DEPARTMENT OF AGRICULTURE

THE BUREAU OF PUBLIC ROADS AND ITS EXHIBIT

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Supplementing Exhibit
of the
BUREAU OF PUBLIC ROADS
at the
BRAZIL CENTENNIAL EXPOSITION
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THE BUREAU OF PUBLIC ROADS AND ITS EXHIBIT.

It is an interesting commentary upon the growth of the "good roads" movement in the United States that in 1893, when the Bureau of Public Roads was created, it was granted an annual appropriation of $10,000. To-day it is supervising an expenditure for the construction of Federal-aid roads amounting to more than $80,000,000 a year; and nearly the equal of its first annual appropriation is now required to build a quarter mile of some of the higher classes of roads which are being built at the rate of thousands of miles yearly.

Created by Congress as a bureau of inquiry and investigation the Office of Public Road Inquiry, as it was first named, was the center of an educational activity designed to teach the people of the United States the benefits of improved highways and to demonstrate the best methods of construction, maintenance, and administration. Throughout the period of developing popular sentiment its influence was one of the most potent of the forces the culminating effect of which is realized in the tremendous building campaign of the present, and in this campaign it still occupies a position of leadership.

To the educational and experimental activities which formerly constituted its only functions there has now been added the duty of supervising the construction of the roads which form the Federal-aid highway system, an arterial system covering the whole country and including the most important roads of each State.

For more than a score of years, however, its rôle was that of the teacher and the seeker after knowledge. The tests of highway materials and the researches in the field of design which it carried on during this period resulted in contributions to the science of highway engineering which are comparable in value with those of the École de Ponts et Chaussées of France.

Much of the testing apparatus which is now used the world over to measure the value of road materials was developed by it during this fruitful period. One of the most useful testing instruments, the Page impact machine, bears the name of its late director.

THE SAND-CLAY ROAD DEVELOPED BY THE BUREAU.

Every type of road construction adaptable to rural conditions has been carefully studied by the bureau and the simplest and best methods of constructing them taught to local road builders of counties all over the United States.

One type of road, the sand-clay type, thousands of miles of which have been constructed in the southern section of the United States where climatic conditions approach those of Brazil, was developed almost entirely by the bureau. The combination of sand and clay in suitable proportions results in a mixture the properties of which, differing widely from those of the constituent materials, permit its use as a very satisfactory surfacing material for roads which carry light traffic in a region relatively free of frost. As the materials are commonly found by the roadside, it is one of the cheapest types of road to build, and it should be as useful in parts of Brazil as it has been in the United States.

PROBLEMS INTRODUCED BY AUTOMOBILE INVESTIGATED.

When the automobile came to demand a further improvement in the character of the roads which were being built the bureau's chemists took a leading part in the development of the bituminous materials—tars and asphalts—by the use of which the dust problem and the problems presented by the raveling of macadam roads were finally solved.

Recently the rapid increase of heavy motor trucks has raised other problems which are being attacked in the same spirit, and toward the solution of which the investigations made thus far have contributed much information of value. The studies of the impact of heavy motor trucks and the various experiments with subgrade soils, to determine their bearing power with different degrees of moisture, and to devise methods of treatment to increase the bearing power, have produced information of special value.

FEDERAL-AID ROAD WORK.

Considering the amount of money involved and the size of the force employed, the research work of the bureau is dwarfed by the magnitude of the Federal aid and forest road work which it administers. Together these works constitute what is probably the greatest program of road construction ever undertaken under single control in the history of the world.

The Federal-aid roads are built with funds appropriated by the Federal and State Governments and under their joint supervision. Since 1916 when the work was begun the National Congress has appropriated $540,000,000 to be expended over a period of ten years. When this appropriation is matched by State funds in the prevailing proportion the total expenditure for this period will amount to more than a billion and a quarter of dollars, the equivalent in Brazilian money at the present rate of exchange of more than 10,000,000,000 milreis.

Up to May 30, 1922, the total cost of the 17,039 miles of completed roads was $298,824,511, of which $127,911,770 was the portion of the Federal Government. On the same date the roads under construction amounted to 14,491 miles and their estimated total cost was $251,913,148, of which $108,014,077 will be contributed by the Federal Government.

NATIONAL FOREST ROADS

For roads in the national forests the Congress has appropriated $47,000,000. The forests have been set aside as areas under Federal control in order to conserve their timber resources. Most of them are in the western part of the United States, a few small areas being located in the East. The western forests have a total area of 154,000,000 acres, a territory of greater extent than the State of Rio Grande do Norte.

