

BOSTON PUBLIC LIBRARY



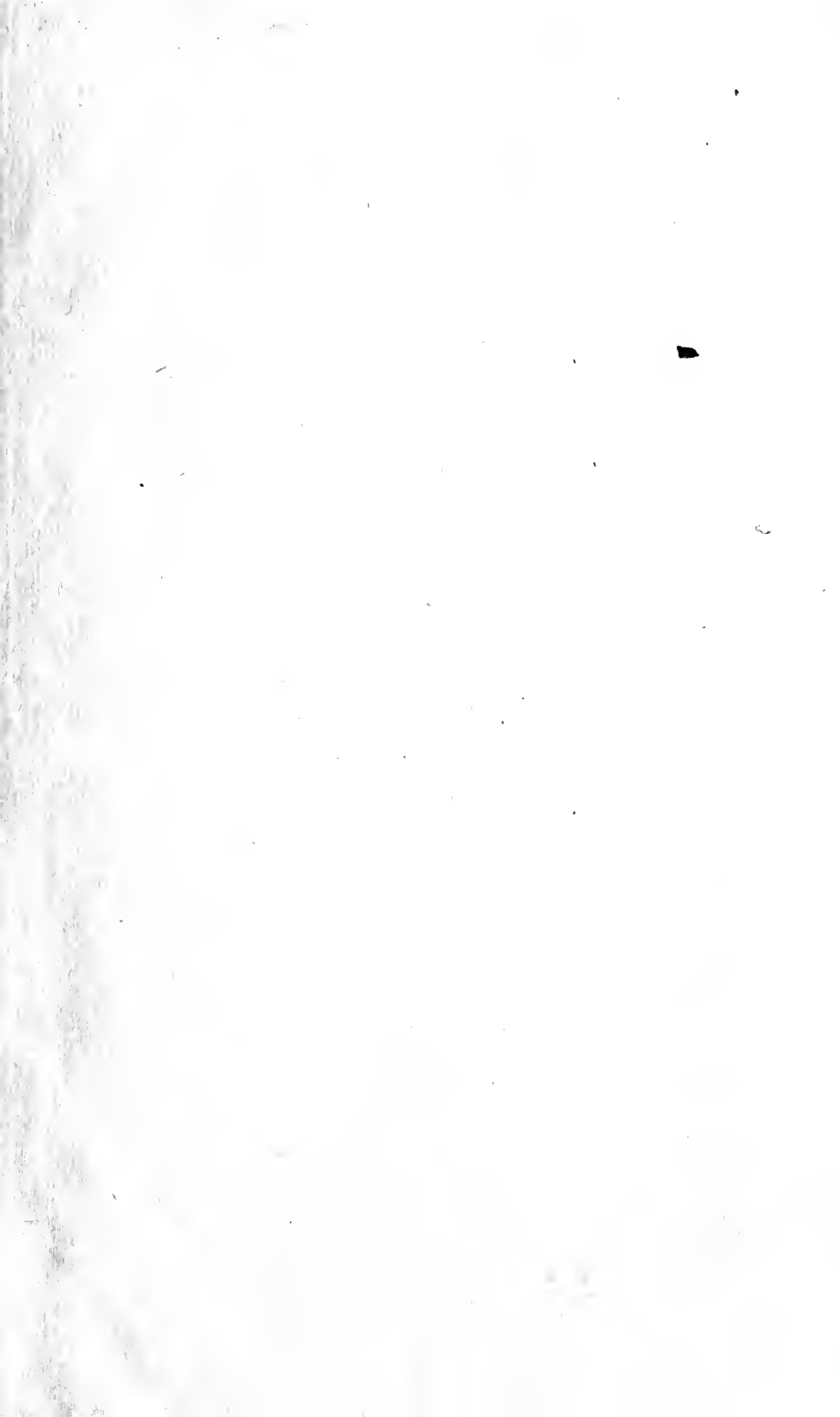
3 9999 06317 534 1

9388.173^a3

1931-35



GIVEN BY



115-19,1437
508.177-3
1931-35

REPORT OF THE CHIEF OF THE BUREAU OF PUBLIC ROADS

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF PUBLIC ROADS, *c*
Washington, D. C., September 1, 1931.

SIR: I submit herewith the report of the Bureau of Public Roads for the fiscal year ended June 30, 1931.

Respectfully,

THOMAS H. MACDONALD,
Chief of Bureau.

HON. ARTHUR M. HYDE,
Secretary of Agriculture.

Road work of all kinds in which the Federal Government has participated through the agency of the Bureau of Public Roads has been greatly increased during the fiscal year 1931 with resulting large increases in the employment of labor.

In the Federal-aid road work the roads on which improvements were completed and paid for, including those improved for the first time with Federal aid and those further improved by stage construction or reconstruction, measured 11,033 miles. The corresponding figure for the preceding year was 8,682 miles.

At the close of the year the projects under construction totaled 16,480 miles as compared with the 9,916 miles that were in progress at the end of the preceding year.

During the year Federal-aid funds to the extent of \$157,952,903 were obligated to new projects and \$133,340,910 were actually paid to the States for work done on the Federal-aid highway system. The largest previous totals corresponding to these figures were the \$102,498,084 obligated in 1930 and the \$95,749,998 paid to States in 1925.

Yet, even these unprecedented figures do not measure fully the extent of the Federal Government's monetary contribution to the States for road work during the year. To them must be added the \$76,777,000 of emergency advance funds obligated to projects and the \$20,296,266 actually paid for work done during the last six months of the year. These funds were not appropriated until December 20, 1930. Yet their virtually complete expenditure for labor performed and materials supplied is assured by August 31.

In the national-forest road work the mileage of projects completed was slightly above the record of the preceding year—281 as compared with 267 miles—and the mileage under construction at the end of the year was more than 75 per cent greater than at the close of the preceding year.

In the national parks 68 miles were completed and 328 miles were under construction, as compared with the corresponding figures of 89 and 67 miles a year ago.

EMPLOYMENT OF LABOR

By three separate actions taken during and shortly before the beginning of the last fiscal year the volume of Federal-aid road construction, normal during the previous eight years, was virtually doubled in the space of one year, and the labor employment afforded by the work correspondingly increased.

For the fiscal years 1925 to 1930, inclusive, the appropriations authorized were \$75,000,000, and during that period the rate of construction—at first somewhat higher by virtue of available balances from earlier years—had settled down to the level fixed by these annual authorizations. The movement toward an increase in the volume of work came with the authorization by Congress of an additional appropriation of \$50,000,000 for the fiscal year 1931. This authorization, made by the act approved April 4, 1930, increased the funds approved for appropriation for the year beginning July 1, 1930, from \$75,000,000, as previously authorized, to \$125,000,000, and the additional allowance, immediately apportioned, was available at once for allotment to new projects.

As stated in the last annual report, the States at once proceeded to adjust their plans to the increased rate and in the three months that remained of the fiscal year 1930 had obligated to projects \$102,498,083.84, instead of the approximate \$73,000,000 which would otherwise have been absorbed.

Allotment of the balance of funds still unobligated continued at a rapid rate into the early months of the last fiscal year, and the beginning of construction on the new projects followed just as rapidly.

The effect of the increased authorization of funds is perhaps best reflected by the mileage of road under construction from month to month. At the end of January, 1930, the mileage under construction was 8,452. By the end of February it had fallen, because of the completion of work on old projects, to 8,204 miles, and by the end of March to 8,186 miles. At each of these periods the mileage under construction was approximately 500 miles less than at the corresponding date in 1929. If this parallelism of the course of the work in the two years had continued the mileage under construction at the end of April, 1930, would have been approximately the same as at the end of March and the upturn to be expected with the opening of the new construction season would have manifested itself in a moderate increase by the end of May.

But, instead of remaining at the March level, the mileage under construction at the end of April rose by more than 500 miles to 8,716 miles, a total slightly in excess of the figure for April, 1929, and by the end of May the mileage under construction—9,431 miles—instead of being about 500 miles less than at the corresponding date in 1929, was about 500 miles greater.

This increase in the volume of active construction work, following so closely after the increase of the authorized appropriation, was the result of the anticipation of the congressional action by the States in the earlier months of 1930. In June, 1930, just two months after the increase in the authorization, the volume of work done, as indicated by Federal aid earned, exceeded by 28 per cent the greatest volume of work completed in any previous June and was greater than the average for that month in the eight preceding years by nearly 75 per cent. In only three previous months during the entire history of the Federal-aid work had the volume of work performed and the amount of Federal aid earned, exceeded the amounts for this last month of the fiscal year 1930. This was the prompt result of the increase in the authorization from \$75,000,000 to \$125,000,000 a year.

In the next two months—the first of the last fiscal year—the drought which had set in early in the year reached the proportions of a national disaster. Threatened with heavy crop losses, farmers in a number of States faced a grim prospect with the onset of winter unless in some way they could find work which would provide the means to purchase their necessities.

With the purpose of affording through Federal-aid road work the greatest possible measure of relief consistent with the limitations of existing authorized appropriations, the Secretary of Agriculture apportioned the appropriation authorized for the fiscal year 1932 on September 1, 1930. Ordinarily this apportionment would not have been made until December.

Although at the time of this action there was still unobligated about \$57,000,000 of the previously apportioned authorizations, the rate of obligation, i. e., initiation of new work, had begun to fall off rapidly and this reduction in the rate of initiation of projects could be expected in a few months hence to be reflected in the volume of active work. In June the amount obligated had been more than \$17,500,000, a sum greater by nearly 20 per cent than the greatest amount obligated in any previous June and greater than in any other month of any previous year. By August the amount obligated in the monthly period had dropped to a little over \$8,000,000, which was but little above the previous normal for the month.

This falling off in the aggregate rate of obligation with a considerable unobligated balance still on hand is explainable in two ways: (1) Available funds had been virtually exhausted in a number of States, and (2) other States which still had considerable balances unobligated were proceeding normally to absorb the money in the allotted time, believing that the new apportionment would not occur until the end of the calendar year as usual. To these there might perhaps be added one other reason already effective in a few States, namely, the virtual exhaustion of State funds with which to match the Federal apportionment.

The effect of the new apportionment was first evident in the obligations during October. September's total dropped to a little over

\$6,500,000, just about the previous normal for the month, but October's aggregate, stimulated by the new apportionment, rose to more than \$10,200,000, which was nearly twice the previous normal for the month, and although the November obligations declined to approximately \$6,800,000, they were still nearly twice the previous normal for the month and were followed by more than \$10,600,000 in December, which was nearly three times the previous December normal.

These heavy obligations in the fall of 1930 were the consequence of the early apportionment of the appropriation authorized for the fiscal year 1932. Meanwhile, favored by the extraordinarily mild and dry weather that prevailed generally, construction work was continued actively late into the fall and expenditure of the obligated funds was much greater than usual at this time of the year. Expenditures of State funds on the Federal-aid projects were, of course, correspondingly heavy and besides the Federal-aid work the States were also carrying on active work at an increased rate on independent State projects.

