; and J. A. Sanderson, Oxford Station, Ont.

THE CONTRACT AND SPECIFICATION FOR PAVING.*

By Charles A. Mullen,
Director of Paving Dept., Milton Hersey Co., Limited.

IT is only necessary to look at the contract and specification forms in use by our many city, county and provincial road departments to realize that the importance of this subject either has not been fully grasped, or, if understood, has been sadly neglected. For my part, though I have had occasion to examine and study many paving contracts and specifications, I have never found even one that seemed to be a finished product; or, in fact, any more than the throwing together of many more or less disconnected sentences and paragraphs. When it has fallen to my lot to prepare such documents, I am free to confess that I have added but little or nothing to the art, and that I am no more pleased with the form and lack of completeness of my own products than with those of my contemporaries.

Some one has aptly remarked that a short contract makes a long law suit. It may well be added that a poorly drawn contract makes a long law suit still longer. I do not know that anyone has ever estimated the cost per square yard of the many litigations growing out of road and street paving work, but certainly this can be no inconsiderable amount. To the judgments and law costs paid directly by public bodies must be added that part of a contractor's contingency figure included in his bid price to cover probable legal expenses. It may truly be said that, no matter which side wins the law suit growing out of a paving contract, the public always loses. If it wins the suit, it loses possibly not so much; but it should be remembered that the contractor's losses and expenses always go to make up other contingency items. Therefore, it behoves those entrusted with the design and construction of public road work to do all in their power to reduce the possible causes of such law suits.

The Relations Between Contractor and Engineer.—The relations between the road department and the paving contractor are no different than those existing between any other buyer and seller. Their interests are diametrically opposed. The main reason a contractor builds a road is for the profit there is in it. With him, use is a secondary matter; in which, if he is in the better class of his calling, he is mildly interested. Where road paving is done on a strictly competitive basis, no matter how high a contractor's ideals may be, or how much secondary pleasure he might be able to get out of doing a good piece of work, the least that the road department can be induced to accept is the most that any contractor can afford to give. After all, the standard of road construction in any community is not so much the letter of the contract as the interpretation of it that the road authorities are accustomed to permit in actual practice. A well-drawn contract and specification is a prime necessity, of course; but with it, competent supervision and careful inspection are also indispensable to good roads.

Nothing in the foregoing paragraph is intended in any way as an aspersion upon contractors. As fine men may be found amongst them as in any other walk of life. They are quite as human as other people, and equally governed by their practical necessities. In justice to him and to the public alike, a better understanding between the contractor and the road department is essential if we

*Paper read before the Dominion Good Roads Congress, Ottawa, April 10th to 14th, 1917.

are to get the best results obtainable through the contract system. Being in many respects the underdog, the contractor will, in nearly every case, be found ready and anxious to co-operate in matters that promise to bring about that better understanding. Fully realizing that the basis of their relations to the road departments is the contract they sign and the specification for the work that accompanies it, any forward step looking to the improvement of these documents by making them more practical and definite will meet with very general support from at least the better element in the road-building fraternity. These men will also be found quite ready to submit to the most rigid systems of direction and inspection; provided the work is carried out in a commonsense way, and provided that it is known in advance of the bidding that even-handed justice will be dealt out to all parties alike.

Contract: An Agreement Between Equal Parties.—In the first place, the contract should be in the nature of an agreement between equals; one of whom is ready and willing to deliver the goods specified, the other, ready and willing to pay the price stipulated. Many, in fact, most of the paving contracts that I have examined, and some that I have been bound by, more nearly resemble a master-and-slave contract. The engineer, especially if he is a man of superficial understanding, always poses as master to the contractor's slave. Since freedom-of-contract is very largely a legal fiction, one should not be surprised to learn that, as soon as they have signed such one-sided documents, most contractors have the feeling that anything they can get away with is theirs. Some engineers,—and I have one in mind who rode on my neck for several unpleasant months,—do not even admit that their interpretation of the contract must necessarily be reasonable. The contractor, especially if he is a man of small finances, must often grin and bear this attitude of the engineer; denying himself even the luxury of telling the man what he thinks of him until the work is completed and the money collected.

Now, such a condition of affairs is not conducive to the best results in road building. No matter how clever an engineer may think himself, the contractor who feels that he is being badly used can deliver and collect for a job that is much less than the best that is possible under the agreement, even though he save no money to himself thereby. Inversely, an engineer who is ill-disposed to the contractor working under him can always cause more expense than is actually required to do the work properly, especially if such engineer is armed with the too common poorly drawn specification coupled to the master-and-slave form of contract. While it is true that the interests of the contractor and the interests represented by the engineer are opposed in the major premise, there is no reason why both parties should not candidly recognize this fact, and then go ahead, with the least friction possible, to the building of a good road. One of the prime necessities of team work between engineer and contractor is that each thoroughly understand and respect the rights of the other. As a basis for this, there must be the well-drawn and easily understood contract and specification in which what each party has agreed to do is clearly stated. Enough unforeseen details will then crop up, during the progress of the work, to call for the exercise of good sense and a sweet temper between even well disposed men.

Some Work that Should Precede the Contracting.—No engineer is fully competent to draw a road or street paving contract until he has made certain preparatory moves. We will assume that the selection of the road site and the proper attention to drainage are accomplished facts, that the traffic is sufficient to warrant a hard road surface, and that the money can be made available. It is up to the engineer to determine what kind of pavement can be laid to the best advantage, and to draw a contract and specification therefor preparatory to accepting bids from contractors. If the work is to be done by direct employment, the contract form may be dispensed with; but the specification should not be omitted, though it may be shortened. There is no reason why public employees doing road work should not live up to just as strict specifications as would be imposed upon a contractor doing similar construction.

It is doubtful if any two paving situations are identical, though most of them closely resemble each other in many important details. Therefore, prior to making the important decision as to what type of pavement to lay, the engineer should very carefully study all the different forms of construction that are possible, the available materials therefor, and the costs and other factors involved. He should be thoroughly conversant with not only the prices that have been bid by contractors at previous lettings in his neighborhood; but, by having made his own careful detailed estimates of actual costs of labor and materials, he should also be in a position to know if the prices formerly charged were reasonable, and whether or not he can lower them by good management and fair dealing. Some well-known paving reports have been based on absolutely false values because the engineers making them either did not know enough or did not care to look into the matter of actual costs. Needless to say, such practice as this is entirely indefensible, and quite justifies the assumption on the part of those who read such reports, and know the things that they do not say, that some of our professional brethren have fallen by the wayside.

The Contract Fair, the Specifications Clear.—In many contracts, it is stated that certain things must be done when the engineer has no intention at all of demanding them, and other things are expressly prohibited that in practice the engineer will quite properly permit. Such a contract is not fair to the contractor. What is necessary should be stated; what is not necessary should be omitted. The requirement for planking a concrete foundation to haul upon it after it has been down seven days is such an instance. Few engineers enforce this clause; and if one did, I should be very suspicious of the quality of his concrete. Any pavement foundation that has set seven days and will not then carry without risk the hauling incident to further construction is not fit to accept. Planking grade is also frequently required in the contract when it is unnecessary and not demanded in practice; unless, perchance, the engineer wishes to punish his "slave." Can one blame the slave if, in order to get even with his "master," he stays awake nights devising a scheme by which he can use two bags of cement instead of three under his master's very nose? This is being done every day; but sad to relate, it is the public and not the engineer that sustains the loss.

In drawing the specification, the rule should be: A reason for everything, and everything in its place. Can engineers much longer go on specifying things that they do not understand? The unfortunate attitude of many public bodies in thinking that, because they have hired a man who is a graduate engineer, he should be able to solve every problem submitted to him without special assistance, is the cause of more poorly drawn specifications than anything else. I have sometimes noticed that the smaller the salary an engineer receives, the more he is expected to know. The poorly paid village engineer,

who is expected to know it all, and is thought to be too expensive even at that, finds himself compelled to get along as best he can alone in order to hold his livelihood. The result is a brave attempt at a specification that is taken in chunks from standard and other specifications; and through which, when it comes to a law suit, the contractor and his attorneys can drive a team of horses at most any point. It is all that could have been expected from the engineer under the circumstances. Family doctors are not expected to perform appendix operations; and those who require it of them must expect to suffer in the process of cutting.

Engineer to Guarantee; Not the Contractor.—As paving engineers, why do we ask a contractor to guarantee the work that we design, direct and inspect? We tell the contractor what to do, how to do it, and when. If the pavement goes wrong,—barring absolute fraud, of course,—why should the contractor pay the penalty? Fair play demands that the engineer guarantee his own road. I do not mean to actually suggest that he be asked to give a bond and make good the loss, but that the contractor should not be required to make good a failure if it is in no way his fault. The engineer's reputation should suffer; not the contractor's pocket, and through him, the public's. If this rule held true, engineers would be much more careful in the paving work that they specified and constructed. I have noticed that the contracts which leave the contractor with the least to say about how the work shall be actually done, also frequently bind him the tightest with a guarantee of the result. This is an element of chance that is forced upon the contractor; and, as with everything else, he of course figures on it in his bid.

Mr. E. M. Perdue, of Kansas City, has remarked that the guarantee is a two-edged sword which cuts the taxpayer both ways. Mr. J. W. Howard, of New York City, opines that what we want are good pavements on our streets, not guarantees on paper. I agree with them both. The practice of requiring a five or ten-year guarantee on paving work has done much harm in the past, and will probably live enough longer to do more harm in the future. It has been the excuse offered by innumerable city officials for not bothering about good inspection and careful testing of materials; and it has been productive of more expensive law suits between city and county governments and contractors than any other one item. We have already remarked that all law costs find their way to the ultimate consumer, who is always the public. Verily, he gets it both coming and going, especially if the engineer has shirked his responsibility upon a guarantee company and permitted the laying of a poor pavement.

Testing and Inspection a Sound Investment.—If the money paid for guarantees to contractors, and, through them, to the bonding companies, should be put into the actual road work in the form of careful testing and inspection, the yield from the investment would on the whole be much greater and far more satisfying. Why be content with the five-year guarantee of a pavement on a street where that type of pavement should last twenty-five years; and on heavy traffic roads and streets, why force the contractor into the position of a gambler? Is it reasonable that he will be able to make any better guess than the engineer on the probable life of the pavement that the engineer has himself designed, the construction of which he has supervised, and the materials for which he has or should have tested and approved? No one takes a business risk these days without a sufficient premium, and the overhead costs and profit expected from such risks is easily one-hundred per cent. That is the figure for fire insurance, when the totals of losses paid is one-half the amount of the gross premium receipts.

Now, it sometimes happens that good construction of some type costs no more than the poor constructions that are permitted where there is no sufficient inspection and testing and no one in consultation who is possessed of the special knowledge required to differentiate. This will even happen where the testing is well organized if the directing force is not what it should be. Testing alone is not sufficient. Many can make the bare tests more or less well who do not recognize the significance of the results after they have got them, and who do not know how to go about correcting the defects indicated by the tests. To be of certain value, the scientific work should begin with a study of the sources of supply of the materials, the costs of securing them, their proper selection and combination regulated by field tests, and the final laboratory analyzing and testing of the finished product as a check upon the practical work that has been done in the field. Only in this way can a road department be certain that it is not squandering the public funds in under-grade work.

