

**PAGES**

**MISSING**

# The Canadian Engineer

A Weekly Paper for Civil Engineers and Contractors

## Canadian Good Roads Association's Convention

Six Provincial Governments, Federal Government and Many Municipalities Represented at Successful Meeting Held Last Week in Winnipeg—Program of Road Construction Adopted by Eight Provinces Requires \$73,000,000—"Co-operation and Co-ordination" the Convention Slogan

REPRESENTATIVES of six provincial governments, of many municipalities and of a number of local highway associations and automobile clubs, met last week in Winnipeg for the seventh annual convention of the Canadian Good Roads Association. The registration totalled over two hundred, of whom fifty were from Ontario and Quebec and about

sessions in the road-building history of this continent. The technical papers were of a high order of technical merit, the discussion was valuable, and all present agreed that from a "get together" standpoint the convention was the best ever held by the association. "Co-operation and co-ordination" was the official slogan of the meeting, and everyone tried to



HON. SAM J. LATT  
Second Vice-President, Canadian  
Good Roads Association



A. E. FOREMAN  
President, Canadian Good Roads  
Association



DR. E. M. DESAULNIERS  
First Vice-President, Canadian  
Good Roads Association

twenty-five from the three provinces to the west of Manitoba. A complete list of all who registered, excepting residents of Winnipeg, appears on another page of this issue.

The convention opened Tuesday morning, June 1st, and there was a technical session every morning and afternoon for three days, the final session adjourning about 3.30 p.m., Thursday, in order that the delegates might witness a road-building exhibiton. Upon invitation of Sir James Aikins, lieutenant-governor of Manitoba, the delegates spent Tuesday evening at government house, where an excellent musical program was enjoyed and dainty refreshments served. The annual banquet was on Wednesday evening, with over two hundred in attendance. The banquet was tendered to the delegates by the city of Winnipeg. The annual meeting of the association was held Thursday evening, concluding the program of one of the most interesting three-day

co-operate heartily throughout the three days with a view to co-ordinating highway work throughout Canada.

All of the technical sessions, and also the banquet and annual meeting, were held in the Royal Alexandra Hotel.

The convention was formally opened by Sir James Aikins and the president of the association, S. L. Squire, of Toronto. Sir James declared that the assembly had a meaning far broader than the mere scope of the meeting, for it exemplified the spirit of unity which should prevail in all parts of Canada. They were gathered from all the provinces for the exchange of ideas, and all were animated with the one object of helping in the upbuilding of the Canadian national spirit. Not only were they working to improve the highways, but they were working for the creation of that highway from one end of Canada to the other, along which the spirit of unity and harmony and progress will travel, re-

moving all the obstructions on the road, taking out the stones of prejudice, so that there may be created a national conscience, and so that they might get into the habit of thinking constantly of other things than the place in which they live.

B. Michaud, deputy minister of highways of the province of Quebec, spoke of the part that Quebec had played in the development of the Dominion, remarking that the first trail led from Quebec. His province had spent \$26,000,000 on good roads, and they now have 3,000 miles of improved roads, of which 350 are main communication roads, and are drawing to the province millions of dollars every year. They have spent money for the benefit of the farmer even when they have been spending it for the benefit of the motorist, because they have the same interest in proper means of communication. The French of Quebec inherited from their fathers the desire of connecting with other trails, and that is why they will not rest until they have persuaded all the provinces to build roads to connect with the province of Quebec. They were knocking at the door of Ontario and of New Brunswick, and now it was the turn of Manitoba to drop a line of invitation to Saskatchewan and Ontario.

#### Highways to Promote Good Feeling Between Provinces

Premier Norris, of Manitoba, adding to the welcome, said that there is a great mileage of roads clamoring for improvement, and one of the purposes of the convention was to devise ways and means of economic construction of roads which would stretch far and wide and serve the whole community, not only touching the big centres that have been organized, but stretching out into the country and giving better means of transportation for the produce of the farms. Their population is so scattered that highway communication is a big problem, for all are clamoring for consideration. Highways are going to be one of the strongest aids to the development of good feeling between the provinces and also between Canada and the United States, and they are building great hopes on the Jefferson Highway, which will enable them to motor from Winnipeg to New Orleans. He had last year travelled over the highway from Montreal to Quebec and was delighted with the splendid quality of that road, and he looked forward to the time when there would be an interprovincial highway between Manitoba, Ontario and Saskatchewan.

Mayor Chas. F. Gray, of Winnipeg, joined in the welcome, declaring that they want roads to run in every direction, believing they are the greatest factor in the advancement of civilization. With rapid means of transportation, people and communities can get together and exchange views, and that means better civilization.

#### Message from Ontario

Hon. F. C. Biggs, minister of public works, Ontario, brought from Premier Drury the assurance of the heartiest co-operation of the Ontario government in the development of good roads in the Dominion, and more particularly in Ontario. When the late Ontario government went to rest in October last, he said, there was a great deal of supposition as to what was going to become of the banner province of Ontario because a farmer government had been chosen, but he believed to-day they had the fullest co-operation of every motor organization, labor union and farmers' club in the province. Previous to the last election they had 422 miles of provincial county roads and they have increased this to 1,824 miles, which they expected it would take \$175,000,000 to construct, so that they could have a complete trunk system of roads in the province which would serve every county. They are not building these roads for automobile traffic, but for the purpose of serving the basic industry of agriculture, although, of course, they expect the automobilists to take advantage of them. In a year or two every farmer is going to be an automobilist in Ontario, not only for pleasure but as the owner of trucks, because they have come to realize that for the short haul, the quickest and most dependable way to place their produce

on the market in first-class condition is by the rapid transportation of the truck.

Mr. Biggs said that the government is willing to co-operate with the other provinces, and they hope to have in the near future the connections which will make a highway from Windsor right through to Halifax, as well as other connections, including one from Kenora to Winnipeg, and so far as finances and labor permitted, they hope to provide their share of the transcontinental route. The industries of Ontario require so many workmen this year, particularly in agriculture, that they do not feel justified in competing with them for labor, but they intend to push forward with all available labor and materials. They have \$5,000,000 available for highways, plus the Dominion grant, and he hopes they will be able to show wonderful results. He hoped that the next federal grant would be a hundred millions instead of twenty millions; and, whatever the next government might be in Ottawa, that they would take this road question a little bit more seriously and help the roads in a free manner in the same way that they had subsidized the railways.

#### Situation in Manitoba

Hon. G. A. Grierson, minister of public works, Manitoba, said the convention was playing a very important part in the industrial and agricultural life of the Dominion. They have many problems in Manitoba, for it seems that the more fertile the soil, the more difficult it is to build a road. Some provinces have the benefit of material with which to make good roads and consequently had them, while others have wealth with which to secure the materials. When the history of road construction is written it will, he thought, be found to be in three volumes: First, that of educating the people as to the necessity of good roads, which education is nearly completed throughout Canada, for most people realized that they are a necessity. The second would describe the construction of good roads, and much has to be learned about that. They are assisting this very greatly by holding conventions at which addresses are given dealing with such matters. And the third volume would deal with the maintenance of roads, and very little, so far as their province is concerned, has been done in this connection. If they are going to construct good roads they must learn to maintain them. The convention should emphasize the importance of this, for until they had proper organizations and facilities for the maintenance of their highways, they would continue to have bad roads.

W. E. Parker, of New Orleans, chairman of the Jefferson Highway Association, spoke of the value of this high-class road, stretching from Winnipeg to New Orleans, a distance of 2,400 miles. It had seemed an enormous undertaking, but in five years they have completed 60% of the work. In the United States they are spending hundreds of millions of dollars building 365-days-in-the-year-service roads, and the highway from New Orleans to Winnipeg would, in time, give them access to the entire Canadian system of highways, with mutual advantages to everyone. Mr. Parker read messages of greeting and goodwill from the governor of Louisiana and the mayor of New Orleans.

#### High Ideal in Saskatchewan

Hon. S. J. Latta, minister of highways, Saskatchewan, said the convention was international in character. In Saskatchewan they have 180,000 miles of roads in the settled districts, of which they consider 24,000 miles their main market roads. They are trying to push a couple of roads to the north to tap the vast resources of that country, which is not by any means a snow-bound and outlandish land, but a fertile country. They have to contend with scarcity of material, a small population, and shortage of labor, but they have before them a high ideal, based on the immense possibilities of their country and a persistency that would not down. Their aim is to give to every settler a highway that will enable him to get his produce to market.

Hon. J. H. King, minister of public works, British Columbia, also spoke of the resources of the west. It would pay the people to build roads in order to settle and develop

that section of the country, and in British Columbia they are adopting the best available methods of road construction. They have 16,000 miles of road that are passable, of which 8,000 are trails, and they now have under construction roads that will connect up their provincial system, and they hope they will soon make them interprovincial. There is one piece of road which is being blasted out of the rock and will cost a million dollars to build, but the people are in earnest in regard to road construction and are willing to pay and be taxed in order that in a few years they will have roads equal to those of any province in Canada.

L. C. Charlesworth, deputy minister of public works, Alberta, said that in his province they have also the problems of large mileage, small population and lack of materials, and the basic problem is the need of money. There is still something to be added to the volume on education, and that concerns the value of the roads, for people should realize that the money spent will be returned ten times over if properly expended.

A. W. Campbell, Dominion Highway Commissioner, expressed gratification that the people in all provinces were showing such a keen interest in road construction, and he thought the convention did good in bringing the problems of east and west together for discussion.

President Squire then appointed various committees, including those dealing with program, resolutions, registration, reception, etc., concluding the first session of the convention.

#### Second Session

The second session was held Tuesday afternoon, and the program was somewhat altered, due to the fact that C. A. Magrath, B. M. Hill, A. Fraser and A. H. Blanchard, who had been scheduled as the four speakers for the afternoon, had all found it impossible to attend the convention. Addresses were delivered instead by Hon. Beniah Bowman, minister of lands, forests and mines, Ontario; S. L. Squire; E. O. Hathaway, district engineer of the U.S. Bureau of Public Roads; and A. W. Campbell, Dominion Highway Commissioner.

Hon. Mr. Bowman outlined the difficulties of building roads in Northern Ontario, and said that in the newly settled districts they were mainly desirous of obtaining good foundations. He hoped that a trunk highway from Winnipeg to Kenora would soon be built.

Mr. Squire called attention to the fact that, while there are 37,500 miles of railroads in Canada, there are 350,000 miles of roads, occupying land valued at \$750,000,000, yet the 350,000 miles of roads have obtained less assistance from the government than have the 37,500 miles of railroad. The rolling stock on the roads is fully as valuable as the rolling stock on the railroads.

Fully half the perishable food never reaches a market, for lack of better highways, declared Mr. Squire. In 1914 the average cost of haulage in the United States was 21c. per mile per ton. Gravel had reduced the cost to 13c. and macadam to 7c., although these figures had doubled since 1914. Had all the roads in Canada been macadamized last year, the saving in transportation costs would have greatly exceeded the amount (\$20,000,000) voted by the Dominion government as five-year aid to highway construction.

In outlining Canada's assets, one large U.S. bond house recently referred to the Dominion's progressive road policy as a national asset. "Grants" for highway construction are not gifts, but investments, said Mr. Squire. The road problem in Canada is great because we have a mile of road allowance for every 22 people in the Dominion, while the United States has a population of 55 for every mile of road.

Mr. Hathaway's paper on "Federal Aid" will receive attention in a later issue.

#### Commissioner Campbell Emphasizes Proper Location

Mr. Campbell said that every province has organized a complete highways department, and that, although the federal aid act had been passed less than a year ago, eight of the nine provinces had already submitted general program plans involving the improvement of 18,000 miles of roads. The

ninth province has its plans nearly ready. As federal aid is only 40% of the cost of the road, the \$20,000,000 voted by the Dominion government contemplated an expenditure of \$50,000,000 by both provinces and Dominion. It is interesting to note, said Mr. Campbell, that the eight provinces which have submitted plans have received legislative authority for the expenditure of \$73,000,000 on their programs.

The chief anxiety of his department, said Mr. Campbell, is not to dictate the types of roads that are to be built, but to see that the roads are properly located. Thousands of miles of roads, he declared, have been poorly designed, following the lines of survey over hills and valleys. He emphasized the importance of proper drainage and crowning, and stated that the earth road will have to form a great part of the mileage in the west for many years to come. At the same time, he declared that it would be uneconomical to build cheap roads for heavy traffic, and where high-class roads are needed, the government's 40% aid will be forthcoming. Mr. Campbell expressed his pleasure at learning that in one Manitoba municipality only 10 or 12 miles out of 195 miles of road were not gravelled. This shows remarkable progress, he thought, as gravel makes an excellent road if properly attended to and applied in layers so that the traffic can work it in.

Motorists are entitled to much of the benefit of road improvements, said Mr. Campbell, for the taxpayers in the cities and towns pay more than half the cost of the roads. The roads should be maintained very carefully in order to protect the investment.

#### Third Session Begins

President Squire requested J. A. Duchastel, a past-president of the association, to take the chair at the third session, Wednesday morning. Hon. F. C. Biggs delivered his paper on "Roads as an Aid to Agriculture;" A. P. Sandles, secretary of the National Crushed Stone Association, spoke extemporaneously; A. R. Hirst, state highway engineer, Wisconsin, read his paper on earth, clay and sand roads; and Mr. Cuthbert showed numerous lantern slides relating to highway work.

Russell T. Kelley, of Hamilton, a director of the association, presided at the fourth session. The papers presented were: "Bituminous Treatment of Sand Roads," by Col. W. D. Sohler, ex-chairman of the Massachusetts Highway Commission; "Organization of Provincial Highway Departments," by A. E. Foreman, chief engineer, British Columbia Public Works Department; and "Broken Stone Roads," by Geo. Hogarth, chief engineer, Ontario Highways Department. Mr. Hogarth was not present, but his paper had been received and was read by J. R. Roberts, of the Barrett Co., Ltd., Montreal.

#### Banquet

At the banquet Wednesday evening, speeches were delivered by Hon. Mr. Grierson, Hon. F. C. Biggs, Hon. S. J. Latta, Dr. Desaulniers, Dr. Doolittle and several other prominent guests, Mayor Gray acting as toastmaster, assisted by Mr. Kelley.

The papers delivered at the fifth session, Thursday morning, Mr. Squire presiding, were: "Road Dragging and Maintenance," by H. S. Carpenter, deputy minister of highways, Saskatchewan; "Highway Bridges and Culverts," by M. A. Lyons, chief engineer, Good Roads Board, Manitoba; and "Asphaltic Concrete Pavements," by W. H. Connell, consulting engineer, Philadelphia. Brig.-General C. H. Mitchell, of the University of Toronto, was not present to read his paper on "Schools for Highway Engineering."

At the opening of the last session, Thursday afternoon, the delegates sang the national anthem and gave three cheers and a tiger for the King in honor of the King's birthday. Wm. Findlay presented his paper on "The Value of the Local Association in a Nation-wide Highways Movement."

Hon. S. J. Latta gave an address in which he emphasized the importance of the home in British patriotism. What is needed in the western country is the provision of good, utility highways that will serve the homes of the settlers, and they will have to get down to business and spend immense sums

of money, not only on lateral roads, but on local highways, that would provide proper communications for the people, he declared. The chief interest lay in the home, then in the community in the province and in the Dominion, and they should adopt this principle in their highway problems, first providing roads for the community in order that they might link up all the people in the community and create a healthy community spirit. They have gotten past that to a certain extent, and have to branch out and link the different communities together to make a united province. When past that, the great problem will be to get a broader viewpoint and reach out further and link up all the larger provincial communities in order that we may have a Dominion sentiment, and that is the problem the Canadian Good Roads Association is trying to solve, and towards the solution of which they are directing all their energies.

#### Duty of Federal Government to Highways

Mayor T. L. Church, of Toronto, gave a brief address, in which he pointed out that the Dominion government has paid over \$900,000,000 of the people's money, directly and indirectly, to the railways, but have never had any money to spend on the King's highway, except an old wagon road, built shortly after British Columbia entered Confederation. He said 500,000 men had left Ontario in the past ten years and gone elsewhere because of lack of good roads, proper telephone and telegraph systems and cheap light and power. The solution lay in the provision of good roads and a system of international waterways throughout the country. There should be a trunk highway from Halifax to Vancouver, and that would do a great deal to solve the economic problems of the day. There is a serious lack of vision on the part of the federal authorities, and the time has come when the people of the country must go forward and demand good roads. The average member of the county council and farmer has far more vision and is far in advance in the matter of public opinion in regard to good roads than some of the people representing them in parliament. We have done enough for the railways, and the federal government must give additional assistance to the highways immediately.

A. McGillivray, who presided, remarked that Manitoba has the same problems as Saskatchewan, and the government is co-operating with the municipalities in developing the main market roads and endeavoring to lay out a provincial highway system from Winnipeg to the western boundaries of the province. They do not hope to build the high-class roads which the eastern provinces are doing, for they look forward to gravel as being the standard, for some years at least, on their main roads in the province. They have under way a very heavy program of gravel road construction which will take them five years at least.