As a result of this uncommonly active prosecution of work and the long construction season, it became evident late in the autumn of 1930 that balances of available funds which under ordinary circumstances would have been carried over the winter to pay for work recommenced in the spring would this year be reduced in many States to negligible amounts. Since the renewal of resources depended in 43 States upon action of the legislatures, which in most cases did not convene until January 1 or later, it appeared that notwithstanding the availability of a large unobligated balance of Federal-aid funds there would be a period during the winter in which a number of States might find themselves unable to initiate new projects because of a lack of State funds with which to match the Federal aid.

At the same time it was becoming increasingly evident that there would be urgent need to provide every possible opportunity for employment to prevent actual suffering and want during the winter and early spring months.

It was to meet this situation that Congress on December 20 appropriated \$80,000,000 to be apportioned among the States in the same manner as Federal aid and used by them in lieu of an equal amount of State money to match the regular Federal-aid funds. The act appropriating the money provided for the reimbursement of the Federal Treasury by deduction of the amounts actually expended by each of the States from their respective apportionments of future Federal-aid authorizations over a period of five years, beginning with the fiscal year 1933. It also limited the amounts to be advanced to the sums actually paid out by each State for work performed before September 1, 1931.

The effect of this act was immediate. Within seven days the first projects calling for a part of the money advanced were submitted by Delaware and Maryland. By the end of January—little more than a month after the appropriation—more than \$15,000,000 had

been obligated to projects. By the end of February nearly half a million dollars had been earned by work completed. By June 30 nearly \$77,000,000 had been allotted to projects and more than half of the appropriation had been earned, the money actually paid to workers and material producers. By August 31, the limiting date, the whole amount available for use on Federal-aid roads—the sum of \$631,800 having been transferred at the request of the President to other road uses—had been allotted to projects, and although it is still too early to report exactly the amount earned, it is certain that it will come within \$1,000,000 of the total appropriated.

When the appropriation was made available a condition existed in Arkansas as the result of the previous year's drought which made it particularly desirable to start road work promptly in order to relieve distress. By June 30, six months after the appropriation of this money, every cent of the Arkansas apportionment, which was \$1,388,157, had been paid out by the State and passed into the hands of workers. But, although Arkansas was the first State to earn its entire apportionment, Iowa was the first to submit its claims in full and the first to be paid its full apportionment by the Federal Government. The last claim from this State was paid on August 7.

A full and exact report of the amounts paid to each State under this appropriation will be prepared at a later date when the final vouchers have been received from all States. A brief summarization of the operation is, however, herewith submitted in Tables 1 and 2, which, though subject to minor change, are substantially correct.

TABLE 1.—*Emergency advance fund apportionment and preliminary estimate of the amount earned to August 31, 1931*

State	Apportionment of the \$80,000,000 emergency advance fund	Preliminary estimate of the amount earned to Aug. 31, 1931	State	Apportionment of the \$80,000,000 emergency advance fund	Preliminary estimate of the amount earned to Aug. 31, 1931
Alabama.....	\$1, 698, 645	\$1, 698, 645	New Hampshire.....	\$400, 000	\$400, 000
Arizona.....	1, 170, 481	1, 169, 000	New Jersey.....	1, 107, 807	1, 167, 807
Arkansas.....	1, 388, 157	1, 388, 157	New Mexico.....	1, 303, 288	1, 303, 288
California.....	3, 108, 233	3, 108, 233	New York.....	4, 050, 566	4, 050, 566
Colorado.....	1, 507, 832	1, 507, 832	North Carolina.....	1, 926, 775	1, 926, 775
Connecticut.....	520, 491	520, 491	North Dakota.....	1, 298, 532	1, 298, 532
Delaware.....	400, 000	400, 000	Ohio.....	2, 998, 538	2, 998, 538
Florida.....	1, 086, 438	1, 086, 438	Oklahoma.....	1, 926, 351	1, 926, 351
Georgia.....	2, 077, 996	2, 077, 996	Oregon.....	1, 320, 287	1, 270, 000
Idaho.....	1, 008, 035	1, 008, 035	Pennsylvania.....	3, 512, 943	3, 512, 943
Illinois.....	3, 400, 116	3, 400, 116	Rhode Island.....	400, 000	400, 000
Indiana.....	2, 045, 929	2, 045, 929	South Carolina.....	1, 114, 636	1, 114, 636
Iowa.....	2, 116, 369	2, 116, 369	South Dakota.....	1, 337, 973	1, 337, 973
Kansas.....	2, 192, 301	2, 192, 301	Tennessee.....	1, 741, 882	1, 741, 882
Kentucky.....	1, 504, 715	1, 504, 715	Texas.....	5, 088, 080	4, 880, 218
Louisiana.....	1, 147, 927	981, 156	Utah.....	926, 521	926, 521
Maine.....	715, 799	715, 799	Vermont.....	400, 000	400, 000
Maryland.....	678, 752	678, 752	Virginia.....	1, 505, 522	1, 473, 266
Massachusetts.....	1, 141, 460	1, 141, 460	Washington.....	1, 270, 933	1, 270, 933
Michigan.....	2, 521, 382	2, 521, 382	West Virginia.....	875, 384	875, 384
Minnesota.....	2, 249, 993	2, 249, 993	Wisconsin.....	1, 992, 410	1, 992, 410
Mississippi.....	1, 434, 736	1, 434, 736	Wyoming.....	1, 029, 383	1, 029, 383
Missouri.....	2, 526, 823	2, 349, 220	Hawaii.....	400, 000	400, 000
Montana.....	1, 671, 930	1, 671, 930			
Nebraska.....	1, 708, 031	1, 708, 031	Total.....	80, 000, 000	79, 242, 122
Nevada.....	1, 049, 638	928, 000			

TABLE 2.—*Approximate summary of Federal-aid road operations, by months, under \$80,000,000 emergency advance appropriation*

Date	Accumulated amount obligated to projects	Estimated accumulated amount earned by completion of work	Accumulated amount paid to States	Date	Accumulated amount obligated to projects	Estimated accumulated amount earned by completion of work	Accumulated amount paid to States
1931				1931			
Jan. 31.....	\$15,366,000	-----	-----	May 31.....	\$74,555,000	\$20,365,000	\$3,642,130.88
Feb. 28.....	37,716,000	\$486,000	-----	June 30.....	76,777,000	40,719,000	20,296,266.24
Mar. 31.....	57,728,000	2,582,000	\$36,917.04	July 31.....	79,063,000	63,266,000	35,948,781.35
Apr. 30.....	69,168,000	8,409,000	402,991.35	Aug. 31.....	79,368,000	79,242,122	53,066,701.76

As stated above, the reason for the emergency advance appropriation was the knowledge that because of the depletion of their funds a number of States could not match the Federal aid available at the end of the calendar year 1930 and that initiation of new work would be retarded for this reason. The immediate result of the appropriation was largely to increase the obligation of regular Federal-aid funds. From \$10,600,100 in December the obligations increased to \$14,500,000 in January, to nearly \$22,000,000 in February, and to more than \$27,000,000 in March. These were by far the largest monthly obligations in the history of the Federal-aid work, and they were reflected quickly in the amount of active construction work.

As a result of the high rate of completion of projects made possible by the long working season of the previous year and the momentary lag in initiation of new work because of the depletion of State funds, the mileage of Federal-aid road under construction had dropped at the end of January, 1931, to 8,812 miles, but little larger than the total at the same date in 1930. But by March 31 the mileage had risen to 10,388, virtually the figure attained by July 31 in the previous year. And at the end of the fiscal year on June 30 there were under construction 16,480 miles, exceeding by several thousand miles the largest volume of work under construction at any one time in the whole course of the Federal-aid program.

In the foregoing it has been the purpose to trace separately the separate effects of the three principal actions successively taken between April and December, 1930, to increase largely and quickly the size of the Federal-aid road construction program as a means of providing employment for idle labor.

The combined effects of all three actions were manifest in the extraordinarily large amount of construction work carried on during the first six months of the present year and the remarkably early beginning of this work. The records show that the mileage of road under construction at the end of February this year was greater than at the end of May last year, and by the end of March of the present year work was under way on a mileage of road practically equal to that which was under construction at the end of July, 1930.

Virtually complete reports of labor employed on the various classes of road work under the supervision of Federal and State agencies have been received by the bureau monthly since March by arrangement with the several State highway departments. The average number of persons employed each month on each class of work as

shown by these reports is shown in Table 3, summarized for the entire United States.

TABLE 3.—Average number of persons employed directly on various classes of road work under the supervision of Federal and State agencies, by months, from March to June, 1931, inclusive

Month	Construction of roads						Maintenance of roads	Total	
	National forest roads	National park roads	Federal-aid roads		Total Federal and Federal aid	State and State aid			Total on construction
			Regular projects	Emergency projects ¹					
March.....	1,278	172	28,068	25,334	54,852	58,701	113,553	92,889	206,442
April.....	2,619	350	39,415	55,099	97,483	72,250	169,733	90,129	259,862
May.....	3,684	1,002	39,518	82,387	126,591	89,804	216,395	95,050	311,445
June.....	4,660	2,168	40,223	107,402	154,453	101,311	255,764	111,053	366,817

¹ Under this head the figures represent the number of men employed on Federal-aid projects on which a portion of the State's share of the cost was paid with money advanced by the Federal Government under the appropriation of Dec. 20, 1930.

It will be noted that the average number of persons employed on all Federal and Federal-aid road construction, including the national-forest and park work, increased from 54,852 in March to 154,453 in June, a gain of 100,000 in the three months. In March the number given employment by the Federal and Federal-aid work was a little over a fourth of the total employed on all Federal and State work, which was 206,442. In June the Federal work employed 42 per cent of the total of 366,817 persons, the average number reported as employed on all Federal and State work. The figures given in Table 3 do not include the large numbers of laborers engaged upon road and street construction and maintenance under the administration of city, county, and township authorities, and represent only persons directly employed upon road construction and maintenance work of the Federal and State Governments.

We have estimated that for every person directly employed on the road work proper two others are employed on the average in the manufacture and transportation of road materials and equipment. The estimate has been subjected to a number of tests and appears reasonable. Assuming that it is approximately correct, the total employment furnished by the Federal and Federal-aid road work in June, 1931, was probably equivalent to the full time of more than 460,000 persons, and the Federal and State work combined probably furnished employment to over 1,000,000 persons.

We have estimated that the number of persons directly employed in June, 1930, on road work supported in whole or in part by Federal funds was approximately 64,000, or less by 90,000 than the 154,000 directly employed on work of like character in June, 1931.

PROGRESS IN FEDERAL-AID ROAD CONSTRUCTION

Initial improvements were completed during the fiscal year on 7,938.8 miles of the Federal-aid highway system; advanced stages of construction were completed on 3,082.5 miles; and 12 miles previously improved were reconstructed. The total mileage upon which im-

provements were completed was therefore 11,033.3 miles. These projects, classed as completed, were not only physically completed but had also been paid for to the full extent of its obligation by the Federal Government.

