The National Highway Program
by
Thos. H. MacDonald, Chief, Bureau of Public Roads

The gradual development in the highway building activity of this country from a composite of unorganized and more or less ineffectual local efforts to the highly organized, efficient and productive industry with the State as a unit and a definite program of action, national in extent is one of the most remarkable facts of the economic development of the country.

Twenty years ago road building was in the hands of thousands of local government bodies. A negligible part of it was then controlled by the pioneers among State highway departments. By 1916 - six years ago - only 27 per cent was under the control of State departments. Today about 60 per cent of the road construction of the country is under State control. One-half of that amount is under the control of both the State and Federal governments.

The placing of so large a proportion of the work under State control is the result of the Federal-aid act of 1916 which required the creation of a highway department in all States as a condition of the allotment of Federal aid. Seventeen States created highway departments outright as a result of that Act, and many others were strengthened and given larger funds. If there

had been no other beneficial results of the act, I should consider the nation more than repaid for the expenditure that has been made. There is, of course, the very tangible result of the 25,000 miles of road which have been completed. But in the long run the creation and strengthening of these State agencies to replace the local road building bodies will prove to be more important than the roads bought by this first appropriation. But for this departure from the old methods of administration the present definiteness of our program of highway construction could never have been reached.

The Federal Highway Act, approved last November comes in logical sequence after the Federal-aid act. The first act and its amendment built up a great Federal and State cooperative organization for the building of highways, and provided for the combined organization, the means with which to test their capacity and efficiency by practice. The new act corrects the defects that were found in five years of trial and lays down a program for the construction of a great system of interstate and intercounty roads.

The system is to be made up of primary and secondary roads to be selected by the States subject to the approval and correlating influence of the Federal government, the system in each State to be composed of not more than 7 per cent of the total mileage

of existing roads in the State, of which not more than three-sevenths may be upon the primary system.

The cooperating agencies are now at work selecting the roads which are to comprise the system. Practically all of the States have submitted their initial proposals and these are now forming the basis of a series of conferences with the Federal officials out of which will emerge the approved system. It appears that the system as finally decided upon will embrace about 180,000 miles of the most important road in the United States. As we set out to follow the program we look forward to the time not much more than a decade removed when we shall have 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 laterals to distribute and collect the traffic of the rural sections.

The work which will be done upon this system will constitute almost half of all the road construction that will be carried on for the next ten or fifteen years. The balance of the work will be done under the control of the State departments and the counties. Much of the State work is quite as definitely planned as the Federal-aid system, and while the counties have heretofore conducted their work in a more or less haphazard fashion, it is hoped that the existence of the definite plan for the backbone system will lead them inevitably to fall into the general scheme by tieing their roads up with the main system, so that by

the time that system is complete there should also be a considerable mileage of local road connected with it which will extend it to the rural dweller in even the more remote sections.

What gives us especial confidence that the result of the program will be a success is that it contemplates not only very definite arrangements for the construction of the roads, but also for their continuous maintenance from the time construction is complete.

There should be no loss of any of the money that is invested. No roads will be permitted to fall into the state of decay which unfortunately has vitiated much of the effort that has been expended heretofore. Rather, we are determined that when the whole system is completed all parts of it will remain, including the earliest roads constructed, and that all parts will be in as good and possibly better condition than when they were completed. This result will be assured by constant and careful maintenance.

How well we shall perform the duties laid upon us rests with the future to disclose. One of the hopeful signs as we set out is the dawning realization of their common interests by highway builders and motor vehicle producers. They realize that their common business is not to produce motor trucks only, or build roads, but rather to provide better transportation, by economic adjustment of the motor vehicle to the highway and the highway to the motor vehicle.

The whole purpose of highway building is to make possible highway transportation, and the common endeavor of producers of vehicles and roads is to reduce the cost of transportation to the lowest possible level. I, for one, therefore, should deplore any legislation which limits too greatly the loads which may be hauled over the highways. Laws which blindly fix some maximum weight may prohibit the really profitable traffic and allow less economical and conceivably more destructive vehicles to operate practically unchecked.

I think we may safely leave the question of the proper relation of the road to the vehicle to be determined by the results of the exhaustive researches now actively under way. In this work there is another promise of the success of our huge undertakings. Experience, judgment, superficial observation, heretofore our only guides are now being supplemented by scientific experiments conducted in practically every State. At Arlington, Va., the Bureau of Public Roads is measuring the destructive force of impact and determining its effect upon various road surfaces. By specially devised instruments we measure the effect upon the covered subgrade of loads applied to the surface.