W. P. Near, city engineer of St. Catharines, Ont., presented his paper on concrete roads, and replying to B. Michaud, of Quebec, who asked if he knew of any important work where they have omitted expansion joints, Mr. Near said they had been omitted in some of the states on miles of work, an expansion joint being put in only at the end of a day's work.

Other papers presented (or taken as read on account of lack of time), included "Road Oils and Carpet Coats," by J. A. Duchastel; "Refined Tar in Construction and Maintenance," by Andrew Macallum; and "Traffic Census," by W. A. McLean.

At the annual meeting of the Canadian Good Roads Association, held Thursday evening, A. E. Foreman was elected president for the ensuing year; Dr. E. M. Desaulniers, first vice-president; and Hon. S. J. Latta, second vice-president. A full report of this annual meeting will appear in next week's issue.

#### List of Delegates

Following is a complete list of the delegates who registered, excluding those resident in Winnipeg:—

A. M. Arnott, reeve, Riverside municipality, Hyder, Man.; Capt. Lucius E. Allen, pres., Ont. Good Roads Association, Belleville, Ont.; Fred Armstrong, councillor, Carman, Man.; Duff A. Abrams, prof. in charge, Structural Materials Research Laboratory, Lewis Institute, Chicago; S. Archer,

reeve, Sutton municipality, Ettington, Man.; E. Ashton, chemical engineer, "Lehigh," Allentown, Pa.

J. W. Baldrick, good roads engineer, Brandon, Man.; N. Breton, councillor, Letellier, Man.; J. E. Battershell, engineer, East Kildonan, Man.; S. A. Button, good roads dist. engineer, Brandon, Man.; Thos. Brown, sec.-treas., Selkirk, Man.; A. H. Browning, councillor, Charleswood, Man.; Hon. B. Bowman, minister lands and forests of Ontario, Toronto; W. D. Bliss, Ottawa, Ont.; H. W. Bright, Municipal Districts Association, Alberta, Macleod, Alta.; Hon. F. C. Biggs, minister of highways of Ontario, Toronto.

A. W. Campbell, Dominion commissioner of highways, Ottawa; Geo. F. Chapman, reeve of Charleswood, Man.; Controller Cameron, controller of works, Ottawa; W. Chapple, councillor, Shoal Lake, Man.; E. Casselman, mayor, Emerson, Man.; T. W. Clarke, municipal engineer, Gladstone, Man.; M. Cameron, vice-pres., Saskatoon Municipal Association, Saskatoon; A. E. Counsell, salesman, Cleveland Tractor Co., Regina; H. S. Carpenter, deputy minister of highways, Saskatchewan, Regina, Sask.; A. Coles, councillor, Strasbourg, Sask.; E. S. Church, M.L.A., Shellbrook, Sask.; S. A. Churchill, assist. supt. public works, St. Johns, Newfoundland; R. H. Cameron, controller, Toronto; L. C. Charlesworth, deputy minister public works, Edmonton, Alta.; Wm. H. Connell, consulting engineer, Philadelphia, Pa.; T. L. Church, mayor, Toronto.

Alderman Dennison, Ottawa; V. E. Duclos, sales dept., Canada Cement Co., Regina, Sask.; Chas. W. Dill, supt. of highways, Regina, Sask.; J. A. Duchastel, city engineer and manager, Outremont, Que.; Dr. E. M. Desaulniers, physician, Montreal, Que.; J. T. Davies, Neepawa, Man.; Dr. P. E. Doolittle, ex-pres., Ontario Motor League, 619 Sherbourne St., Toronto.

T. H. Emes, reeve, West St. Paul, Middlechurch, Man.

E. R. Finch, town engineer, Kenora, Ont.; J. E. Freeman, engineer, Tech. Bureau Portland Cement Association, Chicago, Ill.; John Foster, reeve, Keyes, Man.; A. G. Fleming, chief chemist, Canadian Cement Co., Montreal; A. E. Foreman, chief engineer, public works dept., Victoria, B.C.; Allan Findlay, dist. engineer, Manitoba Good Roads Board, Portage la Prairie, Wm. Findlay, director, Canadian Good Roads Association, "The Globe," Toronto.

Gordon Grant, chief engineer, Dominion Highways Commission, Ottawa; W. S. Gibson, Port Credit, Ont.

Wm. Heale, councillor, Teulon, Man.; G. R. Hill, engineer, Virden, Man.; R. D. Harper, civil engineer, Sanford, Man.; E. O. Hathaway, dist. engineer, U. S. Bureau of Public Roads, Minneapolis, Minn.; N. J. Hansen, councillor, Keewatin, Ont.; A. R. Hirst, state highway engineer, Madison, Wis.; G. A. Hodgson, pres., Ontario Motor League, Toronto.

Chas. E. Ivens, reeve, Wallace municipality, Virden, Man.

A. E. Jennings, assist. general manager, *The Canadian Engineer*, Toronto.

J. H. King, minister public works, Victoria, B.C.; W. W. King, publicity dept. Canadian Cement Co., Oakville, Ont.; Brig.-Gen. Kirkealdy, Brandon, Man.; Thos. L. Kennedy, director, Ontario Good Roads Association, Dixie, Ont.; Russell T. Kelley, president, Board of Trade, Hamilton.

Hon. S. J. Latta, minister of highways, Saskatchewan, Regina, Sask.; C. C. Lapierre, Montreal; John J. Lamb, member, Saskatchewan Municipal Association, Ogema, Sask.; C. W. Lowman, assist. dist. engineer, Portage la Prairie, Man.

C. J. Mackenzie, prof. of engineering, University of Saskatchewan, Saskatoon; Fred E. McKenney, road drags, Boissevain, Man.; G. A. McNamee, Montreal; Andrew F. Macallum, commissioner of works, Ottawa; Col. W. G. Mackendrick, Toronto; J. H. McKie, councillor, Neepawa, Man.; W. A. McLean, deputy minister of highways, Ontario, Toronto; T. A. McElhanney, assist. controller of surveys, Ottawa; D. J. Miller, dist. engineer, Manitoba Good Roads Board, Minnedosa, Man.; B. Michaud, deputy minister of roads, Quebec, Que.; D. L. MacQuarrie, Regina, Sask.; P. W. Mullins, municipal engineer, Selkirk, Man.; H. R. Mackenzie, chief field engineer, department of highways, Regina, Sask.; A. B. Macdonald, Cranbrook, B.C.; Malcolm

MacVicar, M.P.P., Belmont, Ont.; Geo. E. Martin, highway engineer, Barrett Co., Chicago, Ill.; H. Wm. Meech, commissioner of public works, Lethbridge, Alta.; W. G. Mawhinney, municipal engineer, Selkirk, Man.

M. T. Nagle, vice-pres., Russell Grader Co., Minneapolis; W. P. Near, city engineer, St. Catharines, Ont.

Wm. Ord., manager, paving dept., Lakewood Engineering Co., Cleveland, Ohio; C. J. M. Osler, councillor, St. Claude, Man.; M. Ornal, councillor, Fannystella, Man.

R. H. Parsons, Montreal; Walter Parker, pres., Jefferson Highway Association, New Orleans; W. H. Pelham, Regina, Sask.; J. H. Putnam, sec.-treas., Ninette, Man.; J. A. Penrose, assist. engineer, Good Roads Board, Dauphin, Man.; E. A. Poulain, sec.-treas., Norwood, Man.; Alfred Pitt, pres., Central Canada Colonization and Highway Association, Dryden, Ont.

G. W. Robinson, engineer of projects, Bismarck, N.D.; J. R. Roberts, manager, paving dept., Barrett Co., Montreal, Que.; J. D. Ruttan, engineer, Fort Garry, Man.; J. D. Robertson, provincial engineer of highways, Edmonton, Alta.; W. G. Robertson, sec., Ontario Motor League, Lumsden Bldg., Toronto.

Col. W. D. Sohler, Mass. highway commissioner, Boston, Mass.; Wm. Smail, chief engineer, Northern Construction Co., Vancouver; Geo. D. Sewell, M.P.P., R.R. 2, Waterford, Ont.; C. D. Smith, sales engineer, Lakewood Engineering Co., Minneapolis, Minn.; L. D. N. Stewart, Ontario governing engineer, Collingwood, Ont.; W. H. Shillinglaw, municipal engineer, Brandon, Man.; Geo. A. Sherron, consulting engineer, Philadelphia, Pa.; A. P. Sandles, sec., Crushed Stone Association, Columbus, Ohio; H. Spenger, municipal engineer, Dauphin, Man.; O. T. Soole, sec.-treas., Elm Creek, Man.; David Smith, assist. engineer, Good Roads Association, Dauphin, Man.; W. J. Short, reeve, Shoal Lake, Man.; S. L. Squire, pres., Canadian Good Roads Association, 98 Albany Ave., Toronto.

W. E. Thomas, Box 1229, Brandon, Man.; W. C. Thompson, member Hamilton Suburban Highway Commission, Hamilton, Ont.; Geo. A. Toole, mayor, Kenora, Ont.

H. P. Urie, dist. engineer, province of Manitoba, Deloraine, Man.; J. E. Underwood, Murphy and Underwood, Saskatoon; K. J. Urquhart, Saskatoon.

H. S. VanScoyoc, manager, publicity dept., Canada Cement Co., Montreal; J. T. Vance, clerk of Wentworth Co., Hamilton.

R. E. Weeks, municipal engineer, Souris, Man.; C. R. Wheelock, director, Canadian Good Roads Association, Orangeville, Ont.; Thos. T. Wilson, assist. director, Good Roads Board, Dauphin, Man.; Wm. Wright, member, Good Roads Board, Regina, Sask.; J. F. Whitson, commissioner, Northern Deevolution Bureau, 617 Huron St., Toronto; B. Weedmark, councillor, Regina, Sask.; Wm. Waugh, councillor, East St. Paul, Bird's Hill, Man.; G. M. Williams, assoc. engineer, Bureau of Standards, Washington, D.C.; G. E. Wennerly, adv. manager, Russell Grader Mfg. Co., Minneapolis.

The twenty-eighth annual meeting of the Society for the Promotion of Engineering Education will be held at the University of Michigan, June 29th to July 2nd, 1920.

R. A. Brown, electrical engineer, stated recently that the proposed amendments to the Electrical Act, as recommended by the Workmen's Compensation Board, would cost the city of Calgary \$150,000 to put into effect.

The Canadian National Railways have ordered their new equipment for the year 1920. The new contracts call for 117 locomotives of various types, freight cars, refrigerators, cabooses and ballast cars to the number of 5,556, passenger coaches, sleepers, diners and baggage cars, 100.

It is reported on the authority of the daily press that a man sent out by the engineer of a municipality in western Ontario to scrape and paint the bridges in the county occupied much time and energy in putting three coats of black paint on a concrete bridge. Our daily contemporary observes that this will be a dark memorial for somebody.

## ASPHALTIC CONCRETE PAVEMENTS\*

By W. H. CONNELL

Consulting Engineer, Philadelphia, Pa.

NINE-TENTHS of the highway problem to my mind has always been the upkeep. The "stitch in time saves nine" maxim is really the whole problem, after the location of the road has been selected and provision made for drainage. Location comes first, and drainage comes second of course. After provision has been made for those two fundamentals, then the question is what kind of road is the one that should be built in this particular locality. That depends upon traffic, social and local conditions. It would be perfect nonsense and waste of money to put down asphaltic concrete, or concrete, or sheet asphalt in a location where there will not be enough traffic for that kind of pavement in a great many years. One must start at the bottom and build up gradually. First, the earth road, then the gravel road, then macadam roads, then macadam roads, surface treated. Then come penetration roads, bituminous or asphaltic concrete on a macadam foundation, and sheet asphalt on a concrete foundation then comes the concrete, then the brick and last but not least, the granite pavement.

### Macadam Excellent if Given Surface Attention

I have heard a great many engineers in different localities say that the day of macadam has gone by, that macadam will not stand up under present day traffic in localities where there is considerable motor traffic. It will stand up, and almost indefinitely under automobile traffic, if given surface treatments as frequently as are required. Surface treatments should be applied to macadam roads under some conditions every year, and under other conditions every two years or three years, depending on the amount of traffic. I recently went over a number of roads in Pennsylvania where there are a great many good roads of all descriptions with a number of engineers, and they said "we have come to the conclusion that we are going to lay off these roads and let them all go, all gravel and macadam, until we can afford to put down one of the more or less permanent types of pavement." That policy will result in an unwarranted waste of money. We have proved right in New York city and some of the heaviest travelled roads in Philadelphia that one can take an ordinary broken stone road and keep it almost indefinitely at a very modest cost, if it is given constant attention. Keep the surface treatment on it. Patch the road, and give it the day-to-day attention that anything else in the world requires if it is to be kept up, and the road will give first class service, until the time when it is going to be turned over to very heavy motor truck traffic.

I resurfaced a macadam road in New York City, the Grand Boulevard and concourse, the main highway leading out from the Bronx to Boston, with from ten to twelve thousand automobiles a day travelling over it. It was built in 1910. We did not have any pressure means for putting down our surfacing material, but used the old crude method of the watering can. It was macadam surfaced with tar. That road has been kept up and treated as often as required and is in perfect condition to-day, and was when I saw it a few weeks ago. That is an illustration of what can be done with materials at hand. If you take the materials at hand in this part of the country, and follow out the principles laid down by Mr. Hirst and some of the other speakers who have dealt with the problem of handling earth and gravel roads, and you can build up a road system here that will be adequate for the traffic you have. If that road is located right, and the drainage is properly taken care of, all the money you put into the roadbed to-day is going to be returned to you a hundredfold when the time comes to lay the asphaltic

\*Address delivered at the Seventh Canadian Good Roads Convention, Winnipeg, June 1st-3rd, 1920.

concrete or the concrete road on top of it, for the main thing is to have a sub-base that will hold the traffic.

#### Value of a Solid Sub-Base

The great trouble we are having to-day is that we lay a six-inch concrete road on a new sub-base, where there has been no road before. Concrete will not crush under traffic. In New York city about two years ago they made an investigation at my request to find out if the concrete did crush under the heaviest traffic they had in the city, and they found that it never did crush or give under traffic. A great many say that six inches of concrete will not stand very heavy motor traffic. They miss the point. The concrete stands, but the sub-base under the concrete goes with the traffic and that breaks the concrete. If you build your road, and it is desirable to put a road in certain locations, build it up on materials that you have at hand, and let the traffic keep going over it for years and when the time comes to put on your concrete, you will have a perfectly firm and solid sub-base that will enable you to keep your road under the heaviest possible traffic, because four or five inches of concrete will stand up if the sub-base is sufficiently solid.

#### Basing Outlay on the Traffic

The building of roads is like any other business problem. When you start in business, you don't start in at the top. You organize the company, usually in a small way, and then gradually build up, until you get a big corporation. The same thing applies to the road. You have to creep before you walk, and it is the pioneer work that makes it possible to get the good road system later on. You must not be discouraged because you cannot lay one of the modern, more or less permanent, types of pavement. It would not be the thing to do; the financial outlay would be too great for the amount of traffic that these roads will require to carry. This whole thing must be viewed from the purely cold-blooded business standpoint. You must realize that the road that you are going to build here should be the one that you are justified in building in the locality for the amount of traffic existing there. Of course, once you build roads you are going to attract traffic, and it will gradually become heavier. Then, there will gradually be a change in the type of pavement, until you get to the more or less permanent type.

#### Segregation of Traffic

The time has come to my way of thinking, when, between the big cities we shall have to have two types of roads, one for ordinary passenger automobiles, and one for motor trucks. I do not believe that we as roadbuilders should strive for legislation limiting the weight of trucks, but we should have legislation limiting the weight of trucks per inch of width of tire. The trucks carry our produce, and no matter how we try to limit their weight, they are going to grow in size as big as they can grow, for two to pass, one going in one direction and the other in the opposite direction. So our problem is to build roads, where the motor truck traffic is heavy between cities, that will carry the greatest amount of weight that there can be put on a truck of reasonable size, keeping in mind always that the width of tire must conform to the weight on the truck. I was asked by the Manufacturers' Association of Baltimore, several months ago, to say something on that subject, and I told them that the time was coming, and I firmly believe it is, when we shall have steel tracks for our heavy motor truck traffic, paved with granite block in between, and on the shoulder, to carry the large trucks between such cities as New York, Philadelphia, Baltimore and Washington. We cannot build a road to carry the kind of traffic that passes through a park that will also carry the kind of traffic expected over an inter-city freight motor truck road. It would be a waste of money to build a road for such heavy motor truck traffic, where probably 80% of the traffic is passenger automobile traffic. We should be building a very expensive type of

road to carry the 20% traffic, one that would be entirely unnecessary for the 80%. That problem is already confronting us, and it is not going to be long before it is going to confront you here in Canada, in Quebec, Montreal, Hamilton, Toronto and other thickly populated districts.

In Manitoba your problem is largely one of earth and gravel roads. Several years ago, I had the pleasure of attending the first convention of this association held in Montreal, and road-building at that time was very new in that part of the country. They were then building the King Edward highway, an ordinary water-bound macadam road, and had completed fifteen or twenty miles of it. They have made tremendous strides since that time, so that their problem is now the same as ours, and they are building more or less permanent types of road. In this part of the country you will make the strides they have made in the more populated centres, and will later be building more or less permanent types of road.