Have Nothing to Offer; Wish to Start Something.—I have nothing to offer in the line of a satisfactory plan for the general improvement of road and street paving contracts and specifications at the present time. Some particularly flagrant instances of defective documents, and their consequences, have come under my observation recently, and it is the deep feeling engendered by these instances that makes me willing at this time to help start something in the nature of an organized advance along these lines. I do not know yet what I may be able to do, but whatever part of the work of reconstruction comes my way, I shall be ready to do it. Such work, however, is usually the combined effort of many; and I see no reason why we should not find in the Canadian and International Good Roads Congress an organization through which effort in this direction may be centralized and made to bear good fruit.

I have not in mind the issuance of additional standard specifications; though there is, of course, still much to be done in that line. The matter that seems to me to be of the greatest present importance is the proper use, by local adaptation, of even those standard specifications that are extant. When one has found cities using sections from such standard specifications in such a way that they were putting themselves in the position of advertising for something that could not be delivered from their environment, and could only be secured at a cost that they had no intention whatever of paving and should not pay, it is time to realize that something more requires to be done than the adoption and promulgation of standard specifications. In order to get a standard that will be possible in most sections of a country, much has to be sacrificed that can later be cured by adaptation of the general specification to fit the special needs and local advantages. It is time we bestirred ourselves to do this work of adaptation; and much other work in the proper drawing of a contract and specification besides.

A meeting of the Council of the Royal Architectural Institute of Canada will be held at the Chateau Laurier, Ottawa, Ont., on Saturday, April 28th, 1917, at one o'clock p.m., for the consideration of very important matters, to decide where and when the Tenth General Annual Assembly will be held this year, the creation of the R.A.I.C. Medal, the celebration of the Tenth Anniversary, etc. Hon. Secretary, Alcide Chaussé, Montreal.

HIGHWAY BRIDGES AND CULVERTS.*

By W. G. Yorston, C.E.,
Assistant Road Commissioner, Province of Nova Scotia.

THE agitation of late years for better highways has involved much more than the grading and surfacing of the roads, as one of the most important items to be looked into and dealt with has been the question of highway bridges and culverts. That this is so is due to two causes. One of these is that when permanent improvements are to be put on any section of highway many of the old structures are found too far gone to be of service and have to be renewed because of their old age. There is, however, a second very important factor entering into the matter, and that is the size of the load which has to be taken care of at the present time, due primarily to the advent of the motor truck and its rapid development, and in consequence of the heavy individual loads carried by these vehicles, structures which were thought to be built permanent enough to render good service for many years have to be replaced, not being thought safe enough to carry traffic.

On any length of highway the bridges are the spots of special danger, and it, therefore, becomes necessary to take the greatest care to make these crossings as safe as they can be made in order to carry traffic without accident. A bridge, to be satisfactory, must fulfil three main requirements: It should be strong. It should be durable. It should be sightly and of pleasing appearance. The first of these requirements is altogether a matter of design, and almost any structure can be made strong enough if enough material is used in building it and it is properly placed. The second desirability that the structure should be durable can also be readily obtained by building only of durable material. The third condition, however, is the one in which so many of our structures fail, as sufficient care is not taken in the designing of the bridges to obtain that result or effect which makes all the difference between something pleasing to the eye, and which blends with nature, and something in which the discord is so great that it cannot help but be noticed.

Steel Bridges.—In the province of Nova Scotia the construction of steel bridges was commenced in the year 1883, and since that time upwards of 800 steel bridges of different spans have been erected. Previous to the year 1883 the bridging in the different counties was under the control of the municipal authorities, and the bridges up to that date had practically all been built of wood, and in most cases the substructure for these bridges was also built of cribwork. Steel has been substituted for these wooden structures almost altogether since that date, and at the present time only a few samples of the original constructions in wood are to be found throughout the province. Some of these bridges have been in use about fifty years and are still in a state of good preservation, and are doing good service at the present time.

In the specifications in use in the province of Nova Scotia the steel bridges are divided into three classes as regards live loads:—

Class "A"—For bridges subject to heavy city traffic.

Class "B"—For bridges on country roads with heavy traffic.

Class "C"—For bridges on country roads with light traffic.

The live loads for which they are designed are respectively 15 tons, 12 tons and 8 tons. In the construction of steel bridges the types preferred are as follows:—

For spans up to 30 feet... Rolled beams.
For spans from 30 to 80 feet Riveted pony strusses or plate girders.
For spans from 80 to 200 feet ..... Riveted trusses.
For spans over 200 feet... Either riveted or pin-connected trusses.

All steel bridges are now designed to carry concrete floors with wood block or bituminous wearing surface, although at the present time these materials are not used universally, as it is found that with the present prices of materials plank can usually be delivered at the bridge site for $20 per M., or under, and in consequence a double floor of planking can be maintained at cheaper cost than the more permanent concrete floor and wearing surface. On all more important bridges, however, it is intended to use concrete flooring.

The concrete floor is heavy and adds very considerably to the amount of dead load of the bridge, and, consequently, increases the weight of the steel required in the trusses. One great advantage of concrete floors in addition to their durability, is that they distribute the concentrated load very much better than the wood, as the weight of passing traffic is spread over a greater area of the bridge structure. The structure is also much stiffened when a reinforced concrete flooring is used.

After a steel structure has been erected and properly field painted, it should remain in good condition for a period of from four to five years, depending largely on the condition of the surface of the steel, the quality of the paint, and the care taken in its application.

The best practice in purchasing bridges would undoubtedly be to first determine just what type and form the new structure will be, and then to prepare the necessary stress sheets and drawings, so that all who intend tendering for the structure will do so on the same basis. For this work it is best to secure the services of a competent bridge engineer. The cost of the plans prepared in this way is a little more than if they were prepared in the department office by members of the regular staff, and in addition the benefit is obtained of greater experence and the consequent assurance of safety.

Concrete Bridges.—Concrete for bridge substructure has been used very largely in the province of Nova Scotia since the year 1883. Dr. Martin Murphy, who was at that time and for many years after the Provincial Government Engineer for the province of Nova Scotia, is regarded by the profession as one of the pioneers in concrete construction, and many of the structures erected of that material bear witness to the wisdom of Dr. Murphy's choice of material.

A paper on the subject of "Bridge Substructure and Foundations in Nova Scotia" by Dr. Martin Murphy, which was read before the Engineering Congress at the Columbia Exposition in 1893, elicited much favorable comment at the time, and also affords much valuable information relative to the employment of concrete in bridge work.

The experience so far gained in the employment of concrete for bridge substructure in the province of Nova Scotia would go to show that it is eminently suited for the work for which it has been used. At the same time it cannot truthfully be said that none of the construction has so far shown signs of deterioration. It is the case that concrete has been employed in Nova Scotia in as

*Abstract of paper read before the Dominion Good Roads Congress, Ottawa, April 10th to 14th, 1917.

difficult situations as are to be met with anywhere. The bridges constructed over many of the tidal streams entering the Bay of Fundy where concrete has been employed are exposed to heavy abrasing conditions due to heavy currents, and are, in addition, exposed to frost effects for a wide range of tide, sometimes as great as thirty feet. Under such conditions it is not remarkable that some deterioration has taken place. On the other hand, it can truthfully be said that concrete in these situations has shown itself at least the equal of cut-stone masonry. Where concrete has been employed in other situations, not exposed to tidal influence, it has been found to be entirely satisfactory. It must not be forgotten, also, that in the early days it was difficult and almost impossible to secure skilled foremen for concrete work, and part of the deterioration which has taken place is due rather to defective construction than to any imperfect concrete material. Concrete is now used almost universally throughout the province of Nova Scotia for bridge substructure, and also for masonry culverts where these have been built.

Concrete bridges are built in three general forms: (1) Arches. (2) Girders. (3) Trusses. Few concrete trusses have so far been built, and this form is so rare that is hardly need be discussed. Concrete arches can be used for all spans. Especially for the longer spans it is the most pleasing and graceful form in which concrete can be employed, as the lines of the arch particularly lend themselves to a beautiful outline. Of all the types of concrete bridges, the arch is the favorite, and it is also perhaps more often employed. Girder bridges are very useful for spans between eighteen and forty feet, but this form of bridge is much more severe in outline than the arch and cannot be made as pleasing to the eye.

Sand tests are as important as cement tests, and should be made regularly. In order to secure uniform strength, the proportion of the different materials required should be accurately gauged.

Where reinforcing is used in concrete, care should be taken to have it accurately placed and spaced. The steel should be carefully wired in place according to the dimensions on the plans, and in the placing of the concrete great care should be taken that the steel is not disturbed. All reinforcing bars should be free from scale, rust or grease, which tend to decrease the bond if left on the iron.

Culverts.—Pipe culverts are generally used up to a diameter of two feet, and in many instances to three feet. These pipes are of concrete or vitrified clay, and when used must have a sufficient covering of earth to protect them from traffic. Culverts of this class require to be laid in good manner and with a good grade, so that the water will not stand in them. It is most important, also, that a good outlet be provided to carry the water freely away from the structure. Great care should always be taken to have the pipes carefully laid on even bearing and the filling around them properly compacted. There should be at least fifteen inches of earth over the pipe when it is laid in order to properly protect it from the wheels of passing vehicles. For waterways requiring more than three square feet of opening, box or arch culverts are generally used, and these are usually built of concrete. Masonry ends are built on all pipes to protect them from breakage, and also to prevent water from following along the pipe. Inlet and outlet ends should be paved to prevent scour.

Records.—Records of larger bridges for the office are most important, as it is always essential that it should be known just what the cost for construction and maintenance of the different structures has been. This is especially important in the case of bridge painting, as it is only by such means that any accurate idea can be had, both as to the cost of the work and the anticipated requirements in any season. A good system is to keep a card record on cards six by eight inches. On the face of the card is given all important information regarding the construction of the bridge, its dimensions, cost, etc.; in fact, all essential information can be given in concise form in this manner. On the reverse side of the card provision is made for records of the cost of repairs and painting. The painting record should show the kind of paint used, the time of year in which the bridge was painted, and its cost. From such records as these it is possible to tell at any time the state of repair of all structures on the different highways. As it is too cumbersome and perhaps unnecessary to file individual records for the smaller structures, these can be grouped together in sections in any way desired.

The structures must be treated as an integral part of the roadway and to meet the demands of traffic, especially of safety, all parts of the roadway must be wide enough to carry the traffic without danger. To this end all the structures must be made of such dimensions as will allow the maximum width of roadway demanded. All parts of the highway should be kept in good condition, and it is of little use to have well surfaced and smooth roads if the bridges are not strong or are unsafe; nor is it good business to have all the bridge structures of the most substantial and ornamental character if quagmires exist at either end of these structures. On the contrary, the whole scheme must be balanced in order to get the best results. Quite true, the element of safety in highway structures must never be lost sight of, but it is quite possible, also, in the fervor of erecting permanent bridges and culverts, to erect these at too great a cost, leaving not enough money to finish up all parts of the highway to the same standard. All engineers take the utmost pride in building their structures permanently, but at the same time there is a feeling that the garment should be cut to suit the cloth, and the expenditure should be made to suit the circumstances, and where it is demonstrable on any road of little traffic that structures of wood can be kept up for a fraction of the interest and maintenance costs of permanent bridges, then the cheaper structure should be built, and the money so saved should go to the main arteries which, in most instances, owing to the greater traffic conditions, are generally in need of more money than is available for their construction and upkeep. No general lines for these expenditures can be laid down, but each must be considered on its own merits and dealt with accordingly.

EMERSON GOOD ROADS ASSOCIATION.

A large number of representatives of southern Manitoba municipalities attended the annual meeting of the Emerson Good Roads Association, held recently at the Russel House, Emerson, Man.

