

there may be as expensive as the construction of a concrete road in another province.

Each difficulty between the provinces cannot be singled out as an entity. The whole question must be treated from ocean to ocean. It is simply a matter of how we are going to build these roads to carry the load.

Certain conclusions can be reached and put away as settled. We all agree that good roads are necessary to agriculture and to the industrial and commercial development of this country. Transportation is the most important public work we have to deal with. It falls under three headings: Railways, waterways and highways. These three make up the transportation system of this country. All are important, all are necessary, none can be neglected. Our waterways have cost millions of dollars and our railways an enormous sum, but after all, the most important, so far as the transportation system is concerned, is the ordinary road.

Roads must carry all freight to be brought up to the waterways or railways. Close the common roads of the country and the railways will starve and the ocean freighters rust at their wharves. The big question is how to improve the common roads of the country.

Finance vs. Lack of Finances

In this connection, said Mr. Campbell, he had reference to the 250,000 miles of wagon roads in Canada as a unit. There are 40,000 miles of railways but there are 250,000 miles of wagon roads to keep up.

Mr. Campbell declared he found it interesting that the congress was discussing the higher classes of pavements. He felt that if an organization were formed to discuss the higher classes of pavements alone, that it would take all of its time, as it is so big a subject. The people must look after the whole mileage and how to better the common roads and to extend them to reach those not properly constructed now.

How to care for the leading roads is possibly a simpler problem than how to care for the earth roads. One is a matter of finance and the other is matter of the lack of finances. These roads are passing away from the jurisdiction of those originally in charge of them, because we have now come to a cash system of building these roads, even the most elementary roads in the country.

The roads should be mapped out and then classified according to the requirements of the traffic, declared Mr. Campbell. Traffic is largely measured by the population and the importance of the community. The first class contains all the leading roads through a province, connecting the town and market centres, passing through the densely settled communities. These carry the majority of the traffic in each community. It may be that in one community the road to meet this class of traffic will cost from \$25,000 to \$30,000 a mile. For building these roads bitulithic, concrete, asphalt or some other hard-crusted road will be required. The second class of roads are the principle feeders through out the central parts of the province. The first class of roads forms probably 10% of the total road mileage. If this percentage is correct throughout the Dominion, there are 25,000 miles of road in the first class, leaving 225,000 miles of other roads to be considered.

Department in Each Province

In each province there is now a special department of roads making surveys, locating the roads and designing them. Such departments did not exist five years ago. They are doing splendid work, for the roads must be properly located and graded according to well-established grades. The width must be left to the engineer in charge of the road, as the traffic determines the width. Traffic requirements of a community must be studied very fully and carefully before the width can be decided upon. The width of a road may vary in different places also. A road may start out of a large city with a width of 30 ft., and after 15 miles or so, it might possible taper off to 20 ft. The money spent in study of problems of this kind is money more wisely spent than most people realize.

Drainage, said Mr. Campbell, is of first importance. He declared it a crime to put one of these hard shells on top of a weak, wet or yielding foundation. It is an unpardonable offence; yet one often finds that in our haste to make a showing in surface work, chances are taken on the foundation without proper drainage. As much care should be given to the building of the foundation as to the planning of the surface. It is a problem which must be considered scientifically.

Ditching Must Receive Attention

Ditching should also receive more attention. There is no use building a drain on the side of the road and then allowing water to stand in the ditch, as frost will act on it in such a matter as to dig up the road.

In building earth roads, there should be a crown of at least one inch to the foot, said Mr. Campbell. For harder surfaces a quarter inch might be sufficient, but at all times materials should be used that will shed water and not absorb it. The earth road is inclined to absorb water, and after a rain must be dragged and repaired.

Hard-finished roads should be graded and paved to offer the least resistance to traffic. These roads must now be built to carry the very heaviest traffic,—vehicles carrying 15 tons and travelling 40 miles an hour. For traffic of this sort, to build anything but the best class of road would be negligence and waste. At the same time, to build a more expensive road where the traffic does not require it, would be equally reprehensible.

The earth road is as good to some communities as the road costing \$15,000 a mile. It would be as wasteful to put the \$30,000-a-mile road down where it is used by an occasional settler, as it would be to put the earth road which he needs, between two great cities. Maintenance should be built into construction as far as possible, said Mr. Campbell. It is better to pay \$10,000 a mile if maintenance is obliterated than to pay \$7,000 a mile and be troubled with maintenance at all times. The cheapest road is sometimes the most expensive.

"Show me that you were planning the most efficient and economical road for the purpose, and I will say that there is a road worthy of expenditure of money," said Mr. Campbell, "but if you call for extravagant outlay for a road, we will say, 'No.' We do not want to lead you into building expensive roads that are not justified."

Gravel Road Requires Engineering

There is as much engineering in building a gravel road as in building a high-class road, he declared. The careful engineer is not the one who wishes to make the greatest show of expensive pavements. The foundation of a road is the only part of a road which can be made permanent. The foundation should be built so it can be surfaced and resurfaced. If you build a good foundation, well-located, well-drained and well-graded, after twenty years' use you will be able to raise any amount of money desired to put any surface required upon it, however expensive it may be, as the people will then know the benefits of the road.

Judgment, care and caution should be exercised. If you want to get ideal specifications, they can easily be had. "I would like to warn all those in charge of road improvements with a view to getting assistance other than the assistance that you have at present, that you should design cautiously, construct efficiently and maintain by careful attention, to protect the investment which you have put into it, whether for common earth road or for building the ideal high-class and high-finished road," said Mr. Campbell.

"Build your bridges and culverts substantially and get them off your hands for all times. Get rid of patching and repairing on temporary bridges. Use concrete for foundation and steel or concrete for superstructure. Then there is time to think of the surface coat after all this work has been finished and the foundation in the road thoroughly settled."

Mr. Campbell expressed his pleasure in listening to the different papers read at the congress, and thought that the