#### Macadam vs. Concrete Foundations

There are two ways of building asphalt roads, namely, on a macadam foundation or on a concrete foundation. If you build your roads now, on a proper location, and with proper drainage and plenty of outlets, and when gravel is required you put it on, then when the time comes to put on an asphaltic concrete, you will have a foundation that you can lay the road on, provided it is a travelled road. I believe that if you put the asphaltic concrete road on a broken stone foundation, or on a gravel foundation that has been travelled over, so that it is thoroughly compact, you really get better results than if you put it on concrete. Concrete will crack. We cannot stop it from cracking, and the pavement will crack right through to the surface. That of course does not injure the pavement seriously. You can bind up those cracks with a little bituminous material, but you are not likely to have that trouble on an old macadam or gravel road.

#### Kinds of Asphaltic Concrete Pavements

An asphaltic concrete that we have built successfully, is the one that is covered by the Warren patent, and that is about 7½% of asphalt, 8 to 10% of limestone or Portland cement dust, 50 to 55 or 60% of stone and 25 to 30% of sand, all properly graded. I have laid several hundred miles of that type of pavement, but laid it in the locations where the patent did not affect us, and we were not disturbed. That is the best asphaltic concrete pavement. The second is that known as the Topeka pavement. In that you put a moderate percentage of asphalt, about 8 or 9%, because you use a small-size stone, about a quarter of an inch, and you also use a different grade of sand. We have had very satisfactory results with it. In an inspection tour I made recently, I particularly noted the results of the wear of heavy motor truck travel over the various types of pavement. The asphaltic concrete has stood up as well as any one of the types of pavement I speak of, and has given the service that we expected it to give, and in my classification of pavements I put it ahead of concrete, that is if it is on an old broken stone road or on a concrete base.

#### Comparison with Concrete Pavement

This statement would probably be disputed by a great many people, because concrete seems to the layman better than anything else, because he does not know anything about it except in a superficial way. The simplest thing to a layman's mind is concrete. Concrete roads are good roads, but you cannot build them that they won't crack. If you can do that, there are untold millions waiting for you. A concrete road after it is laid must be maintained like any other road, and it is usually maintained by being patched and chequered with tar and asphalt poured into the joints, resulting in a very ugly looking pavement, to my mind not a fit one for a park or a city. The asphaltic concrete pavement on a firm base will give

(Continued on page 559)

## FLOWABILITY OF CONCRETE AND ITS MEASUREMENT BY MEANS OF THE "FLOW TABLE"\*

BY G. M. WILLIAMS

Associate Engineer, U.S. Bureau of Standards

**F**LOWABILITY is one of the several expressions sometimes used to describe the consistency or placeability of concrete. The quality of a concrete or mortar mixture which has to do with ease of placing may be referred to as "consistency," "mobility," "plasticity," "workability," or "flowability," and these words, although having, perhaps, slightly different meanings to many people, are generally synonymous as used.

The consistency or flowability which must be used in any case is dependent upon the nature of the work, type and arrangement of forms and reinforcing steel. For any given condition there is some minimum flowability which must be attained to result in good workmanship, and in economy and proper progress in the process of concreting. With given materials and proportions, flowability may be increased only by the use of more mixing water, which in turn will lower compressive strength. It is generally agreed that concretes must have the same consistency or flowability to be comparable, yet we have had no satisfactory method for measuring and controlling consistency. Consistency has usually been crudely estimated by eye or the judgment or feel of the operator, and, as a result, test data obtained even in the same laboratory, must in many cases remain as small and isolated groups of tests, none of which bears any definite and known relation to the others. Studies made of the results of such tests are likely to lead to faulty conclusions since such concretes are not comparable.

### Slump Test Unsatisfactory

The cylinder slump test and its modification, the cone slump, have been proposed and used for this purpose, and while they are far superior to the old method of "eye" and "feel," they fail to fully meet the requirements of such a test. One criticism of both is that the concrete seldom really slumps when the form is withdrawn, but the mass merely collapses into an unsymmetrical pile. In this respect the cone slump is less satisfactory than the cylinder, since when the former is employed the mass loses all lateral support as soon as the upward movement of the form is started and the tendency of the top to fall over is unresisted. A further criticism of both slump tests is that with different gradations of aggregates, or with different proportions of cement to aggregate, equal slumps do not result in concretes of equal flowabilities, so that the resulting concretes are not comparable.

Investigations in the concrete laboratory of the Bureau of Standards have emphasized that the control and the measurement of flowability is of fundamental importance, not only in laboratory testing of concrete but in the practical application of the results of such investigations to concreting practice in the field.

### Nature and Use of Flow-Table

During the past year and a half a new form of consistency measuring apparatus, designated as the "flow-table," has been used in the concrete laboratory of the Bureau. The type first employed consisted of a piece of sheet metal about 30 ins. square, supported at its centre in a horizontal position. A mass of concrete was molded at the centre, the mold withdrawn, and the edge of the plate struck

a given number of weighted, downward blows with a suitable hammer arrangement. The amount of spread of the results, but further experiment resulted in a table of the mass was a measure of the flowability of the concrete.

The preceding type of apparatus gave very satisfactory type shown in Fig. 1. This consists of a metal covered table top which can be raised vertically by means of a cam working at the end of a vertical post to which the top is attached. The height of drop can be adjusted by means of a bolt at the lower end of the shaft. A mass of concrete or mortar is molded at the centre of the table in a sheet metal mold which has the shape of a hollow frustrum of a cone. For aggregates up to 2-in. maximum size this cone has a height of 6 ins. and upper and lower diameters of 8 ins. and 12 ins. For smaller aggregates, when made up in small quantities, a cone having a height of 3 ins. and upper and lower diameters of 4 ins. and 6 ins. is used. The mass of concrete is tamped just sufficiently to completely fill the form, the form is withdrawn, and the table top is dropped 15 times through a distance of  $\frac{1}{2}$  in. The mass flattens and usually spreads concentrically. Two diameters at right

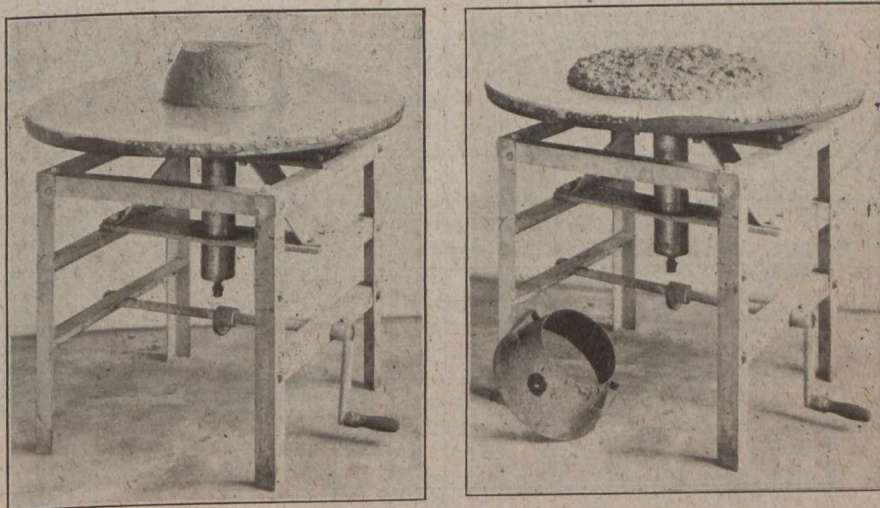


FIG. 1—FLOW-TABLE USED IN LABORATORY OF BUREAU OF STANDARDS FOR MEASURING CONSISTENCY OF CONCRETE. CONCRETE SHOWN IS 1:1½:3 OF STIFF CONSISTENCY

angles to each other are measured, the long and the short if difference is apparent, by means of a self-reading caliper which is so graduated that the sum of the two readings is the value for "flowability," which may also be calculated by dividing the new diameter by the old and multiplying by 100.

### Relation Between Flowability and Quantity of Mixing Water

A typical curve showing the relation between the flowability of concrete as measured by the "flow-table," and the quantity of mixing water used is shown in Fig. 2. Five separate batches of 1:2½:3½ volume proportion concrete were prepared with percentages of mixing water ranging from 7 to 11. 7% resulted in a concrete too dry for ordinary construction work. 9% of mixing water resulted in a concrete which flowed sluggishly in a steel chute which had an angle of 21 degs. 10% furnished as wet and fluid a concrete as is ever needed in practice. With 11% a sloppy, segregating concrete difficult to properly sample was obtained. The added water in excess of 10% resulted in practically no increase in flowability as measured by both the flow-table and the steel chute. This straight line relation between mixing water and flow as measured by the flow-table is characteristic of results obtained with other concretes, mortars, neat cement and lime pastes.

### Comparison of Flow-Table and Slump Methods

Fig. 3 shows graphically some results of tests in which the "flow-table" and the "cone slump" were used. A single batch of concrete was employed in this case for all determina-

\*Published by permission of the Director, Bureau of Standards.



tions shown, additional quantities of mixing water being added for each 1/2% increase. Due to loss of paste, absorption, etc., a slightly flatter curve was obtained with the flow-table than resulted for the individual batches of concrete included in Fig. 2. With the exception of the dip in the curve for 10% mixing water, the values for the cone slump are of the usual order of accuracy obtained by either of the slump methods. It is seen that the change in values for the "cone" between 8 1/2% and 9%, omitting the 5 1/2 slump

the cement is indicated by reduction of flow of the mass on the flow-table.

The rapid stiffening due to absorption of water by the cement and the aggregate is so marked that it is found necessary to measure the flowability at some definite interval of time after the addition of the mixing water. This is especially necessary when working with concretes composed of aggregates varying widely in gradation. This time interval is that which would be required in practice to properly place the concrete in the forms.

While the apparatus shown in Fig. 1 is rather heavy and cumbersome for use in the field, the method of test is fully applicable to field conditions, and a machine of more recent design now used in the laboratory can easily be carried about by one man. So far as comparative tests have been made on various tables, the results indicate that flow for any given number of bumps and height of drop is independent of the weight of the top, so that in standardizing the apparatus consideration need be given only to (a) size and shape of molded specimen, (b) height of drop of the table top, and (c) number of drops of the table top.

**Other Properties Determined by Flow-Table**

Although the flow-table was first employed as a means of measuring consistency of concrete, its use has indicated that it may be of value in the control and measurement of

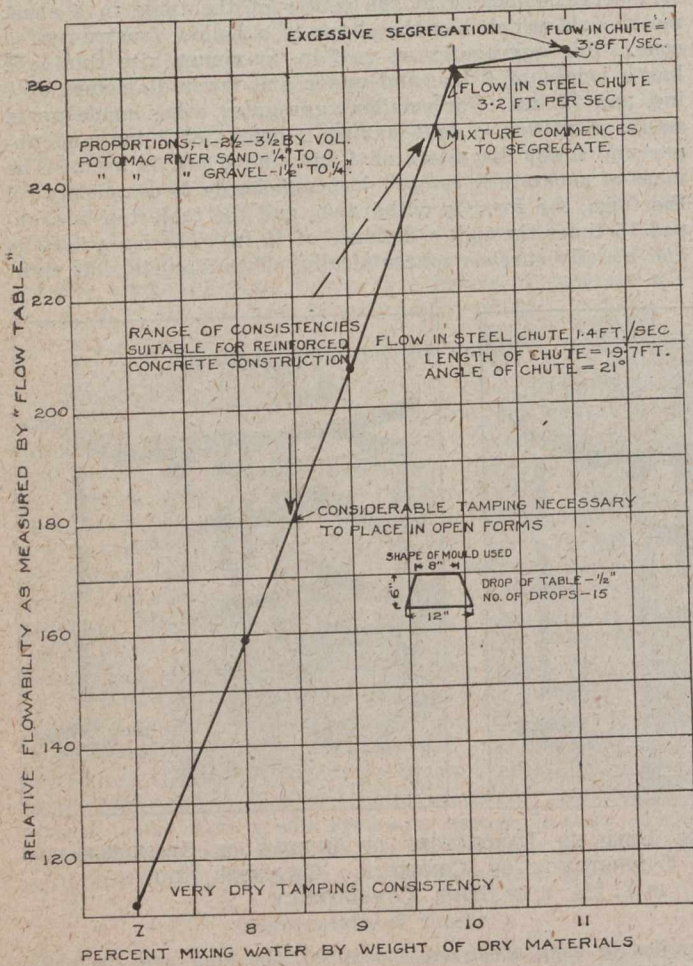


FIG. 2—FLOWABILITY OF 1:2 1/2:3 1/2 CONCRETE AS INDICATED BY THE FLOW-TABLE

for 8 1/2%, is greater than that caused by the addition of all the mixing water beyond 9%. A really desirable and necessary consistency for reinforced concrete work was not obtained until 9% mixing water was used. It is characteristic of consistency measurements made by the slump methods that marked differences in slump result for differences in quantity of mixing water over a very narrow range only, and before practical working consistencies are obtained.

**Advantages of Flow-Table**

The advantages of the "flow-table" over the slump methods may be listed as follows:—

1. The flow-table accurately measures flowability or consistency of a concrete, mortar, cement or lime pastes for all consistencies varying from dry masses which have only a slight tendency to flow or change their shape when acted upon by external forces, to those consistencies which are so fluid that the water and laitance will flow away from the coarse aggregate.
2. The relation between flowability and quantity of mixing water is practically a straight line relation for all workable and usable mixtures and consistencies.
3. The stiffening of a mass of concrete due to absorption of water by the aggregate, evaporation or setting of

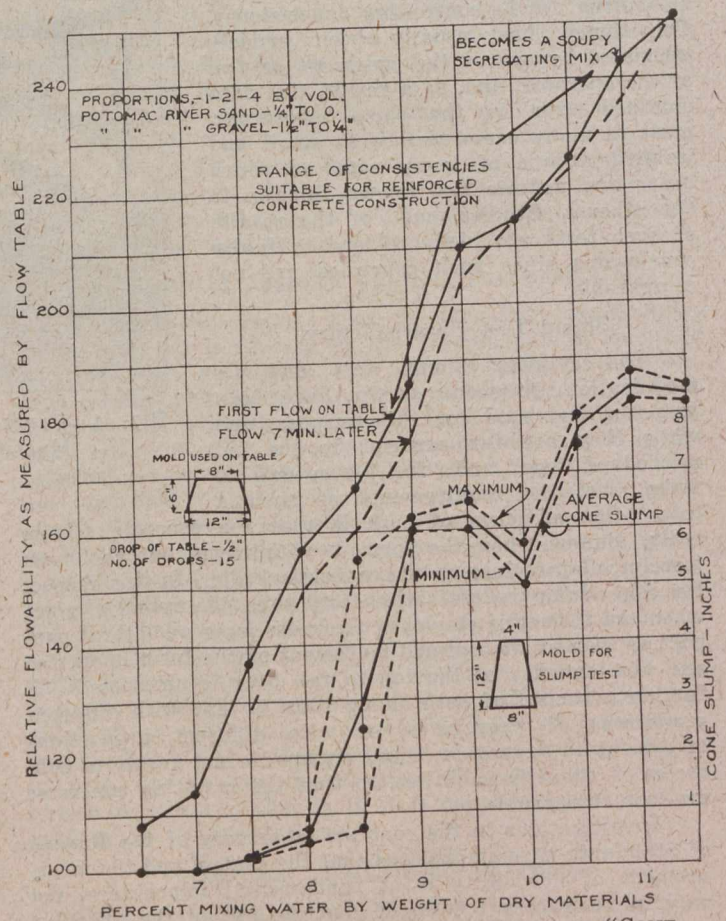


FIG. 3—COMPARATIVE CONSISTENCIES GIVEN BY "CONE SLUMP" TEST AND FLOW-TABLE

several other properties involved in the tests of cement and concrete, as follows:—

1. Segregation.—In working with dry concretes or concretes having a small ratio of cement to aggregate, or small quantity of fine aggregate, it has been noted that considerable of the coarse aggregate may be found outside of the well defined line of mortar which is considered as the flow line. The quantity of such coarse material appears to be a measure of the harshness or tendency to segregate, and such observations will permit of determination in the labora-

tory of the ease of working in the field of different combinations of aggregates whose flowabilities are the same.

2. Time of Set.—The rate of hardening of mortar or concrete from the time mixing water is added is measured by "flow" of separate specimens on the table at intervals. A practical application was the determination of the rate of hardening of two mortar floor toppings, one containing an accelerator, on actual construction work. The mortar containing the accelerator was finished in one-half of the time required for the other, and the rate of hardening as measured on the flow-table was twice as fast for the former.

3. Normal Consistency.—The apparatus shown in Fig. 4 has been in use in the cement testing laboratory of the Bureau for checking determinations of the quantity of mixing water required for normal consistency of neat cement and standard sand mortars. Results so far obtained indicate the method to be more accurate and consistent than determinations by the "ball method" or the Vicat Needle.