By careful observation we learn that supposedly inert concrete road slabs curl up and down daily under the influence of changing temperature. We find that the motion is so responsive to the warmth of the sun that we can almost instantly detect the

effect of a passing cloud. In Illinois the State has built a road the public will never use. It has been built solely for experimental purposes and will be tested to destruction by a carefully regulated motor truck traffic. At Pittsburg, California, an oval track 1500 feet in length furnishes the means of experimenting upon various designs of concrete pavements. The Federal Bureau, at its Arlington laboratory and through its investigators in the field has set for itself the problem of the waves that form in gravel and other similar types of road. And so I might go on to mention investigation after investigation, each aimed at the solution of some specific problem, each being attacked in a truly scientific spirit by earnest investigators whose efforts are coordinated with those of others through the agency of the Advisory Board on Highway Research of the National Research Council.

With State and National administrative bodies working together in close cooperation, the vehicle producers working hand in hand with the road builders, and highway research beginning to bear fruit in more rational methods of design, with the material producers, and contractors keenly alive to their jobs and rendering more perfect service year by year, with sufficient funds available to carry out the extensive programs that are planned there is every reason to indulge a spirit of optimism with regard to the immediate future of highway building.

The total expenditure for roads in 1921 has been estimated at $600,000,000. This was the maximum expenditure during any one year up to that time. This year we estimate that there is available for expenditure nearly $800,000,000. How much of that amount will be actually expended cannot be closely predicted, but it is safe to assume that the expenditure will be at least as great as that of last year; and if we are to obtain the full benefits of the program we have laid out for the future in any reasonable time, it will be necessary to continue the expenditure at a rate at least as great for the next decade, and maybe longer.

The traffic to use the roads is ready and waiting. In this our highway problem is different from the problem of the railroad builders. In the development of rail transportation the building of the roadbed preceded the establishment of the rolling stock. In the development of highway transportation the individuals composing the public have equipped themselves with rolling stock to the extent of more than 10,000,000 motor vehicles, to say nothing of the large numbers of horse drawn vehicles in use, and the public as a whole has charged itself with the task of providing the roadbed. An examination of the progress in highway building over the past ten or twelve years indicates a very serious lag in the development of the roadbed in comparison to the increase in the rolling stock. This lag is so serious that there is an insistent demand on the part of the very large body of owners that the providing of improved

roadbeds shall be hastened. This demand in turn is followed, and properly so, because of the very large expenditures required, by the equally insistent question of who shall pay. There can be no question as to the service that highways render to the owner of the motor vehicle privately operated. In fact, the utility of the vehicle is to a large extent dependent upon the improved highway. There can be no question as to the service which is rendered by the highway to the operator of motor truck lines and motor bus lines. The granting of franchises should be followed by a real financial return. There can be no question that the improved highway serves the real property in the rural districts. There is also a real service rendered by the rural highway to the property within the urban limits. For example, the recent report issued by the Port of New York Authority states that in the port district comprising within its area a population of nearly 8,000,000 people, over 4,000,000 tons of foodstuffs alone are required annually by the people of the district. This means an average of one-half ton per person per year. All of the foodstuffs originate upon a highway, some place, and the nearer to the district that the perishable foodstuffs, such as garden truck, milk, eggs, butter, can be produced, and the more directly and quickly they can be transported from their point of origin, to these people, the cheaper will be the cost and the better will be the quality. Can there be any doubt as to the interest of the urban dweller in the rural highways

quite distinct from any direct use which he may make of them? Likewise, can there be any doubt of the real service which the highway renders rural property?

Under these four classes may be grouped the major services which are rendered by the highway, but these do not bear a constant relation to each other, nor does the highway maintain a constant relation to each of these. The truck gardener is more dependent upon improved highways than is the farmer who raises only annual crops.

Thus the relative share of the cost of highways may not remain constant, but it is difficult to harmonize with the tenets of fairness and equity any plan of financing which does not distribute some part of the cost to each of these four services.

