oratory and technical staff. Thousands of samples of materials used in county road building are analyzed in the laboratory; and the state department, when appealed to under the law, sends inspectors to see that county road work is up to the standard engineers prescribe.

Under Indiana highway laws, the maintenance division cooperates with the Engineering Department of Purdue University. Each year our engineers take part in the discussions at the Road School. Mr. Ben H. Petty, in charge of the University's highway activities, is greatly responsible for county and township road superintendents maintaining their road systems after the state.

To one giving only cursory attention to state road expansion and the insistent public demand for more roads, development in the last decade is seemingly miraculous.

Records of the automobile license department show that motor registrations increased 18 per cent in 1921, 20 per cent in 1922, and about the same in each succeeding year except 1930. Ownership of automobiles in the United States registered an increase of 56 per cent in five years between 1924 and 1929, according to a survey of the American Research Foundation, which gives total 1929 registrations in excess of 26 million. Compared to the increase in population of the United States figured on the 1930 census, the Bureau says that automobiles are increasing six times as fast as the nation's population.

All of which has been made possible by the development of state and national systems of highways.

WHAT ABOUT OUR LOCAL ROADS?

By Norman M. Blaney, Director, Farm-to-Market Roads, American Farm Bureau Federation, Chicago, Illinois

We have made remarkable progress in providing transportation facilities for our stockholders—the taxpayers of this nation. On a basis of population there is no doubt that we have taken care of at least the minimum requirements of a majority of the people, and no doubt that was the proper and correct method of procedure. However, I do believe that the time has come when we must stop for a moment, and take stock, in an endeavor to arrive at the decision required in ascertaining what the future policy should be.

The building of roads to me is simply the expanding of our factory. We are adding to our investment solely for one purpose; that is, so that we may produce more economically by facilitating the transportation of our merchandise from its
point of production, along the line of processing, to its point of ultimate consumption.

I like to picture the United States as one great manufacturing plant, not several million separate units. I cannot conceive otherwise but that each of the units is an integral part of the whole and that this nation cannot make the advance it should when any portion of these small units is forced continually to balance its ledgers on the wrong side.

Considering the entire nation as one unit, with the parts being so interlocked with each other, I often wonder just what we mean when we say "local roads." Where is the line of demarcation which designates the difference between a local road and any other road? I suppose the term "local roads" would mean those which are used only by the local community and therefore are of only local interest. What do we mean by local? Webster's definition is "pertaining to place; restricted to a particular place." When we speak of the local grocery store, the movie theatre, the local park, the playground or golf course, we refer to the one nearest our home. On this basis, my local road is a main highway south out of Chicago—none other than U. S. 41. But I have never heard of anyone who classed U. S. 41 as a local road. Yet it is just as much a local road to me as the most remote township road in this or any other state is to the person who lives on it. The definition of the word "local", as I see it, when used in connection with roads, is that it means a road which is of use solely by, and of interest solely to, the particular community through which it passes. But generally we mean a township road which doesn't happen to connect a couple of towns together and on which only farmers live. I believe it is time we realize that neither the township nor the county we live in can be considered as the extent of our locality. The state is rapidly becoming our locality. I, for one, am doing whatever lies within my power to bring the population of the country to see that only the boundaries of the nation are the boundaries of our individual locality. And so, let me ask you another question, or I should say, the same question in another way—When does a road over which the public is permitted to travel, and over which produce and merchandise are transported in both directions, cease to become of interest to other than the people who happen to live on that road?

What Is a Local Road?

Let me give you an example, a mythical one perhaps, but nevertheless not an unheard of, nor yet an impossible one. Let us take for instance, a small section of one of the townships here in Indiana where the farmers are engaged in producing milk. I can picture a road in the most outlying section of the township—a road as far removed from the center of the county.
as possible. On the most distant portion of that road I can picture three or four dairy farmers who have quite a considerable volume of milk being shipped daily to Indianapolis. I can picture this road leading in one direction to the trunk highway and, in the other direction, leading, as it were, nowhere, or at least not directly to any city or town. Certainly that road cannot be classified as a trunk road. The milk produced on these farms, being shipped and sold outside the county, brings new capital into the county. This new capital is partly absorbed in the payment of taxes, the larger share of which goes into the construction and maintenance of roads and schools. It is partly absorbed in payment of the interest on loans and mortgages to the banks or other financial institutions of the county or state. The balance, if any, is absorbed by the purchase of supplies, clothing, furniture, fertilizer, equipment, and so forth.