It was unanimously decided that the movement for securing better roads should be continued during the coming season, and last year's officers and executive were re-elected. They are: Reeve J. McCartney, Franklin, president; Mayor E. Casselman, Emerson, vice-president; and R. E. Masterton, secretary-treasurer.

BITUMINOUS MACADAM ROADS.*

By Wm. D. Sohier.
Chairman, Massachusetts Highway Commission.

I HAVE been requested to speak about bituminous macadam roads, particularly those built by the penetration method. In Massachusetts we have used both tars and asphalts, using both the penetration and the mixing methods.

The Highway Commission has just made its 24th annual report. We began to construct our state highway system 24 years ago, and the highways that were built then are still in existence, though naturally the older roads have required resurfacing.

Ever since the motor vehicles became so numerous, the number using the roads about doubling every three years, the older roads have been worn out very fast.

We have now on our main highways during the summer season an average of over 700 motor vehicles a day, and on the roads with heavy traffic 2,000 to 3,000 a day is not unusual.

Consequently, we have had to prevent our roads from being rapidly destroyed by the use of some form of bitumen on the surface at least.

Motor trucks are now increasing rapidly. Our older roads, which were built of a standard width of 15 feet of macadam with a three-foot shoulder on each side of gravel or the best material obtainable, are too narrow for the increased traffic and should be widened.

This will tend to distribute the traffic and make the road surfaces wear longer. We are now building our new roads at least 18 feet in width of hardened surface, with a three-foot shoulder on each side. In some cases, on hills especially, etc., we are trying to secure six feet on the side, of waterbound macadam or gravel for the use of horse-drawn vehicles.

On most of our main highways, whether State highways or town ways, some form of bitumen has had to be used on the surface at least, or the motor vehicles would tear up and destroy the roads in a few weeks. This brings me to my topic, "Bituminous Construction."

For the last few years, because of the number of motor vehicles using our roads, we have found it necessary to build some form of bituminous pavement or else to build a road of cement concrete.

We have used this form of construction on all main lines, not only in construction, but when the road was resurfaced.

Bituminous Surfaces.—Another change that has been made, because of the increase in the weights that the roads had to carry, has been the use of the larger crushed stone (2½ inches) on the surface of the road.

We have used both tars and asphalts in penetration work. The methods are much the same.

After we have secured an adequate foundation, well compacted and rolled, we have spread on this enough broken stone to make it four inches deep after rolling. It has been thoroughly rolled until it will not creep under the roller. On top of this we have spread about 3 inches of 2½-inch stone, and rolled this thoroughly down to about 2 inches.

Into this top surface we spray hot asphalt or tar, under pressure, using one of the various mechanical sprayers or trucks. The asphalt has to be heated to about 250° F., the tars to about 250° F.

We spray in about 1¾ gallons to each square yard of surface, finding that this hot bitumen will penetrate about 2 inches, coating the stone.

We then spread all the ¾-inch stone that can be rolled in, and roll it thoroughly, thus filling the voids in the surface.

After this is done all surplus stone is thoroughly swept off with bamboo brooms, and a surface coating of asphalt or tar, ½ to ¾ of a gallon to the square yard, is sprayed onto the road.

This is thoroughly covered with peastone and well rolled. This peastone has to be constantly swept back or more stone added for a few days, until there is no sign of bleeding.

When any work of this character is done in cold weather, the road must be carefully watched every warm day, and especially the next season, and wherever there is any indication of bleeding more stone or gravel must be spread on it immediately, or the road will be picked up by the passing vehicles. Covering must always be kept on the road until all the bitumen has been taken up; otherwise teams, trucks and automobiles will pick up the surface on their wheels.

We spray the bitumen on one-half the road surface at one time, cover it, etc., and then do the other half of the width.

The ¾-inch stone and the peastone are got out beforehand and stacked on the roadside, so that the covering can be put on immediately and the stone rolled in before the bitumen cools.

We hope and believe that roads of this character built on an adequate foundation and properly maintained will carry a very considerable traffic for five years at least, before they need a new surface treatment, when a good grade of the asphalts is used. Where tar is used our experience, in common with the best English practice, seems to show that a light surface treatment of about ¼ gallon to the square yard is advisable and necessary every two years. (I can give anyone figures in detail.)

Wages were so high with us in 1916 that all our costs increased nearly or quite 50 per cent.

In 1915 the cost of this penetration work was as follows: For the 4-inch lower course and the 2-inch upper course penetrated with bitumen:—

Uxbridge—$1.02 per sq. yd.; trap; oil asphalt, $.08¾ a gallon; 110 penetration.

Dedham—$1.25 per sq. yd.; trap; bermudez, $.12½ a gallon.

Saugus—$1.06 per sq. yd.; trap; tar, $.07¾ a gallon; viscosity, about 125.

Middleton—$0.81 per sq. yd.; local stone; tar.

Cost of some resurfacing work, penetration method, in 1916:—

Weyland and Sudbury—$1.30 per sq. yd.; trap 6-in. to 7-in.; bermudez, $.12½ a gallon.

Shrewsbury—$.98 per sq. yd.; trap, 5-in.; same bitumen.

Northboro—$.79 per sq. yd.; local stone; same bitumen.

Tar-Sand Grout, Brodie Method.—Mr. Brodie, city engineer of Liverpool, and one of the most experienced road builders in the world, has developed a form of construction that he believes will and has proved economical for ordinary light city traffic but not for heavy teaming.

Certainly when some of his roads were 12 years old, in 1914, the roads built by this method were in most excellent condition. They had not been patched or resurfaced, whereas the waterbound macadam road just beyond, carrying the same traffic, had been lightly resurfaced every year.

*Abstracted from a paper read at the Dominion Good Roads Congress, Ottawa, April 10th to 14th, 1917.

The usual method is as follows: After the foundation is properly prepared and well compacted, about 4½ inches of 2-inch to 2½-inch stone is spread and well rolled. This is grouted with pitch and sand mixed and kept constantly agitated. They then spread and roll in with a steam roller, stone of about 1½ inches, which is grouted with pitch and sand and rolled down with a steam roller, the wheels of which are kept constantly wet. Into this top they roll chip or ¼-inch stone.

During the last few years they have been putting on a surface application of the pitch and sand and covering it with peastone, all well rolled.

In Liverpool the tar and sand is usually heated at a central plant and hauled to the road by a steam tractor. The tar and sand is mixed in a "dandy," which is a two-wheeled, 35-gallon tar kettle. They use about an equal quantity of tar and sand, to 60 per cent. sand. This is mixed and kept constantly agitated by a man with a paddle. The men pour it by hand from buckets that hold about 1½ gallons, pouring it very evenly.

The sand used is a fine sand about like the sand used in plastering.

The important point is to secure a sand that is the right size to stay in suspension in the tar and not settle to the bottom too quickly. Of course, the coarser the better, if it can be kept evenly in suspension until used.

The tar and sand are both heated to about 250° F.

Mr. Brodie, if I remember correctly, figured the additional cost of this work over and above the cost of a waterbound macadam road, at from 25 to 35 cents a square yard.

Where we have constructed some roads of this character, we have heated our sand and tar on the roadside, using tar kettles and a sand heater to heat the sand. We built a box on wheels, sloping to the end, and had a flexible pipe with a flat nozzle from which the tar and sand mixture was poured into the road.

In Natick, where some work of this character was done in 1914, the old macadam road was scarified, about 2 inches of 2½-inch stone was spread and rolled; this was grouted with the tar and sand mixture, finer stone rolled in, etc., and the cost was about 75 cents a square yard.

The road has been most satisfactory, and it certainly looks now as if it would last for 10 years at least, on a road with about 50 trucks a day and over 700 motor vehicles.

We have used this method of construction on quite a number of stretches of road, especially on grades, as it seems to be less slippery for horses than any other type of bituminous surface, especially if the surface coat is left off and the stones are allowed to project a little.

The tar and sand seems to stiffen and strengthen the whole road, and we believe the use of the sand prevents the tar from oxidizing for many years, and thereby adds to the life of the road.

We developed this year a very good contrivance for securing an even distribution of the mixture. Two plank bridges were made that bridged the road. They were 2-inch plank supported in the middle on a 2-inch plank on the crown of the road and built up on the sides. Another 2-inch plank running lengthwise of the road was supported on these, and the man pouring the mixture walked along this plank, held his bucket right against the plank and walked at a rate of speed that just emptied the bucket in the length of the plank. A flat-nosed bucket was used, with a nozzle about 8 inches in width.

By placing the bridges the right distance apart, one bucket covered just the proper area, and we poured about 2 gallons to each square yard of surface.

Keeping the bucket against the edge of the plank secured a straight edge on the road. The plank was then moved along on the bridges across the road, and the process repeated, until the whole width was done. There were practically no spaces left where the voids were not filled and the bitumen did not lap.

By keeping the same men on the pouring and having the hot mixture brought to them, uniform results were insured and the work progressed rapidly.

In England, in several instances, I think in all where they were rolling either a sand-pitch grouted road, or grouting with tar a stone road, they were wetting the wheels of their roller. In one or two cases they had a man on each side constantly pouring water on the roller wheels. This was to prevent the tar from picking up on the wheels of the roller.

In Liverpool, they make a little ordinary water box and place it over the wheel of each roller. In the bottom of the box they leave a little opening on one side, and put in a piece of crash or linen towelling, which hangs down over the roller wheel and keeps it just moist, the roller man filling the box from time to time with water. They say it does not need much water but merely enough to keep the wheels of the roller damp, and when they tried other methods they got too much water and it interfered with the hot tar surface, pitting it. The box is just the width of the roller wheel, about a foot to fourteen inches square. When they used too much water, they got blow-holes in the tar.

Gravel Asphalt Mixed Surfaces.—There are two forms of bituminous construction that we have used with considerable success in Massachusetts, that certainly until a year or two ago have not been used elsewhere, to my knowledge.

The processes are about the same, except that in one case sand is used combined with an asphalt, by either the layer or mixing method, and in the other case a sandy gravel is used combined with asphalt.

We have constructed a good many miles of road where these materials have been used. They make very satisfactory roads for medium and light traffic, and cost comparatively little to build.

We do not claim even for the gravel asphalt road that it is superior to various other forms of bituminous surfaces, which cost a good deal more to construct, but that where stone is expensive, the haul long, if a good quality of sandy gravel may be obtainable at a very low cost near the road, in many cases a road can be constructed using this material, the first cost of which will be relatively low.

A short description of the process of construction will be of interest. For instance, in Shirley, Mass., a road, 18 feet in width with 3-foot shoulders, was built, the curves being banked and widened to 21 feet. A gravel foundation was put in wherever the bottom was bad, and about 4 inches of local crushed stone was spread and well rolled.

On this was spread, as evenly as possible, about 3 inches of a bituminous mixture, made of gravel that had been run through the crusher, and sand or stone dust, mixed with a heavy asphaltic product.

The gravel and sand and the asphalt were thoroughly heated and were mixed in a hot mixer, and then carted onto the road and spread. The surface was rolled down to about 2 inches in thickness, when the mixture was sufficiently cool not to crawl under the roller.

Great care is necessary to insure a uniform product, uniformly heated, mixed and spread, and that sufficient Mix, 1 to 6 of pit gravel. Transverse joints every 30 ft.

asphalt is used and no more than sufficient to bind the mixture properly.