Of the $600,000,000 expended last year we estimate that the sources were as follows:

Federal aid	14 per cent
State road bonds	7 " "
State taxes and appropriations	12 " "
County, township and district taxes and assessments	47 " "
Motor vehicle revenues	19 " "
Miscellaneous	1 " "

Federal aid and motor vehicle revenues constitute 33 per cent; the remaining 67 per cent comes either directly or will eventually be paid from State and local taxes. It is believed that a very considerable readjustment of these sources of revenue must be made, so that a larger percentage will be paid by the

road user and a lesser percentage from State and local taxes. What part of the cost should be thus shifted and what part we can fairly continue to derive by taxation of the land is a matter to be determined by a very careful consideration of the purposes for which our expenditures are made and the relative service rendered to the several classes of our population. Upon over 31,000 miles of Federal-aid roads involving a total cost of over $188,000,000, the surfacing cost has been 60 per cent and the remaining 40 per cent is made up of grading 22 per cent, structures 14 per cent, shoulders 1 per cent, and engineering 3 per cent. That is, 40 per cent of the expenditure was for the permanent features of the road. This part is certainly a fair charge against the land. What it purchases is not destroyed by the traffic, but remains as an abiding improvement to the land. For the balance of 60 per cent the problem is to determine what part can be retained by constant maintenance and what part must inevitably be lost as a result of use. The cost of the maintenance and the cost of replacing that which is lost in spite of maintenance are clearly charges which should be assessed against the motor vehicle owner and other users of the road, either in the form of license taxes or taxes upon motor fuel which are now generally thought to be preferable. [illegible] Of all the financial demands which will be made in carrying out the program it appears that the funds for new construction

will be the most difficult to secure. The public should not be called upon to bear this entire cost as an annual expense. Rather is it fair to distribute these costs over a period of years extending beyond the time of the maximum expenditures for new construction. It is not doubtful that succeeding generations will enjoy the use of the highways which are being built now, and there is nothing unfair or to be criticized in pursuing a financial policy which distributes a portion of the cost beyond the immediate period. No enterprise requiring funds in the large amounts that they will be required for the new construction of highways can go forward without anticipation of revenues.

Experience in the administration of highway work has already established certain definite principles without the observance of which it would be highly unsafe to resort to bond issues. The major principles may be outlined as follows:

1. As a general proposition State, not local, bonds should be issued for the building of the State highway system. In any case the total amount of bonds to be issued for any one year or over a period of years in any State should be subject to the control of one central body.

2. Sufficient revenues must be derived from the users of the highways to pay all of the maintenance and a percentage of any reconstruction charges.

3. All bond built highways ought to be maintained under the direct supervision of the State Highway Department, which also must have jurisdiction of the revenues from the road users, and the proper maintenance of all bond built roads must be considered a first lien upon such revenues.

4. The proceeds of bonds must be devoted to a system of roads so devised that as the system is completed these roads will in fact continually serve the major traffic in the vicinity. This means that the only safe sequence of improvement is in the order that the different sections of the system serve the traffic.

5. Bonds should not be issued in an amount beyond the ability of the traffic of the present and immediate future to pay revenues sufficient for the proper maintenance of the roads built from the proceeds.

6. The type of roads built with bonds should be adjusted to the traffic which they will be called upon to bear within the reasonable future.

It will be noted that little has been said as to the uses which are to be made of the highways, but it must be remembered that the whole question of highway transportation is in its infant stages. Very careful investigations and studies are now going forward to determine both the economic limitations of highway transport and the necessarily adjusted highway construction. We have made rapid progress during the past two years toward such

determination, and the suggestions which have been made are based upon an administration of a highway program predicted upon the results and determinations of these scientific researches and investigations. The science of highway administration is being rapidly developed, but the principles and information available must be given the widest publicity. It makes no difference how sound a policy may be adopted by one administration. The work of providing a roadbed for the rolling stock now in existence will extend over more than a decade into the future, and it will lie with the public to determine whether the policies shall be carried out or whether there shall be a change with every change in the complexion of the administration. This is the most uncertain feature of any connected with the financing of road improvements, particularly where it is desirable to issue bonds for a long period. If permanent policies can be adopted and carried forward without change over a period of years, the necessary roads can be built without undue burdens upon the public. But only can this be done by foreseeing now and adhering to safe and sound financial policies. The objective, after all, is to furnish the cheapest possible highway transportation, which involves both the rolling stock and the roadbed. But the public have undertaken to provide the roadbed as a public responsibility, and there should be no misunderstanding of the huge sums which are involved in the undertaking.