In addition to these projects, there were others on which at the end of the year all work was physically completed to the satisfaction of the bureau, and only the final payment of Federal money remained to discharge the Government's full obligation. Projects in this stage have previously been reported as completed, but, since it is not possible to report the exact cost and Federal expenditure until the final voucher has been paid, it has been deemed proper this year to report such projects separately and to indicate clearly that the total cost and Federal-aid reported are approximate.

In projects at this stage of progress there were at the end of the year 2,131.9 miles of initial construction, 881.4 miles of stage construction, and 17.5 miles of reconstruction, a total of 3,030.8 miles.

At the close of the year construction of initial improvements was in progress on 12,305.8 miles, and other initial improvements had been approved for 1,945.6 miles. Stage construction was in progress on 4,138.5 miles already initially improved with Federal aid, and similar advanced improvements had been approved of 1,033.3 miles. In addition, 35.5 miles of roads previously improved were in process of reconstruction.

The total mileage on which initial improvements had been completed and the final payment made by the Federal Government up to the beginning of the fiscal year was 90,755.2. In addition, there had been physically completed and opened to traffic 2,131.9 miles upon which some money was still due to the States for work done. Initial improvements had thus been physically completed on 92,887.1 miles included in the system on June 30. At that time, however, 4,174 miles included in the above were undergoing stage construction or reconstruction, and were, therefore, temporarily removed from the mileage available for travel, so that the bureau classifies as completed on June 30 last only 88,713.1 miles. The location of this mileage by States is shown in Table 17. Its classification by types and location is shown in Table 22.

As required by law, the progress of improvement on the entire Federal-aid highway system is each year charted on maps which are revised, as nearly as possible, annually. During the last fiscal year such maps showing the progress of construction in 46 of the 48 States were published.

Since the law requires that such maps shall show the condition of the whole system, including parts on which no Federal money has been expended, it is necessary that the bureau regularly compile information on work done independently by the States on the system as well as the work in which the Federal Government cooperates.

To present the required map record of progress it has been necessary to publish sectional maps of the United States on 108 sheets each 22 by 32 inches in size. On these sheets the location of the Federal-aid system is plotted and the various types of construction employed on each section of the system, whether by the States alone or with Federal aid, are indicated by appropriate symbols.

Official distribution is made to other Government agencies, State highway departments, map-publishing companies, recognized tour-

ing agencies, and free public libraries, aggregating over 19,000 maps. A number of the libraries have obligated themselves to provide suitable binders or containers so that the maps may be freely available and conveniently consulted.

Under arrangement with the Superintendent of Documents, separate copies for each State may be purchased at the nominal price of 10 cents per sheet.

STAGE CONSTRUCTION AND RECONSTRUCTION

As in previous years, advanced stages of improvement have been carried forward on portions of the Federal-aid system previously improved with Federal aid concurrently with the extension of initially improved mileage. Also, as in the preceding year, there has been a small amount of reconstruction of roads previously improved with Federal aid.

As explained in the last annual report, there is a clear distinction between stage construction and reconstruction. The former represents a continuation of work anticipated as eventually necessary at the time of the original improvement but deliberately deferred for one reason or another, generally because it is undesirable to expend more money upon the improvement at the moment. Reconstruction, however, becomes necessary when an improvement originally believed to be adequate is overtaxed by an unanticipated increase in traffic, or simply when a surface originally adequate and perhaps still adequate for the traffic, wears out. It is now 14 years since the Federal-aid policy was inaugurated and it may be expected that henceforth there will be from year to year a certain amount of reconstruction becoming heavier as years go on. For, even with the best of maintenance, some of the earlier improvements of the less durable sort are now approaching the limit of their life.

As year follows year the ratio of stage construction to initial construction operations increases. This is clearly shown by Table 4, in which it will be seen that the stage construction has increased from a mileage equal to only 1.2 per cent of the year's initial improvements in 1923 to a mileage equal to 38.8 per cent of the initial construction in 1931.

TABLE 4.—Mileage of initial construction, stage construction, and reconstruction completed and final payment made, by fiscal years 1923-1931, inclusive

Fiscal year	Mileage of initial construction completed and paid for	Stage construction completed and paid for		Reconstruction completed and paid for		Mileage of total construction
		Mileage	Percentage of initial construction	Mileage	Percentage of initial construction	
1923.....	9,940.5	117.8	1.2	.....	.....	10,058.3
1924.....	9,145.6	280.7	3.1	.....	.....	9,426.3
1925.....	9,437.1	495.3	5.3	.....	.....	9,932.4
1926.....	10,533.3	783.9	7.4	.....	.....	11,317.2
1927.....	8,413.5	1,376.6	16.4	.....	.....	9,790.1
1928.....	8,532.2	2,085.8	24.5	.....	.....	10,621.0
1929.....	7,267.4	2,069.7	28.5	.....	.....	9,337.1
1930.....	6,675.4	1,988.0	29.8	18.8	0.3	8,682.2
1931.....	7,938.8	3,082.5	38.8	12.0	.2	11,033.3

This increase is the natural result of the policy that has been followed for years under which the first endeavor has been to spread a certain minimum of improvement over as large a mileage as possible and subsequently, as rapidly as funds became available or the need became acute, to further improve the roads already improved to some degree.

Under this policy many thousands of miles have been improved initially only by grading and draining, with a definite understanding expressed in the agreements with the States that surfacing and further improvement would be added in due time.

The stage-construction work does not increase the mileage of improved road but it is constantly raising the standard of improvement of the system; and it is due to the stage-construction work that although each year the initial-improvement work adds many miles of low-type improvement, the total mileage of these types is either increasing very slowly or actually decreasing. On the other hand, the mileage of high-type improvement is increasing at a more rapid rate than the initial improvements of this class would indicate.

These effects of stage construction are brought to light by a comparison of Tables 23 and 31, the first presenting the mileage of each type of highway initially completed and paid for during the last fiscal year, and the second, the net change in the mileage of each type of improvement in the portion of the system improved with Federal aid.

Thus it will be seen that although during the year there was an initial improvement of 1,854.4 miles merely by grading and draining, the mileage of road thus simply improved in the system actually shrank during the year by over 1,200 miles. And, although the year's completion of initial concrete pavements was only 3,160.3 miles, the mileage of this high type of pavement in the system increased by 4,316.5 miles.

Detailed information in regard to stage construction completed, in process, and approved will be found in Tables 18-21 and 27-30.

Information on the small mileage of reconstruction work will be found in Tables 5-11 and 18-20. In Tables 8-11, which show the old and new surface types of mileage that has been reconstructed or is now being reconstructed, and the age at the time of reconstruction, it will be seen that in every instance the new construction is of a type at least as high as the original and in nearly every instance higher.

The general age of the original surfaces at the time of reconstruction ranged from 9 to 12 years. The only surfaces below 9 years of age at the time of reconstruction were 2 of gravel—1, in Louisiana, 4 years old, and the other, in Vermont, 5 years old.

TABLE 5.—Federal-aid projects on which reconstruction had been completed and paid for during fiscal year 1931

State	Total cost	Federal aid	Miles	State	Total cost	Federal aid	Miles
Maine.....	\$78,476.74	\$23,190.00	1.6	Oklahoma.....	122,289.26	60,763.24	2.7
Massachusetts....	101,799.71	39,225.00	2.6	Vermont.....	52,258.11	21,495.00	1.4
New Hampshire..	241,861.41	55,155.00	3.7	Total.....	596,685.23	199,828.24	12.0

TABLE 6.—Federal-aid projects on which reconstruction had been completed, but final payment not made, as of June 30, 1931

State	Estimated total cost	Federal aid allotted	Miles
Maryland.....	\$587, 282. 72	\$284, 646. 88	11. 7
Oklahoma.....	160, 506. 17	62, 846. 59	6. 8
Total.....	747, 788. 89	347, 493. 47	17. 5

TABLE 7.—Federal-aid projects on which reconstruction was in progress on June 30, 1931

State	Estimated total cost	Federal aid allotted	Miles
Maryland.....	\$150, 870. 25	\$46, 100. 00	1. 8
Michigan.....	763, 792. 32	243, 375. 00	16. 1
Nevada.....	327, 117. 79	198, 652. 66	9. 2
Oklahoma.....	185, 963. 65	102, 767. 15	8. 4
Total.....	1, 427, 744. 01	590, 894. 81	35. 5

TABLE 8.—Federal-aid projects on which reconstruction had been completed on June 30, 1931, by types of construction

State	Age	Original type							
		Gravel, untreated		Bituminous macadam		Bituminous concrete		Portland cement concrete	
		New type	Miles	New type	Miles	New type	Miles	New type	Miles
Louisiana.....	Years 4	Bituminous concrete.	7. 5						
Maine.....	9			Concrete.	1. 6				
Do.....	7			do.	1. 9				
Maryland.....	8			do.	6. 6				
Do.....	11							Concrete.	5. 9
Do.....	11			Concrete.	5. 8				
Massachusetts.....	8			do.	2. 7				
Do.....	10					Bituminous macadam.	2. 6		
New Hampshire.....	12					Concrete.	1. 2		
Do.....	12					do.	. 5		
Do.....	10					do.	2. 0		
Oklahoma.....	9	Concrete.	2. 6						
Do.....	9	Bridge.	. 1						
Do.....	9	Concrete.	2. 5						
Do.....	9	do.	3. 3						
Vermont.....	5	do.	1. 4						

TABLE 9.—Federal-aid projects on which reconstruction had been completed and paid for during the fiscal year 1931, by types of construction

State	Age	Original type					
		Gravel, untreated		Bituminous macadam		Bituminous concrete	
		New type	Miles	New type	Miles	New type	Miles
	<i>Years</i>						
Maine.....	9			Concrete..	1.6		
Massachusetts.....	10					Bituminous macadam..	2.6
New Hampshire.....	12					Concrete.....	1.2
Do.....	12					do.....	.5
Do.....	10					do.....	2.0
Oklahoma.....	9	Concrete..	2.6				
Do.....	9	Bridge.....	.1				
Vermont.....	5	Concrete..	1.4				

TABLE 10.—Federal-aid projects on which reconstruction had been completed, but final payment not made, as of June 30, 1931, by types of construction

State	Age	Original type					
		Gravel, untreated		Bituminous macadam		Bituminous concrete	
		New type	Miles	New type	Miles	New type	Miles
	<i>Years</i>						
Maryland.....	11					Concrete.....	5.9
Do.....	11			Concrete.....	5.8		
Oklahoma.....	9	Concrete.....	2.5				
Do.....	9	do.....	3.3				

TABLE 11.—Federal-aid projects on which reconstruction was in progress on June 30, 1931, by types of construction

State	Age	Original type							
		Gravel, untreated		Bituminous macadam		Bituminous concrete		Portland cement concrete	
		New type	Miles	New type	Miles	New type	Miles	New type	Miles
	<i>Years</i>								
Maryland.....	9			Concrete..	1.5				
Do.....	11			do.....	.3				
Michigan.....	8					Concrete..	10.0		
Do.....	6	Concrete..	1.3						
Do.....	6	do.....	4.8						
Nevada.....	8							Bituminous concrete..	9.2
Oklahoma.....	9	Concrete..	4.5						
Do.....	9	do.....	3.9						

CHANGES IN THE FEDERAL-AID HIGHWAY SYSTEM

In the last annual report the mileage of the Federal-aid system within the boundaries of national forests, Indian reservations, and other Federal reservations was reported as 5,456.11 miles as determined up to the close of the fiscal year 1930. During the past year further determinations have increased this mileage to 5,580.07, located, by States, as shown in Table 12.