The quantity of asphalt has to vary somewhat, according to the amount of voids in the mineral aggregate. The variation is usually from 18 to 22 gallons of the cold asphalt to the cubic yard of gravel. When the mixture is right it has about the consistency of brown sugar, and compacts under the roller, though when it is first spread and rolled it sometimes has a few hair cracks which the traffic soon rolls out. The asphaltic product used in this work has a penetration of from 80 to 120 with a Dow penetrometer.

Roads constructed of sand and asphaltic oil were first tried by my Commission in 1905, and that road is still in existence, though it has required a considerable expenditure each year, to keep it up, renew and widen it.

The gravel and asphalt mixture was first tried by me in 1907, and that piece of road is still in reasonably good condition.

Such mixed asphalt gravel roads certainly look as if they would last for a considerable period of time. Several quite long stretches have had already five years' wear. A few, but not many, weak places occur, and these have to be patched, but the expense is very slight.

With the higher wages, the higher cost of all materials, etc., the cost of all road construction has increased.

I am giving below a few of the costs of roads of this character. These costs are all for the 4-inch broken stone base, rolled, with a 3-inch mixture spread on top and rolled to 2-inches. The grading, foundation, if any, drainage, etc., were all additional.

Cost—Gravel-Asphalt Mixture.

Shirley	(1914)	$0.81 a square yard
(Residuum asphalt, 8 cents a gallon.)		
Sterling	(1914)	$1.01 a square yard
Gloucester ...	(1916)	$1.29 a square yard
Andover	(1916)	$1.20 a square yard
Reading	(1916)	$1.08 a square yard

The asphalt used was a residuum asphalt, usually one with some lake asphalt in it. It cost from 9½ cents a gallon to 12½ cents a gallon, depending on the quality.

We used a penetration of about 85 for this character of road.

I will annex some specification forms which can be printed.

I wish to congratulate you on this splendid Congress. I wish to congratulate you still more on the great progress in road improvement that has been made in some of our Canadian provinces during the last few years.

Above all, I wish to congratulate you upon the class of men that you have here interested in good roads. It has been a great pleasure to me to meet so many of them. I have learned much from them. They help us in the States, and we try to help them here.

I hope you realize fully what you owe to these men. Whatever progress you have made is largely due to their devotion to the cause, their knowledge and skill. I cannot name them all, so I will only say to look at the men who have been presidents of your association, and look at the men who have been in charge when good roads have been constructed, and you will see men who have no superiors and few equals in my country or any other.

In conclusion, I wish to say that I very much appreciate the opportunity that has been given to me to come to Canada, especially this year when practically we have vital interests in common, when my country is just beginning the war preparation which you have been so ably carrying on during the last two and a half years.

I only hope that our people will prove as efficient, as resourceful, as unselfish, and as patriotic as the people of Canada have been during these trying years.

We have a great deal to learn, a great way to go, but at least we stand shoulder to shoulder with our northern neighbors, ready, if necessary, to make the last sacrifice, if thereby we can secure to the coming generations of the world "the blessings of liberty" for which our ancestors fought, "the right of seeking and obtaining their safety and happiness" to the end that a government "of the people, by the people, for the people, shall not perish from the earth."

MONTHLY RAILROAD EARNINGS.

The following are the weekly earnings of Canada's transcontinental lines during March:—

Canadian Pacific Railway.

	1917.	1916.	Inc. or dec.
March 7	$2,442,000	$2,198,000	+ $244,000
March 14	2,670,000	2,258,000	+ 412,000
March 21	2,648,000	2,281,000	+ 367,000
March 31	3,932,000	3,491,000	+ 441,000

Grand Trunk Railway.

March 7	$1,063,190	$ 992,026	+ $ 71,164
March 14	1,068,837	957,542	+ 111,295
March 21	1,054,639	967,233	+ 87,406
March 31	1,815,571	1,592,442	+ 223,129

Canadian Northern Railway.

March 7	$ 669,100	$ 540,200	+ $128,900
March 14	738,200	538,000	+ 200,200
March 21	719,100	549,000	+ 170,100
March 31	1,146,000	979,000	+ 167,000

The Canadian Northern Railway February statement is as follows:—

	1917.	1916.	Inc.
Total gross earnings.	$ 2,358,600	$ 2.089,200	+ $ 269,400
Operating expenses ..	2,250.400	1 959,800	+ 290,600
Net earnings	$ 108.200	$ 129,400	
Aggregate gross earnings from July 1st.	$26.822.700	$21.527,600	+ $5,295,100
Aggregate net earnings from July 1st.	$ 6,886,400	5,909,300	+ 977,100

Results of operations of the Canadian Pacific Railway for the half-year ended December 31st last were:—Gross earnings from railway and lake and coastal steamers, $76,717,965; working expenses, $45,643,199; net earnings from railway and lake and coastal steamers, $30,874,766; deduct fixed charges, $5,132,951; surplus, $25,742,215; deduct contribution to pension fund, $200,000.

Deduct net earnings of coastal steamers, commercial telegraph and news department transferred to special income account, $1,144,071. Net revenue from earnings of railway and lake steamers available for dividends, $24,395,144. After payment all dividends declared for half-year the surplus from earnings of railway and lake steamers is $13,684,505.

Special income for the half-year after making allowances for contingent reserves, $6,415,352.

The first foreign shipment from the new plant of the Vancouver Creosoting Co., Ltd., Vancouver, was made about a month ago, consisting of creosoted railway ties for China. The firm expects considerable foreign business when shipping becomes normal.

A preliminary report on the mineral production of Canada during the calendar year 1916, by John McLeish, of the Division of Mineral Resources and Statistics, Ottawa, says: "The total value of the metal and mineral production in 1916, as shown in the preliminary report, was $177,357,454, which, compared with a production in 1915, valued at $137,109,171, shows an increase of $40,248,283, or 29.3 per cent. The previous maximum production was $145,634,812 in 1913.

ESSEX BORDER UTILITIES COMMISSION*

FAR-REACHING RECOMMENDATIONS ARE MADE BY MORRIS KNOWLES, CONSULTING ENGINEER—INTAKE AT LOWER END OF PEACH ISLAND WITH PUMPING STATION AND FILTRATION PLANT ADJACENT — ESTIMATED COST, $1,800,000

THE preparation of this report has involved the study of the various methods available for the water supply and collection and disposal of sewage for Ford City, Walkerville, Windsor, Sandwich, part of the township of Sandwich West, and Ojibway; the preparation of numerous comparative estimates on different projects for accomplishing these ends; and the determination and selection of the most economical project in each case.

Metropolitan Idea.—The co-operation of several municipalities in building and operating public works of magnitude, has been tried with success in all parts of the world.

Population.—It is concluded that the population of the territory under the commission's jurisdiction amounts to 37,467 in 1916, and that it will increase to 110,000 in 1930, to 150,000 in 1940 and to 175,000 in 1950, all within the present limits of the district. This latter figure, however, does not represent the total population that may ultimately have to be provided for; for long before this time, it will be necessary to enlarge the boundaries of the district, if public works are to be carried out in a comprehensive manner.

Quantity of Water Required and Sewage to be Treated.—These subjects are considered together and a careful estimate, based upon the available information, leads us to conclude that Ford City will require one and one-half million gallons of water per day in 1930; Walkerville, one and one-half million gallons; Windsor, seven and three-quarter million gallons; Sandwich, two and one-quarter million gallons; Sandwich West, one and six-tenths million gallons; and Ojibway, two million gallons.

Quality of Water.—In studying the quality of the water of the Detroit River we have had available a great mass of analytical data collected by the International Joint Commission and by the city of Detroit. These data show clearly that the river is seriously polluted by municipal sewage and by the discharge of wastes from boats and that while the pollution increases progressively, downstream, best water being obtainable from the main ship channel near the lower end of Peach Island, no portion of the river can be considered satisfactory as a source of water supply for domestic use, without treatment.

The appearance of the water, also, is frequently unsatisfactory.

Water Supply System and Estimated Costs.—The recommended ultimate water supply system provides for an intake at the lower end of Peach Island, a pumping station on the river front with purification works adjacent, and a trunk pipe line extending through the various municipalities with take-offs at various points to supply the existing distribution systems. The estimated cost of this project is $1,890,000, with annual charges of $209,160.

The immediate improvement of the existing supplies of Windsor and Sandwich and the furnishing at once of a supply to Sandwich West and Ojibway, may be accomplished by the Commission's endeavoring to arrange with the proper Windsor authorities to have the Windsor pumping station operated for the benefit of the four communities named. The 20-inch cast iron pump line recently laid in Windsor might also be used for the same purpose, in which case an extension through Sandwich and Sandwich West to Ojibway, should be made.

The cost of supplying the larger quantity of water would be materially less per million gallons than the cost to Windsor at present, and in addition, Windsor would be compensated for the use of the supply works for the benefit of the Commission. Thus Windsor would be enabled either to reduce her outstanding debentures or to make extensions and improvements to the distribution system, which it would still retain, as is provided and always contemplated by the Essex Border Utilities Act.

The estimated cost of these immediate improvements, including an approximate allowance for the payment to Windsor, if the works mentioned were purchased, is $278,000, and the annual expense is $41,610.

Methods of Sewage Disposal.—Various methods of sewage disposal are discussed in an appendix, and it is concluded that for the local conditions, treatment by settling in two-story tanks, by screening, or by the activated sludge process, followed by disinfection and disposal through multiple outlets in the main channel of the stream, may eventually be required. This agrees with the conclusion of the International Joint Commission's engineers, and also with those of the engineers of the city of Detroit. But this final treatment is not necessary until all the communities on both sides of the river are required to treat their sewage, and for the immediate future, it would appear that all reasonable requirements can be met by the construction of a sufficient portion of the proposed interceptors to permit the collection of the sewage now discharged above the existing waterworks intake, and its discharge downstream and to care for the urgent necessities of Ojibway, Sandwich and a portion of Sandwich West.

Sewage Collection and Treatment Works.—Eight main projects have been studied in detail, and are presented, with estimates. It is concluded that the best and most economical project in first cost and annual operating charges is that providing interceptors on Sandwich, Bedford and Main Streets, which will collect the sewage from the various municipalities, beginning at Pelette Road in Ford City, and at Fourteenth Street in Ojibway, and meeting at a disposal site on Prince Street, between Chewett and Detroit Streets, Sandwich.

The estimated cost of the recommended project, including the Turkey Creek Works, is $900,000; the annual charges (excluding those of the Turkey Creek works) are estimated at $101,000. This estimate is based upon sewers and pumping stations designed for the ultimate population of the territory, with disposal works and pumping equipment sufficient for 1930 requirements.

*Abstracted from Morris Knowles' report on Metropolitan Water and Sewerage Systems for Essex Border District.

As in the case of the water supply, this whole expenditure is not required at once. The most urgent demands are for the collection and disposal of the sewage of Ford City and Walkerville, below the intake of the Windsor waterworks, and the collection and disposal of the sewage from Ojibway and from those parts of Sandwich West and Sandwich which will soon have a considerable population. A program of construction is suggested, the estimated cost of which immediate construction is $210,300; and the total annual cost $18,590. The works proposed are shown in Fig. 1.

The following specific recommendations are made:—

Water Supply.—(1) That the commission arrange at once to operate the Windsor pumping station and the new 20-in. pipe line in Windsor, and adequately compensate Windsor for such an arrangement, and to extend this line through Sandwich and Sandwich West to Ojibway.

(2) That the Commission proceed to furnish water to Windsor, Sandwich, Sandwich West and Ojibway, at cost, but that each municipality control its own distribution system, the delivery of water to its consumers, and the collection of water rents.

(3) That as soon as economic conditions permit, the Commission next proceed to build works and secure a water supply from the recommended source near Peach Island.