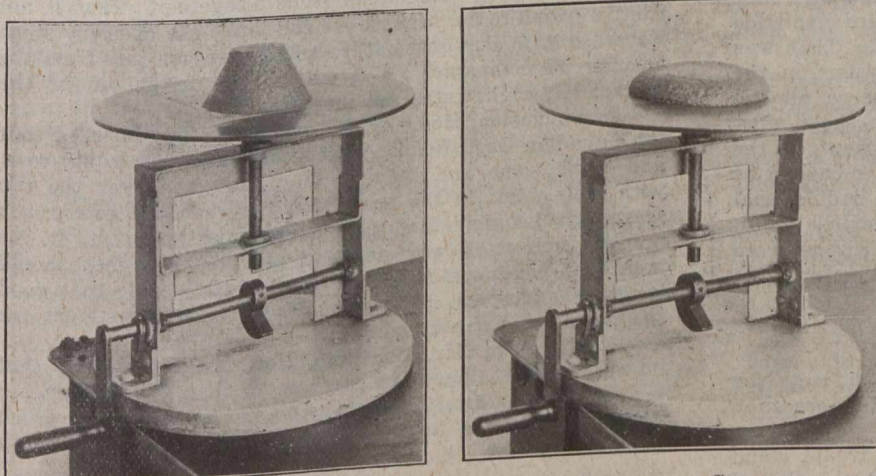


FIG. 4—FLOW-TABLE USED IN LABORATORY OF BUREAU OF STANDARDS FOR DETERMINING NORMAL CONSISTENCY OF NEAT CEMENT AND STANDARD SAND MORTARS

4. Selection of Concretes for Field Use.—The flow-table furnishes a means of measuring and expressing the missing factor "flowability" which is needed to permit predicting in advance the approximate strength values which may be obtained for any given proportions of cement and aggregate. The ranges of strength values which may be expected for any aggregate when used with varying cement content and for the extreme ranges of consistencies needed in practice can be determined by a series of tests. Knowing in advance the type of construction, experience will permit the minimum usable flowabilities to be estimated, and for any required strength values the necessary ratios of cement to aggregate may be selected. The selections may be checked by the results of field tests of concrete, and a few trials will indicate strength variations which may result for the degree of thoroughness of field inspection employed, and permit of proper allowance for unavoidable variations in cements, aggregates, and curing conditions, etc.

The foregoing description of the flow-table and its method of use is given with the hope that those who are interested in the testing of concrete will give the method a trial. No doubt further tests under widely different conditions will point out modifications and changes in the method and apparatus which will increase its value, and any criticisms based upon its application under such conditions will be appreciated.

P. W. Burton, manager of the Caraqueet and Gulf Shore Railway has announced that arrangements are being made to transfer the road to the government as part of the Canadian National Railway System.

## GOOD ROADS AS AN AID TO AGRICULTURE

Hon. F. C. Biggs Addresses Seventh Canadian Good Roads Convention at Winnipeg on Importance of Satisfactory Highways

HON. F. C. BIGGS, Minister of Public Works of Ontario, speaking on "Roads as an Aid to Agriculture" at the afternoon session of the Canadian Good Roads Convention on Wednesday, June 2nd, said that the basic production on which all else depended was agriculture, and something had to be done to keep people on the farms. One thing that was essential was education, and the Ontario government was endeavoring to work out a system of consolidated schools and continuation schools where a typical rural education would be given. To enable children to attend these schools, there must be roads. In such schools, they would pay particular attention to subjects bearing on agriculture, for if boys and girls had to go to the towns to complete their education, they returned with little taste for farm life.

### Good Roads as an Investment

Any money spent on roads was a good investment, if properly spent, and the Ontario government expected to invest very large sums of money in roads as a paying proposition. There were 200,000 cars and trucks in Ontario, and if the upkeep on them were lessened by 10%, which would be entirely reasonable with better roads, it would represent an invisible income to the owners of two million dollars a year; while if the efficiency of the cars and trucks were increased by 10%, which was a very low percentage, it would add two million dollars more each year to the users of the roads. That would make an invisible income of four millions a year from good roads on the motor cars and trucks alone. Furthermore, good roads would be a big

time saver in production, for 100% of the time would be saved on a five-mile haul on a good road, as compared with a poor road, and on a ten-mile haul, double that percentage, because a farmer could use his truck and give more time to producing.

### Increase in Land Values Due to Good Roads

Speaking of the increase in assessable value of lands through improved roads, the Minister of Public Works said that on the Toronto-Hamilton highway, before the road was built, land was assessed at \$200 an acre, and to-day they could not get a foot under \$500 an acre, an increase of \$150,000 a mile in value. Municipalities also got increased taxes from the higher assessment, so that the road that seemed to cost a lot had, as a fact, increased property value by five millions of dollars, or about three times what it cost. So when they had their two thousand miles of provincial highways in the province the cost of construction would not be a debt, since the value of adjacent property would be increased by two or three hundred per cent. They found that with roads in passable shape, land alongside county roads increased in value from \$100 to \$125 an acre, which meant an increase of \$20,000 a mile in land value.

Hon. Mr. Biggs remarked that they hoped soon to be free of statute labor, and instead of people being called out for the King's holiday, they were going to have to pay taxes for road improvement, and thus get away from the joker commonly known as statute labor. Another new thing was that all county superintendents would, from now on, have to be engineers, a thing which was not compulsory before.

The provincial highway system had been extended from 422 miles to 1,824, and they hoped soon to have 2,000 miles

of provincial roads connecting up the very best agricultural districts of the province to the large centres. In taking over this system, the government wanted to make it as quickly as possible of the utmost benefit to the rural people and also to the urban people. They were getting their engineers appointed. They had a chief engineer for the whole system, three divisional engineers and under them resident engineers who would have from 80 to 125 miles of road under their personal care and under those resident engineers they would have local foremen each having just what he could carefully look after. As they went on they would look carefully over those roads, pick out all the weak spots, and get after them first and put the whole system on an equalized standard before they did much of a permanent nature. They proposed to provide the foremen with material at regular intervals, gravel, fine crushed stone chips, one, one and a half and two-inch stone, and provide them with water and oil penetration, and have men ready with necessary machinery. If they had a road 25% perfect it would never go down to 24, and if 50%, never back to 49, but it would be kept where they had it, and as fast as labor and material were available it would be brought up to a perfect standard. That was the way they proposed to develop the road system in the province, and by doing that they hoped to serve all the people of the province, rather than to serve a short mileage with a very expensive road, to the detriment of the rest of the system. They wanted to work out suburban or market influence districts for which they had special legislation, and in those the cities would be called on to pay 20% of the cost of the roads, as the citizens were deriving a direct benefit by quick transportation and the delivery of goods.

#### Building Roads to Market Centres

The government had already let several contracts for short sections of roads out of these centres because they were the most expensive to keep up, as traffic was concentrated, and they proposed to build roads that would stand up, and as time and money and labor warranted, they hoped to stretch out from these centres until the roads from every different direction met and they had a complete road system. There was no place where the development of good roads would assist agriculture and production more than close to the large centres, because the market garden was one of the largest industries they had, and if the people could get to market with their produce when it was fresh, the people in the rural districts reaped the benefit of good transportation facilities and the people in the cities received the same benefit.

#### Getting After Overloaded Trucks

Hon. Mr. Biggs then referred to amendments made to the locomotive vehicle act, and said they had found from experience that the worst enemy they had to the roads was the heavily-laden vehicle or truck when the frost was coming out of the ground during March and April. One truck heavily laden on the rear axle, would do more damage with one trip over a road during those months than it would do running the whole of the rest of the season. The truck simply broke the crust right through so that it had to be resurfaced. The government had added to the statute books an act providing that no motor vehicle carrying over a ton weight could carry half its rated capacity during the months of March and April on the county provincial roads. If the cities wished it, they could readily have similar legislation. Another amendment was that no truck could carry more load than the license the truck was taken out for. They found that the three-ton truck was carrying five or six tons and the five-ton truck up to ten tons on a good road, and if they wanted to do that in future they would have to pay the license for the bigger load. They were getting some jack scales so that they could weigh the trucks at any point and were having three or four jitneys on the roads with those jacks. The inspector could then jack up a truck at any time, and the driver of the truck must help him do it. If his load was more than the certificate of his license called for, he would be fined. Furthermore, he had to have his

shipping bills of the load from the man who had consigned it. This was being done because they felt that they were being defrauded out of substantial motor license fees that they should be collecting.

#### Effect of Possible Increase in Freight Rates

"We are faced with increased freight rates," continued Hon. Mr. Biggs, "and the word is quietly going around that the railways intend to increase their freight rates on stone by 25 per cent. I think the provinces should get together and fight this to the last ditch. I cannot see any reason or commonsense in the Dominion government granting the provinces federal aid, and then allowing the railroads, of which the Dominion government is a large owner, to come around and take that money back in increased freights. This matter should have immediate and careful attention, because it means that the province of Ontario would have to pay more for freight on stone than the stone costs at the quarry, and it would mean that we should simply have to cut out buying commercial stone altogether. That is not what we wish to do, because we can make use of every stone we crush with our own outfits and all we can get from the commercial companies. But we will be driven out of the market if freight rates are increased."

In conclusion, Hon. Mr. Biggs said he was satisfied that the Canadian Good Roads Association was doing a big work, and while some had thought they had gone over the top with their work, in the sense that they had the good roads movement booming, and people enthusiastic for it, in his opinion their work was only just starting, and they should launch an educative campaign to show the people that good roads as a business proposition was a good investment for the people of Canada to make.

Replying to Mr. Macallum, Hon. Mr. Biggs said that no vehicle was allowed to carry more than 650 pounds per inch of width of tire. There was no statute at present which limited the load a truck could carry other than the width of tire.

#### BRITISH READINESS FOR HYDRO-ELECTRIC ENTERPRISE

ONE of the largest electrical manufacturing groups in Great Britain has made efficient preparations for undertaking complete contracts for hydro-electric enterprises. The business of a prominent firm of water-power engineers and contractors has been acquired in order to provide facilities for making the largest sizes of water turbines, while the resources of the group are available for the electric generators, the construction work, the transmission of power, and all the other sections of hydro-electric work in any part of the world. Valuable patents have been acquired in connection with this development. A French company associated with the group is undertaking the construction of water turbines with a total output of 300,000 kilowatts, two hundred electrical locomotives, and other electrical machinery required in an important scheme of railway electrification.

The membership of the Water Works Manufacturers' Association consisted of 98 member firms at the close of the last fiscal year. Five new members of the Executive Committee are now to be elected to fill the expiring terms of the Columbia Iron Works, Electro Bleaching Gas Co., Hersey Manufacturing Co., Neptune Meter Co., and the Waterworks Equipment Co.

Although the United States commission to inquire into the feasibility of building a bridge over the Niagara River at Buffalo was authorized by act of congress last fall and the commission named by President Wilson several months ago, it has been impossible for it to do any work because of the delay in appointing the Canadian commission. This matter is in the hands of Frank R. Lalor, M.P., for Haldimand county, and Major Evan E. Fraser, M.P., for Welland county.

# Organizing Provincial Highways Departments\*

Necessity for Well-Organized Highway Departments—Subdivision of Areas and Duties—  
Workable Designation and Filing System—Technical and Clerical Staffs—The Staff as  
an Energizer—Adequate Remuneration—Annual Conferences—Value of Co-operation

By A. E. FOREMAN

Chief Engineer, Department of Public Works, British Columbia

**R**EMARKABLE though the increase in the number of motor vehicles used during the last few years has been, there is every indication that it will continue for some considerable time. One result of the tendency will undoubtedly be the requirement of a more substantial and more expensive type of highway and a more extensive program of highway improvement than have obtained in the past. This fact is recognized in the United States, where it is estimated that during the next five years some three billions of dollars will be spent upon highway construction, or in other words, nearly four times as much as was expended on railroad construction during the record five years of railroad development in that country. In Canada, too, we have passed the peak of railroad construction and are now at the dawn of a new era of highway construction and improvement.

## Canada Realizes Importance of Highway Problem

That those in authority in Canada are fully cognizant of the importance of providing large sums for the improvement of our highways to take care of this speedier, heavier and more destructive type of traffic is indicated by the action of the federal government in passing the "Canada Highways Act" at the last session of the House, providing for assistance to the provinces for their main roads to the extent of twenty millions of dollars extending over a period of five years; by the action of Ontario, which I understand, has a highway program that will involve an expenditure of sixty millions of dollars during the next five years and by the large program of the other provinces, including British Columbia, which, with a population of little more than half that of the city of Montreal, has voted for expenditure on roads and bridges this year of over three and a half millions of dollars, or \$9.00 per capita, and in addition has authorized the borrowing of a further sum of five millions for construction and improvement of the main highways during the next three or five years, and these sums do not include expenditures that will be made by municipalities or federal assistance under the "Canada Highways Act."

## Necessity for Well-Organized Highway Departments

I quote these figures to show that the need for more and better highways is not only recognized, but what is more important, that millions of dollars have actually been voted for highway improvement. It is my opinion, and I believe I am voicing the sentiments of those present, when I say that it is *equally* and as *vitaly important* that there should be well organized and efficient highway departments to ensure the spending of these large sums so as to obtain a maximum amount of service at a minimum of cost. It is not going to encourage the taxpayers of the country to vote further sums—and much larger amounts will certainly be required for highway improvements in the near future—if the moneys already voted are unprofitably spent through incompetency, lack of organization, or any other cause, and it is with this highly important question of the organization of provincial highway departments that I wish to deal.

When we have a large and expensive work to undertake, whether it be construction work, or manufacturing, there are three primary essentials that must be considered:—

1.—We must decide upon the most suitable type of machinery for the work in hand;

2.—We must procure the most economical power available to operate the machinery;

3.—We must place an experienced mechanic in charge and see that all the parts are kept in the best working order and properly oiled so as to reduce the friction to a minimum and enable it to be operated as efficiently as possible.

Similar factors enter into the formation of a provincial highway department. These impose the following requirements:—

(a)—We must decide upon the type of organization that will give the best results;

(b)—We must procure the most efficient motive power available to energize the organization, and this energy is represented by the personnel of the staff;

(c)—Having the organization and a competent staff, we must see that every individual unit is in the best and most efficient working order by keeping his systematically in touch with the latest highway engineering practice, and to reduce the friction to a minimum by engineering a spirit of co-operation and *esprit-de-corps* among the members of the staff that will cause the organization to function smoothly and effectively.

To get results, the engineer in charge must not only have experience, tact and executive ability, but he must be an enthusiast and be able to inspire enthusiasm in others, as the spirit and activity of the organization depends largely upon his initiative and example.

## Subdivision of Areas and Duties

Now, dealing first with the type of organization, I believe that experience has proved the best results are obtained by dividing the province into engineering districts, the size of which will depend upon the mileage of roads and nature and extent of work to be done, and by placing a competent and experienced engineer in responsible charge of each district. These engineering districts should be further subdivided into units consisting of one, two or more townships, municipalities or electoral districts, depending upon their size and the method of accounting in the provincial department, and each placed in charge of an experienced and practical assistant engineer or superintendent of construction, who would report and be responsible to the district engineer and to the district engineer only, just as the district engineer in turn should be responsible to the chief engineer and to him only. A highway organization chart is of great importance in graphically defining the relationship of one official to another. Each official should have full control of the employment and dismissal of his subordinates. Centralization of responsibility is only possible by centralization of authority and both are necessary for effective organization and satisfactory results. Nothing will disorganize a department more quickly than having the men realize that their appointments are due to outside influences and that their superiors in office cannot dismiss them. Human nature is such that even capable men sometimes take advantage of such a situation and a little leaven leaveneth the whole lump.

## Technical and Clerical Staffs

The different engineering offices should have adequate technical and clerical assistance, but should not be over-staffed, as this encourages leisurely habits. There should be experienced bridge engineers, or inspectors, to examine regularly and report upon the condition of all bridges, parti-

\*Read before Seventh Canadian Good Roads Convention, Winnipeg, June 1st-3rd, 1920.

cularly where there are structures which are subjected to traffic conditions for which they were not designed, and they can also co-operate with the district officials in the choice of more suitable sites for bridges which require renewing and which are poorly located. Where the government has a large amount of costly plant, it is advisable to place it under the charge of a mechanical superintendent. It would be his duty to see that the plant is kept in good working order and not abused, that competent mechanics are employed to operate the different pieces of machinery, and that plant be transferred from one district, when not in use, to another

Trail district, ferry number 4, and so on. These numbers not only fix definitely the road or bridge, but they are also the file numbers under which correspondence on the individual roads or bridges is filed in the different offices. When a district engineer is writing about a certain road, the number of that road is also his file number as well as that of the office to which he is writing. The results are that it facilitates filing; it gives the head office a check on how the system is being kept up in the outside offices; it gives uniformity throughout the province, and when an assistant is promoted to another district, he is at once familiar with



Officials, Delegates and Advocates of Better Highways in Attendance at the Seventh Canadian Good Roads Convention, Winnipeg, June 1-3, 1920

where required, and to dispose of old equipment that is no longer serviceable or economical to operate.