The merchants in the county towns are certainly relying on this capital. Therefore, they must be vitally interested in these farmers' cost of transportation. If the production cost of the milk, which includes the transportation cost, exceeds the return, these farmers do not have any money with which to purchase the commodities the merchants are relying on for their cost of operation. The interest of the farmers living on that road may be, on the other hand, quite as much in the city of Indianapolis as it is in the near-by town. The production of their milk certainly is of considerable interest to the city of Indianapolis. This milk, with that from other farms, is of very vital interest to the men and women who find employment in the processing plant in Indianapolis. It is of material interest to the people who supplied the capital for the processing plant. It can readily be seen that the workmen and the owners of the capital are as much interested in getting the milk to the city as are the people in the local town. The transporting of that milk to Indianapolis instead of some other place means the providing of labor for the workmen in that city. The merchants in Indianapolis, also, are vitally interested because the people who are employed in the processing, bottling, and distributing of this milk, represent a considerable portion of their market. This milk provides a material on which Indianapolis capital may make a profit. The transportation of it to Indianapolis contributes directly to the building and progress of that city. This transportation is facilitated or impeded in direct ratio with the adequacy of the poorest road over which the milk must be taken. That particular road may be said to be of greater interest to the city of Indianapolis than it is to the farmers who live on a neighboring road and possibly than it is to the people in the neighboring town. The Indianapolis consumer is also vitally interested in the condition of the roads because this road condition is reflected in the cost of trans-
portation that, in turn, is reflected in the cost of production, which cost governs the retail or consumers' price of milk.

More than 40 per cent of the population of the United States lives in rural America. This percentage of our people are directly dependent upon the farm income to provide them with money to buy the things they need which are not produced by their own labor. I have never seen any figures on the number of city dwellers who are equally dependent upon farm products for their livelihood. It would be rather interesting to know just how many people derive their incomes from the meat packing industry, from fertilizer manufacture, from the handling of poultry and poultry products, from dairy products, from the manufacture of farm machinery, and from the distribution and sale of these products. In addition to these, we have a number of other industries which are very directly concerned with the ability of the agricultural industry to have money left over at the end of the business year with which to buy. The building materials producers, the manufacturers of motor cars and trucks, of clothing, of shoes, of furniture, look to the agricultural population for a very considerable portion of their market. Obviously, unless the farmer has been able to conduct his business—production, distribution, and sale—in such a manner as to leave him a surplus over cost, not only is he prevented from buying those things he needs, but, by the same token, the people who are interested in the production, distribution, and sale of the commodities he needs are in the condition where their profit is reduced by a like amount.

Farmers' Excess Transportation Costs. Certainly no one would be foolish enough to say that the farmer's lack of net profit over cost is solely attributable to the lack of adequate roads; but the excess cost of transportation of the products of the 4,746,436 farmers, who, according to the 1930 census, live on dirt roads, is certainly no small item. The census reveals that the average distance to market is 6 miles. It is reasonable to estimate that the average farmer will go to market twice each week, or 100 times a year. Using these figures, we find that the average farmer, therefore, travels at least 1200 miles a year in going to and from market with produce.

Professor Agg of Iowa State University calculates that the cost of transportation on dirt roads is 2.06 cents per mile greater than the cost on pavement, and 1.07 cents per mile greater than the cost on intermediate types. Certainly we do not have enough money to pave all the roads. Furthermore, it would be gross foolishness to try. Comparing the cost of transportation on dirt roads with the cost on intermediate types, we can easily compute the excess in cost of transportation paid by the farmers who live on these dirt roads. In the United States, therefore, we find that each farmer is penalized
$12.84 per year; the group as a whole is penalized $60,944,238 in excess transportation cost. We must admit that this is a waste to the nation.