(4) That as Ford City and Walkerville at that time may wish to arrange to secure control of the distribution systems within their town limits. In that event, the Commission might arrange for the use or acquirement of so much of the supply works of the Walkerville Water Company as are used to supply water for municipal service within those towns.

Sewerage.—(1) That Ford City proceed to construct the sewer system as designed by Mr. T. Aird Murray, Toronto.

(2) That the sewage of Ford and Walkerville be collected, at once, in an intercepting sewer and delivered to a pumping station near the west main sewer in Walkerville and there lifted to an intercepting sewer, connecting with the Parent Avenue sewer outlet, thus removing all sewage from the river above the present water intakes.

(3) That Ojibway and parts of Sandwich West proceed to construct sanitary sewerage systems, and deliver sewage to an intercepting sewer extending to Park Street in Sandwich, where it will be pumped into the Park Street sewer outlet.

(4) That as soon as economic conditions permit, the intercepting sewers to Parent Avenue in Windsor and to Park Street in Sandwich, be extended to the ultimate disposal site at Detroit Street and that the sewage be there pumped to a detention tank and treated with a disinfectant.

(5) That the sewage treatment works be built when required by the conditions existing in the river or by the action of governmental authorities.

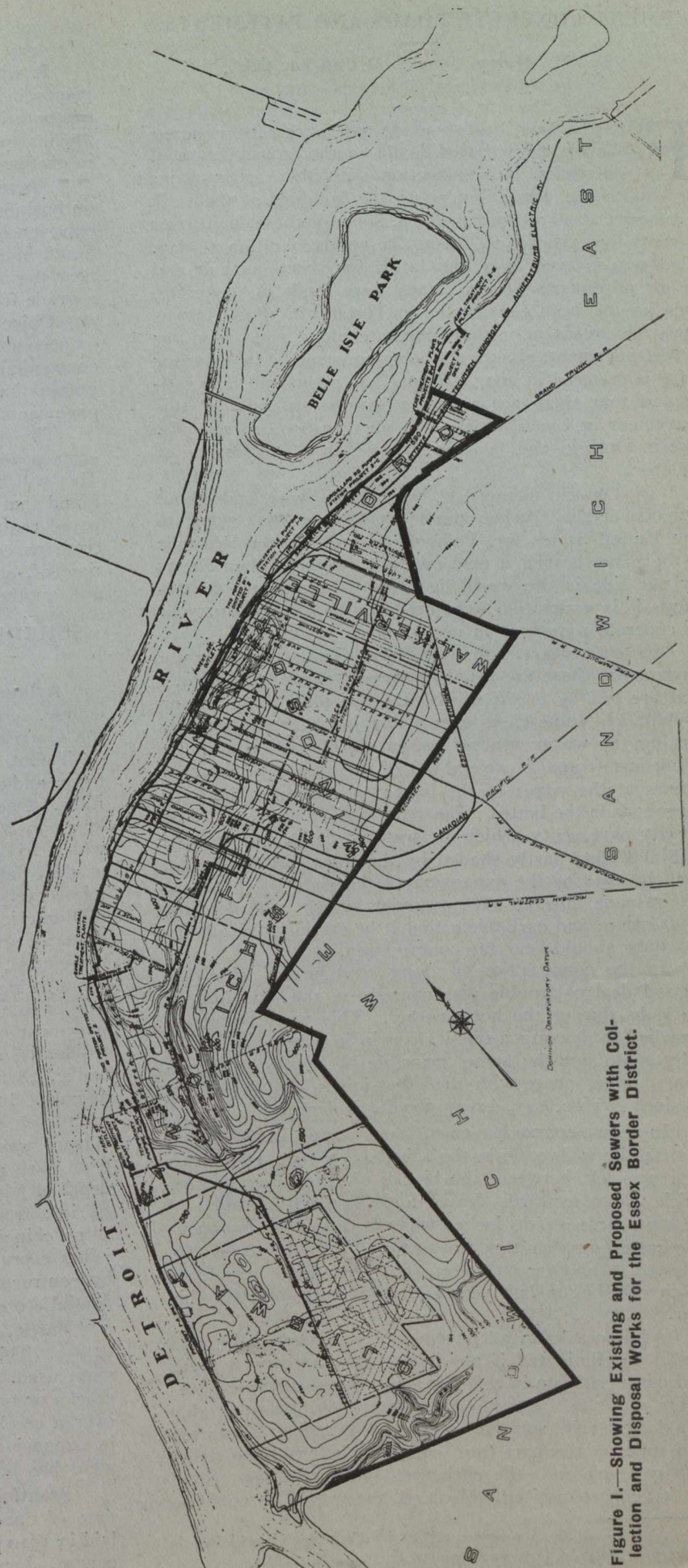

Figure 1.—Showing Existing and Proposed Sewers with Collection and Disposal Works for the Essex Border District.

CEMENT CONCRETE ROADS AND PAVEMENTS.*

By T. Harry Jones, M.Can.Soc.C.E.,
City Engineer, Brantford, Ont.

FOR the past twenty-eight years cement concrete has been used in Canada in the construction of sidewalks. In connection with the earlier walks its use was extended to the building of the walk crossings at street intersections, some of these, built over twenty-five years ago, being in good condition to-day. It was also used as a foundation for sheet asphalt and other pavements. Later, lanes were built of concrete, one having been constructed in Toronto in 1898. It was only ten years ago that concrete alone was used for street pavement, six streets being constructed in Windsor of this material in 1907. Its use has grown till it is estimated that there are about 2,800,000 sq. yds. of this pavement in Canada, of which about 1,600,000 sq. yds. are in Ontario and 600,000 sq. yds. in the Province of Quebec.

In Ontario alone last year there was laid about 370,000 and in Quebec about 100,000 sq. yds., while in the United States, or, I should say, our sister Republic —the name having a new meaning to-day, when she is by our side in the world fight for freedom and democracy—it is estimated there are over 60,000,000 sq. yds. of concrete pavement in use to-day.

In connection with transverse joints in concrete pavements, these are usually termed "expansion joints," and are left ¼ in. in width, and are filled with tar or asphalt. In some cases even wider joints are advocated. During the warm weather, when expansion occurs, the filling is soft and is pressed out of the joint. As abrasion occurs at the edges of the joint, the narrower the joint can be made the better. The writer is of the opinion that in city pavements, which are watered daily, and on residential streets partly shaded by the trees, little attention need be paid to the expansion of the slab. If a simple cut is made through the pavement, which will allow for contraction, and care taken that it be vertical, the adjoining slabs should bear the compression.

In the construction of long stretches of sidewalk a good deal of trouble was caused by the buckling of the slabs during the hot weather. This was completely remedied by leaving a one-inch strip in every city block. Why could not the same principle be applied to pavements, doing away with the cross-joints and leaving a two-inch bridge, say, every 500 ft. in length?

In a two-course pavement constructed in Brantford in 1914 (Park Avenue in the schedule) a strip 1½ inches wide was left between the blocks of the lower course, which was afterwards drawn and filled with sand and the top course of two inches was cut through. No buckling has occurred in this pavement. This matter was also followed in another pavement (Erie Avenue in schedule), which was begun last year and is to be completed this year.

While cracks in all pavements are objectionable and should be eliminated if possible, there has been a great deal more criticism in reference to these in concrete pavements than the facts justify. The writer the other day in a large city counted 120 cracks in about a quarter of a mile on the part (not concrete) between the street railway track and the curb, yet ordinarily they would not have been noticed. Most of the cracks in concrete pavement are in the earlier ones, when the specifications of to-day were not followed.

It will be seen from the schedule that a number of places in Ontario can be cited which have roads with comparatively few cracks, while this, it is believed, also applies to the St. Rose Village Road and many others in the Province of Quebec.

There is no reason why concrete should not be laid on business streets or those subject to heavy traffic. The experience in Wayne county has demonstrated this. The South Market Street pavement, laid in Brantford in 1912 near the intersection of the two main business streets on a grade from 5 to 8 per cent., is another example.

Objection is sometimes made to concrete pavements on account of the difficulty in breaking through in making connections or repairs to services. It seems to be forgotten that the same objection largely exists in other pavements which have a concrete foundation.

The maintenance charges in connection with concrete pavements are less than those of any other class. This will be more appreciable as time goes on, and it is found that other pavements with which concrete is compared require replacing, while properly constructed concrete pavements, instead of lasting their estimated lifetime of, say, ten years, are good for another ten, and still another.

SCHEDULE OF CEMENT CONCRETE PAVEMENTS LAID IN ONTARIO.

Aylmer.—Total number of square yards of one course, 6,681. This was the model road constructed by the Ontario Government Highways Department in 1914 on Talbot Street, one of the leading entrances to the town, and on the main highway from Windsor to Niagara Falls. One-course pavement, 7 ins. thick, 1,918½ ft. long, 30 ft. wide between curbs. Mix, 1 of cement (of which 10 per cent. by weight is hydrated lime) to 4 washed lake gravel. Steel reinforcement. Transverse joints every 30 ft. and longitudinal joints next curb. (A full description of the road in Highway Improvement Ontario 1915 report.) Total number of square yards of two course, 24,336. Average cost, $1.49, including Baker joints, which cost 9 cents per square yard. Base, 5 ins.; mix, 1 to 4 pit gravel; top, 2 ins.; mix, 1 : 1½ : 3. All pavement reinforced. The first section laid in 1913 on a residential street—the main road to the station. Heavy traffic, 28 ft. wide, 7 ins. thick, reinforced ½-in. joints at curb. In 1915 a 5-in. concrete top was laid by contractor on old surface. For 14 ins. from curb existing surface was picked to a depth of 3 ins. to about 5 ft. from curb and holes that had developed dug out to a depth of 7 in. Concrete 5 ins. thick was laid from a point 14 ins. from curb over whole surface mixed 1 : 2 : 4 of stone chippings. Steel reinforcing used with transverse joints every 30 ft. filled with prepared felt. Cost borne by contractor. Pavements laid on business and residential streets. First concrete pavement laid in 1913.

Barrie.—Total number of square yards of one-course, 14,850. Thickness, 6 ins. Mix, 1 : 2 : 4. No reinforcement used. Ninety per cent. of blocks are free from cracks or ones not requiring repairs. Except for 250 ft. over a creek, where sub-grade settled, Tarvia was used in expansion joints and a few large cracks. The pavement has been entirely satisfactory.

Brantford.—Total number of square yards laid to date of one-course, 2,626. The first concrete pavement laid in 1910 on Lorne Crescent, a residential street. One-course. Length, 394 ft.; width, 24 ft.; depth, 6 ins.

*Abstracted from paper read at the Dominion Good Roads Congress, held in Ottawa, April 10th to 14th, 1917.