A satisfactory system of entering and filing correspondence should be inaugurated so that government business will be carried on with the same promptness and dispatch that obtain in a private corporation, and with some governments this is the exception rather than the rule. In British Columbia our method of accounting is based upon electoral districts and we have taken advantage of this to introduce a system of filing that is proving satisfactory.

#### A Workable Designation and Filing System

A brief explanation of this may prove of interest. In the Constitution Act the electoral districts are placed alphabetically and numbered according, so that Alberni is No. 1, Comox is No. 6, Trail is No. 36, and so on. We have then taken arbitrary numbers to represent the different classes of work; 20, for example, represents roads; 40 represents bridges, and 50 represents ferries. I may add that in British Columbia the highway department is a branch of the public works department and the other numbers represent other classes such as public buildings, wharves, river bank protection, etc. Every individual road, bridge and ferry in each electoral district is numbered, which fixes it definitely although it may have a number of local names. The result is that 1-20-32 is Alberni district, road number 32; 6-40-75 is Comox district, bridge number 75, and 36-50-4 is

the filing system in use in that office. By introducing this system and making other changes at the head office, we were able to reduce the staff and still handle a 30% increase in the correspondence, and what is more important, answer it promptly.

#### Plans, Specifications Forms and Cost Data

Standard plans and specifications for all classes of work are most essential, as well as bulletins on the basic principles of road construction and maintenance for the use of the foreman and others. Further it is necessary to have standard forms for submitting reports so that they will be uniform and comparable. Cost data where they can be procured accurately and at reasonable expense are most valuable. On provincial and municipal work, foreman are usually paid the same wage for similar classes of work and there is no monetary inducement to rise above the average. Again, they are too frequently subject to criticism by the public and seldom commended, so that about the only method of arousing their interest in their work is to keep cost data as the work progresses. This will show them what it is costing and will be an incentive for them to try to steadily reduce the cost by improved methods. Also, the moral effect of having cost records on file in the office for future reference is beneficial.

An illustration of the value of such records was afforded in connection with the building of a wooden bridge 425 ft.

long consisting of three Howe trusses and trestle approach by day labor over the Nechaco River at Fort Fraser in 1918. A timekeeper was placed on the work and the bridge foreman was supplied with unit costs as the work progressed. Notwithstanding the greatly increased cost of labor and materials, this bridge was erected for nearly nine thousand dollars less than a similar bridge over the same river at Vanderhoof in 1916 and the latter is only 70 ft. longer. Thus, it pays to keep a check on the cost of the work as it proceeds. Again there should be forms for keeping the cost of loading gravel and rock by hand, by trap and slip scrap-

There are many other important forms which the limited time at my disposal will not permit me to enumerate or explain, but which are essential parts of the machinery of organization.

#### Energizer of the Organization—The Staff

The success of the department depends very largely upon the personnel of the staff. A government should endeavor to secure the services of the most competent and experienced engineers available, and I may say that in addition to technical knowledge and experience, tact and



Officials, Delegates and Advocates of Better Highways in Attendance at the Seventh Canadian Good Roads Convention, Winnipeg, June 1-3, 1920

ers and by mechanical loaders; for hauling road metal with teams, tractors and trucks; and for keeping the cost of operating automobiles.

In British Columbia over 99½% of the area is unorganized district in which the provincial government collects all the taxes and carries out all of the improvements. We, therefore, have many requests for roads. The applicant is given a form to fill in involving answers to a number of questions respecting the physical and financial conditions affecting the proposed road. The assistant engineer then examines conditions on the ground, checks the statements made by the applicants and prepares an estimate with a sketch plan on the back of the form and submits it with his recommendations, to the department. All the facts are thus intelligently upon its merits and not necessarily upon the size of a petition, or the influence of some of the petitioners.

Another branch of the highway service is that of ferries. There are over 50 of them in British Columbia and it is of the utmost importance to keep detailed traffic records respecting them. Since systematic returns have been kept in British Columbia it has been possible (a) to eliminate some small ferries which did not appear to justify their operation; (b) to calculate approximately the estimated revenue from some of the larger power ferries on which tariffs are now imposed; (c) to reduce operating expenses of others by amending running schedules, etc.

sound judgment or good horse sense are important and essential in the government service. A clerk in a store may know his business thoroughly and he may be a hard and conscientious worker, but if his manner estranges and drives away customers then he is not a satisfactory man for the position and the same argument applies to an engineer on government work who may have the other necessary qualifications but lacks tact. In fact, I believe that a successful engineer on government work, and I emphasize the word *successful*, requires more attributes than are necessary to fill a position of similar responsibility with a private corporation. To procure men of this calibre a government must be prepared to do two things:—

- 1.—Make appointments purely on the basis of qualifications and fitness, and
- 2.—Pay equitable remuneration for services rendered.

#### Appointments on Merit Only

All vacancies in the higher positions should, where possible, be filled by promotion from within the service and such promotions should be based on merit and not on seniority. Failure in this respect will seriously affect the spirit and efficiency of an organization. It will not only discourage good men in the service, but it will deter the desirable type of man from entering the service. Engineers should be employed who can inspire the confid-

ence of the general public, men of firmness who will report adversely upon a request for work which is not warranted, no matter by whom the request is made, and do so with such fairness, tact and judgment that they will retain the confidence of their chief and of the general public, and when possible the goodwill of the applicant.

#### Adequate Remuneration

Such men are none too plentiful, but where a government is spending large sums of public money it should be prepared to pay sufficient salary to obtain their services, and then treat them so that it can retain their services because men of the right calibre will not permit themselves to be used as tools or buffers for ambitious or selfish individuals.

Qualified engineers will save their salaries many times over and I shall give you an illustration. A road 15 miles long, ran through a somewhat barren section, but connected a large and rich area to the nearest railroad station. The road as laid out some years ago was located by the local foreman under the supervision of the road superintendent. The grade, alignment and road material were so poor that two years ago it was decided to re-locate all but two miles of the 15. The new road is better in both alignment and grade, is over more suitable road building material, is free from gumbo, has a southerly exposure and is actually some 700 ft. shorter than the old one. When the old road was built the cost was not segregated and the original cost cannot be obtained, but to-day the old road would cost over \$60,000 to build, or about \$10,000 more than the new one and now has to be abandoned. The traffic over the road can be closely estimated from the records kept on a nearby ferry, and it is estimated that owing to improved grades, etc., the saving on the tonnage hauled over the road last year would be over \$19,000, which capitalized at 6% would roughly amount to \$300,000; besides the traffic will increase very rapidly and become very heavy as the settlers are just commencing to go into that district.

I could quote many other instances where experienced engineers and a proper organization would have saved in the aggregate hundreds of thousands of dollars. Thus the importance of engaging competent men cannot be too strongly impressed. This not only applies to the district and the assistant engineers but the local foremen and other employees of the department as well.

#### Keeping the Organization Running Smoothly

There are two factors that have to be considered in keeping the organization working smoothly and effectively:

1.—It is necessary to keep the engineers in touch with the latest engineering practice on highway work by means of literature, etc.;

2.—It is necessary to arouse in them an interest in, and enthusiasm for their work, by creating a camaraderie among the members of the staff and by making each one feel that he is an important unit of an active, progressive and up-to-date organization.

#### Instruction and Example

Engineers should, undoubtedly, be provided with the best and latest literature on road work. Arrangements should be made with provincial libraries whereby standard technical books might be loaned to any of the district and assistant engineers when required in connection with any special work they were doing. They should also be placed on the mailing list for such publications as those issued by the Office of Public Roads of the United States Department of Agriculture and similar bulletins; and special articles in mechanical journals should be called to their attention, or copies supplied to them. Whenever possible they should be given every opportunity of seeing actual

construction work carried on, for example, the laying of concrete roads in which the methods are continually being improved.

#### Annual Conferences

The second factor may be brought into play by holding annual conferences of the engineering staff. Every member should take an active part in the conference by preparing either a paper, or a discussion on some work which he has been doing. The program should be drawn up well in advance, so that every engineer may come fully prepared and the very fact of his having to prepare information to place before other experienced engineers will cause him to use every care in securing his data, give him a more thorough grasp of the details and cause him to take greater interest in his work. I might say that some of the papers which were submitted by the district and assistant engineers at our annual conference last January are now appearing in one of the Canadian technical journals. The results obtained by bringing the men together and giving them the opportunity of exchanging ideas and the inspiration derived from such a meeting will be most beneficial and will add greatly to the efficiency of the men and of the department.

Last spring one of our general foremen in eastern British Columbia was so interested in the program for the engineering conference that he wrote for permission to attend the conference, stating that he would be willing to take his holidays at that time and pay his own expenses. One of the assistant engineers in the interior where they have no hard surfaced highways arranged to take his holidays at the coast during paving operations so as to gain experience on this class of work and when this spirit is in evidence, the best of results should follow.

Those who are in attendance at this convention, will, I am sure, appreciate the benefits and inspiration to be derived from such gatherings.

In order that the fullest benefit may be derived from such annual conferences, and that the good work initiated may be sustained, special committees should be appointed to deal respectively with road, bridge and ferry matters. Each committee should be under a responsible chairman whose duty it would be to keep in touch with the members thereof, circulate suggestions for improvements in methods of design and carrying out of work, and finally to submit concrete data to the chief engineer for his approval. If properly followed out much splendid work can be accomplished, particularly in providing specifications, plans and forms which are likely to meet general requirements.

#### Value of Co-operation

Co-operation should be the keynote of the department. There should not only be co-operation between the different members of the staff, but co-operation with other departments of the government and with the general public. You can well afford to dispense with the services of even a capable man if he refuses to co-operate. He is a misfit and out of gear and has the same effect upon the organization as sand upon the bearings of a machine.

Monthly meetings of the heads of the different branches at head quarters for suggestions for improvements and for constructive criticism are valuable in creating the best departmental organization and upon the efficiency of these largely depends the successful working of the service inside and outside. Every member of the staff and every employee of the department should be encouraged to make any suggestion that he or she considers would improve the service.

There should be close co-operation between the department and municipalities, and the district and assistant engineers should be encouraged to co-operate with responsible public bodies, such as boards of trade, farmers' institutes, and good roads associations, but they should not deal with partisan or political associations as such. The latter should communicate with their members or the Minister direct. When you attempt to mix the two in-

redients, business and politics in the department, the combination certainly does not give efficiency. There should be a clear line of demarcation between the administrative and the legislative, and to accomplish this harmoniously takes TACT spelt with capital letters.

Finally, there should be close co-operation between the highway departments of the different provinces so that they should be of mutual assistance and so that each may benefit by the experience of the others. This could possibly be best attained through the medium of the Canada Highway Branch of the federal Department of Railways and Canals, which could act as a central bureau for collecting and distributing information.

#### Value of a Bulletin

And here I would venture the suggestion that a monthly bulletin be inaugurated by the federal authorities, in which would be discussed the more important highway problems common to each province. Such a publication could be an excellent medium for disseminating useful information in addition to keeping the different provinces in touch with what is being done in the other provinces.

In this matter we could well afford to follow the lead of the United States Bureau of Public Roads.

In summing up, I believe that if we introduce a proper system of organization, employ only the best qualified men available, keep them efficient and enthusiastic by means of systematic education and co-operation, and discourage outside interference, then the money will be spent wisely and honestly, and when the people are convinced that such is the case I have no doubt they will furnish unstintingly the large sums that are and will be urgently required for the improvement of our highways.

#### FUEL RESEARCH IN GREAT BRITAIN

A LARGE and admirably-equipped fuel research station has been established near London, England. It was designed by the Fuel Research Board formed under the Department of Scientific and Industrial Research and has been built out of funds provided by the Treasury. Its main object is to carry out large-scale experiments in the low-temperature carbonization of coal with a view to obtaining smokeless solid fuel for domestic and industrial use, gas for power purposes, oil fuel for the navy and internal combustion engines, and a number of other by-products. Careful arrangements have been made for exact measurements in every step in the treatment. Plant has also been installed for research into the economies of pulverized coal, the utilization of peat, and the production of fuel alcohol. A detailed survey has been made of the qualities of coal available in Great Britain; and the analysis of the samples of coal used in the experiments has been placed on a scientific basis. Important results are expected to flow from the costly investigations thus set on foot.

F. H. McKechnie and A. J. McLaren have formed the firm of McKechnie & McLaren, 263 St. James St., Montreal, taking over the business of Booker & McKechnie, and of Morris & McLaren. The new firm will carry on the business of sales engineers, representing the eight firms formerly represented by the two absorbed firms.

E. R. Gray, city engineer of Hamilton, Ont., has urged that a deputy city engineer be appointed immediately, as the pressure of work in his department made it impossible for him to give personal attention to the many matters that came up for consideration. Mr. Gray stated that his department, with 650 men on the pay-roll was in the middle of the heaviest construction year since his connection with it. Besides the yearly budget of \$580,000, there were pavements, trunk sewers, mountain highways, new asphalt plant, athletic field and other works to bring the total for the year up to \$2,155,000.

#### HOW TO IMPROVE AND MAINTAIN EARTH, CLAY AND SAND ROADS\*

By A. R. HIRST

Highway Engineer, State of Wisconsin

ROADS made only of the natural earth of the various localities, with such little adjustments in the composition of their surfaces as may be made by the work of man, will comprise probably for all time in Canada and in the United States a very large percentage of the total highway mileage.

On these roads there will originate a very large share of the total traffic using the more adequately improved county highways, provincial or state highways and national highways. Acre for acre, the lands in a given locality produce about the same tonnage and, therefore, mile for mile the agricultural production on its highways is, roughly speaking, an equal amount.

While systems of national highways, systems of provincial or state highways, and systems of county highways will probably ultimately be improved with adequate surfacings, a large portion of these systems, and practically all local roads are now, and for years to come will be, earth roads. Their composition will be the natural soil as deposited by nature, or as modified by man.

#### Characteristics of Natural Soils

Some of these natural soils have been by nature mixed exactly right, so that they may be maintained with drags, road planers, or road machines (blade graders) and give for a large percentage of the time very adequate and excellent service. These roads are usually in soils which have been called sand clay loams, whose texture is not so sandy that it gives a surface which cuts up readily, and not so clayey that it gives a surface which becomes slippery and ruts badly or holds water in wet seasons. On roads of this class, given proper drainage and a proper cross-section, maintenance is a simple matter. The intelligent and persistent use of an adequate smoothing tool as soon as possible after each rain and a proper amount of care to keep the ditches and waterways clear, will insure road structure adequate in many places for even moderately heavy traffic.

Lighter than the loams above described, are the sandy loam soils which should be treated in the same general manner, but which, on account of their more unstable character, will often require light applications of clay in order to keep them from getting mealy. Where such roads are not standing up after proper regrading and proper maintenance, clay of a proper character should be added in small quantities, an inch or two at a time, and the surface worked and reworked until stability is secured.

Next down the scale are the roads consisting of actual uncombined sand which are totally hopeless if not properly handled. Unless a real improvement is to be made in a sand road, the less it is disturbed the better it will be. Nothing is more annoying than to try to pass over a piece of sand road which has been recently graded or smoothed so as to fill ruts previously several inches deep with loose, dry sand. Until funds are available to do something worth while with these roads, they should be left severely alone.

There is one exception to this general rule. Quite often there is a top soil deposit overlying the real sand. In many cases, sand roads are sandy because this top soil has been cut through or worn out and the use of a road machine to bring in new top soil from the sides to cover the worn-out road bed will work wonders. But don't cut through into the sand. The top soil only is of value.

#### Fibrous Applications to Sand Roads

If it is the only remedy available with the funds, sand roads should be shaped and brought up slightly with a blade

\*Paper read at Seventh Canadian Good Roads Convention, Winnipeg, June 1-3, 1920.

grader and a temporary covering of some fibrous material should then be applied. Cedar bark or cedar shavings, marsh hay, rye straw and pine needles have been used for making these fibrous applications. The material should be spread to a loose depth of about six inches in a trench which has been opened to receive it, and the sand which has been thrown out should then be moved back on top of the fibrous material to protect it in some degree, from the traffic. Our experience is that these fibrous coverings when lightly buried last at least twice as long as when left uncovered and exposed to the direct wear of traffic. They will, if properly handled and properly covered, usually last one season, except on very heavy travelled roads. They do not make boulevards, but they do make passable roads at a very reasonable expense.

Some three years ago we tried in Wisconsin the building of mats consisting of marsh hay or rye straw impregnated with tar. We tried several methods of doing this, but found that the best method was to open the trench, spread about four inches of marsh hay carefully, apply one-half gallon of tar, cover adequately with sand; then spread a similar thickness of marsh hay, cover with one-half gallon of tar, and again with sand. We were able to build up in this way a fairly resistant mat which, on a road of moderate traffic, gave excellent service for over a year. Marsh hay produced somewhat better results than rye straw. Not to go into details (which will be found in our last biennial report, 1918), while these tar mats give excellent surfaces, they were too expensive for the length of service secured. Such a covering would cost, at present prices, probably at least \$1,000 per mile for a surface 16 ft. wide.