TABLE 12.—*Mileage of Federal-aid highway system within Federal reservations, being the amounts by which the 7 per cent limiting mileage may be exceeded in each State or Territory*

State	Mileage within Federal reservations	State	Mileage within Federal reservations
Arizona.....	547.20	New Mexico.....	368.88
Arkansas.....	119.70	New York.....	16.47
California.....	457.00	North Carolina.....	176.34
Colorado.....	423.70	North Dakota.....	23.39
Georgia.....	57.80	Oklahoma.....	16.25
Idaho.....	468.40	Oregon.....	360.10
Illinois.....	4.50	Pennsylvania.....	108.21
Iowa.....	2.00	South Dakota.....	474.50
Kansas.....	14.70	Tennessee.....	66.04
Kentucky.....	6.00	Utah.....	68.90
Maine.....	4.50	Virginia.....	30.72
Michigan.....	26.50	Washington.....	353.21
Minnesota.....	74.80	West Virginia.....	29.06
Mississippi.....	10.40	Wisconsin.....	45.50
Montana.....	878.82	Wyoming.....	275.90
Nebraska.....	11.25	Hawaii.....	4.34
Nevada.....	21.77		
New Hampshire.....	33.42	Total.....	5,580.07

Under the amendment of the Federal highway act approved May 21, 1928, the original 7 per cent system in the several States may be increased by these mileages within Federal reservations, and such addition raises the permissible mileage of the initial system to 206,142 miles.

By addition to the system during the past year, made possible in part by the provisions of the amendment of May 21, 1928, the mileage of the initial system has been increased to 194,294 miles. This mileage has been further increased by extension of the system in six States in which the initial 7 per cent system has been improved to the satisfaction of the Secretary of Agriculture. The States in which such extensions have been approved are: Connecticut, in which the extension is 63.66 miles; Delaware, 341.83 miles; Maryland, 791.55 miles; New Jersey, 116.20 miles; New York, 984.10 miles; and Rhode Island, 286.06 miles. The sum of these extensions, being 2,583.40 miles, added to the initial system thus far designated, raises the mileage of the total system to 196,877 miles as of June 30, 1931, an increase of 3,827 miles in the last year.

The mileage of the designated Federal-aid system in each State, including the authorized extensions in the six States mentioned, and the mileage within Federal reservations is given in Table 17, which also shows the distribution, by States, of the 88,713.1 miles classified as completed on June 30, 1931.

The mileage classified as completed with Federal aid still includes some roads improved before 1921 and not since included in the designated Federal-aid system. These roads, if found not sufficiently important to be added to the designated system, gradually are being dropped and the Federal money invested in them transferred as a credit to the improvement of other roads in the system.

A year ago it was reported that the Federal aid originally paid for the improvement of 696 miles of such roads outside of the system had been transferred to other roads within the system. The continuation of this procedure during the past year has returned to

the Government the amount originally expended on other roads outside the system totalling 315.3 miles, and this money has been allotted to the initial or stage construction of other roads within the system.

The mileage classified as improved has also been reduced this year by reductions in the length of previously improved roads by relocations effected in stage construction, aggregating 36.2 miles.

BRIDGE CONSTRUCTION

The bridges completed as initial improvement and fully paid for during the fiscal year have with their approaches an aggregate length of 56.4 miles. Those added by stage construction completed and fully paid for aggregate 7.5 miles, making a total of 63.9 miles of bridges and their approaches completed and fully paid for during the fiscal year. In addition there were physically completed 25.2 miles of bridges as initial construction and 3 miles as stage construction, a total of 28.2 miles, on which the full share of the Federal Government has not yet been paid.

Including the structures just completed, the Federal-aid bridges completed and fully paid for by the Federal Government to date have a total length, with their approaches, of 389.7 miles.

A list of bridges completed during the year which cost \$75,000 or more is given in Table 13. These, the longest and most expensive of the projects completed, range in length from about 0.1 mile to 3.7 miles, and have an aggregate length with their approaches of 21.8 miles. The rest of the completed mileage is made up of numerous smaller and less expensive bridges, each more than 20 feet in span.

TABLE 13.—Federal-aid bridges completed during the fiscal year 1931 at a cost of \$75,000 or more each

State	Location	Stream or railroad	Estimated total cost	Length of bridge and approaches
				<i>Miles</i>
Arizona.....	Phoenix-Gila Bend Road near Coldwater.	Agua Fria River.....	\$168,800	0.2
	Benson-Douglas Highway.....	San Pedro River.....	76,000	.1
	Red Bluff-California-Oregon State line.	Cottonwood Creek.....	161,300	.2
	Near Cottonwood.....	Underpass Southern Pacific R. R.	138,000	.2
California.....	San Lucas-Santa Maria.	Salinas River.....	231,000	.3
	Victorville-Barstow.....	Mojave River.....	125,000	.1
	Stockton-Sacramento Road near Lodi.	Mokelumne River.....	91,900	.2
	Lamar-Las Animas.....	Arkansas River.....	145,000	.2
Colorado.....	Grand Junction-Palisades Highway.	Overpass Denver & Rio Grande Western R. R.	75,600	.5
	Boston Post Road-Fairfield-Westport.	Southport Cutoff-New York, New Haven & Hartford R. R.	454,700	.6
Connecticut.....	Norwich-Putnam Highway.....	Quinnebaugh River.....	500,800	.5
	do.....	Tadpole Crossing-New York, New Haven & Hartford R. R.	77,400	.2
Florida.....	Live Oak-Madison.....	Suwannee River.....	126,800	.2
	Tampa-Bradenton at River-view.	Alafia River.....	103,900	.1
Indiana.....	Indianapolis-Jeffersonville Highway.	Overhead Bridge Pennsylvania R. R.	109,900	.1
Kentucky.....	Louisville-Bardstown.....	Salt River.....	113,600	.1
	Harlan-Whitesburg Highway.	Poor Fork of Cumberland River.	98,700	.1

TABLE 13.—Federal-aid bridges completed during the fiscal year 1931 at a cost of \$75,000 or more each—Continued

State	Location	Stream or railroad	Estimated total cost	Length of bridge and approaches
				<i>Miles</i>
Louisiana	(Near Oberlin.....	Calcasieu River.....	\$110,800	0.3
	Tallulah-Monroe.....	Boeuf River.....	77,300	.1
	Jonesville-Harrisonburg Highway.....	Little River.....	127,300	.1
	New Orleans-Chef Mentour Highway.....	Chef Mentour Pass.....	591,700	.2
do.....	Rigolets Pass.....	1,350,000	3.7	
Maine.....	At Edgecomb.....	Cod Cove.....	118,200	1.1
Massachusetts	New Bedford-Wareham.....	Weweantic River (3 bridges).....	149,900	.1
	Ann Arbor-Ypsilanti Highway.....	Ann Arbor R. R. and State Street.....	138,300	.3
Michigan	Muskegon-Ludington.....	Muskegon River-Cedar Creek (3 bridges).....	380,600	1.4
	Dix-Toledo Road.....	Underpass Detroit, Toledo & Ironton R. R.....	172,900	.3
Minnesota	(Champlen-Anoka.....	Mississippi River.....	398,400	.2
	Big Lake-Montrose.....	do.....	158,900	.2
Mississippi	Gulfport-Pascagoula.....	Biloxi Bay.....	764,100	1.5
	Columbus-Aberdeen.....	Tombigbee River.....	91,900	.1
	South edge of Vicksburg.....	Overpass Yazoo & Mississippi Valley R. R.....	84,300	.1
Missouri	(Carrollton - Keytesville Highway.....	Grand River.....	185,700	.3
	Bowling Green - Wentzville Highway.....	Cuivre River.....	104,300	.1
Montana	(Livingstone-Laurel.....	Yellowstone River.....	78,300	.1
	Knowles-Weeksville Road.....	Clark Fork River.....	188,900	.2
	Dillon-Butte Road.....	Nissler Viaduct over Great Northern R. R.....	78,800	.1
do.....	Little Wolf Creek.....	100,500	.1	
Nebraska	White Way near Clarks.....	Missouri River.....	361,200	.1
New Hampshire	Potter Place-Lebanon.....	Platte River.....	85,400	.2
		Overpass Boston & Maine R. R.....	98,600	.4
New Jersey	Jersey City-Newark Highway.....	Passaic River.....	682,900	.2
New Mexico	Aztec-Farmington Highway.....	Las Animas River.....	105,200	.6
North Carolina	Weldon-Pleasant Hill Road.....	Roanoke River.....	225,600	.3
	Perrysburg-Maumee.....	Maumee River.....	351,100	.7
Ohio	Columbus - Lancaster Highway.....	Underpass Hocking Valley R. R.....	107,600	.2
	Southeast of Centerburg.....	Underpass New York Central R. R.....	117,900	.2
Oklahoma	(Perkins-Coyle.....	Cimarron River.....	93,900	.2
	West of Spur.....	Boggy Creek.....	149,600	.2
Oregon	Waurika, Okla.-Ringgold, Tex.....	Red River.....	145,200	.2
	Grants Pass.....	Rogue River.....	125,900	.1
Pennsylvania	(Lemoine-Duncannon.....	Sherman Creek.....	85,600	.1
	Bedford-McConnellsburg.....	Juniata River.....	202,800	.1
	erie-Waterford.....	Mill Creek.....	144,700	.1
do.....	Overpass New York, New Haven & Hartford R. R.....	132,400	.3	
Rhode Island	Hope-Anthony.....	Pawtuxet River.....	75,200	.1
	Alton-Bradford.....	Wood River.....	132,900	.2
	Houston-Beaumont Road.....	Trinity River.....	201,000	.3
	State Highway 5, Route 5.....	Red River & South Plains R. R.....	179,800	.5
Texas	Madisonville-Crockett.....	Trinity River.....	260,100	.7
	Forney - Dallas - Kaufman County line.....	East Fork Trinity River.....	91,600	.3
do.....	Lavaca River.....	92,100	.2	
Virginia	Jacksonville-Athens.....	Neches River.....	75,100	.2
	Jackson's Ferry.....	New River.....	87,800	.1
do.....	do.....	do.....	104,700	.2
Washington	At Prosser on Inland Empire Highway.....	Yakima River.....	84,800	.1
West Virginia	At Shinnston.....	West Fork River.....	144,100	.1
Wisconsin	At Princeton.....	Fox River.....	83,600	.1

CONSTRUCTION OF ROADS THROUGH PUBLIC LANDS AND FEDERAL RESERVATIONS

By the act approved June 24, 1930, the Secretary of Agriculture was authorized to cooperate with State highway departments and the Department of the Interior in the survey, construction, recon-

struction, and maintenance of main roads through unappropriated or unreserved public lands, nontaxable Indian lands, or other Federal reservations other than forest reservations. The act provided that sums which might be subsequently authorized to be appropriated for this purpose should be apportioned among States having more than 5 per cent of their area in lands of the kind described and prorated to such States in the proportion that the area of such lands in each bears to the total area of the lands in all eligible States. No contribution was required of the States, and it was provided that in the allocation of such funds as might be authorized preference should be given to projects located on the Federal-aid highway system.

