

undertaken. It is to be regretted that a similar Commission had not been appointed before the Government committed the country to the expenditure of several hundred millions, on the simultaneous construction of two additional transcontinental railways, and numerous other expensive projects.

The following figures are added for reference. They have been taken from Canal Statistics, Department of Railways and Canals, 1911, and Report of Government Engineers on Georgian Bay Ship Canal, 1908. It is very difficult to get definite and accurate information regarding water transportation costs, which heretofore have not been obtained by the Government, and some of these figures are subject to correction; especially those relating to freight rates, insurance charges and interest, which are liable to change from year to year.

Distances—	Miles
Fort William to Montreal, via Georgian Bay Canal	934
Fort William to Montreal, via Welland Canal	1,216
Fort William to New York, via Erie Canal	1,358
Proposed Georgian Bay Canal—	
French River Village to North Bay...	82½
North Bay to Montreal harbour.....	357½
	440
Free navigation.....	346
Improved channel.....	66
Canal excavation.....	28
	440

Canal Depths—	
Proposed Georgian Bay Canal...	22 ft.
Welland-St. Lawrence Canals...	14 "
Proposed Welland Canal.....	24 "
Sault Ste. Marie Canal (Canada)...	20.2 "
Sault Ste. Marie Canal (U.S.)...	16 and 20.5 ft.
Erie Canal	7 ft.
New York State Barge Canal...	12 "

Excavation in St. Mary River, below the locks, has materially reduced depths over lower sills below figures in the above table.

Lockage—	Up and down
Proposed Georgian Bay Canal	27 locks 758 ft.
Existing Welland Canal.....	26 " 326 "
Proposed Welland Canal.....	7 " 326 "
St. Lawrence Canals.....	22 " 207.5 "
Erie Canal	72 " 660 "

Rates—	
Water rate on grain Fort William to Montreal	4½c.
Water rate Fort William to Buffalo	3½c.
Rail rate Buffalo to New York	5½c. 9c.
All water rate Fort William to New York. 5.3c.	
Water rate Fort William to Buffalo is at times as low as 1½c. per bush.	

Although distance and rates are in favor of Montreal, diversion to U.S. ports is due to the following reasons: Availability of ocean tonnage at New York. Lower ocean rates between New York and foreign ports. Lower insurance rates from New York.

Insurance—	
Montreal, 65c. to \$1.10 per \$100.	
New York, 12½c. to 15c. per \$100.	
Cost of existing Canadian canals, Fort William to Montreal.....	\$80,000,000
Interest at 3½ per cent.....	\$2,800,000
Maintenance and operation. 1,400,000	4,200,000
Water freight rate per ton mile, Fort William to Montreal.....	0.163c.
Interest and maintenance.....	0.135c.
	0.298c.

Government contribution. 0.135c. per ton mile. Welland Canal traffic, 1912, 2,537,629 tons, of which 51 per cent. was Canadian and 49 per cent. U.S.

On the 51 per cent. of Canadian traffic the Government contribution would amount to 0.265c. per ton mile, as compared with a freight rate of 0.163c. per ton mile.

Rail freight, Fort William to Montreal on grain 0.421c. a ton mile.

Water freight, Fort William to Montreal, including interest and maintenance, 0.428c. a ton mile.

It will be seen that the all water rate from Fort William to Montreal, including interest and maintenance of canals would exceed the all rail rate by 0.007c. a ton mile, based on the amount of Canadian traffic passing through the Welland

Canal, but in case tolls were charged to meet these interest and maintenance charges, the U.S. traffic would also have to contribute towards this revenue, and the ton mile charge for the all water route would be reduced to 0.259c. per ton mile.

Government contribution does not include cost and maintenance of harbors, lighthouses, buoys, etc.

The foregoing paper, which was prepared in 1914, was read before the Canadian Society of Civil Engineers in Montreal recently.

Discussion by H. K. Wicksteed.

H. K. Wicksteed, B.A.Sc., M.Can.Soc. C.E., Chief Engineer of Surveys, Mackenzie, Mann & Co., Ltd., Toronto, contributed the following to the written discussion of the paper: I have read with particular interest Mr. Leonard's paper on the economic aspect of canal enlargement and construction; the more so as for a time I was one of the few champions of the Ottawa-French River route. On the whole, I heartily endorse Mr. Leonard's views, and such fault as I have to find with his paper is rather as to his failure to emphasize some of his points. His estimate of the value of waterpower, for instance, to be controlled on the Ottawa is 1,000,000 h.p., which he values in the future at from \$20 to \$100 per h.p. per annum. This power would not be developed by the canal works, it would merely be made susceptible of development. Turbines and power houses, etc., would have to be added to the capital cost, and in an essay of my own on the subject, I was content with the very modest estimate of \$5 per h.p. per annum for the use of the water so controlled and rendered available. This is sufficient to pay 5% on the estimated cost of \$100,000,000. The canal could be made practically free to navigation without imposing any burden on the nation.