Mix, 1 to 6 of pit gravel. Transverse joints every 30 ft., filled with pitch, others with wood strips and a few with neat cement. Longitudinal cracks have developed. Pavement laid late in year and caught by frost. Cost, 80 cents per square yard. Gravel cost 25 cents per cubic yard at pit. No repairs have been necessary. Another one-course pavement laid in 1911 on Chestnut Avenue. Length, 535 ft.; width, 26 ft. This is a residential street, but subject to heavy teaming from gravel pit. Grade, from 1 per cent. to 5 per cent. Depth, 5 ins. Mix, 1 to 5 of crushed gravel. Joints made by pine strips ¼ in. wide at top and at bottom to full depth of pavement. A longitudinal joint left in centre for a length of 110 ft. Longitudinal cracks have developed excepting the part where longitudinal joint left. No repairs necessary. Total number of square yards of two-course, 10,779. A two-course pavement laid on Market Street in 1912 runs from main street to the Victoria Bridge. Length, 200 ft.; width, curb to curb, 40 ft. Grade, from 5 per cent. to 8 per cent. A single track of the street railway curves into double tracks at the main street. Business street at intersection of the two main streets and subject to the heaviest traffic in the city. Base, 4 ins. Mix, 1 to 4 of gravel and broken stone. Top, 2 ins. Mix, 1 to 1½ coarse sand. Corrugations, ½ in. deep left every 4 ins. at right angles to the street. No joints left. Very few cracks except in lower section, where a 30-ft. excavation had been made. No repairs necessary other than re-cutting the corrugations. Cost, $1.25.

Park Avenue.—In 1914 a pavement was laid on this residential street, which is subject to the heavy teaming from the factory district, being the shortest route to the main part of the city. It is 1,532 ft. in length and 27 ft. wide; 5-in. crown. This was a two-course pavement. Depth, 7 ins. Bottom course, 5 ins., composed of 1 part of cement to 4 parts of bank gravel. The top 2 ins. was 1 of cement to 1½ of a coarse sand. Transverse joints left every 30 ft. One-half the width of the pavement for its full length was first constructed; the other half joining it was constructed without any filler between. This pavement has given good satisfaction. Only two or three cracks have developed, and these owing to local conditions. It has cost nothing to repair. Cost, $1.30.

Erie Avenue Pavement.—This is on the continuation of the Cockshutt Road from Brantford township, and is the main street from Eagle Place to the city. This pavement was begun in 1916. Its length is 3,200 ft., of which 1,350 ft. have been completed. Concrete curb and gutter put in before pavement laid. A single track of street railway is laid down the centre of the street. Width from curb to curb, 36 ft. Sub-foundation, gravel. Between ties one-course concrete, 6 ins deep, 1 to 6 of pit gravel. Above ties and between rails one-course 1 to 3½ of pit gravel. Cross-joints every 11 ft. From rails to water table two-course pavement 11 ins. deep at rail and 9 ins. at water table. Bottom course, 1 to 4 of pit gravel. Top course, 2 ins. 1 to 1½ of coarse sand. In bottom course, 1½ ins. of sand between slabs. Joint for top cut through and groover run across. Transverse joints left every 33 ft. Cost per square yard, $1.55, of which 46 per cent. was for material. All the pavements were broomed after being floated. The sand, gravel and broken stone is from the city pits, drawn in Brantford dump wagons. A Brantford Waterous road roller and Goold, Shapley and Muir mixer is used, and the cement used is supplied by the Ontario Portland Cement Company, of this city. Brantford labor alone is employed.

Chatham.—Total number of square yards of two-course, 50,000. Base, 3½ ins. Mix, 1 to 4. Top, 2½ ins. Mix, 1 to 3. Average cost, including grading, $1.30. Number of square yards of two-course, laid in 1916, 19,000. Base, 3½ ins. Mix, 1 to 4. Top, 2½ ins. Mix, 1 to 3. Average cost, including grading, $1.30. Reinforcement used in all pavements except about 2,000 sq. yds. All pavements giving perfect satisfaction except one strip 900 ft. long, laid in 1915. The pavement laid in 1908 was not reinforced and is in good condition. Pavements laid on business and residential streets. First concrete pavement laid in 1908.

Dunnville.—Total number of square yards of one-course, 11,833. Thickness, 6 ins. Mix, 1:2:4 of stone. No reinforcement used. Eighty per cent. free from cracks in 1915. A few holes developed by 1915, but most of it in good condition. Most of it resurfaced 2 ins. with Tarvia at cost of 35 cents per square yard. Pavement laid with intention of resurfacing. On business and residential streets. First concrete pavement laid in 1912.

Grimsby.—Total number of square yards of one-course, 17,500. Thickness, 6 ins. to 8 ins. Mix, 1:2:3. Average cost, 84 cents. No reinforcement used. The road has given every satisfaction. While cracks show on minute examination on 50 per cent. of blocks, no crack is serious or requires attention and in no way affects the road. Low cost partly owing to sand and gravel obtained for cost of hauling, 65 cents per cubic yard. This pavement laid in 1916.

Ingersoll.—Total number of square yards to end of 1915, 4,100. Semi-business and residential streets. One-course, laid in 1915. Depth, 7 ins. Mix, 1:1½:3 crushed stone. Cost, $1.35; where extra grading, $1.50. In 1916 number of square yards laid, 11,122.

Jarvis.—Total number of square yards of one-course, 14,000; thickness, 7 ins. at centre; 5 ins. at sides; mix, 1:2:3 stone. Except in about 300 sq. yds. no reinforcement was used. 25 per cent. of the blocks free from cracks. Cracks attributable to excessive heat and dryness of 1916 and foundation not having been thoroughly consolidated. First concrete pavement laid in 1914.

Kitchener.—Total number of square yards of one-course, 600; thickness, 7 ins.; mix, 1:1½:3 screened gravel; average cost, $1.48. Total number of square yards of two-course, 9,100; base, 5 ins.; mix, 1:2:4 screened gravel; top, 2 ins.; mix, 1:1½:3 stone; average cost, $1.50. Number of square yards laid in 1916 of two-course, 6,040; base, 5 ins.; mix, 1:2:4 screened gravel; top, 2 ins.; mix, 1:1½:3 stone. All the two-course work is reinforced and 99 per cent. of the blocks are free from cracks. Pavement laid on business and residential streets. First concrete pavement laid in 1914.

Kemptville.—Total number of square yards of one-course, 1,682; thickness, 7 ins.; mix, 1:2:3; no reinforcement used; only one lateral and one cross. First concrete pavement laid in 1913.

Leamington.—Total number of square yards of one-course, 36,935; thickness, 6½ ins.; mix, 1:1½:3 gravel or stone; average cost, $1.27. Number of square yards laid in 1916, 25,735; same as above; average cost, $1.25. All pavement reinforced; 99 per cent. of blocks free from cracks. Specifications same as Wayne County. Business and residential streets. Soil, light sandy loam. First concrete pavement laid in 1915.

London.—Total number of square yards of one-course, 19,673; thickness, 5½ ins. at side, 7½ at crown (1913-14); 9 ins. (1915-16); mix, 1:4½ gravel; average cost, $1.60; number of square yards laid in 1916, 4,420 one-course; average cost, $1.66. All pavement reinforced,

24 ins. wide, laid on 4-in. gravel sub-base; crown, 5 ins. Longitudinal joint of ¼ in. Elastite between gutter and curb. Cross-joints of armor plates and ¼-in. elastite, 40 ft. to 50 ft. apart. Heavy clay sub-soil. Tile under curb. Closed to traffic 3 weeks. Cost includes grading (average 18 ins.), sub-base, reinforcing and expansion joints. First concrete pavement laid in 1913.

New Hamburg.—Total number of square yards of two-course, 8,000; base, 5 ins., mix, 1:2:4; top, 2 ins., mix, 1:1½:3, reinforcement used; average cost, $1.41, including grading and engineering. This pavement laid in 1916.

Niagara Falls.—Total number of square yards of one-course, 9,800. In 1913 there was laid 6,500 sq. yds. 7 ins. thick, 1:2:4 mix, costing about $1.47; no reinforcement. In 1915 there was laid 3,300 sq. yds. Width of roadway, 24 ft.; thickness, 6 ins. at sides, 8 ins. at centre; mix, 1:2:3; reinforced with No. 20 Kahm mesh. Expansion joints 35 ft. to 45 ft. apart; ½-in. joints at curb; cost, $1.40, exclusive of engineering, inspection, interest, etc., amounting to 24 per cent. No transverse cracks, 50 per cent. of blocks show slight longitudinal crack near centre which has not opened up. First concrete pavement laid in 1913.

Oshawa.—Total number of square yards to end of 1915, 26,375; business streets; one-course; thickness, 5 ins. at side and 7 ins. at centre; mix, 1:2:4; majority 16 ft. to 18 ft. wide; average cost, including grading, 90c.; no reinforcement used; cost per square yard in 1915, $1 (gravel and sand furnished by town at 10c. per load); let by contract; guaranteed for 2 years. First concrete pavement laid in 1913. Number of square yards laid in 1916, 3,111.

Peterborough.—Total number of square yards of one-course, 975; pavement laid in 1912, 403½ ft. x 21 ft. 9 ins.; mix, 1 to 5 pit run gravel; ½-in. expansion joint in centre at curb and every 25 ft.; cost, 97¾c.; no charge for gravel; hauling included; 95 per cent. of the blocks free from cracks; no heavy traffic, really a lane.

Sarnia.—Total number of square yards of one-course, 10,571; constructed by Ontario Government Highway Department in 1913 on main artery to the town; length, 5,946 ft.; width of concrete, 16 ft. with 4-ft. gravel shoulders on each side; depth, 7 ins.; mix, 1 of cement (10 per cent. of which by volume is hydrated lime) to 4 of gravel. Unit cost per square yard: Grading and ditching, $0.155; mixing lime and cement, $0.084; hydrated lime (29 tons), $0.022; cement (3,462½ bbls.), $0.367; gravel (3,117½ cu. yds.), $0.294; labor on concrete, $0.200; expansion joints, $0.011; drainage, $0.111; gravel shoulders, $0.187; supervision, $0.057; tools and sundries, $0.054; total, $1.542. Men employed, 1 superintendent, 1 working foreman, 1 team delivering cement-lime mixture, 1 man handling cement at mixer, 8 gravel shovellers, 2 men wheeling gravel to mixer, 1 engineer, 1 fireman, 1 man dumping bucket, 2 men shovelling concrete and operating first template, 2 concrete finishers who also operated the box template and set the wooden curbs or concrete forms, 2 extra men for watering concrete, removing forms, greasing expansion joint strips and covering concrete with gravel. The above record is from the Highway Improvement Ontario 1914 Report where full description of the road is given.

Simcoe.—Total number of square yards of one-course, 2,475; thickness, 9 ins. at centre, 6 ins. at gutter; mix, 1:2:3; width, 48 ft.; not reinforced; centre joint. No cracks have developed. Average cost, $1.45, including grading. Laid in 1916.

Sault Ste. Marie.—Total number of square yards of two-course, 19,700; base, 5 ins.; mix, 1:5; top, 2 ins., 1:2 screened gravel fine to ⅓ in.; average cost, $1.37, including grading (without overhead charges). Number of square yards laid in 1916, of two-course, 10,700; same as above. No reinforcement used. First concrete pavement laid in 1914.

Stratford.—Total number of square yards of one-course, 6,400; thickness, 5 ins.; curb, 7 ins. at centre; mix, 1:1½:3 crushed stone; reinforced No. 7 triangular mesh and Kahn joints; 99 per cent. of blocks free from cracks—remarkable considering sub-grade. This pavement laid in 1914.

Stamford.—Total number of square yards of one-course, 2,050; thickness, 6 ins.; mix, 1:2:4; cost, $1.47 (labor 15c. per square yard); no reinforcement used.; 80 per cent. of blocks free from cracks. This pavement laid in 1913.

St. Jacobs.—Total number of square yards of one-course, 4,392; thickness, 7 ins.; mix, 1:4; average cost, 97 cents. Square yards laid in 1916, one-course, 1,777; thickness, 8 ins.; mix, 1:4; no reinforcement. Very few cracks. Makes a good road. First concrete pavement laid in 1913.

