Paper read before Conference on Highway and Highway Transport Educati
University of Tennessee. October 10, 1921.

The Problems to be Studied

Thos. H. MacDonald, Chief of the Bureau of Public Roads.

There is a term that is frequently used at such meetings as this, that I should like to see stricken out of our vocabularies and erased from every program. I refer to the hackneyed term "good roads". It has been used so long and so questionably in connection with an outgrown propaganda, that it no longer stands for our ideas of the goal toward which we are now working. What we are interested in now is not "good roads" or "better roads" but better transportation, which involves not roads only but vehicles as well, and the proper relation of the vehicle to the road.

We are meeting here in conference under the auspices of the University of Tennessee in order that we may discuss some of the problems that lie before us in preparing the way for better transportation; and that we may decide upon methods and means by which young men who are now studying in the engineering courses of the Universities may be brought up in the knowledge of these problems.

The University is cooperating in this movement with the Committee on Highway and Highway Transport Education. The Committee, which was gathered together as the result of a conference held in Washington over a year ago, is made up of representatives of Government Departments and private industry. On it are represented the War Department, the Agricultural Department, through the Bureau of Public Roads, the Bureau of Education, the Rubber Accessories Association and the National Automobile Chamber of Commerce. As

you will see it combines in its membership the producers of vehicles, the builders and the users of roads, and the educators upon whom must fall the task of training those who are to work for the development of the new idea of highway transport which differs from the old "good roads" propaganda as day from night.

To the "good roads" enthusiast the good road was the end to be sought - a thing to be possessed for itself alone - something in which the community could properly take pride as in a new monument for the courthouse square. His demand was for the best road obtainable, usually with total disregard for the character or volume of the traffic to be accommodated. Largely at his behest we have begun upon the development of our highways without system and without method. Without rhyme or reason we have built a piece of good road here, another there, each as they were demanded by this or that community acting upon the urge of its "good roads" enthusiasts.

These roads have been built for the locality rather than for the State or Nation. In general they are not connected with each other, and, in some instances, their location is so lacking in elements of economy as to warrant no connection with the highway systems which are now being developed.

With such a conception of the purpose of roads our present ideas of highway transportation have no relation. Within our broader view there lies a national system of connected roads, each road a link in the national chain, bearing its due proportion of interstate traffic, yet each a local road as well, serving with well placed lateral roads to distribute and collect the traffic of the rural sections. Each road

in our projected system must be designed for the particular traffic it will be called upon to carry. There must be no superfluous expenditure for roads beyond the economic requirements of the vehicles that will use them, yet the roads built must be fully adequate if we would avoid waste and deterioration.

It has been given to me to outline - not to solve - the problems we confront in building such a system and providing for highway transportation in this higher sense. To outline them is not a difficult matter; to solve them is a task for many men and long unselfish labor. Only now, I feel, are we approaching the study of these problems in the proper manner.

The lines along which we are attacking them are as follows: (1) Highway Economics; (2) Highway Engineering; (3) Automotive Engineering; (4) Highway Transport.

I place first the line of highway economics because it is along that line that we propose to find out why and for what purpose we should build the roads; in a general way, where they should be; and how we may best pay for them. It is in this first line of attack that Prof. Dougherty is working. We have made arrangements with him to study the use of the roads in Tennessee; to show the use you are now making of your highways, the probable effect of improved roads on the distribution of traffic, and the value of such improved roads as a means of bettering transportation conditions in the State. I am hopeful that he will be able to continue his studies until he has covered all the counties of the State, for I know of no way in which he can render better or more important service to the State. He has had splendid cooperation

from every one, and in a little while, if his work is continued, he should be able to say to the State "this is the service our highways are giving us now, and these are the developments of service that improved highways can bring to us".

Along the second line - we are studying the design of roads from the technical standpoint, and endeavoring to develop better methods of construction, and especially of maintenance. In order to improve our designs we are going into a study of sub-soils and foundations and wearing surfaces, the effect of climate, drainage and loading; and we are finding some things that will, I believe, surprise most people. It is the popular belief, I am sure, that our highway surfaces are absolutely inert and stationary, and that they remain in one place and one position until they are worn out. That is not correct, we find, For example, take a concrete road; it is constantly moving; back and forth lengthwise as seasons change and expansion gives way to contraction and vice versa; and up and down each day. During the day the edges of the slabs curl down as the upper surface expands under the influence of mounting temperature; at night they curl up when the surface cools and contracts. We have measured displacements of the slab as great as half an inch from the subgrade. Should a heavily loaded truck come along at such times it would find the road in the air with absolutely no subgrade support, and it is easy to imagine what would happen.

In our studies to determine how thick we shall make our road surfaces and their foundations we are investigating the effect of the impact of motor trucks. Due to irregularities in the surface of the roads, it is not unusual for a heavily loaded truck to fall with a thud upon the road surface from a height of a quarter or even a half an inch.

At such times the blow delivered to the road is equivalent to many times the weight of the truck and load. We have measured blows equivalent to 20 tons and more, yet people wonder why our roads break down.

We must discover such facts as these before we invest our money, because it is impossible to build roads that will hold up properly unless we find out exactly what conditions we must build them for - just as a tailor must measure you before he can cut the cloth.

Along the line of automotive engineering are those problems of size and distribution of the load, economic truck capacity, design of the various parts of the truck for economy in operation, etc. As related to the roads there is the study of the value and effect of various kinds of tires in relieving and cushioning the blows of impact, and the possibility of better distribution of the weight of the load to the road. I am trying to convince my automobile friends that we have found trucks so designed that we get the equivalent of 110 per cent of the carried load under the two rear wheels alone. Such a concentration of load is, of course, extremely difficult to cope with, and one phase of our study aims to relieve this condition by a more uniform distribution to four or six wheels.

Along the fourth line - that of highway transport lie the broad problems involved in the development of an economic system of roads and the use and regulation of such a system to supplement the other transportation systems and relieve the dangerous situation into which we have been permitted to drift by failure of our transport to keep pace with our production.

I do not know of any State in the Union that will be helped more by the development of a system of primary and feeder roads than the State of Tennessee. If you will tie this whole State together, from the East to the West, and from the North to the South, with primary roads, joined to feeder roads there will come about a development of your State that cannot be brought about in any other way.