THE EFFICIENCY OF THE HIGHWAY IN THE PRESENT TRANSPORTATION DIFFICULTIES*

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FFICIENCY is the ability to accomplish work with a minimum of time or energy. The efficiency of good highways is well shown by a report which I received on April 19th, 1918, on road tests with motor trucks, by R. E. Chamberlain, of the Packard Motor Company. Mr. Chamberlain made some elaborate tests to determine the relative value of different road surfaces under operation of motor trucks. Results of these tests show the resistance to tractive effort offered by unsurfaced concrete to be 30 pounds per ton, surfaced concrete 50 pounds, gravel 82 pounds and dirt 90 pounds.

A three-ton truck, with capacity load, which maintains a speed of 12 miles an hour over unsurfaced concrete, will make 7.2 miles an hour over surfaced concrete, 4.8 miles an hour over gravel and 3.6 miles an hour on dirt roads. relative cost per ton-mile is \$.167 on surfaced concrete, \$.194 on gravel, and \$.207 on dirt roads. Mr. Chamberlain in his report states that "a computation would show that if all roads travelled were gravel instead of dirt, annual savings in operating America's 400,000 motor trucks would amount to \$70,200,000; if concrete instead of gravel, \$167,400,000; and if concrete instead of dirt, \$237,600,000."

Roads a Big Factor in the War

The fact that the tractive resistance of an earth road is 306 lbs. as compared with 83 lbs. for concrete, is of the utmost importance at the present time, as the results of the war will depend fully as much upon roads and highways as upon any other one factor, because it is manifest that if you cannot feed your men, move your guns, supply them with artillery and ammunition, you cannot maintain an army in an existing location. While the railroads and steamships are vitally necessary to bring the supplies and men, ammunition to the artillery, and everything needed for modern war, to the country, and from the large storehouses to the railheads, the soldiers in the trenches, and more particularly the soldiers back of the trenches, have to be almost entirely supplied over the roads.

The whole battle of Verdun was really fought, so far as the French were concerned, with soldiers, ammunition, guns, and supplies that were transported over the roads, because the one railroad which originally supplied that region was cut by the Germans, and the other one was dominated by their artillery. The consequence was that the army was supplied with ammunition, guns and men that came over the roads.

All Important Roads are Military

From one point of view, all roads which are of any importance are military; to wit, any roads which have to be used for the transportation of any of the products which are necessary for the conduct of the war or the feeding of the people with the articles that are necessary to sustain life. It is a question of relative importance, but under existing conditions we should certainly confine our efforts to those roads which are of the most importance from this point of view.

Practically all of the roads in France were military roads. The French road system was admirably adapted to be used for military purposes. This can be illustrated by a few figures.

France, with a population of ten times that of Massachusetts, and an area of about twenty-five times the area of Massachusetts, had, when the war started, over 371,000 miles of macadam road. These roads had been built for many years; they were all graded, with foundations where necessary, and all had adequate drainage. Virtually all had a hardened surface of waterbound macadam, though a certain percentage had been built with a bituminous surface.

There were about 32,000 miles of national or departmental highways, or about 10 per cent. of the whole. These main arteries connected all the more important cities and villages with a network of main highways through the whole of France.

The width of the "Route Nationale," including ditches, was 60 ft.; the macadam surface was usually 24 ft. wide, with about 15 ft. of graded road on each side and then a ditch. The "Route Departmentale" was about 42 ft. in width, with a macadam surface usually about 18 ft. wide.

French Roads Helped to Save Paris

There were also over 107,000 miles of road of secondary importance, what might be called county roads, connecting all the little towns, villages and hamlets. There were 47,500 miles of road that were perhaps of interest to two or more towns. These roads were graded about 30 ft. in width, including ditches. Then there were about 184,000 miles of what might be called ordinary country roads. The roads of the least importance had a macadam surface about 9 ft. in width, but were graded 27 ft. in width.

So far as I can learn, it was this road system which enabled the armies of France to stem the German armies' rush on Paris, and to throw them back to where the trenches were first dug. France has been so well supplied with roads in most of the sections on the battle line that it has been unnecessary to build very many new ones. The big problem has been to keep up and maintain what they had, with the tremendous traffic that had to go continuously over them.

By way of comparison with the French mileage, I may say that Massachusetts has about 23,000 miles of roads, of which about 6,000 miles are village, town or city streets.

I tried an interesting experiment recently with a French map. I could not put a pin on any point on the map which was further than one mile from a macadamized road.

The French roads are not accidental. They have not happened. They are well designed and built to better plans, better grades and better alignment than is the practice anywhere on this continent,—but even those roads could not stand the pounding by army traffic. The French road system was started in 1826 by a decree of Napoleon. The location, width, alignment and grade of the whole system as originally planned has been very largely adhered to, so that their policy has been continuous.

Planned in Napoleon's Time

Some time ago I asked a high French road official how many miles there were of macadamized roads in France. He replied that there were 400,000 miles. Later I wrote for further information and secured the names and mileages of the various roads. Upon adding these, I discovered a total of only 371,000 miles, or nearly 30,000 less than the figure originally given. I wrote again enquiring where the error had been, and received a most gracious apology and explanation that only 371,000 had really been built,

^{*}Abstract of address delivered May 8th, 1918, at Canadian Good Roads Congress.