This sum divided among the 4,746,436 farmers who are paying the penalty does not mean much to the individual. It does, however, mean quite a considerable reduction in their purchasing power. It represents a loss which must be sustained and absorbed by the capital invested in the various manufacturing industries which look to these people for the purchase of their commodities. It is also a loss to the men living in the city who rely on the purchase of those articles whose manufacture provides their living. This, however, is not the only loss. The loss to the nation as a whole, in time, because road conditions do not permit the utilization of modern transport equipment; the closing of this tremendous market to motorized equipment manufacturers; the loss to the nation through forcing the farmers to market their produce hurriedly, and at a time when their roads will permit, thus giving rise to lack of price stability through commodity gluts and scarcity—these losses never have been nor ever can be computed. Therefore, I ask you again, when is a road only of local interest?

Let me call your attention, now, to several other reasons why we must consider the question of providing still more adequate service on our outlying roads through agricultural territories.

School Consolidation. Not infrequently we read about the tremendous strides which are being made in the establishment of consolidated or union schools. It is readily admitted by the modern educator that the one and two-room school is not adequate. The latest information available shows that there were approximately 20,000 consolidated schools in rural America at the end of 1928. The White House Conference on Child Health and Welfare, held in Washington recently, reports that there are still 161,000 one-room and 22,000 two-room schools in this country. If the children who are in attendance in these one and two-room schools are to be given the type of education necessary in fitting them to be the kind of citizens we need in America, we must make even greater strides in consolidation. It must also be recognized that the cost of maintaining these one and two-room schools, on the basis of cost per attendant, is much greater, in comparison to the benefits received, than that of consolidated schools. The consolidation of educational units means a greater distance for the individual attendant to travel from the home to the school. Therefore, before the problem of consolidation is finally worked out, we have a problem of transportation to settle. Frequently the condition of our roads prevents the consolidation of schools. In many instances where consolidated schools have been established, the farmer is obliged to house the children in town dur-
ing the school term, solely because the transportation problem in his territory has not yet been solved.

**Fire.** Then we have the matter of loss by fire. Each year, in rural United States, fire takes a toll of 3,500 lives. Farm buildings, equipment, stored crops and stock of a value of $150,000,000 are destroyed annually by fire. Some time ago, Major General George O. Squier, a retired army officer, developed a plan to provide motorized fire-fighting apparatus with a crew of men in each township. Certainly such a plan would be of considerable assistance in reducing this economic waste. It is equally certain that such a plan cannot be put into economic operation until a much greater percentage of our rural homes are served by roads over which the trucks can travel during the fall, winter, and spring, when fires are most frequent, and when dirt roads are as frequently impassable.

**Medical Care.** Let me give you some figures on the cost to the farmers of America of medical, dental, and hospital care. A recent survey shows that the average farm family pays $104.94 a year for such service—an average of $7.63 for each visit, with 13% of these visits costing more than $15.00 each. Twenty-five per cent of Indiana’s population lives on farms. I do not happen to have the exact number of families, but it is reasonable to expect that there is at least one family on each of the 195,786 farms in this state. On this basis, the cost of medical, dental, and hospital care to these people is $20,545,782.84 per year. The average farm family has approximately 13.7 calls or visits, each year, for medical service. In the city a similar call will not average more than $3.50, or approximately half as much as the cost of the rural call. Therefore, the farmers in Indiana are again penalized to the extent of at least $10,000,000 a year. It must be admitted that the greater distance over which the doctor must travel in answering rural calls should be charged with a portion of this amount. Yet, today distance does not mean as much as the time required to make the trip. Distance cannot be compared in the open country with a similar distance in congested metropolitan areas. Time there is also the controlling factor in the cost. Consequently, we can attribute a very reasonable portion of this $10,000,000 penalty to the time it requires for the doctor to make the trip. This time is in direct ratio to the condition of the roads over which he must travel.