The emergency employment act of December 20, 1930, appropriated \$3,000,000 for this purpose. After deduction of the 2½ per cent administrative allowance the remaining sum of \$2,925,000 was apportioned as required by law among the 13 eligible States as shown in Table 14.

TABLE 14.—*Apportionment and obligation of appropriation for roads through public lands and Federal reservations*

State	Sum apportioned	Sum obligated by June 30, 1931	State	Sum apportioned	Sum obligated by June 30, 1931
Arizona.....	\$416,328	\$416,328.00	Oregon.....	\$193,377	\$173,042.75
California.....	230,614		South Dakota.....	65,715	
Colorado.....	130,197		Utah.....	326,633	326,027.47
Idaho.....	174,316	73,997.99	Washington.....	55,165	55,165.00
Montana.....	164,521	66,378.26	Wyoming.....	280,916	229,881.60
Nevada.....	588,914	200,933.98			
New Mexico.....	256,790		Total.....	2,925,000	1,541,755.05
Oklahoma.....	41,464				

The rules and regulations promulgated by the Secretary of Agriculture on December 29, 1930, construed the term "main roads" as used in the act of June 24, 1930, to include sections of the Federal-aid highway system, continuations thereof, and necessary connections between routes thereon, and required that projects be selected and recommended jointly by the district engineers of the Bureau of Public Roads and the interested State highway departments. The rules and regulations also permitted work to be undertaken by either the States or the Federal agency, as might be provided by project agreements entered into between the State highway departments and the Secretary of Agriculture.

By the end of the fiscal year \$1,541,755.05 of the money apportioned had been obligated to definite projects and the balance will be obligated early in the next fiscal year. The portion of each State's apportionment obligated on June 30, 1931 is shown in Table 14.

In selecting projects preference has been given, as required by law, to roads in the Federal-aid system as approved at present; and those projects which lie on roads not at present in the system are on roads of such importance that it is considered likely they will be taken into the system by future extensions.

Thus far only two projects have provided for surveys only and one has provided for surveys and the preparation of plans together with

construction. All other projects involve construction only, and no requests have been received for the use of any part of the money for maintenance purposes.

FEDERAL FUNDS APPORTIONED, OBLIGATED, AND EXPENDED

The appropriation for the fiscal year 1931 was authorized in two parts. The first part—\$75,000,000—was apportioned on December 2, 1929. The second part—\$50,000,000—authorized by the act approved April 4, 1930, was apportioned April 7, 1930. In each case the 2½ per cent allowed by law for Federal administration and research was deducted before the authorized funds were apportioned, so that the total sum apportioned was \$121,875,000 and the amounts credited to each State are as shown in Table 32.

The balance of all funds apportioned that were unobligated at the beginning of the fiscal year was \$75,716,790.80, i. e., there had been obligated to projects at the beginning of the fiscal year the equivalent of all funds apportioned for prior fiscal years and over \$46,000,000 of the funds apportioned for the fiscal year then beginning.

On September 1, 1930, the appropriation authorized for the fiscal year 1932 was apportioned. The total of this authorization was also \$125,000,000 and the amount apportioned after deduction of the administrative and research percentage was again \$121,875,000, which amount increased the total sum available for allotment to projects during the fiscal year to \$197,591,790.80.

The amount obligated during the year reached the unprecedented total of \$157,952,902.76, a sum almost twice the average amount obligated annually from 1923 to 1929 and more than \$55,000,000 greater than the amount obligated during the fiscal year 1930, which was the largest sum obligated in any year up to that time.

As a result there remained available for allotment to new projects on July 1, the first day of the fiscal year 1932, only \$39,638,888.04. Of this amount, \$2,378,280.39 consisted of unobligated 1931 funds credited to the States of Alabama, Florida, and Mississippi, and the Territory of Hawaii, and \$880,000 consisted of the sum authorized by an act approved February 23, 1931, to be paid to Hawaii from funds theretofore authorized, appropriated, allocated, and unobligated for road construction in the Territory, the sum appropriated being equal to the amount the Territory would have received for roads built and incorporated into the 7 per cent system as approved during the period from 1917 to 1925.

The remainder of the amount unobligated on July 1 consisted of funds authorized for the fiscal year 1932 in the amount of \$36,380,607.65. No other year since 1919 has opened with so small a balance of unobligated funds, notwithstanding the fact that the amount apportioned within the preceding 18 months largely exceeded the amount apportioned in any previous like period. This condition is the result of the special effort put forth during the past year by the Federal and State agencies to increase the rate of progress as greatly as possible in order to increase employment.

As stated in the report for the fiscal year 1930, the Territory of Hawaii had failed by June 30, 1930, to expend \$326,864.96 of the sum apportioned to it for the fiscal year 1928. In accordance with

the provision of law that requires that amounts unexpended of sums apportioned to any State for any year by the end of the second succeeding fiscal year shall be reapportioned among all the States, the above amount was reapportioned on August 29, 1930. The amounts apportioned to the several States are shown in Table 15.

TABLE 15.—*Reapportionment of the portion of funds apportioned to the Territory of Hawaii for the fiscal year 1928 unexpended on June 30, 1930*

State	Sum apportioned	State	Sum apportioned
Alabama.....	\$7,015.00	Nevada.....	\$4,288.00
Arizona.....	4,742.00	New Hampshire.....	1,634.00
Arkansas.....	5,832.00	New Jersey.....	4,199.00
California.....	11,214.00	New Mexico.....	5,322.00
Colorado.....	6,211.00	New York.....	16,098.00
Connecticut.....	2,125.00	North Carolina.....	7,702.00
Delaware.....	1,634.00	North Dakota.....	5,369.00
Florida.....	4,139.00	Ohio.....	12,295.00
Georgia.....	8,893.00	Oklahoma.....	7,838.00
Hawaii.....	1,634.96	Oregon.....	5,357.00
Idaho.....	4,169.00	Pennsylvania.....	14,798.00
Illinois.....	13,813.00	Rhode Island.....	1,634.00
Indiana.....	8,508.00	South Carolina.....	4,747.00
Iowa.....	8,933.00	South Dakota.....	5,509.00
Kansas.....	9,113.00	Tennessee.....	7,207.00
Kentucky.....	6,320.00	Texas.....	20,437.00
Louisiana.....	4,681.00	Utah.....	3,799.00
Maine.....	3,009.00	Vermont.....	1,634.00
Maryland.....	2,821.00	Virginia.....	6,383.00
Massachusetts.....	4,865.00	Washington.....	5,206.00
Michigan.....	9,796.00	West Virginia.....	3,553.00
Minnesota.....	9,380.00	Wisconsin.....	8,248.00
Mississippi.....	5,926.00	Wyoming.....	4,207.00
Missouri.....	10,613.00		
Montana.....	6,921.00	Total.....	326,864.96
Nebraska.....	7,093.00		

The expenditure of Federal-aid funds during the fiscal year 1930 was \$75,880,862.84. For several years the expenditure had regularly exceeded the amount authorized to be appropriated. The unexpended balances of prior appropriations had permitted this result. These had finally been virtually exhausted and the expenditure exceeded only slightly the year's apportionment of \$73,125,000.

In the report submitted last year it was pointed out that the large increase in funds obligated, as a result of the increase in the authorization to \$125,000,000, might be expected to result in a considerable increase in expenditure this year; but it was added that the annual expenditure would not reach the rate fixed by the new authorizations of \$125,000,000 for at least two years or perhaps longer.

This estimate was based upon the experience of past operations. The fact that the total expenditure this year, within 15 months of the increase in the authorization, has mounted not merely to the amount apportioned but to \$133,340,910.64, is simply another indication of the celerity with which work has been prosecuted this past year.

The largest disbursement in any previous year was nearly \$96,000,000, paid to the States in the fiscal year 1925. In no other year has the expenditure reached \$90,000,000.

A comparison of the amounts apportioned for and obligated and paid during each fiscal year from 1923 to 1931, inclusive, is presented in Table 16.

TABLE 16.—*Federal-aid funds apportioned to the States, obligated to projects and paid to the States each fiscal year from 1923 to 1931, inclusive*

Fiscal year	Apportioned amount of appropriation authorized for the year	Amount of Federal-aid funds obligated during the year	Amount of Federal-aid funds paid to States during the year
1923.....	\$48,750,000	\$77,461,559	\$69,677,241.86
1924.....	63,375,000	89,866,864	79,217,397.90
1925.....	73,125,000	87,294,396	95,749,998.11
1926.....	73,125,000	79,608,897	87,754,534.57
1927.....	73,125,000	77,453,046	81,371,013.03
1928.....	73,125,000	88,922,185	80,802,232.55
1929.....	73,125,000	70,428,896	82,097,380.38
1930.....	73,125,000	102,498,084	75,880,862.84
1931.....	121,875,000	157,952,903	133,340,910.64
Total.....	¹ 672,750,000	831,486,830	¹ 785,891,571.88
Average.....	74,750,000	92,387,425	87,321,285.76

¹ The excess of total payments over total apportionments for these years was possible because of the fact that from 1917 to 1922 inclusive the appropriations exceeded the payments by more than an equal amount.

COST OF THE ROADS

The total cost of the 7,938.8 miles of initial construction, the 3,082.5 miles of stage construction, and the 12 miles of reconstruction completed and completely paid for during the year was \$255,088,414.09, of which the Federal Government paid \$105,918,451.14, or 41.5 per cent, and the States the balance. These expenditures were made over the period required to construct the roads, and during the same period there were additional expenditures for other projects under construction and not yet completed.

As previously stated, the total of Federal funds disbursed during the year on all active projects was \$133,340,910.64, as shown in Table 32. Of this sum, the largest amount paid in any one year, 1 State, Texas, received more than \$7,000,000; 2, Pennsylvania and Ohio, received more than \$6,000,000; 2, Illinois and Missouri, received more than \$5,000,000; 3, Georgia, Iowa, and Oklahoma, received more than \$4,000,000; and 12, Arizona, Arkansas, California, Kansas, Kentucky, Minnesota, Montana, New Mexico, New York, North Carolina, Tennessee, and Wisconsin, received more than \$3,000,000. With the exception of six States—Connecticut, Delaware, Mississippi, New Hampshire, Rhode Island, and Vermont, and the Territory of Hawaii—every State received for work done during the year in excess of \$1,000,000.