But this does not represent the whole of the interest which the public has in the development, by any means. The gathering of the iron ores of Minnesota, and the coal of Ohio, in one spot, which has resulted in the enormous steel production of the United States, was rendered possible by the navigation of the upper lakes; the railways alone could not have accomplished it. The conjunction of cheap power and cheap transport in the Ottawa Valley would inevitably result in industrial development quite impossible under ordinary conditions. There are numerous other natural products which, like iron ore, cannot pay for a long railway journey; and in such products the Laurentian wilderness is very rich; crystalline limestones, phosphates, marbles, graphites, feldspars, etc., etc. The carriage of grain to the sea is not the only useful purpose which our east and west lines of communication are intended to serve.

At the time my last essay was written, no one was thinking of the war, and allusions to what Mr. Leonard terms the strategic aspect of the question, merely provoked a smile. He points out that the enlargement of the St. Lawrence Canals, if feasible, would be carried out and operated within a stone's throw of the International Boundary, and would require a very large force, and probably permanent fortifications, to protect them, but he neglects to mention that it was this very consideration, 100 years ago, which led up to the construction of the Rideau Canal. While we are on terms of perfect amity with our friends to the south, as a nation, we do not consider it unnecessary to guard the Welland Canal,

and the time may come, it may even be close at hand, when an approach to Lake Huron and Lake Michigan and the outlet of Lake Superior may be worth to us many times the \$100,000,000 which he quotes, and which is somewhere about four days' expenditure of Great Britain on the present war. Our present treaty with the United States forbids the maintenance of armed vessels on the Great Lakes except such light armament as is necessary for revenue or police purposes. Consequently in time of trouble any attempt to run even a destroyer or submarine further up the river than Cornwall would be considered a hostile act or casus belli. In the case of the Georgian Bay Canal, on the other hand, no exception could be taken to the mustering of a fleet on Lake Nipissing, which could overrun Lake Huron and blockade the entrances to Lakes Michigan and Superior in 24 hours. We all hope it may be long before such a step is called for, but the mere possibility would be a deterrent to acts of hostility. One of the transcontinental railways is on the edge of boundary waters at a dozen points. Surely it is a matter of some importance to be able to take steps for the protection of such points. Even in these times, when we have ample evidence of the goodwill of the United States as a nation, a raid of Teuton sympathizers organized in the U.S. without the knowledge of the authorities, has not been considered an impossibility.

This is only one aspect of the question, and we will hope an unimportant one, although the events of the last few months have lent to it an importance which it was hard to realize as possible before. The main justification must be in the commerce which it would serve and foster. The people of Canada have decided that an enlarged waterway from the lakes to the ocean is worth a great deal of money, at least the \$100,000,000 of the Georgian Bay estimate, for however the necessity for the enlargement from Prescott to Montreal may have been ignored or kept in the background, there are few who have not realized that the enlargement of the Welland in itself could do little good to anyone or any seaport, except perhaps that of New York.

Like Mr. Leonard, the writer regrets extremely that vast expenditures such as are involved in these public works should have been determined on so largely as matters of local advantage, or as he puts it, "in the spirit of parochial politics," instead of the broad basis of national advantage. If a great artificial highway is to be built at the expense of the nation, it should surely be such a one as will do the nation the most good, and as will be completely within the territory and under the control of that nation; and it is a matter of surprise to the writer that the two communities which should be most vitally interested in the matter, the city of Montreal, and the farmers of the central plains, should have displayed such comparative indifference, and allowed the matter to be decided by Ontario politicians who had little to gain or lose, except while the expenditure was going on.

The arguments adduced against the Georgian Bay route, by some of the Toronto papers, for instance, dealing with sharp curves and high waves on the Georgian Bay, and early morning fogs on the Ottawa, are too unspeakably silly to be repeated; yet the writer was refused publication of a perfectly friendly letter of remonstrance against such childishness. Mr. Leonard's figures as to distances and lockages differ slightly from