#### Covering Sand With Clays and Gravels

We, therefore, gave up the idea of using tar mats and have devoted all our energy to covering sand with clays and gravels. We find that the application of three to five inches of good binding clay, well mixed with the sand will, if properly mixed and maintained, give in a very few months a very satisfactory road on even the deepest sands. The cost per mile varies, of course, with the distance of the clay deposit from the road, but we are convinced that it is a much better investment to cover sand with clay or gravel, almost regardless of cost, than it is to bother with temporary fibrous surfacings. Clays used in modifying sand roads should be clays which, when made into balls and dried until hard, will not dissolve too quickly when immersed in water. Usually, the longer the period necessary to dissolve the clays the better the clay for use in combination with sand, provided always that the clay as it occurs naturally can be pulverized when dry and mixed with sand.

#### Moderately Heavy Clays

Going up the scale from the ideal earth road (the sand clay loam) we come next to the moderately heavy clays—clays which rut rather badly, but which do not usually become excessively slippery. These clays should be drained and given a proper cross-section, and then if they verge upon slipperiness after rains, should be given light treatments of sand until the texture of the surface is such that it can be travelled in wet spells without sliding all over the crown.

In general, the result is practically the same as upon the clay impregnated sandy loams, but the clays are more difficult to maintain, because the drainage conditions are worse. Given sand applications from time to time until the proper surface is secured, they make quite satisfactory roads.

#### Heavy Clays and Mucks

The next and final class is the heavy clays and mucks. These and the loose sands constitute the real "enfants terribles" in the earth-road family. Given a proper application of a smoothing tool the other three broad classes of earth roads will give good service. But nothing in the way of smoothing will make wholly adequate a road of real sticky clay or muck which is rough and dusty in dry seasons, a quagmire in wet seasons and a nuisance at all times. These

roads should be especially well drained and be graded to adequate widths, at least 30 ft. between the ditches. The ditches should be cut well below the crown and the top of the grade should be quite flat. Places often becoming impassable should be carefully graded and well drained, either with stone drains or tile underdrains. It is often a very small percentage of the total length that renders clay roads impassable at certain times. The adequate treatment of this small percentage will often make a wonderful improvement in the general condition and passability along their whole length.

If a satisfactory earth road is to be secured upon these soils it is, in our opinion, absolutely necessary to surface them with sand or sandy gravel. Surprisingly light applications of these materials will remove the slipperiness and make smoothing with a plane or road grader effective. We have converted many, many miles of heavy clay roads, previously practically impassable during every wet spell, into boulevards for a large fraction of the year with the surface application, usually at separated periods, of a few inches of sand. The amount of sand required will vary almost directly with the stickiness of the clay, and the amount of sand it will absorb without getting mealy. Experiment only can determine this in each case, but, as a usual thing, to get a maintainable surface will require several applications totalling from four to six inches of loose sand. These applications are placed on the well graded and well compacted surface and are not mixed with the underlying clay at the time of application. Nature and constant smoothing will do the rest. The clay will finally come up from below sufficiently to properly bind the sand.

#### Intensive Patrol Maintenance

I have sketched, very briefly indeed, the general treatment of earth roads of the various classes in order to make them maintainable. None of these suggested improvements will make a good earth road unless they are immediately supplemented by an intense system of patrol maintenance. I have reached the conclusion that outside of the benefits derived from grading hills and getting proper widths and proper drainage, it is almost a waste of money to grade earth roads unless their surfaces are afterwards modified to make them maintainable and they are then patrol maintained.

Maintenance is the key to the whole earth road situation. Without patrol maintenance, good earth roads are not possible, no matter what care is taken in their construction. Good drainage structures, good ditches, adequate cross-sections and even good tile drainage will fail totally to provide a good earth road surface unless that surface is naturally maintainable or is modified so that it can be maintained, and is then maintained.

Our system of patrol maintenance of 7,500 miles of state trunk highways in Wisconsin, and our county systems of patrol maintenance of an additional 5,000 miles, have been a revelation, not only to the people of the state, but also to the State Highway Commission and the County Highway Commissioners. In the short period of two years we have been able to effect a wonderful improvement in the general condition of our earth roads. In fact, the improvement made at small cost by using the above methods is almost unbelievable even to those who helped to produce it.

#### Cost of Maintenance

The roads which are being maintained are the most important roads in the state. Upon them the traffic is heavy. The Wisconsin cost of patrol maintenance is large, the present cost being about \$175 per mile per year. The gang maintenance, including the regrading, widening and the more extensive applications of surface modifying materials, totals an additional \$125 per mile per year, on the average. This gang maintenance is practically construction work done on a comparatively small mileage of road at bad sections, but its total cost divided by the total mileage maintained gives the above average of \$125 per mile. The patrol maintenance of roads of lesser importance would cost less per



mile because the traffic would not cut them so deeply and so great widths would not have to be maintained, and thus the patrolmen's sections could be well extended. Our team patrol sections on earth roads vary from six to nine miles in length, according to the character of the road, and the intensity of traffic. The average length is about seven miles.

#### Limitations of Earth Roads

It must be remembered, however, that while earth roads constructed and maintained in general accordance with the standards given above will give good service during the period between the date when frost is fully out of the ground and the roads have dried and settled and the time of heavy snows, they are not at all adequate for heavy traffic in prolonged wet seasons or in the spring.

No care in construction or in maintenance will make the ugly duckling into a swan. Given all possible care in their preparation for maintenance, given the best possible maintenance, in the final analysis earth roads are just earth roads, and especially on clay soils, can never be made to stand the heavy concentrated traffic on main highways during the spring break-up or during prolonged wet spells. On less important roads where traffic is light to moderately heavy, they will serve quite adequately all purposes during practically all seasons, if they are well maintained.

#### Maintenance to Facilitate Permanent Improvement

It is, of course, ideal, if the proper grading and draining frequently mentioned above as being necessary before an earth road can be properly maintained, can be done to the final profile and cross-sections, and it is equally desirable for the culverts and bridges to be built of the final type so that, no matter what changes may later occur in the surfacing upon the road, the road bed proper and its drainage structures will be adequate. However, it is not often that this can be done over the whole mileage which should be instantly maintained. Each year all of this kind of permanent grading work should be done that it is possible to finance and to build, taking the worst stretches first and doing well what is done on the proper locations and to the final grades.

Pending the time that this final grading work can be completed for the whole mileage, it is not necessary to throw up one's hands and say that nothing can be done with the stretches not fit for maintenance and for the grading of which no adequate funds are available. Wonders can be performed on even the worst stretches of road by intelligently reshaping them with a heavy blade grader drawn by a good stout tractor. Temporary drainage structures can be used where necessary. Where no dirt is available from the sides, some slushing or wheeling may be necessary to raise and widen certain of the fills.

#### Gang Maintenance

We call this kind of work gang maintenance in Wisconsin, and do hundreds of miles of it annually at a cost of from \$150 to \$500 a mile, and at an average of probably \$250 a mile under our present conditions as to wages, etc. Such work does not give the final road bed, but it does give a maintainable road bed, which can be kept safe and passable and which will serve quite adequately until funds are available for the final grading necessary before the permanent surfacing is applied.

Cutting and filling done to the nearest tenth of a foot is not a prerequisite to the maintenance of a good earth road. Fair widths, good shape, and good drainage are necessary. These can be secured very cheaply and rapidly by the use of the methods broadly outlined above. There is required only good judgment, a few good men, a good heavy road machine and a reliable tractor with adequate power.

One other point should be distinctly accentuated, and that is that the travelled way of well-constructed earth roads, when patrol maintained, should be given a very slight crown. Excessive crowns are not necessary if earth roads are kept smooth. In general, the less the crown, the better the result will be. We believe that during the summer season a crown of not to exceed  $\frac{1}{8}$  of an inch to the foot is ample for

any earth road, and that as it approaches its going into winter quarters the crown should be increased to not to exceed  $\frac{3}{8}$  of an inch to the foot. The time when heavy crowning was considered to be the acme of earth road perfection, is past. The portion of these roads which is to be travelled should be almost flat, but must always be kept smooth.

#### Conclusions Respecting Earth Roads

Based on our Wisconsin experience and our highway experience of nearly seventeen years, we believe we are safe in stating the following conclusions in regard to earth roads:—

1. Earth roads will, for all time, comprise the largest fraction of our road mileage; therefore their intelligent construction and maintenance is of paramount importance.
2. They should be given a proper cross-section adjusted to the soil of which they are made, and to the drainage conditions prevailing, as rapidly as the funds can be made available for the work. Gang maintenance grading methods should be used where funds are not available for the final grading.
3. They should be well drained by providing them with proper ditches, waterway structures of adequate size and blind stone or tile drainage where necessary.
4. The most adequate attention should be first given to the real road terrors—these sections upon which traffic is constantly being stuck. These sections constitute an astonishingly small percentage of the total mileage of earth roads and cause an astoundingly large percentage of the traffic troubles on earth roads.
5. The grading and draining of earth roads is of little value unless it is immediately supplemented by an intensive system of patrol maintenance.
6. The surfaces of many earth roads should be modified by applications of the proper material if they are to be properly maintainable, and are to give efficient service.
7. These modifiers are, for sand roads, clay or clay gravels, and for clay roads, sand or sandy gravels.
8. Given proper drainage and the proper modification of the top surface, earth roads will give good satisfaction during the summer traffic season on roads carrying almost an indefinite amount of traffic.
9. They will, however, if on clay, fail to give service on very heavy travelled roads, and practically on all other roads during the spring break-up and during prolonged wet seasons when their surface cannot be given effective smoothing.
10. The maintenance of earth roads should take the form of patrol maintenance, a man and team or a man and a motor truck being given a specific section of road for the condition of which section he is made solely responsible.
11. The best tools for the maintenance of earth road surfaces are: (1) The light two-horse blade grader, and (2) the Minnesota or the Wisconsin planer. Split-log and other forms of drags should be seldom used because they go down into every transverse depression, and up on every transverse ridge, and accentuate these defects instead of removing them. Planers with long longitudinal bearings and road graders with long wheel bases remove these humps and depressions and can be operated practically as cheaply as the much less effective road drags.
12. Very moderate crowns should be used on the travelled way of all earth roads. Practically flat surfaces can be patrol maintained. They should be maintained flat until the road has to be made ready to go into winter quarters, when the crown should be increased.
13. Most of the modifications for earth road surfaces to make them more maintainable and more passable are slow processes. Additions of material are best made a little at a time and then worked, mixed and kept smooth, additional material being added as necessary until a maintainable surface is finally secured.
14. Skill, patience, and a large amount of religion are needed to cope successfully with earth roads. Given these requisites wonders can be performed with them.
15. It is a poor highway official or a poor highway system which leaves earth roads to care for themselves, while all time, all attention, and all money is expended upon the construction of a few miles of surfaced highway.

16. We are firmly convinced, that in practically any unit of government given the alternative of expending all of the highway funds available in regrading and draining earth roads, and in the modification and maintenance of their surfaces, or of expending all of the fund available in the construction of a few miles of surfaced roads, the people of the unit of government will receive much more benefit if the money is expended in the regrading, draining, modifying and maintaining.

17. This does not mean that I believe that construction should be neglected. It must be pushed as fast as it can be financed, but the speed of construction can well be retarded, if necessary, to provide for the proper maintenance of all important roads.

18. It is not conducive either to religion or to economic transportation to pass traffic over several miles of adequately surfaced highway, and then stall it in a sea of mud or swirl of sand a few feet from the end of the improvements.

19. The text of this discourse is, "Maintain Your Earth Roads." Build adequately surfaced roads as fast as you can afford to build them. For those roads which are not good and which you cannot afford to make good, at least do your level best. Give them a proper cross-section, proper drainage and a proper surface, and then give them the proper chance to do effective work by keeping that surface smooth and that drainage open.

20. Anyone can take \$50,000 and with it build a mile or so of beautiful road, but it takes brains and care to take the \$50,000 and give the community 170 miles of travelling earth surfaces, good the first year and growing better each year the \$50,000 is furnished.

#### Discussion

In the discussion of Mr. Hirst's paper, Mr. Leo Ward asked whether any consideration had been given to the cultivating of fibrous root growth in the bed of the roads for binding the road. Mr. Hirst replied that they had not tried that, but they had tried planting rye with the expectation of ploughing it in on the sides.

Mr. Michaud asked whether they had prolonged rainfall in Wisconsin, and the effect that it had on the roads. Mr. Hirst said that they sometimes had a very wet period, and they found that the sand clay mixture did well in those conditions, as they slightly crowned the roads before they clayed them.

Hon. Mr. Latta asked about the mixing of clay and sand, and Mr. Hirst said that they placed the clay on the sand about three inches deep and that it was spread, and cultivated, and mixed and then rolled with a light horse-roller. Then they pulled a little sand from the edge over the top, and if it unravelled they added more clay. If it was mealy they added more sand until they adjusted it to a surface that would give service.

MR. HILL: You advocate a very flat crown. In western Manitoba we find they are cut into, and the water washing down the long grades in the ruts causes washouts at the foot.

MR. HIRST: We don't allow ruts to form. They will cut in more with a high crown than a flat crown, anyway. The first thing we do is to drag for traffic in the centre both ways, and then do the sides. If you have patrol maintenance you will have very little trouble with washouts in your roads, because the ruts will not be there very long. In 36 hours after any rain in the summer our whole 7,000 miles have been dragged over once.

HON. MR. LATTA: Do you do road maintenance with horses or light engines?

MR. HIRST: We have approximately 900 patrolmen. I don't believe we have in all over 25 truck or tractor sections. It is our opinion that for all-round service in maintaining an earth road the horse is best. There are so many things a horse can do that a tractor cannot do, and while there is a slight loss in the dragging operations he makes it up in other directions. Tractors have not given us the satisfaction that the horses have given, because to have a tractor patrol it is necessary to have such long sections that they cannot get over them quickly enough.

HON. MR. LATTA: There are many portions of highway in my part of the country that pass through a boggy part of the land which is not drainable without large expense, and we grade that sufficiently high to keep the surface of the grade quite dry, but there is always water at the side of the grade.

MR. HIRST: We throw the ditches as far away as possible to allow a good berm between the ditch and the road proper, and have the grade three feet above the marsh.

MR. ROCKWELL: How do you organize the patrol system? Are patrolmen employed on anything else, on the farm, for instance, with instructions to go out after the rain?

MR. HIRST: No. They are employed by the season. We have eight months' patrol work, and patrolmen do nothing else. The patrolman works ten hours a day, six days a week, for about eight months, and we are considering making it a year.

HON. MR. LATTA: What is the width of earth roads from base to base, how much does a patrolman cover, and what do they do in exceedingly dry weather for a month?

MR. HIRST: The average patrol section is about seven miles with a team patrol. The grades are 18 to 20 ft. of travel with from 24 to 26 ft. for the new roads, before the slope starts. The patrol man is engaged in hauling sand and clay and gravel and putting on the surfaces in the dry weather and in some cases we have done quite respectable construction work by patrols. He never has it easy if he wants to work, for there is brush to be cut and burnt, and the weeds must be attended to. He is always busy. But we are not paying our patrol men enough. Our average pay for a man and team this year is about \$150 a month. If he works the whole season he gets a bonus of \$5 a month in addition at the end of the season. If he leaves before that he does not get the bonus.

Question: What does he do in the winter?

MR. HIRST: He has to find another job, and we have very little trouble in getting our patrol sections filled, although the towns are picking up our patrol men as town road superintendents.

#### NEW FUELS ON RAILWAYS

IMPORTANT trials with pulverized coal and "colloidal" fuels have been carried out recently on the Great Central Railway, England. Colloidal fuel is powdered fuel suspended in thick oil, and pulverized coal is dry coal reduced to a fine dust. The trials which were made in comparison with ordinary coal, showed that the special fuels could easily maintain a full head of steam with a high degree of superheat, even on heavy gradients and sharp curves. Locomotives adapted for burning pulverised coal or colloidal fuel show an economical freedom from ashpan cleaning, smoke-box cleaning and repairs, fire cleaning, and so on. Further, when the locomotive is delayed in a siding there is much less waste of fuel than in the case of ordinary engines.

It is reported in financial circles that the Canadian General Electric Co., of Toronto and Peterboro, has acquired a controlling interest in the Canadian Tungsten Lamp Co., of Hamilton, Ont.

Important work is being carried on this year by the Ontario Provincial Division of the Engineering Institute of Canada. The Advisory Conference Committee, brought into being by the Ontario Division, is hard at work on the problem of legislation for the engineers of this province and is making good progress. Strong support is also being given the Niagara Branch in its arrangements for the professional meeting of the Institute to be held there in September. This promises to be one of the best meetings ever conducted by the Institute.