St. Thomas.—Total number of square yards of one-course, 22,160; thickness, 7 ins.; mix, 1:1½:3 stone; all reinforced; average cost, $1.50. First concrete pavement laid in 1913. Street car tracks laid in 1914. Sub-grade, 9 ft. wide, 4½ ins. concrete of 1:1½:3 stone, on which ties and rails laid and concreted to top of rails.

Steelton.—Total number of square yards of two-course, 8,866; base, 5 ins., mix, 1:5 gravel; top, 1½ ins., mix, 1:1:1 granite screenings. Laid in 1912.

Toronto.—Total number of square yards laid since 1895, 144,243; number of square yards laid in 1916 of one-course, 2,837; thickness, 6 ins.; mix, 1:1-1½:3; average cost, $2.42. Number of square yards laid in 1916 of two-course, 16,875; base, 4 ins.; mix, 1:1-1½:3; top, 2 ins.; mix, 1:1-1½:3; average cost, $2.07. The first concrete pavement was laid in 1895. Total number of square yards to date in which reinforcement was used, 16,875. The prices quoted include the entire cost involved in laying the pavements, trimming the boulevard, adjustment of walk and all grading on the actual line of the pavement.

Toronto and Hamilton Highway.—162,841 sq. yds laid in 1915; 149,159 sq. yds. laid in 1916; general width of pavement, 18 ft.; spur line near Burlington of 7,323 sq. yds. is 9 ft. wide. In Oakville, about 7,400 sq. yds. is 50 ft. and 30 ft. wide. One-course pavement; mix, 1:1½:3. Coarse aggregate of crushed stone from Dundas quarry. Fine aggregate, a coarse sand. Estimated cost, $1.40 per square yard. The completed cost will be in the neighborhood of that figure. The surface is standing the wear very well. The repairs to cracks and joints on the 1915 work made in 1916 cost $76.71 for material and $200.34 for labor.

Walkerville, Sandwich, Ford City, Sandwich East and Canadian Steel Corporation.—Total number of square yards of one-course, 70,410; thickness, 6½ ins. to 7 ins.; Sandwich East, 6 ins. wide and 8 ins. centre; average cost, $1.25. Number of square yards of two-course, 223,992; base, 4½ ins. to 5 ins.; top, 2 ins.; 7,000 sq. yds., 1½ ins.; average cost, $1.25. Number of square yards of one-course laid in 1916, 7,960; thickness, 7 ins.; mix, 1:1½:3; reinforcement used in all excepting about 13,000 sq. yds. First concrete pavement laid in 1908.

Mr. Owen McKay, M.Can.Soc.C.E., of Walkerville, who was engineer for these pavements, after describing the earlier pavements laid, states he laid more than 4½ miles in 1914 in Sandwich East under the Wayne County specifications. One-course: mix, 1:1½ clean, washed gravel; 1½ miles 16 ft. wide and 3 miles 15 ft.; depth, 6 ins. at side, 8 ins. at centre; base filed; expansion steel joints 25 ft. apart. Only 500 lin. ft. to-day found with cracks and so fine as to be scarcely noticeable. No reinforcement used.

In 1915 he laid two lines of pavement for the Canadian Steel Corporation each 3½ miles long with a 25-ft. strip between reserved for street railway. Mix, 1:2:4. No cracks have appeared excepting in a strip about ¾ of a mile long where drainage imperfect. Mr. McKay concludes where width does not exceed 18 ft. with base flat, sides 6 ins. and centre 8 ins. and expansion joints not more than 30 ft. apart, wire reinforcement may be safely dispensed with providing the sand and gravel are washed and free from impurities and all stones over 2½ ins. in diameter, crushed and used in the above proportions.

Wingham.—Total number of square yards of one-course, 11,448, on main business street of town; length, 2,410 ft.; width, 40 ft.; thickness, 7 ins.; crown, 6 ins.; mix, 1:2:4. Reinforcement used throughout of No. 9 gauge steel wire, 6-in. x 12-in. mesh. Expansion joints 40 ft. apart; Baker armor plates; cost, $1.35. This pavement laid in 1913. No cracks have developed. Repairs to a few high joints, holes and rough spots caused by frost. In all other respects the pavement has proved entirely satisfactory.

Woodstock.—Total number of square yards of two-course, 13,523 (these laid in 1916); base, 5 ins.; mix, 1:2½:4; top, 2 ins.; mix, 1:1½:2½; reinforced by No. 9, 4-in. x 10-in. wire fencing.

Windsor.—To end of 1915 total number of square yards, 346,843; in 1915 number of square yards laid, 18,986; cost per square yard prior to 1915, $1.15; cost per square yard in 1915, $1.35. First concrete pavement laid in 1907. About 45,000 square yards in 1916.

The concrete pavement laid in the 33 places given in this schedule amounts to 1,366,660 sq. yds., of which over 75 per cent. is one-course work. The quantity reported as laid in 1916 is 350,048 sq. yds.

CANADIAN SOCIETY OF CIVIL ENGINEERS, REGINA BRANCH.

At the regular meeting of the Regina branch of the Canadian Society of Civil Engineers, held last Thursday evening, it was unanimously decided to support most heartily the proposal of the council of the parent body in Montreal to present a memorial to Premier Borden on his return to Canada from England, showing the number of large and important Canadian engineering works which have been handled by alien engineers.

Following this, a discussion arose on the proper treatment of W. S. Tye's paper, "Canada's Railway Problem and Its Solution," read before the parent body in Montreal. It was thought by those in attendance that the engineering profession throughout the Dominion does not express its opinion strongly enough on the difficulties of the railway problem facing Canada.

It was decided to call a special meeting of the Regina branch to read Mr. Tye's paper, and discuss this question thoroughly. It was also decided to invite representatives of the provincial government and other public bodies to take part in the discussion of this paper, and to make public the opinion of Saskatchewan engineers.

HOW CANADIAN ENGINEERS ORGANIZE.*

By Professor C. H. McLeod, Ma.E., F.R.S.C.

THE organization of Canadian engineers, from a strictly professional point of view, is comprised in the history and growth of the Canadian Society of Civil Engineers. There are in Canada, of course, a number of societies which are only in part professional, and which do not base their membership test on scientific or technical qualifications. Although these institutions are of importance, they cannot be considered as representative of the profession, and, in fact, Canada may be looked upon as exceptional, in that one corporation is exclusively representative of the engineering profession within its boundaries.

The Canadian Society of Civil Engineers was established by a charter of the Dominion of Canada in 1887 under an old English definition "as having for its objects and purposes to facilitate the acquirement and interchange of professional knowledge among its members, and more particularly to promote the acquisition of that species of knowledge which has special reference to the profession of civil engineering, and further, to encourage investigation in connection with all branches and departments of knowledge connected with the profession."

It will thus be seen that the Canadian Society in its formation was modelled on the lines of the British Institution of Civil Engineers. The majority of the charter members, of whom there were 19, were members of the Institution.

The life conditions, however, of the Canadian Society, representing so vast a territory, were soon found to be quite different from one having to concern itself with the profession in the British Isles, and some considerable additional provisions to the original conceptions regarding it were found to be necessary. Chief amongst these was emphasized the need for auxiliary societies, having headquarters in various centres of the country. In the early years of the Society provision was, therefore, made for the establishment of branch societies. The branches, of which there are now ten in existence, are representative of the Society, and occupy points of vantage at various centres, from the Atlantic to the Pacific Coast. They have, under our constitution, complete freedom of action, and are, in so far as their professional activities are concerned, independent local societies. An intimate corporate relationship, however, exists, and the establishment of a branch at any centre does not release the members of the branch from their obligations to the Society. The members of a branch are the corporate members of the Society residing within 25 miles of the branch headquarters, and such other members as desire to identify themselves therewith. It will be seen that the branch societies are thus sentinels for the central body, of which they are a corporate part. They interest themselves not only in general professional affairs and in the work of the Society as a wohle, but also in local matters of engineering concern, and thus constitute a very important cementing material between the engineering profession as represented by the Society and the public at large.

The financial relations of the branch to the central Society—always a troublesome consideration—have been arranged on a system of rebates of the dues paid by each

*Synopsis of a paper read before the Third Conference, Committee on Engineering Co-operation, at Chicago, March 29th, 1917.

and every member of the branch. In many instances, also, special branch dues are imposed by the branches, so that the revenues of the Society are, in these cases, not tapped to the full extent necessary for the upkeep of the local institutions.

In the endeavor to broaden the professional scope of the Society it was found desirable to establish sections representative of the chief lines in which civil engineering practice divides itself. These we designate as "electrical," "mechanical," "mining," and "general," the latter standing for the work usually understood as comprised under "civil" when used in its narrow sense. Each section has its own chairman and vice-chairman, one or other of whom presides over the professional meetings of his section, which are held at the Montreal headquarters, and both of these officials are supposed to interest themselves in securing suitable papers. Some of the larger branches operate along similar lines and have their own officers of sections. To provide for articles or discussions covering technical work of interest to all sections, monthly Society meetings are held. It thus follows that each of the sections, meeting alternately at fortnightly intervals, has an opportunity of holding two meetings during the winter session.

The professional papers of the Society, which are issued in the form of advance proofs, are promptly distributed to the branches and to the membership at large, and thus become available for discussion by the branch members, as well as by those who assemble at the Montreal meetings.

There are, of course, many matters of interest to Canadian engineers, as, I suppose, to the engineers of all countries, on which opinion is largely divided, and some of these stand out, perhaps, with the most marked prominence in a country such as Canada, covering so large a territory and comprising as it does men of different lineage and divergent attitude of mind. Chiefest amongst such problems is the question of legislative protection, in connection with which we have, as elsewhere, those who do not desire any (however remote) a suggestion of legal control, and those who, on the other hand, would wish to see established the most exclusive protection in the practice of their profession.

It should here be explained that in Canada the Dominion Parliament has no authority over educational or professional affairs, and that, as a consequence, legislative control of professional practice must, if it is desired, be obtained separately in the several provinces. The exponents of the wide-open door are probably those engineers who occupy the important positions, either as consulting practitioners or as the official representatives of large corporations. Those, however, who would limit the practice of engineering by legislative enactment, whether they so express themselves or not, are unquestionably in the majority. This majority desires such protective legislation as is everywhere accorded to the legal and medical professions. In Canada we have what are known as the "Quebec Act" and the "Manitoba Act," both, of course, provincial, and designed to govern the practice of civil engineers. The former has a penalty clause, while the latter has no such governing condition, and is, consequently, inoperative. The Quebec Act, however, in practice permits all members of the Canadian Society of Civil Engineers, whether they become such under the provisions of the act or not, to practice their profession within the province, and hereby there is, fortunately, a safety valve introduced which makes for a smooth running.

That further legislative control of engineering practice in Canada is one of the problems which we shall have to face, and that in the very near future, is, to my mind, beyond peradventure. As an indication that this is a coming event, the Society has recently, under strong pressure, made provision in its by-laws for the establishment of provincial divisions, and already there are such organizations in operation in British Columbia and Alberta. A function of these bodies has clearly to do with controlling legislation, and the object of their establishment would seem to be to gain a vantage point of local knowledge and at the same time to secure the co-operation of the profession throughout the Dominion as represented by the Society. While there undoubtedly exists a considerable range of opinion as to the desirability of a certain form of legislative enactment, there is amongst Canadian engineers a united front as regards the necessity of insistence on advanced educational requirements. In this respect the Society demands an educational test of candidates seeking admission to the grade of associate membership, which is practically equal to the degree standards of an engineering course. It is a pleasure to record that the number of candidates for admission to corporate membership who have not had the advantage of university training is steadily decreasing. In other words, that the scientific training of those young men now entering the profession is, year by year, reaching a higher plane.