SUMMARY OF FEDERAL-AID ROAD WORK, BY STATES

The progress made in each of the States during the year and the results of the 15 years of Federal-aid road construction are reported in the following condensed summary for each State.

ALABAMA

The Federal-aid highway system includes 3,931 miles, of which 2,115.8 miles have been improved with Federal aid. Of the improved mileage, 83.9 miles were added during the year. At the close of the year 351.5 miles were under construction and 4.1 miles had been approved.

The mileage improved with Federal aid consists of 189.7 miles of graded and drained earth roads, 519.4 miles of untreated sand-clay, 900.9 miles of untreated gravel, 4.4 miles of treated gravel, 15 miles of treated macadam, 62.8 miles of bituminous macadam, 115.3 miles of bituminous concrete, and 298.2 miles of Portland cement concrete, in addition to which there are bridges and approaches with a total length of 10.1 miles.

The total cost of all Federal-aid roads on which final payment has been made during the year was \$2,768,507.17 of which the Federal share was \$1,327,018.44. The disbursement of Federal funds to the State was \$2,468,137.03. The unobligated balance available on June 30, 1931, of all appropriations authorized and apportioned up to that date was \$3,291,396.79.

ARIZONA

The Federal-aid highway system includes 1,979 miles, of which 841.9 miles have been improved with Federal aid. Of the improved mileage, 239.4 miles were added during the year. At the close of the year 489.3 miles were under construction and 7.5 miles had been approved.

The mileage improved with Federal aid consists of 27.1 miles of graded and drained earth roads, 38.3 miles of untreated sand-clay, 340.6 miles of untreated gravel, 280.8 miles of low-cost bituminous mixed surface, 0.5 mile of bituminous macadam, 37.8 miles of bituminous concrete, and 110.9 miles of Portland cement concrete, in addition to which there are bridges and approaches with a total length of 5.9 miles.

The total cost of all Federal-aid roads on which final payment has been made during the year, including 107.2 miles of stage construction, was \$3,018,902.92, of which the Federal share was \$2,209,372.79. The disbursement of Federal funds to the State was \$3,034,289.82. The unobligated balance available on June 30, 1931, of all appropriations authorized and apportioned up to that date was \$92,674.36.

ARKANSAS

The Federal-aid highway system includes 4,953 miles, of which 1,737.7 miles have been improved with Federal aid. Of the improved mileage, 120.3 miles were added during the year. At the close of the year 337.7 miles were under construction and 53.6 miles had been approved.

The mileage improved with Federal aid consists of 67.2 miles of graded and drained earth roads, 949.1 miles of untreated gravel, 41.1 miles of untreated macadam, 86.5 miles of treated macadam, 266 miles of bituminous concrete and 312.2 miles of Portland cement concrete, in addition to which there are bridges and approaches with a total length of 15.6 miles.

The total cost of all Federal-aid roads on which final payment has been made during the year, including 24.6 miles of stage construction, was \$4,143,719.74, of which the Federal share was \$1,944,640.71. The disbursement of Federal funds to the State was \$3,202,880.66. The unobligated balance available on June 30, 1931, of all appropriations authorized and apportioned up to that date was \$114,579.53.

CALIFORNIA

The Federal-aid highway system includes 4,889 miles, of which 1,928 miles have been improved with Federal aid. Of the improved mileage, 145.2 miles were added during the year. At the close of the year 396.9 miles were under construction and 60.4 miles had been approved.

The mileage improved with Federal aid consists of 397.9 miles of graded and drained earth roads, 417.8 miles of untreated gravel, 29.8 miles of untreated macadam, 133.5 miles of low-cost bituminous mixed surface, 101.2 miles of bituminous macadam, 192.9 miles of bituminous concrete, and 642.6 miles of Portland cement concrete, in addition to which there are bridges and approaches with a total length of 12.3 miles.

The total cost of all Federal-aid roads on which final payment has been made during the year, including 27.7 miles of stage construction, was \$7,125,403.83, of which the Federal share was \$3,188,503.15. The disbursement of Federal funds to the State was \$3,726,979.36. The unobligated balance available on June 30, 1931, of all appropriations authorized and apportioned up to that date was \$926,385.10.

COLORADO

The Federal-aid highway system includes 3,584 miles, of which 1,343.3 miles have been improved with Federal aid. Of the improved mileage, 231.3 miles were added during the year. At the close of the year 295.2 miles were under construction and 37.3 miles had been approved.

The mileage improved with Federal aid consists of 177.5 miles of graded and drained earth roads, 55.9 miles of untreated sand-clay, 545.9 miles of untreated gravel, 95.6 miles of untreated macadam, 91.5 miles of low-cost bituminous mixed surface, 14.3 miles of bituminous concrete, and 344.4 miles of Portland cement concrete, in addition to which there are bridges and approaches with a total length of 18.2 miles.

The total cost of all Federal-aid roads on which final payment has been made during the year, including 37.3 miles of stage construction, was \$4,589,021.87, of which the Federal share was \$2,404,028.79. The disbursement of Federal funds to the State was \$2,970,121.22. The unobligated balance available on June 30, 1931, of all appropriations authorized and apportioned up to that date was \$1,968,342.74.

CONNECTICUT

The Federal-aid highway system includes 904 miles, of which 256.9 miles have been improved with Federal aid. Of the improved mileage, 15.2 miles were added during the year. At the close of the year 49 miles were under construction and 5.5 miles had been approved.

The mileage improved with Federal aid consists of 0.2 mile of untreated gravel, 17.2 miles of untreated macadam, 0.1 mile of treated macadam, 42.7 miles of bituminous macadam, 0.6 mile of bituminous concrete, and 190.7 miles of Portland cement concrete, in addition to which there are bridges and approaches with a total length of 5.4 miles.

The total cost of all Federal-aid roads on which final payment has been made during the year was \$1,387,635.17, of which the Federal share was \$478,982.62. The disbursement of Federal funds to the State was \$826,494.20. The unobligated balance available on June 30, 1931, of all appropriations authorized and apportioned up to that date was \$4,388.65.

DELAWARE

The Federal-aid highway system includes 608 miles, of which 306 miles have been improved with Federal aid. Of the improved mileage, 55.1 miles were added during the year. At the close of the year 52.6 miles were under construction and 7.4 miles had been approved.

The mileage improved with Federal aid consists of 20.2 miles of untreated gravel, 11.7 miles of low-cost bituminous mixed surface, 5.3 miles of bituminous concrete, 262 miles of Portland cement concrete, and 6.2 miles of block pavement, in addition to which there are bridges and approaches with a total length of 0.6 mile.

The total cost of all Federal-aid roads on which final payment has been made during the year was \$1,739,411.96, of which the Federal share was \$761,114.65. The disbursement of Federal funds to the State was \$699,494.71. The unobligated balance available on June 30, 1931, of all appropriations authorized and apportioned up to that date was \$73,516.71.

FLORIDA

The Federal-aid highway system includes 1,926 miles, of which 540 miles have been improved with Federal aid. Of the improved mileage, 36.6 miles were added during the year. At the close of the year 175.5 miles were under construction and 13.3 miles had been approved.

The mileage improved with Federal aid consists of 4.4 miles of graded and drained earth roads, 15.5 miles of untreated sand-clay, 1 mile of treated gravel, 85.4 miles of untreated macadam, 72.5 miles of treated macadam, 72.6 miles of bituminous macadam, 64.3 miles of bituminous concrete, 205.5 miles of Portland cement concrete, and 10.2 miles of block pavement, in addition to which there are bridges and approaches with a total length of 8.6 miles.

The total cost of all Federal-aid roads on which final payment has been made during the year was \$1,626,884.27, of which the Federal share was \$659,708.39. The disbursement of Federal funds to the State was \$1,572,336.43. The unobligated balance available on June 30, 1931, of all appropriations authorized and apportioned up to that date was \$1,604,812.74.

GEORGIA

The Federal-aid highway system includes 5,557 miles, of which 2,795 miles have been improved with Federal aid. Of the improved mileage, 284.7 miles were added during the year. At the close of the year 416.9 miles were under construction and 95.9 miles had been approved.

The mileage improved with Federal aid consists of 233.7 miles of graded and drained earth roads, 1,000.9 miles of untreated sand-clay,

408 miles of untreated gravel, 3.7 miles of treated gravel, 52.3 miles of untreated macadam, 129.7 miles of treated macadam, 227.5 miles of bituminous macadam, 88.2 miles of bituminous concrete, 622.7 miles of Portland cement concrete, and 0.5 mile of block pavement, in addition to which there are bridges and approaches with a total length of 27.8 miles.

The total cost of all Federal-aid roads on which final payment has been made during the year, including 51.6 miles of stage construction, was \$2,890,924.75, of which the Federal share was \$1,311,145.58. The disbursement of Federal funds to the State was \$4,322,392.40. The unobligated balance available on June 30, 1931, of all appropriations authorized and apportioned up to that date was \$1,049,771.28.

IDAHO

The Federal-aid highway system includes 3,116 miles, of which 1,281.9 miles have been improved with Federal aid. Of the improved mileage, 159.6 miles were added during the year. At the close of the year 304.1 miles were under construction and 114.2 miles had been approved.

The mileage improved with Federal aid consists of 197.8 miles of graded and drained earth roads, 604 miles of untreated gravel, 215.1 miles of untreated macadam, 101.4 miles of low-cost bituminous mixed surface, 20.3 miles of bituminous macadam, 89.7 miles of bituminous concrete, and 49.8 miles of Portland cement concrete, in addition to which there are bridges and approaches with a total length of 3.8 miles.

The total cost of all Federal-aid roads on which final payment has been made during the year, including 66.7 miles of stage construction, was \$1,564,466.12, of which the Federal share was \$899,067.70. The disbursement of Federal funds to the State was \$1,660,581.47. The unobligated balance available on June 30, 1931, of all appropriations authorized and apportioned up to that date was \$395,029.73.

ILLINOIS

The Federal-aid highway system includes 6,772 miles, of which 2,267.7 miles have been improved with Federal aid. Of the improved mileage, 281.6 miles were added during the year. At the close of the year 810.4 miles were under construction and 276.6 miles had been approved.

The mileage improved with Federal aid consists of 117 miles of graded and drained earth roads, 0.4 mile of untreated gravel, 3.3 miles of bituminous macadam, 8.1 miles of bituminous concrete, 2,104.3 miles of Portland cement concrete, and 31.6 miles of block pavement, in addition to which there are bridges and approaches with a total length of 3 miles.