In summing up these various facts, and in going through them step by step, let us recognize that the need for change is governed by a fundamental economic principle—the need of facilitating the progress and providing for the needs of the nation as a whole. It is not sufficient that we should terminate our thought on this matter by saying that if these are the actual conditions, why don’t the farmers move?
Supposing the 4,746,436 farmers who, according to the 1930 census, are living on dirt roads, actually did move from the farm, or supposing they did not take such a drastic step but only produced sufficient for their own immediate needs and did so for even as short a period as one year, what then would happen to the 120,000,000 people in the United States who are dependent on these farmers for their food supply? The situation would be much more drastic from the city man’s standpoint than from that of the farmer.

Indiana Conditions

Another subject of common discussion is the matter of unemployment—the serious problem of concentration of population in our metropolitan areas. It is recognized that unemployment is a menace to our civilization. Coupled with these facts, we hear of migration from farm to city. Let me draw your attention to the statistics on Indiana. In 1920 the farm population in this state was 907,295; in 1925 it had decreased to 798,157. This means a migration from Indiana farms of 109,138 people; in other words, 12% of the 1920 population had moved from Indiana farms within a period of five years. This figure is more than twice the increase in the population of Indianapolis from 1920 to the present time. Undoubtedly there are many reasons for this migration; one of them, according to a staff member of the Bureau of Vital Statistics in one of our southern states, is that “the cost of wear and tear on our transportation machinery over our ungraded trails of mud takes the profit out of marketing our products. Under such a burden the younger or more progressive people who are about to establish their own homes are attracted elsewhere.” We may rightly say a good deal of this migration is directly attributable to the dirt roads.

Since the inception of the American Farm Bureau Federation some twelve years ago, the leaders of the organization have recognized these problems. They have recognized the causes of them. They have recognized the results we may expect unless the causes are removed.

The need for main arteries of commerce or main highways, if you prefer that term, is obvious. We must have a backbone to the system. In the building of roads, the objectives may be fairly compared with those which prompt and govern the construction of a drainage system. In the former instance we have certain commodities which, for economic reasons, must be removed from their place of production or their location to some other point. Therefore, we construct a passageway for this movement. In other words, we build a road.

In the latter instance we also have a certain commodity which, for economic reasons, must be removed from its point of production or location to some other point. In this in-
stance also we construct a passageway for the movement. In other words, we build a drain, or, I should say, a system or series of drains because it is very seldom that a single drain will remove all the water from the entire field.

However, the instances when a single drain will serve the purpose are no less few or no more frequent than the instances when a single main highway will suffice. It is granted that the laterals will not need to be as large but they must reach out into all parts of the field; else our main drain will not prove to be of the greatest economy. In the drainage system, if the laterals are allowed to become overgrown with weeds or half filled with debris, we fail to derive the utmost interest on the investment. Similarly if these laterals do not reach out into all parts of the field, those parts not served are prevented from producing to their greatest capacity.

The principle behind building a highway system is no different. If the lateral roads which serve as connecting routes to the main highway are not of such types as will adequately carry the traffic which must naturally travel over them, the territory served is prevented from producing to the utmost of its economic capacity. It is equally certain that under such circumstances we are not getting the best use of our main highway system.

There may be certain parts of the field to be drained which would not produce sufficient revenue to warrant the expense of drainage. A similar situation may be found in connection with the road-building program. Be that as it may, the method of procedure in developing the program to be adopted should be the same whether that program is one of road building or of drainage.

**Road Plan Based on County as a Unit**

In making the plan, particularly as it pertains to the lesser used roads, the unit of study, in my estimation, should be the county. It must be regarded as an accepted fact that very few counties will be identical in their requirements for roads. A county which is wholly agricultural and specializes in the production of cereal crops, and does not contain any area of concentrated population, certainly will have a radically different requirement for roads than the county in which a large commercial city is located. The requirements of each of these counties will be different from those of the semi-agricultural county which contains one or more cities of moderate population.