# Financing a Provincial Highway System\*

Sources of Revenue—Direct Taxation—Classification of Roads by Trained Engineers—Provincial Highway Organizations—Methods of Financing Large Expenditures—Basis of Fees From Motor Owners—Expenditure to be Covered—Marketing Highway Debentures

By A. W. CAMPBELL,

Commissioner of Highways, Department of Railways and Canals, Canada

IT is to be inferred from the subject upon which I have been asked to address you that the objective to be attained is a provincial highway system. Now, whether fighting, building a nation's highways or giving a general talk, it is well to know what is our objective. The question then arises: "What is a provincial highway system?" The answer depends largely upon the authority and powers of the department in each province having the administration of its highways. In the provinces of Prince Edward Island, Nova Scotia, New Brunswick and British Columbia, all roads are under the jurisdiction and control of the central provincial government both as to construction and maintenance. Consequently, a provincial highway system in these provinces embraces and includes by-roads and side-roads, as well as main or trunk roads. A centralized form of administration of highways in these provinces is therefore necessary.

## Sources of Revenue

Now if Nova Scotia may be taken as typical of the provinces having a provincial highway system of this type, we find that their "Provincial Highways Fund" taps six distinct sources of revenue, as authorized by their "Public Highways Act, of 1917." These are: (1) such sums as may be determined by the Governor-in-Council not exceeding the amount voted by the legislature of the province for the purpose; (2) all motor license fees; (3) all sums contributed by the federal government to encourage and assist the improvements of highways; (4) direct taxes on ratable property and income amounting in cities and towns to one mill and in other municipalities to four mills, together with a poll tax of \$1, or if not assessed, a poll tax of \$3; (5) certain income from crown lands; and (6) special contributions by municipalities, corporations, associations or persons.

At the present time, each of these sources of revenue, with the possible exception of the direct taxes, are now available and open to each of the provinces of Canada. This statement could not be made when the provincial legislation of Nova Scotia just referred to was passed, because the Canada Highways Act, which appropriated \$20,000,000 to encourage the provinces in constructing and improving their highways, became law only on July 7th, 1919. As many of you are aware this act makes available to the different provinces 40% of the cost of constructing or improving such highways as the provinces designate to come under the act and subsequently submit such information regarding the public necessity of the various highway projects and as to location, cost, description, specifications, time and method of construction, as is satisfactory to the federal government. The regulations under the act stipulate that this information shall be submitted in what we term a "Project Statement." This statement includes information as to the authority for and sources of provincial and local funds, where such funds are to be used in connection with any project.

## Direct Taxation

At the present time direct property tax including the poll tax for highway purpose are exigible in Canada only in the provinces mentioned as controlling all their roads. While such tax levies for highway purposes usually go into the general fund of these provinces, this source of revenue may

be capitalized and the proceeds expended on roads of a particular class. Such highways generally embrace the main trunk roads connecting the principal centres of population and distribution, linking up a series of market roads. Generally speaking, in the central provinces, that is, from British Columbia to New Brunswick, this class of roads constitutes what is commonly known therein as a "Provincial Highway System." In these central provinces all direct property taxes, including those for road purposes, are collected and spent by the various municipal councils of each province. There is no gainsaying the fact that there has been a strong disinclination in such provinces as Ontario to institute direct taxation for highways or indeed for other purposes. In so far as the setting aside of motor fees for highway construction is a form of direct taxation, there has been a departure in such provinces as Ontario from the indirect methods of taxation. Indeed, the development and expansion of motor transport has been featured by a tendency toward this form of direct taxation in all parts of America; and in the provinces not already having control of all their roads, there has been a further marked tendency towards centralized administration of such highways as are used to the greatest extent by motor transport.

In the United States a direct annual levy, collected by the state on property and income, for general highway expenditures or for highway debenture, is very common even in such states as New York in which the counties also make large expenditures on their highways. The fixed state tax levy varies from  $\frac{1}{10}$  of a mill to  $2\frac{1}{2}$  mills. For highway debenture issues the direct levy, of course, varies according to the amount issued and outstanding, that is without having regard to the term of the issue or the rate of interest payable. The law of New York State regarding its last issue of debenture for highway purposes, provided that the rate of annual tax be  $\frac{5}{1000}$  of a mill of valuation of real and personal property subject to taxation, for each \$1,000,000 issued or  $\frac{1}{10}$  of a mill for a \$20,000,000 issue. This method of raising highway funds has the advantage that the large cities of the province or state are called upon to make a definite contribution toward the financing of the leading highways therein; it thereby lessens the burden of providing adequate highway transport for long distance travel, formerly imposed on local units.

## Classification of Roads by Trained Engineers

Any provincial highway system fundamentally involves a classification of the roads in a given province, followed by the selection of those which carry the heaviest traffic and serve the most people for special treatment. In the case of provinces in which the counties or similar units control all roads it means special legislation under which these highways are designated to come under complete or partial control of the central government.

In this connection it may properly be contended that, prior to the proper classification of the highways of a province, there should be established in each province a department or branch of a department with trained experienced engineers in charge, whose judgment regarding the engineering problems affecting proper locations, designs and materials for road construction, will command the confidence and support of the public which pays the shot. The man on the street quite naturally feels that any large sum of money raised for the special purpose of building the roads

\*Paper read before the Seventh Canadian Good Roads Convention, Winnipeg, June 1st-3rd, 1920.

demanding by the modern road-vehicle, should be regarded as a public investment to be safeguarded. If this investment is to appeal to the public, there must be a reasonable assurance that the contemplated expenditures will be made prudently. The people want to know that their money will not be scattered around on job and patch work, but that proper care will be taken to secure the best location, firm foundations, thoroughly drained and consolidated, and with surface coverings economically justifiable. In this connection, I am pleased to be able to state that all the provinces of Canada have already established highway departments or branches which are under the direction of experienced, competent engineers acquainted with modern methods of road construction and at the same time fully alive to the limitations of local conditions. The ground, to use a figurative expression, is in this respect already paved and prepared for a superstructure of solid achievement in highway work.

#### Provincial Highway Organizations

In passing, perhaps, you will allow me to state that possibly the best evidence, that the provinces now have capable highway organizations, which have been applying themselves to the task of classifying their roads, may be found in the fact that eight out of the nine provinces have, to date, submitted to the federal government, for approval, a programme map of a selected system of highways in these provinces for construction or improvement under the Canada Highways Act. This means that these provinces have chosen the roads of the most general and local importance, in each, for improvement with federal co-operation and assistance. The total mileage of the roads that have been so far designated as Federal Aid Roads is about 18,000 miles; and the total amount that is being raised by these provinces and which will be applied during the next five years on this system aggregates about \$73,000,000. Consequently, it would appear that the manner in which this vast sum of money is to be obtained for highway purposes is a very pertinent question at the present time.

Now experienced highway engineers fully realize that any highway improvements undertaken from special expenditures in grading or preliminary work should be done only with the view to the laying of foundations that will meet all reasonable requirements of future traffic; and that any gravel or stone should be applied with the view to making a suitable surface to accommodate the present requirements of traffic and to fit into a finished work later on, even if that work should be of the most expensive class of pavement. Public confidence in special highway debentures would be more secure if the people were taken into the confidence of highway engineers as to the manner in which the work is to be carried on to a greater extent than has been done in the past. However, it is a well-known fact that engineers are not good advertisers. Still, there is a public which looks for immediate results, forgetting that only the cheap and most impermanent structures are built in a day, and which should be informed as to what is intended.

#### Methods of Financing Large Expenditures

Now let us briefly consider what is the general trend of methods of financing large special expenditures on highways. In the past road work was but one of several so-called public works receiving the attention of a provincial department of public works. All expenditures made by such departments were usually met out of the general funds of the province. Of late, however, there have developed in practically all of our provinces special departments to deal with road matters which in order to satisfy the public demands for improved roads require extraordinarily large expenditures. Since these expenditures are made largely in response to the demands of a limited portion of the public—namely, those using the roads or living adjacent thereto, a tendency towards financing the necessary expenditures from direct taxes on real property, motors or gasoline, or from capitalizations of prospective revenues from these sources in the shape of debenture issues is very strong. This method of finance has its merits. While not forgetting that there is

a very great general public interest in improved conditions owing to the decreased cost of hauling and hence a reduction in the cost of farm products, etc., to the consumer, yet it is undoubtedly a very equitable arrangement by which those benefitting directly from improved road conditions, are called upon to pay the bulk of expenditures on the selected system of trunk highways placed under provincial control. It permits of the ordinary sources of revenue being applied to the lesser important roads while a definite program of permanent construction is being carried out. Because debentures have in the past been issued for highways and other public works and have failed because the proceeds have been spent in constructing hard surfaces on unimproved grades without proper foundation and drainage, is no reason for condemning the principle of capitalizing a given source of revenue for highway purposes.

Moreover, it is a mistake to secure a large highway bond issue on the pledge of the entire revenue from motor license fees for the construction of extensive mileage of expensive highways, unless there is or will be an assured adequate fund from other sources for maintenance purposes. Good business methods demand that provision be made for protecting the investment by proper methods of maintenance.

#### Basis of Fees From Motor Owners

While many states and several of the provinces of Canada are devoting their revenue from motor licenses towards the financing of special expenditures on their roads, it would appear to be timely to consider briefly the basis on which the fees are collected from motor owners. At present there is little uniformity in this regard. One province may levy a flat rate upon all vehicles whether used for touring or commercial purposes having no regard to weight or horse-power. Another province may distinguish between commercial and pleasure vehicles on a flat basis, while its neighbor may base the fee upon both weight and horse-power. Possibly a more equitable plan would be to have regard to each of these factors. In this case the fee would be based somewhat as follows:  $\frac{1}{3}$  on power,  $\frac{1}{3}$  on weight and  $\frac{1}{3}$  on valuation or as a flat tax. There is no doubt that the tonnage and speed of any motor vehicle have a direct bearing on the amount of damage done by the vehicle to highway improvements, and should be taxed accordingly. A proportion of the fee based upon the assessed valuation of the motor vehicle would appear to be a fair means of taxing personal property that is not productive. However, it is doubtful that this method of levying the fee would be generally acceptable, especially in the central provinces.

#### The Babcock Plan

In the neighboring state of Minnesota what is known as the "Babcock Plan" of financing a trunk road system contemplates raising the motor fee to \$18, which is now about one-half that amount, and pledging the extra amount so raised for the creation of a special bond issue, limited in any calendar year to \$10,000,000, with never more than \$75,000,000 outstanding. The greater part of the revenue derived from motorists now consists of a personal property tax on each payable to the state. The average assessed value of all cars listed on May 1st, 1918, was \$140 per car and the average tax on this assessment was \$5.60, amounting together with a license fee of \$1.66 to \$7.26 only. The "Babcock Plan" will, it is claimed, not add a single dollar of taxation to the current expenditure on highways in the state. It would appear that this method of financing highway expenditures is satisfactory all around, providing the motor owners do not kick. Further, that the motorists of the state will have nothing to lose by this increased tax, is sustained by the argument that the improvements will occasion them 20% less expenditure to operate their cars than at present.

It has been estimated by an eminent French highway engineer that there is a reduction of one-third of the amount of gasoline required in driving over improved roads. This fact that the amount of gasoline used in a car is fairly proportionate to the excellence of the roads covered has been

used as the basis for contending that highway improvements might properly be financed by a tax upon gasoline used for motor purposes. A tax of this nature would be somewhat difficult to collect. Each province would require that the owners of garages and gasoline supply depots give affidavits as to the amount of gasoline received by them and sold to the public for motor purposes. However, owing to the extraordinary increase in the price of gasoline within the last year there is no doubt that a tax of this nature would not be very popular with our Canadian motorists. As a measure of alleviation of the rising cost of gasoline, it has been suggested that the provincial governments should take over the control of purchases and sales of all gasoline used for motor purposes. As "The Nation" (N.Y.) puts it: "Why not one fluid more? Why not the one fluid that makes the motor world go round, whose very drops are the touch of nature which makes the whole world spin?" If the tax on gasoline could be collected without too much trouble and expense, it would be a very fair means of arriving at the amount of service which motorists receive from a provincial highway system, and of reimbursing the public for the amount of wear and tear caused to highways by motor vehicles.

#### Expenditure per Mile to be Covered

With regard to the amount of expenditure per mile of road that a debenture issue is to cover, it may be said that, providing the actual tonnage of traffic now using the road as well as the approximate increase of traffic that will result from the improvement is known, the justifiable expenditure can be quite readily determined. All that is required is a calculation based upon the actual differences in the cost of hauling one ton for one mile over the various classes of roads. For instance, supposing the difference between the cost of hauling one ton for one mile is 10 cents greater over an ordinary earth road than over an improved gravel road, or in other words that there is a saving of 10 cents per ton mile in hauling over the gravel road; and that there is a daily traffic of only 5 tons amounting in a year of 300 working days to 1,500 tons. The result is clearly a gain of \$150 in the cost of hauling over this mile during the year. Now, suppose you capitalize this annual saving with interest at the low rate of 5%, and assume that such a saving continues for twenty years, then the amount of highway expenditure that is economically justifiable on this mile is \$3,000. On the same basis there might properly be expended on a road carrying a daily traffic of 50 tons the sum of \$30,000, and so on according to the traffic. Hence it would appear that the traffic a road is required to sustain is the determining factor in the amount of expenditure to be made thereon and of the amount of debentures required for any given stretch of road.

#### Marketing Highway Debentures

In conclusion, I might briefly touch on the question of the best way to sell highway debentures. Owing to the prevailing high rates of interest, it is desirable to sell an issue as cheaply as possible. This, of course, is usually done by asking for competitive bids, but there is a further consideration in connection with highway expenditures—namely, as to the desirability of offering debentures of this character to the public as a worthy enterprise that should be taken up and promoted from the standpoint of patriotism and the general public interest. While Canadians are prone to smile at some of the so-called amendments to the constitutions of some of the American states owing to their having relation to matters of essentially passing importance, there is this much to be said for an amendment to a state constitution proposing a debenture issue for highway purposes, that the public become informed as to the nature of the benefits accruing from improved highway conditions; and a lively interest is secured in promoting the welfare of the country in this regard. Our provinces are not in a position to amend their constitution periodically by popular vote. However, there is no good reason when debentures for highway purposes are being floated, that an active campaign should not

be instituted to help in selling them, setting forth the expected benefits to be derived from the expenditure proposed and urging popular support to the debentures on the dual grounds of patriotism and good business.

#### ASPHALTIC CONCRETE PAVEMENTS

(Continued from page 544)

just as good wear as a concrete road and is a very pleasant type of pavement to look at. It harmonizes with the surroundings. You do not have those ugly cracks staggering all over the road and staring you in the face, and you have a road that is very desirable for automobile traffic, not too slippery for horse-drawn traffic and one that, as I said before, will last and give you the service, as has been proved.

In our part of the country, we have kept very close watch on paving costs, and, judging from our experience, the roads that stand out as the most economical for ordinary traffic, not for the very heavy motor truck traffic that exists between cities on some roads, but for roads accommodating from ten to sixteen thousand automobiles a day, mostly passenger cars and a few motor trucks, those that are the most economical to build and maintain are of asphaltic concrete. The concrete truck road gives service and does not require very extensive repairs, but it costs much more to build it, and it does not prove to be so economical as the other type.

#### Service Test Road in Philadelphia

I was asked to say a word or two about the service test road built in Philadelphia in 1912, consisting of twenty-eight different types of construction. This was very conscientiously maintained until the United States got into the war. One section was asphaltic concrete laid cold, that is an asphalt cut back and mixed in the plant and then hauled out to the road, laid cold and rolled. It is a very satisfactory type of road for ordinary park motor traffic, but it is not so good as the hot asphaltic concrete and will not stand heavy motor traffic. A number of different types were put on this road without considering whether they were types of pavement suitable for the particular traffic existing there, and in analyzing the results obtained, if one style of pavement did not last in that section of road in which it was laid, it should not be condemned. They were analyzed according to the traffic they will stand. The roads that stood up the best were of brick. They are there to-day, and have not had one cent of repair, but they cost twice as much to construct as the concrete and asphaltic concrete. One section of the asphaltic concrete, coming under the specification I have just noted, of 55-60% of stone passing through a 1½-in. or 1¼-in. grade and 7½% of asphalt, has not had any repair. Another section of the road, with the same specification, had only cost two cents a yard, on an average to maintain for seven years. The pavement laid with the smaller stone, the so-called Topeka pavement, has cost only five or six cents a yard to maintain for the same period of years. All the pavements stood up with practically no repairs until the fall of 1917. Up to that time the traffic was the ordinary motor truck traffic with a larger percentage of passenger cars. When we got very active in the war, that particular road was part of the Lincoln Highway and was the main motor truck road to New York and Philadelphia. There were then streams of motor trucks passing over it day after day. And when that started, all the sections laid by the penetration method failed. The traffic was too heavy for them. They were not intended for the heavy pounding of motor trucks. As I say, up to 1917, when this extraordinary motor traffic began all the different types of pavement stood up well, including the macadam with surface treatment, but when

(Concluded on page 561)

# The Canadian Engineer

Established 1893

A Weekly Paper for Civil Engineers and Contractors

Terms of Subscription, postpaid to any address:

| One Year | Six Months | Three Months | Single Copies |
|----------|------------|--------------|---------------|
| \$3.00   | \$1.75     | \$1.00       | 10c.          |

Published every Thursday by

The Monetary Times Printing Co. of Canada, Limited

President and General Manager  
JAMES J. SALMOND

Assistant General Manager  
ALBERT E. JENNINGS

HEAD OFFICE: 62 CHURCH STREET, TORONTO, ONT.  
Telephone, Main 7404. Cable Address, "Engineer, Toronto."