GOOD ROADS SYSTEM IN LATIN AMERICA.

Colombia is the latest South American country to work out a comprehensive road system intended to facilitate highway traffic and to connect interior points with railways, ports and commercial centres, says a consular report. Much interest in road construction has been shown recently in the neighboring countries of Venezuela and there is a certain similarity between the completeness of the Peruvian plan and that of the project passed by the Colombian Congress and promulgated in the Diario Oficial of December 22. No provision has been overlooked for the extension of roads over practically the whole of Colombia, as well as for the selection of the best routes, and for the maintenance of the roads when completed. Important measures have been adopted for the financing of this project and for the execution of the plan in all its details.

An annual appropriation of $700,000 is to be included in the national budget for work on these most-needed roads and certain others, nearly one-third of the whole amount to be used for the great central highway of the north. Careful surveys of all proposed roads must be made and the most practicable routes selected, with the approval of the minister of public works, before construction is begun. The government may authorize local boards to construct and maintain roads for which plans and estimates have been made by authorized engineers, under the direction of a bureau of national roads, created by this law.

A manganese mine in Costa Rica began shipping in May, 1916, and is now putting out about 300 tons a month. Preparations are being made for installing an equipment with a capacity of 3,000 to 5,000 tons a month. The port of shipment will be about two miles south of Braxilito, considerably north of the Pacific port of Punta Arenas. The ore is given as averaging 55 per cent. metallic manganese (80 to 83 per cent. manganese dioxide).

Editorial

THE GOOD ROADS CONGRESS.

If the Governor-General, the leader of the opposition and the Minister of Trade and Commerce back up their spoken pledges of co-operation with any tangible support, federal aid to the good roads movement will certainly have been benefitted by the fourth annual Canadian and International Good Roads Congress held last week at Ottawa.

Federal aid is a necessity if any comprehensive scheme of highway development is to be carried out from coast to coast. There are many municipalities in our sparsely populated country where the total assessed value of the municipality would scarcely exceed the cost of the permanent highways that might have to be built through them as a part of any highway scheme. There are hundreds of municipalities whose borrowing power is entirely too small to permit of costly roads unless aided by province or dominion. Maintenance also is partly a national question, as many of these municipalities could not maintain a highway system even if so much as ten mills were to be added to their tax rate.

The Duke of Devonshire was a leader in the good roads movement in England. Not many years ago the two houses of the British Parliament formed a joint committee for the discussion of road problems throughout the United Kingdom, and the Duke of Devonshire was the committee's chairman.

It will be fortunate for the good roads movement in Canada, and fortunate for the future development of this Dominion, if His Highness takes the same interest in Canadian road work that he did in English highway affairs. And what finer or more practical monument could he leave behind in this country, when his term of office will have been completed, than at least the nucleus of a national, transcontinental scheme of highways that will make more readily accessible the farms, the orchards, the ranches, the mines, the industries and the natural glories of Canada?

By interesting the high officials of the government and the opposition, the Ottawa convention probably did more good than any other convention ever held by the Dominion Good Roads Association. Considering the war and attendant circumstances, the congress was most successful. The attendance was not so large as at some former meetings, but it was more enthusiastic and more earnest, and the discussions were probably better than ever before.

Mr. Duchastel and Mr. McNamee are to be congratulated upon succeeding in holding the congress at all this year. Mr. McNamee, the secretary of the association, has been one of the most untiring good roads workers in the Dominion, and the movement owes a great deal to his initiative, foresight and ability. Mr. Duchastel made an excellent president. He ran the meetings in a most businesslike manner, keeping the discussions well in hand yet bringing out all valuable points, and his re-election to the presidency of the association was well-merited.

The chief reason for Mr. Duchastel's re-election as president, however, was to permit him to finish the work of incorporation of the association. At present the Dominion Good Roads Association is largely a myth. It has officers and directors but no roll of membership, no by-laws, no official prestige and no legal existence. It has "carried on" entirely on good-will—largely the good-will of the manufacturers who have most generously supported the exhibitions, often at very great cost.

This condition of affairs could not continue. The number of exhibitors and the size of the exhibits appeared to decrease each year. This year there was almost the irreducible minimum of exhibits despite the efficient and energetic work of Mr. Leach, the superintendent of the exhibition. It was seen that some other mode of support would have to be found if the congress were to be continued. It was decided, therefore, to incorporate the association under Dominion charter, and to have a paid membership list.

Fees will probably range from $1 a year for ordinary members to $100 a year for manufacturing members. This will distribute the cost of the propaganda more equitably and will give everyone a chance to pay toward the good work, making the congresses more independent of the support of exhibiting manufacturers.

It is expected that the new association will in time have a permanent staff of secretaries who will be able to carry on the work steadily and consistently, probably devoting their whole time to it. The province of Quebec has promised an annual grant to the association, and it is presumed that Ontario and other provincial governments will make similar grants.

CHEMISTRY IN ENGINEERING.

Slowly but surely the field of the chemist is comingling with many branches of the engineering profession. Since war broke out the science of chemistry has more nearly come into its own as a factor in engineering work. With the possible exception of mathematics and physics, the science of chemistry stands closest to engineering, and as the manufacture of materials used in engineering approaches perfection, the more pronounced becomes the handiwork of the chemist.

The production of iron, steel and the alloys for varied and special purposes serve as examples. The constituents of each of these are selected in percentage by the chemist, and the rules of thumb are no more. The chemist furnishes the data by which the engineer varies the chemical content of his materials to obtain the particular physical characteristics desired. The manufacture of cement is another striking example of the important part played by the chemist in relation to engineering.

In the realm of water supply and sewage treatment the position of the chemist is a most important one. What he finds in the nature and extent of impurities determines the policy of the engineer in the methods to be adopted so far as treatment of the water supply is concerned. The utilization of nitrogen, ozone or chlorine to destroy bacteria, the introduction of copper sulphate to dispose of algae,—these are instances in which the sanitary engineer, at least, is dependent upon the chemist.

In the province of highway work, too, the chemist comes into close contact with the engineer. In the

selection and composition of the materials of construction and in the disposal of waste, a knowledge of chemistry is essential to the engineer. The results of engineering skill supplemented by expert assistance from the professional chemist, leads to the belief that the advancement of industry would be relieved of a considerable amount of its hazard if there were more outward acknowledgment of the interdependence of these two sciences.

PERSONAL.

C. CHAS. LAPIERRE, of the roads engineering department of the Canada Cement Co., Limited, has resigned to organize the Quebec Cement Co., Limited.

E. HUBBARD has been appointed town engineer of Bridgeburg, Ont., owing to the resignation of CARLTON MILLER, who was recently named to succeed EDWIN J. JUKES.

E. T. McLAREN, assistant city engineer of Brantford, Ont., who has enlisted in the Canadian Engineers, for overseas service, has been granted leave of absence by the city council.

C. N. SCHRAG, sales engineer of the Ontario District Office of Canadian Allis-Chalmers, Limited, has resigned to become general sales manager of the Bawden Machine Co., Limited, Toronto.

Prof. JOHN C. McLENNAN, of the University of Toronto, and a member of the Advisory Council on Industrial and Scientific Research, has been appointed to the British Board of Inventions and Research.

CHARLES H. WAYBRANT, who for the past six years has been with the Steel Company of Canada, at the Toronto office, has joined the staff of Baines & Peckover, iron and steel merchants, 98 Esplanade E., Toronto.

GEO. H. OLNEY, managing director and treasurer of the Eugene Phillips Electrical Works, Limited, Montreal, has, on the advice of his medical advisors, severed his active connection with the company. Mr. Olney took over the business eighteen years ago when it was comparatively small. Under his care the company has developed until to-day it is in size among the first half dozen of the insulated wire and cable manufacturers on this continent.

J. A JAMIESON, M.Can.Soc.C.E., Montreal, was struck by a street car in Westmount a couple of weeks ago and was very severely injured. He was either unconscious or only partly conscious for about ten days, but is now out of danger and recovering rapidly. Mr. Jamieson was on his way to the Westmount library at the time, the accident happening near his home. Mr. Jamieson is one of the best-known consulting engineers in Montreal, having specialized largely in reinforced concrete construction. He is perhaps best known in elevator construction work on account of his investigations in regard to grain pressures. He was consulting engineer to the city at the time of the Montreal aqueduct break, and it was his investigations in regard to that accident that finally led to the protests by Montreal engineers against the aqueduct power scheme being carried on as planned.

OBITUARY.

Hon. Sir LYMAN MELVIN-JONES, president and general manager of the Massey-Harris Co., Toronto, died on April 15th from diabetes following two operations. Sir Lyman was 74 years of age and had been critically ill for many months.

JAMES BALFOUR, a well-known architect of Hamilton, Ont., passed away recently at the age of 64 years following an illness which confined him to his home for some time. Under his supervision the city hall in Hamilton was erected in 1886-89.

J. D. CAMERON, railway contractor, passed away at his home in Toronto on April 8th at the age of 77 years. The deceased was born in Ottawa, and removed to Toronto four years ago. He was concerned in the building of the Intercolonial and Lake St. John Railways.

Flight Lieut. STANLEY JAMES PEPLER, of Toronto, who in the casualty list of March 12 was reported missing, has now been reported killed, fighting at odds against two German air craft. He was 26 years of age, and a graduate of the School of Practical Science. When war broke out he was assistant engineer with the Harbor Commission.

HENRY SKEFFINGTON POOLE, M.Can.Soc. C.E., died at his home at Guildford, Surrey, England, recently at the age of 72. He was for many years manager of the well-known Acadia Coal Co. Mr. Poole was one of the charter members of the Canadian Society of Civil Engineers, and served on the council of the Society in 1887, 1888, 1893 and 1901.

HENRY A. EVERETT, at one time electrical engineer of the Montreal Street Railway Company, died recently at Pasadena, California. Mr. Everett superintended the conversion of the horse cars into electric driven cars in Montreal. Subsequently he was president of the London Street Railway Co., London, Ont., the Toledo Railways and Light Co., the Cleveland Railways Co., and was financially interested in many other tram companies in the United States.

Lieut.-Col. E. WOODMAN LEONARD, D.C.M., commanding the 3rd Brigade, Canadian Field Artillery, has been killed in action. He was a member of the firm of E. Leonard & Sons, London, Ont., of which firm his father, Mr. F. E. Leonard, is manager. He went overseas in the fall of 1914, and has been on duty ever since. In the first battle of Ypres Major Leonard's generalship stood the crucial test. He was decorated with the D. C. M. and promoted to a lieutenant-colonelcy.

JOHN J. DRUMMOND, of Midland, Ont., died at the home of his brother, George E. Drummond, in Montreal, on Saturday, April 7. Mr. Drummond was long identified with the development of the iron and steel industry in Canada. In association with his brothers, George E. and the late T. J. Drummond, he established iron furnaces at Radnor, Quebec, and opened up large iron properties in the Maritime Provinces. He was president of the Zenith Machine Co., Midland, Ont. The deceased was born in the North of Ireland in 1856 and came to Canada at an early age.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, TORONTO SECTION.

The annual meeting of the Toronto Section of the American Institute of Electrical Engineers will be held in the Engineers' Club lecture room, 90 King Street W., on Friday, April 20th, at 8 p.m. There will be presented to the meeting a report of the chairman and a short report of the secretary.