The factors which are related to the question of requirements are not impossible of study. First of all, a study of the materials to be transported should be made from the standpoint of origin and destination as well as the method of transporting. In this connection also we should study the
number of times the road will be in demand in transporting these commodities. For instance, in a dairy section, where whole milk is hauled, daily use of the road is demanded. If the milk is collected, the collecting conveyance will, under ordinary circumstances, be a fairly large-sized truck. In the grain producing territory, the frequency of use will not be daily. In that sector which produces market vegetables, the individual load will not be as great. Then, too, we must take stock of the conditions and degree of improvement, if any, of the roads in the sector under consideration.

Developing such a plan, at this stage of our highway program, is relatively simple in view of the fact that, in the main, our most heavily travelled arteries have been taken care of. Consequently, the county plan must be developed so that the outlying territories will have ready access to the main highway. To be of the greatest value so that the utmost benefit will accrue to the taxpayer, all questions of politics, or personal gain, or advantage, must be omitted. A road should be built so that the people in the territory through which the road passes may be enabled to maintain an economic communication with the people in other territories; so that they will be enabled to transport their merchandise to the market or shipping point in the most economical manner; so that they will be enabled to bring in from other sectors those things which they need and which are not produced in their own sector; and lastly, so that they will be enabled to avail themselves of the economic and social benefits required by our standard of living. A road plan should be developed with a view to facilitating this merchandising, purchasing, and communication with the greatest economical possibility.

The principal factors which should be taken into this analysis are: the commercial products, both agricultural and manufactured—their types, where produced, where and how marketed or transported to market; the natural resources of commercial value—their location, where and how transported to market; the location of schools and school districts, cities and towns, mail routes, and other points of interest.

The community development, community income, taxation, indebtedness, and ability to pay, must also be studied and analyzed. Actual counting of existing traffic is of value in deciding which of two roads is the more important. Traffic counts will not, however, indicate whether the particular road in use is the logical road over which traffic should travel. The road which bears the traffic at present may not be the most direct between the points of origin and destination. Traffic will naturally move along an improved road in preference to an unimproved road, even though the distance be considerably greater over the improved road. The logical route can be ascertained only by analyzing the origin and destination of the materials transported.
Certainly before any commercial corporation would consider increasing its investment by as much as one tenth the amount taxpayers are spending in the road building program, the most minute detail would be investigated and would be proved to be absolutely essential. Yet we are not using this deliberate method of analysis and investigation in our road building program. In only a few instances have we developed a complete and comprehensive plan.

In the majority of cases our road building funds are under the control of elected officials, and although these officials may have realized the program most obviously indicated, unless a definite plan has been agreed upon to cover a period of years, much of the expenditure they approve will not be of as great benefit as they themselves intended it to be unless their tenure of office is sufficiently long to permit the completion of their plan. They may be followed by men, or women, equally honest, equally conscientious, and equally public-spirited but with entirely different ideas on the road requirements. Even the most loyal and honest men or women cannot outline the most economical expenditures unless those expenditures are based on study and analysis, and are part of a definite plan.

Four problems face our road building officials: First—On which roads should the money be spent? Second—What types will be most economical? Third—How can the construction be made progressive so that the money spent and the work done will not be lost in the future? Lastly—What should the program be so that the use of the tax moneys will result in the greatest benefit to the community? Adequately to ascertain the answers to these four problems, a definite survey should be instituted, in each county at least, and that survey should take into consideration every part and parcel of the most remote, as well as the most centrally, located township in the county.

Until the road requirements are ascertained by a scientific analysis, and are embodied in a definite plan, with adequate finances arranged for, we will not be in a position to commence to care for the road requirements of the various industries of this nation, economically and without prejudice.

SOME NEW DEVELOPMENTS IN ROAD CONSTRUCTION AND MAINTENANCE

By W. H. Root, Maintenance Engineer, Iowa State Highway Department, Ames, Iowa

We learn by experience. Iowa has financed, constructed, and maintained a large mileage of primary roads in the last few years. The engineers of the Iowa Highway Department