Western Canada Office: 1206 McArthur Bldg., Winnipeg. G. W. Goodall, Mgr.

## PRINCIPAL CONTENTS

|   | PAGE |
|---|------|
| Canadian Good Roads Association's Convention .....  | 539  |
| Asphaltic Concrete Pavements, by W. H. Connel .....   | 543  |
| Flowability of Concrete and Its Measurement by Means of the "Flow-Table," by G. M. Williams ..... | 545  |
| Good Roads as An Aid to Agriculture, by Hon. F. C. Biggs .....                                    | 547  |
| Organizing Provincial Highways Departments, by A. E. Foreman .....                                | 549  |
| How to Improve and Maintain Earth, Clay and Sand Roads, by A. R. Hirst .....                      | 553  |
| Financing a Provincial Highway System, by A. W. Campbell .....                                    | 557  |

## PROPER PROFESSIONAL CONDUCT

IT is not possible to state with mathematical exactness the things that a professional engineer may do and the things that he may not do. Formulated ethical principles are a function of time and place, and cannot comprehend all possible future situations. Whatever is found by experience to be best for the community is characterized as ethical, proper or fitting, and whatever is bad becomes unethical and improper. And so, set rules of conduct, professional or private, must therefore be subject to constant revision upward with the endless march of civilization.

Although a final and all-inclusive code of ethics cannot be laid down, much good has resulted from the adoption of working rules of professional conduct by the great engineering bodies. There are many such codes. Years ago the Engineering Institute of Canada (then the Canadian Society of Civil Engineers), adopted a code. The American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Institute of Consulting Engineers, the American Institute of Architects, the American Institute of Electrical Engineers, the American Institute of Chemical Engineers and the American Association of Engineers are among the societies in the United States that have done likewise. At first, the tendency was to draft voluminous and elaborately-detailed rules of conduct, replete with prohibitions. Experience has shown, however, that an engineer who elects to be unprofessional, will be so in spite of any code of ethics that may be devised, and the engineer who wishes to be honorable and upright needs none. The present tendency, therefore, is to adopt brief, positive, suggestive statements of the professional relations of engineers to the public, to their clients or employers, and to one another.

Such was the aim of the committee of the American Society of Mechanical Engineers that drafted the code of ethics appearing elsewhere in this issue. The former code, adopted in 1912, was, like some other codes of the kind, too lengthy, too little known by the members, and too silent on the engineers' duty to the public. The new code is proposed, not only for the guidance of members of the A.S.M.E., but also as a possible starting point for the deliberations of any joint committee that might be named to consider a common code for all engineers.

There is a feeling amongst engineers in Canada that the standing code of ethics of the Engineering Institute should be subjected to review and possible revision. The Toronto Branch of the Institute has named a committee to examine the code, and if necessary, to frame a suggested alternative for submission to Headquarters. In this work the new code of the American Society of Mechanical Engineers should receive careful consideration, as should the recently-issued "Declaration of Applied Ethics" of the American Association of Engineers, and the existing codes of the other great engineering bodies.

## WAR MEMORIALS IN FRANCE AND BELGIUM FOR FALLEN CANADIAN SOLDIERS

FOR some time a committee of the House of Commons has been considering the question of erecting war memorials in France and Belgium on properties which have been purchased or donated. It has been decided to erect eight of these memorials, and preliminary work, such as getting roads made to the sites, is, it is understood, already under way. In addition, the matter of headstones for individual graves, which has been in the hands of the Imperial War Graves Commission, may be taken over by a Canadian section, in so far as Canadian graves are concerned. The stone proposed is of a uniform design, having the regimental badge carved in a seven-inch circle near the top, and below it the name, rank, etc., of the soldier. A cross is carved, with the exception of Jewish soldiers, who are given their own emblem, and there is also room for an appropriate verse or motto, as desired by the relatives.

In order that the Imperial War Graves Commission might have something definite before it when considering the advisability of inviting tenders from Canada for headstones, the commission has asked for tentative tenders from any firms desiring to receive them. The tenders must be in the hands of the chief architect, Department of Public Works, Ottawa, before July 1st next.

## PERSONALS

C. R. MURDOCK, town engineer of Dundas, Ont., has been engaged at an increased salary to superintend all the engineering work of the town.

H. A. BRAZIER, city engineer of London, Ont., reports that the construction record of his department for the month of May passed any previous record.

H. J. MCCANN for some time past, assistant to the president of the Dominion Steel Corporation, has been appointed assistant general manager of the Dominion Coal Co.,

NOULAN CAUCHON, Ottawa, recently urged upon the special committee of the House of Commons the advisability of placing returned soldiers on small irrigated farms in Ontario.

W. G. SWAN, chief engineer of the Vancouver harbor board; has submitted a report to the board on the proposed dam at the Second Narrows. This structure is estimated to cost \$2,560,000.

PROF. R. C. WALLACE, commissioner for northern Manitoba, has recommended that a test well be sunk by

the government to determine whether there is oil in commercial quantities in that region.

L. L. BROWN, who was recently appointed lumber commissioner for British Columbia in eastern Canada, was entertained at dinner on May 27th by the engineers of Vancouver as a mark of appreciation of his efforts in the matter of getting the "Engineering Profession Act" through the legislature.

G. F. RICHAN, Winnipeg, and G. F. HORSEY, JR., Ottawa, have been appointed hydraulic engineers in the reclamation service, Department of the Interior; W. C. WARREN, Ottawa, W. T. MCFARLAND, Ottawa, D. WHITTAKER, Ottawa, G. H. WOOD, Ottawa, H. J. COOPER, Winnipeg, and J. H. BYRNE, Ottawa, have been appointed assistant hydraulic engineers.

CAPT. W. A. STEEL, late chief wireless officer for the Canadian corps in France, has been appointed chief technical officer of the newly-organized Canadian Permanent Signal Corps with the rank of major. Major Steel will take up his duties at Militia Headquarters, Ottawa, at once. It is intended to extend very much the applications of wireless in Canada, especially in assisting the Royal Canadian Mounted Police and in combatting forest fires.

#### CODE OF ETHICS FOR THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

THE following code of ethics has been proposed by a special committee of the American Society of Mechanical Engineers for adoption by that Society in place of the more elaborate one in force since 1912.

1. The mechanical engineer should be guided in all his relations by the highest principles of honor, of fidelity to his client, and of loyalty to his country.

2. His first duty is to serve the public with his specialized skill. In promoting the welfare of society as a whole he advances his own best interests, as well as those of the whole engineering profession.

3. He should consider the protection of his client's or employer's interests in professional matters his essential obligation, provided these interests do not conflict with the public welfare.

4. He shall refrain from associating himself or continuing to be associated with any enterprise of questionable or illegitimate character.

5. He can honorably accept compensation, financial or otherwise, from only one interested party unless all parties have agreed to his recompense from other interested parties.

6. He must inform his clients of any business connections, interests or circumstances, such as might influence his judgment or the quality of his services to his clients.

7. He must not receive, directly or indirectly, any royalty, gratuity or commission on any patented article or process used in the work upon which he is retained without the consent of his clients or employers.

8. He should satisfy himself before taking over the work of another consulting engineer that good and sufficient reasons exist for making the change.

9. He must base all reports and expert testimony on facts or upon theories founded only on sound engineering principles and experience.

10. He must not regard as his own any information which is not common knowledge or public property, but which he obtained confidentially from a client or while engaged as an employee. He is, however, justified in using such data or information in his own private practice as forming part of his professional experience.

11. He should do everything in his power to prevent sensational, exaggerated or unwarranted statements about engineering work being made through the public press. First descriptions of new inventions, processes, etc., for publication should be furnished only to the engineering societies or to the technical press.

12. He should not advertise in an undignified, sensational or misleading manner, or offer commissions for professional work, or otherwise improperly solicit it.

13. He should not compete knowingly with a fellow-engineer for employment on the basis of professional charges or attempt to supplant a fellow-engineer after definite steps have been taken toward the other's employment.

14. He should assist all his fellow-engineers by exchange of general information and valuable experience or by instruction through the engineering societies, the schools of applied science, and the technical press.

#### ASPHALTIC CONCRETE PAVEMENTS

(Continued from page 559)

the motor truck traffic came on, the only ones that stood up were the brick, the asphaltic concrete, and the concrete.

#### Discussion

QUESTION: What is the nature and type of the surface treatment of your macadam roads and the approximate cost?

MR. CONNELL: For surface treatment, the road must be in good condition, the holes must be repaired, and the treatment should be as light as can be given. I aim to give for my first treatment not more than one-third of a gallon of light tar, called "Tarvia B." The object of using the light treatment is not to build up a pad on the road that will sooner or later push or roll and cause the surface to ravel. There is the asphalt cut back with 33% of naphtha, which simply acts as a carrying agent, carrying the stiff asphalt which ordinarily could not be laid without it, and that gives a somewhat similar result. For that type of surface treatment you need a quick-setting material, and you have to get a tar or asphalt that will set quickly. We then sprinkle about 15 or 20 lbs. of thin gravel or broken stone or sand to the yard over the surface. Don't roll it, let it stay there. The second year you should repeat the dose. If you lay your surface in the spring, the third year you will probably go over the roads and find half of them will not require treatment in the spring. You can then postpone it to the fall, and thus save six months and a lot of money. Don't carry out your program of saying you will treat every road, but inspect each road thoroughly and do it as if you were spending your own money. By doing that you will extend the surface treatment and save a great deal. These roads after the second year, require more heavy treatment, some do after one and a half, two or three years according to the traffic, but they can be maintained almost indefinitely if you do that, and at the same time fill all the pot holes. We also use a light oil for the earth roads, which is more or less a dust layer, and also for broken stone roads. This will hold them together for a season until they are replaced by a more permanent type. The cost in 1916 was about five cents a yard, and that was based on \$1.50 labor, 8 cents a gallon for material, and about \$2.50 a ton for the gravel and stone. It will vary with the labor cost, and in some places will be twice and other places three times as much.

MR. SHERRON: What would you estimate the present cost per yard to be?

MR. CONNELL: In Philadelphia it will be in the neighborhood of twelve cents a yard, with \$5 and \$6 labor, and nearly twice the cost for the stone.

MR. SHERRON: That is continued annual maintenance of \$1,200 a mile for an 18-ft. road.

At a meeting of the Hamilton branch of the Association of Canadian Building and Construction Industries, J. P. Anglin, president of the association, said that the greatest profiteers were those who demanded a 50% increase in wages while giving only half production.

# CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand or proposed, contracts awarded, changes in staffs, etc.

## BRIDGES, ROADS AND STREETS

**Amherstburg, Ont.**—Pettypiece's, Ltd., have been awarded the contract for paving several streets involving an expenditure of over \$36,000.

**Bright, Ont.**—Tenders for the construction of a 42-ft. steel girder span, with concrete abutments and floor, will be received by George Oliver, clerk of the township of Blandford, Bright, Ont., up to 2 p.m. of Monday, June 14th. Plans and specifications at the clerk's office and office of F. J. Ure and Son, Township Engineers, Woodstock.

**Calgary, Alta.**—City council approved of the recommendation made by the city commissioners that a \$75,000 five-year by-law be passed for the gravelling of main trunk roads on the streets and avenues of the city.

**Cameron, Man.**—Eighty-four miles of roads will be constructed in this municipality at a cost of \$174,000.

**Chatham, Ont.**—The construction of a pavement on Baxter St. is projected.

**Chatham, Ont.**—City council let contract to the Western Construction Co. for concrete pavement on Grant St. at \$1.75 a yard, and to George Conover for concrete pavement on Duke and Princess Sts.

**Fredericton, N.B.**—Hon. P. J. Veniot, Minister of Public Works, stated that contracts amounting to approximately \$300,000 have been awarded for highway construction. There will also be approximately \$300,000 spent on the principal branch roads of the different counties of the province.

**Fredericton, N.B.**—Provincial Department Public Works awarded following contracts for construction of bridges: For the Peter Richard bridge, Kent county, to Cyrile B. Legere and H. Gallant, Moncton, at \$4,000; Locke's Brook Mouth bridge, Charlotte county, to the Kennebecasis Contracting Co., of St. John, at \$7,000; Gidin dam bridge, Gloucester county, to Bruce L. Simmons, Fredericton, at \$14,000. The Wark arch bridge culvert, in Victoria county, was also awarded to Mr. Simmons at \$10,000.

**Fredericton, N.B.**—Provincial Highway Department awarded the following contracts: Queenstown to Otnabog, Queens county, 5 miles, J. Willard McMullin, Upper Gagetown; Grand Falls section, Victoria county, 4½ miles, W. Everett McCloskey, Grand Falls; Pokiok section, York county, 6½ miles, Concrete Builders, Ltd., Fredericton; Meductic to Woodstock, Carleton county, 12½ miles, Concrete Builders, Ltd., Fredericton. The type of construction is gravel and rock. Small concrete bridges are included in the contracts.

**Fredericton, N.B.**—Hon. J. F. Tweeddale, Minister of Agriculture, will locate a new road in Victoria county, from Plaster Rock to Grand Falls.

**Fort William, Ont.**—Tenders will be received by the city clerk up to 12 o'clock noon, Friday, June 18th, 1920, for the construction of concrete curb and gutter and asphaltic concrete pavement. (See official advertisement in this issue.)

**Halifax, N.S.**—Tenders will be received at the office of the Provincial Highways Board, Halifax, N.S., up to noon, Monday, June 21st, 1920, for the construction of the following road: 4½ miles of broken stone waterbound macadam, between Digby and Rossway. Plans and specifications may be inspected at the office of J. W. Roland, Chief Engineer, on and after June 11th, 1920.

**Hamilton, Ont.**—Toronto, Hamilton and Buffalo Ry. intends to begin work shortly on the reconstruction of the Main St. West bridge, the estimated cost of which is \$9,052. Chief engineer, R. L. Latham.

**Lancaster Tp., Ont.**—Tenders will be received by W. A. McLean, Deputy Minister of Provincial Highways, Toronto, up to 12 o'clock noon on Friday, June 25th, 1920, for crushed stone. (See official advertisement in this issue.)

**Maryfield R.M., Sask.**—The Parsons Engineering Co. awarded the contract for roadwork in Maryfield R.M., No. 91, amounting to \$12,000, to G. E. Davenport, of Elrose, Sask. This contract brings the grand total of roadwork let by the Parsons Engineering Co. this year to \$75,000, all of which work is being supervised by engineers of the company. There are about ten more contracts to be awarded for work to be done this year.

**Montreal, Que.**—Administrative Commission accepted the tender of the Canadian Tar Products Co. for road oil at 12c. a gallon for oiling macadamized streets.

**North Battleford, Sask.**—Contract for the construction of a large reinforced concrete culvert on the road between North and South Battleford has been awarded by the Saskatchewan Department of Highways to Broley and Co., of North Battleford, whose tender of \$1,929 was the lowest received.

**Oakland R.M., Man.**—Contracts for grading let to H. Downie, Wawanesa, Man., and Rowan and Jamieson, Brandon.

**Peterboro, Ont.**—City council intends to construct a sidewalk on the east side of the Monaghan Rd. City engineer, R. H. Parsons.

**Port Dover, Ont.**—The Strauss trunnion bascule bridge has been adopted by Norfolk county, Ont., for a highway bridge to be built across the head of the harbor at Port Dover. Plans and specifications are now in course of preparation. Engineer, E. H. Darling, Hamilton, Ont.

**Portage la Prairie, Man.**—Tenders addressed to D. McCowan, Secretary-treasurer, will be received until 12 o'clock noon, Saturday, June 19th, 1920, for the construction of twelve reinforced concrete culverts and three reinforced concrete bridges. Plans and specifications may be obtained at the office of the Highway Commissioner, New Parliament Buildings, Winnipeg, or at the office of the Secretary-treasurer.

**Quebec, Que.**—The government has decided to grant to the Good Roads Commission 25% upon the cost of a hard-surface road from the city limits to Spencer Wood.

**Regina, Sask.**—E. B. Winn, of Assiniboia, has been awarded the contract for road work in Rural Municipality No. 100 amounting to over \$15,000. The work will be supervised by the Parsons Engineering Co., of Regina.

**Sarnia, Ont.**—City council passed a by-law approving South End pavements on Confederation St., from Christina to Mitton.

**Sillery, Que.**—The matter of improving the St. Louis Rd., between the Quebec city limits and Sillery village is now before the council of the latter municipality.

**St. Boniface, Man.**—Council authorized repairs to the Marion Bridge at an estimated cost of \$10,000.

**St. John, N.B.**—Common council let contract for the paving of City Rd. to the Stevens Construction Co.

**Stratford, Ont.**—Board of Works decided to grade William St. City engineer, A. B. Manson.

**Toronto, Ont.**—Board of Control passed the recommendation of the Committee on Works for the grading of Woodbine Ave., north of Kingston Rd., at a cost of \$285,000.

**Toronto, Ont.**—Board of Control let contract to the Asphaltic Concrete Co. to repair the roads in High Park on the