The total cost of all Federal-aid roads on which final payment has been made during the year, including 3.7 miles of stage construction, was \$7,373,346.03, of which the Federal share was \$3,173,832.47. The disbursement of Federal funds to the State was \$5,337,535.29. The unobligated balance available on June 30, 1931, of all appropriations authorized and apportioned up to that date was \$279,005.33.

INDIANA

The Federal-aid highway system includes 4,740 miles, of which 1,579 miles have been improved with Federal aid. Of the improved mileage, 97.4 miles were added during the year. At the close of the year 281.3 miles were under construction and 129.5 miles had been approved.

The mileage improved with Federal aid consists of 16.9 miles of graded and drained earth roads, 90.2 miles of untreated gravel, 17.1 miles of bituminous macadam, 12 miles of bituminous concrete, 1,431.9 miles of Portland cement concrete, and 6.6 miles of block pavement, in addition to which there are bridges and approaches with a total length of 4.3 miles.

The total cost of all Federal-aid roads on which final payment has been made during the year was \$6,969,639.24, of which the Federal share was \$3,206,979.94. The disbursement of Federal funds to the State was \$1,640,813.75. The unobligated balance available on June 30, 1931, of all appropriations authorized and apportioned up to that date was \$755,222.13.

IOWA

The Federal-aid highway system includes 7,214 miles, of which 3,153.1 miles have been improved with Federal aid. Of the improved mileage, 295 miles were added during the year. At the close of the year 239.4 miles were under construction and 17.4 miles had been approved.

The mileage improved with Federal aid consists of 1,104.9 miles of graded and drained earth roads, 496.7 miles of untreated gravel, 1,527.4 miles of Portland cement concrete, and 21.9 miles of block pavement, in addition to which there are bridges and approaches with a total length of 2.2 miles.

The total cost of all Federal-aid roads on which final payment has been made during the year, including 219.7 miles of stage construction, was \$8,440,583.54, of which the Federal share was \$3,784,337.44. The disbursement of Federal funds to the State was \$4,358,844.68. The unobligated balance available on June 30, 1931, of all appropriations authorized and apportioned up to that date was \$4,059.10.

KANSAS

The Federal-aid highway system includes 7,920 miles, of which 3,148.8 miles have been improved with Federal aid. Of the improved mileage, 506.3 miles were added during the year. At the close of the year 561.4 miles were under construction and 159.2 miles had been approved.

The mileage improved with Federal aid consists of 1,066.7 miles of graded and drained earth roads, 549.8 miles of untreated sand-clay, 350.5 miles of untreated gravel, 30.3 miles of treated gravel, 4.5 miles of untreated macadam, 6.8 miles of low-cost bituminous mixed surface, 129.9 miles of bituminous macadam, 2.9 miles of bituminous concrete, 825.4 miles of Portland cement concrete, and 165.6 miles of block pavement, in addition to which there are bridges and approaches with a total length of 16.4 miles.

The total cost of all Federal-aid roads on which final payment has been made during the year, including 165.3 miles of stage construction, was \$7,507,055.66, of which the Federal share was \$3,543,998.02. The disbursement of Federal funds to the State was \$3,798,165.71. The unobligated balance available on June 30, 1931, of all appropriations authorized and apportioned up to that date was \$386,026.70.

KENTUCKY

The Federal-aid highway system includes 3,699 miles, of which 1,519 miles have been improved with Federal aid. Of the improved mileage, 292.8 miles were added during the year. At the close of the year 415.5 miles were under construction and 80.6 miles had been approved.

The mileage improved with Federal aid consists of 487.5 miles of graded and drained earth roads, 392.2 miles of untreated gravel, 20.5 miles of untreated macadam, 50.3 miles of treated macadam, 14.7 miles of low-cost bituminous mixed surface, 84.3 miles of bituminous macadam, 167.5 miles of bituminous concrete, 293.1 miles of Portland cement concrete, and 3.9 miles of block pavement, in addition to which there are bridges and approaches with a total length of 5 miles.

The total cost of all Federal-aid roads on which final payment has been made during the year, including 169.8 miles of stage construction, was \$7,403,584.13, of which the Federal share was \$3,181,640.29. The disbursement of Federal funds to the State was \$3,197,038.96. The unobligated balance available on June 30, 1931, of all appropriations authorized and apportioned up to that date was \$183,559.55.

LOUISIANA

The Federal-aid highway system includes 2,725 miles, of which 1,418.9 miles have been improved with Federal aid. Of the improved mileage, 125.5 miles were added during the year. At the close of the year 265.2 miles were under construction and 5.7 miles had been approved.

The mileage improved with Federal aid consists of 43.2 miles of graded and drained earth roads, 1,247.2 miles of untreated gravel, 3.2 miles of bituminous macadam, 42.9 miles of bituminous concrete, and 68.5 miles of Portland cement concrete, in addition to which there are bridges and approaches with a total length of 13.9 miles.

The total cost of all Federal-aid roads on which final payment has been made during the year, including 17.4 miles of stage construction, was \$2,497,574.06, of which the Federal share was \$1,108,436.27. The disbursement of Federal funds to the State was \$1,396,140.88. The unobligated balance available on June 30, 1931, of all appropriations authorized and apportioned up to that date was \$253,076.15.

MAINE

The Federal-aid highway system includes 1,576 miles, of which 603.2 miles have been improved with Federal aid. Of the improved mileage, 70 miles were added during the year. At the close of the

year 101 miles were under construction and 19.9 miles had been approved.

The mileage improved with Federal aid consists of 240.6 miles of untreated gravel, 56 miles of treated gravel, 181.7 miles of bituminous macadam, and 123.2 miles of Portland cement concrete, in addition to which there are bridges and approaches with a total length of 1.7 miles.

The total cost of all Federal-aid roads on which final payment has been made during the year, including 1.6 miles of reconstruction, was \$2,626,753.53, of which the Federal share was \$1,043,761.64. The disbursement of Federal funds to the State was \$1,130,502.21. The unobligated balance available on June 30, 1931, of all appropriations authorized and apportioned up to that date was \$612,261.07.

MARYLAND

The Federal-aid highway system includes 1,828 miles, of which 707 miles have been improved with Federal aid. Of the improved mileage, 86.3 miles were added during the year. At the close of the year 52.1 miles were under construction and 17.7 miles had been approved.

The mileage improved with Federal aid consists of 4.8 miles of graded and drained earth roads, 31.5 miles of untreated gravel, 0.2 mile of untreated macadam, 3.9 miles of treated macadam, 219.6 miles of bituminous macadam, 31.5 miles of bituminous concrete, and 414.9 miles of Portland cement concrete, in addition to which there are bridges and approaches with a total length of 0.6 mile.

The total cost of all Federal-aid roads on which final payment has been made during the year, including 6.7 miles of stage construction, was \$2,321,767.52, of which the Federal share was \$1,080,340.41. The disbursement of Federal funds to the State was \$1,498,370.57. The unobligated balance available on June 30, 1931, of all appropriations authorized and apportioned up to that date was \$91,940.51.

MASSACHUSETTS

The Federal-aid highway system includes 1,437 miles, of which 724.2 miles have been improved with Federal aid. Of the improved mileage, 70.3 miles were added during the year. At the close of the year 78.9 miles were under construction and 17 miles had been approved.

The mileage improved with Federal aid consists of 0.5 mile of untreated gravel, 0.4 mile of treated gravel, 0.2 mile of untreated macadam, 2.7 miles of treated macadam, 19 miles of low-cost bituminous mixed surface, 408.8 miles of bituminous macadam, 66.5 miles of bituminous concrete, and 220.9 miles of Portland cement concrete, in addition to which there are bridges and approaches with a total length of 5.2 miles.

The total cost of all Federal-aid roads on which final payment has been made during the year, including 0.8 mile of stage construction and 2.6 miles of reconstruction, was \$4,002,184.04, of which the Federal share was \$1,336,894.86. The disbursement of Federal funds to the State was \$1,665,230.28. The unobligated balance available on June 30, 1931, of all appropriations authorized and apportioned up to that date was \$1,597,158.35.

MICHIGAN

The Federal-aid highway system includes 5,242 miles, of which 1,804.8 miles have been improved with Federal aid. Of the improved mileage, 232.2 miles were added during the year. At the close of the year 338.3 miles were under construction and 109 miles had been approved.

The mileage improved with Federal aid consists of 22.4 miles of graded and drained earth roads, 343 miles of untreated gravel, 16.3 miles of treated macadam, 5.4 miles of bituminous macadam, 59 miles of bituminous concrete, 1,354.9 miles of Portland cement concrete, and 0.4 mile of block pavement, in addition to which there are bridges and approaches with a total length of 3.4 miles.

The total cost of all Federal-aid roads on which final payment has been made during the year, including 27.3 miles of stage construction, was \$10,460,190.17, of which the Federal share was \$4,048,668.07. The disbursement of Federal funds to the State was \$2,947,103.22. The unobligated balance available on June 30, 1931, of all appropriations authorized and apportioned up to that date was \$1,973,791.60.

MINNESOTA

The Federal-aid highway system includes 6,885 miles, of which 3,987.3 miles have been improved with Federal aid. Of the improved mileage, 482.2 miles were added during the year. At the close of the year 358.8 miles were under construction and 55.2 miles had been approved.

The mileage improved with Federal aid consists of 1,017.2 miles of graded and drained earth roads, 11.1 miles of untreated sand-clay, 1,846.3 miles of untreated gravel, 17.7 miles of treated gravel, 32.7 miles of bituminous concrete, and 1,059.8 miles of Portland cement concrete, in addition to which there are bridges and approaches with a total length of 2.5 miles.

The total cost of all Federal-aid roads on which final payment has been made during the year, including 240.6 miles of stage construction, was \$10,843,062.76, of which the Federal share was \$4,275,605.31. The disbursement of Federal funds to the State was \$3,669,096.61. The unobligated balance available on June 30, 1931, of all appropriations authorized and apportioned up to that date was \$27,432.47.

MISSISSIPPI

The Federal-aid highway system includes 3,661 miles, of which 1,772.7 miles have been improved with Federal aid. Of the improved mileage, 24.8 miles were added during the year. At the close of the year 262.5 miles were under construction and 20.8 miles had been approved.

The mileage improved with Federal aid consists of 284 miles of graded and drained earth roads, 15.7 miles of untreated sand-clay, 1,178.4 miles of untreated gravel, 11.1 miles of untreated macadam, 12.5 miles of bituminous concrete, 249.2 miles of Portland cement concrete, and 9.6 miles of block pavement, in addition to which there are bridges and approaches with a total length of 12.2 miles.

The total cost of all Federal-aid roads on which final payment has been made during the year was \$1,324,571.81, of which the

Federal share was \$467,179.27. The disbursement of Federal funds to the State was \$699,603.25. The unobligated balance available on June 30, 1931, of all appropriations authorized and apportioned up to that date was \$3,759,645.69.