There are approximately 14,000 miles of main State and county roads within the forests still to be constructed, and in addition it is estimated that there are about 13,000 miles of service road required for the proper administration and protection of the forests themselves. Roads of the former class are constructed under the supervision of the Bureau of Public Roads; the service roads are built by the Forest Service, another bureau of the Agricultural Department.

AGRICULTURAL ENGINEERING WORK OF THE BUREAU

In addition to its road-building divisions, the Bureau of Public Roads also has a division which carries on research and supplies free advice to the public in matters pertaining to the various branches of agricultural engineering.

One section of this division deals with problems of land irrigation, and its work is of particular benefit to a large part of the western half of the United States, in which the natural rainfall is insufficient to support agriculture. Another section is equipped to furnish information with regard to land drainage. Its field of operation is generally confined to the eastern half of the country, where there are large acreages which can be improved for agricultural purposes by drainage. In addition to the drainage of the soil, this section has also made a study of the means of preventing the erosion of soils by terracing and other means. A third section of this division deals with problems of farm architecture, water supply, and sewage disposal; and a fourth is equipped to give advice to any citizen who requests it on problems of mechanical power for the farm.

THE EXHIBIT OF THE BUREAU

The work of the Bureau of Public Roads is represented in the Brazil Centennial Exposition by a model of a road and bridge behind which there is an oil painting 25 feet long and 10 feet high so arranged as to serve as the background for the model.

The road represented by the model is surfaced with gravel. Thousands of miles of such roads have been built as Federal-aid roads under the supervision of the bureau; in fact, a greater mileage of it has been built than of any other single type of highway. Constructed with gravel obtainable near the site of the road it is one of the cheapest types, and when properly maintained it gives excellent service to relatively light traffic.

At the left of the model against the background are the gravel pit and the bins for the storage of the two sizes separated by means of the revolving screen. Supplies of surfacing material are loaded by gravity from the bins into the motor trucks to be hauled a short distance to the road.

Before the gravel is taken to the road a trench as wide as the surfaced way and approximately as deep is dug in the rough grade, and the bottom of the trench which forms the subgrade of the road is shaped to the crown or transverse slope of the finished road. This crown for gravel roads is generally parabolic, with an average slope from the center to both sides of one-half inch per foot. After the subgrade has been cut it is rolled to uniform shape and hardness. A typical American roller is shown in operation on the subgrade of the road at the left of the model.

Adjoining the section of subgrade which is being rolled there is a section on which the first course of gravel has been laid and rolled. The maximum size of the gravel particles in this course is 3 inches and the compacted depth of the course is 4 inches.

On the next section to the right a truck is shown in the act of delivering a load of gravel for the second course and the workmen are spreading the material previously deposited. The maximum size of the particles composing this course is 2 inches and the depth of the course after compaction will be 4 inches.

The method of construction represented by the model is what is known as the two-course method. If the gravel as obtained from the pit does not have a suitable binding or cementing material mixed with it, such material is added after the gravel is spread upon the road. Generally the binding material is clay, but ferruginous or calcareous materials such as nodules of oxide of iron or limestone particles mixed with the gravel form a better binder. Roads cemented with such materials and containing a minimum amount of clay do not become muddy in the wet season.

Many gravel roads in the United States are now built without excavating the trench as shown on the model, the gravel being deposited on a flat subgrade in one or two courses of such depth as to permit rapid compaction either with the roller or under the wheels of vehicles.

In the center of the model there is a reinforced concrete T-beam bridge, typical of thousands of such structures on modern roads in the United States. Durable bridges of this character are being constructed on nearly all newly built roads in the United States, and the wooden bridges on the older roads are being replaced by structures of the more durable material as rapidly as possible.

To the right of the bridge is shown the completed road and the method of reshaping it when it becomes rutted by the traffic. Once or twice a year the road grader is used, and the drag made of a split log, planks, or possibly of steel is used at frequent intervals after rains. By the

regular use of these devices the gravel road can be kept in good condition at reasonable cost.

The oil painting which forms the background of the model represents a typical scene in the eastern section of the United States, and the farmstead at the extreme right is typical in arrangement and character of structures of these features as recommended by the Agricultural Engineering Division of the Bureau of Public Roads.

The scale of the road model is one-twelfth actual size. The width of the gravel surface is 18 feet and the clear span of the bridge is 16 feet.

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