MISSOURI

The Federal-aid highway system includes 7,530 miles, of which 2,659.5 miles have been improved with Federal aid. Of the improved mileage, 307 miles were added during the year. At the close of the year 311.8 miles were under construction and 87 miles had been approved.

The mileage improved with Federal aid consists of 365.1 miles of graded and drained earth roads, 707.4 miles of untreated gravel, 19.6 miles of untreated macadam, 33 miles of bituminous macadam, 20 miles of bituminous concrete, 1,483.7 miles of Portland cement concrete, and 19.3 miles of block pavement, in addition to which there are bridges and approaches with a total length of 11.4 miles.

The total cost of all Federal-aid roads on which final payment has been made during the year, including 138.2 miles of stage construction, was \$11,764,495.20, of which the Federal share was \$4,742,406.56. The disbursement of Federal funds to the State was \$5,225,783.52. The unobligated balance available on June 30, 1931, of all appropriations authorized and apportioned up to that date was \$30,847.48.

MONTANA

The Federal-aid highway system includes 5,127 miles, of which 1,835.1 miles have been improved with Federal aid. Of the improved mileage, 272.7 miles were added during the year. At the close of the year 1,046.1 miles were under construction and 66.1 miles had been approved.

The mileage improved with Federal aid consists of 225.7 miles of graded and drained earth roads, 1,478.9 miles of untreated gravel, 72.1 miles of low-cost bituminous mixed surface, 12.5 miles of bituminous concrete, and 37 miles of Portland cement concrete, in addition to which there are bridges and approaches with a total length of 8.9 miles.

The total cost of all Federal-aid roads on which final payment has been made during the year, including 25.1 miles of stage construction, was \$3,774,599.56, of which the Federal share was \$2,278,439.12. The disbursement of Federal funds to the State was \$3,161,355.93. The unobligated balance available on June 30, 1931, of all appropriations authorized and apportioned up to that date was \$2,120,118.98.

NEBRASKA

The Federal-aid highway system includes 5,574 miles, of which 3,848.9 miles have been improved with Federal aid. Of the improved mileage, 444 miles were added during the year. At the close of the year 445.6 miles were under construction and 128.8 miles had been approved.

The mileage improved with Federal aid consists of 396.3 miles of graded and drained earth roads, 3,163.8 miles of untreated sand-

clay, 23.3 miles of treated sand-clay, 4 miles of low-cost bituminous mixed surface, 14.6 miles of bituminous concrete, 217.4 miles of Portland cement concrete, and 19.6 miles of block pavement, in addition to which there are bridges and approaches with a total length of 9.9 miles.

The total cost of all Federal-aid roads on which final payment has been made during the year, including 116.2 miles of stage construction, was \$2,141,382.57, of which the Federal share was \$1,012,980.95. The disbursement of Federal funds to the State was \$2,409,323.05. The unobligated balance available on June 30, 1931, of all appropriations authorized and apportioned up to that date was \$904,033.63.

NEVADA

The Federal-aid highway system includes 1,560 miles, of which 1,092 miles have been improved with Federal aid. Of the improved mileage, 169.4 miles were added during the year. At the close of the year 356.6 miles were under construction and 43.6 miles had been approved.

The mileage improved with Federal aid consists of 60.3 miles of graded and drained earth roads, 515.1 miles of untreated gravel, 10.8 miles of treated gravel, 445.3 miles of low-cost bituminous mixed surface, 20.6 miles of bituminous macadam, 2 miles of bituminous concrete, and 36 miles of Portland cement concrete, in addition to which there are bridges and approaches with a total length of 1.9 miles.

The total cost of all Federal-aid roads on which final payment has been made during the year, including 173.2 miles of stage construction, was \$1,280,385.50, of which the Federal share was \$1,117,988.62. The disbursement of Federal funds to the State was \$1,393,804.29. The unobligated balance available on June 30, 1931, of all appropriations authorized and apportioned up to that date was \$204,157.11.

NEW HAMPSHIRE

The Federal-aid highway system includes 988 miles, of which 392.9 miles have been improved with Federal aid. Of the improved mileage, 42.8 miles were added during the year. At the close of the year 27.1 miles were under construction and 10.7 miles had been approved.

The mileage improved with Federal aid consists of 0.2 mile of treated gravel, 96.5 miles of untreated macadam, 82.5 miles of treated macadam, 86.1 miles of bituminous macadam, 34.3 miles of bituminous concrete, and 88.8 miles of Portland cement concrete, in addition to which there are bridges and approaches with a total length of 4.5 miles.

The total cost of all Federal-aid roads on which final payment has been made during the year, including 3.7 miles of reconstruction, was \$1,688,554.45, of which the Federal share was \$566,971.66. The disbursement of Federal funds to the State was \$728,122.94. The unobligated balance available on June 30, 1931, of all appropriations authorized and apportioned up to that date was \$94,801.98.

NEW JERSEY

The Federal-aid highway system includes 1,315 miles, of which 555.2 miles have been improved with Federal aid. Of the improved mileage, 47.3 miles were added during the year. At the close of the year 74.7 miles were under construction and 0.2 mile had been approved.

The mileage improved with Federal aid consists of 11.9 miles of graded and drained earth roads, 6 miles of untreated gravel, 0.2 mile of treated macadam, 0.5 mile of bituminous macadam, 22.5 miles of bituminous concrete, and 511.4 miles of Portland cement concrete in addition to which there are bridges and approaches with a total length of 2.7 miles.

The total cost of all Federal-aid roads on which final payment has been made during the year was \$4,334,773.53, of which the Federal share was \$1,216,111.48. The disbursement of Federal funds to the State was \$1,619,943.80. The unobligated balance available on June 30, 1931, of all appropriations authorized and apportioned up to that date was \$1,177,568.27.

NEW MEXICO

The Federal-aid highway system includes 3,616 miles, of which 1,927.9 miles have been improved with Federal aid. Of the improved mileage, 171.5 miles were added during the year. At the close of the year 397 miles were under construction and 0.2 mile had been approved.

The mileage improved with Federal aid consists of 230.4 miles of graded and drained earth roads, 19.1 miles of untreated and sand-clay, 1,492.6 miles of untreated gravel, 96.1 miles of low-cost bituminous mixed surface, 0.7 mile of bituminous concrete, and 82.3 miles of Portland cement concrete, in addition to which there are bridges and approaches with a total length of 6.7 miles.

The total cost of all Federal-aid roads on which final payment has been made during the year, including 35.7 miles of stage construction, was \$2,613,662.63, of which the Federal share was \$1,780,453.18. The disbursement of Federal funds to the State was \$3,138,928.76. The unobligated balance available on June 30, 1931, of all appropriations authorized and apportioned up to that date was \$86,785.38.

NEW YORK

The Federal-aid highway system includes 6,732 miles, of which 2,684 miles have been improved with Federal aid. Of the improved mileage, 213.5 miles were added during the year. At the close of the year 697.9 miles were under construction and 115.9 miles had been approved.

The mileage improved with Federal aid consists of 46.6 miles of graded and drained earth roads, 75.9 miles of untreated gravel, 410 miles of bituminous macadam, 15.5 miles of bituminous concrete, 2,133.3 miles of Portland cement concrete, and 0.7 mile of block pavement, in addition to which there are bridges and approaches with a total length of 2 miles.

The total cost of all Federal-aid roads on which final payment has been made during the year was \$10,125,403.76, of which the Federal

share was \$3,157,104.88. The disbursement of Federal funds to the State was \$3,669,032.26. The unobligated balance available on June 30, 1931, of all appropriations authorized and apportioned up to that date was \$15,421.72.

NORTH CAROLINA

The Federal-aid highway system includes 4,374 miles, of which 1,970.6 miles have been improved with Federal aid. Of the improved mileage, 241.2 miles were added during the year. At the close of the year 248.5 miles were under construction and 65.4 miles had been approved.

The mileage improved with Federal aid consists of 95.5 miles of graded and drained earth roads, 470.5 miles of untreated sand-clay, 120.3 miles of untreated gravel, 25.8 miles of untreated macadam, 35.4 miles of low-cost bituminous mixed surface, 35.7 miles of bituminous macadam, 250.8 miles of bituminous concrete, and 931.5 miles of Portland cement concrete, in addition to which there are bridges and approaches with a total length of 5.1 miles.

The total cost of all Federal-aid roads on which final payment has been made during the year, including 28.8 miles of stage construction, was \$3,798,790.84, of which the Federal share was \$1,797,835.64. The disbursement of Federal funds to the State was \$3,366,945.86. The unobligated balance available on June 30, 1931, of all appropriations authorized and apportioned up to that date was \$1,608,127.62.

NORTH DAKOTA

The Federal-aid highway system includes 7,439 miles, of which 4,363.2 miles have been improved with Federal aid. Of the improved mileage, 883.7 miles were added during the year. At the close of the year 910.7 miles were under construction and 285.3 miles had been approved.

The mileage improved with Federal aid consists of 1,095.7 miles of graded and drained earth roads, 0.3 mile of untreated sand-clay, 3,116.2 miles of untreated gravel, 129.1 miles of treated gravel, 5.9 miles of low-cost bituminous mixed surface, 1.1 miles of bituminous concrete, and 6.6 miles of Portland cement concrete, in addition to which there are bridges and approaches with a total length of 8.3 miles.

The total cost of all Federal-aid roads on which final payment has been made during the year, including 458.2 miles of stage construction, was \$2,551,573.01, of which the Federal share was \$1,288,488.22. The disbursement of Federal funds to the State was \$1,580,470.90. The unobligated balance available on June 30, 1931, of all appropriations authorized and apportioned up to that date was \$1,087,249.83.

OHIO

The Federal-aid highway system includes 5,899 miles, of which 2,553.6 miles have been improved with Federal aid. Of the improved mileage, 397.4 miles were added during the year. At the close of the year 252.7 miles were under construction and 119.3 miles had been approved.

The mileage improved with Federal aid consists of 118.9 miles of graded and drained earth roads, 34.2 miles of untreated gravel, 106.5 miles of untreated macadam, 26.1 miles of treated macadam, 368.3 miles of bituminous macadam, 159 miles of bituminous concrete, 1,124.9 miles of Portland cement concrete, and 607.4 miles of block pavement, in addition to which there are bridges and approaches with a total length of 8.3 miles.

The total cost of all Federal-aid roads on which final payment has been made during the year, including 34.4 miles of stage construction, was \$16,809,335.96, of which the Federal share was \$6,223,666.28. The disbursement of Federal funds to the State was \$6,542,722.17. The unobligated balance available on June 30, 1931, of all appropriations authorized and apportioned up to that date was \$1,236,446.47.

OKLAHOMA

The Federal-aid highway system includes 5,769 miles, of which 1,981.3 miles have been improved with Federal aid. Of the improved mileage, 211.5 miles were added during the year. At the close of the year 416.1 miles were under construction and 52.9 miles had been approved.

The mileage improved with Federal aid consists of 380.6 miles of graded and drained earth roads, 0.7 mile of untreated sand-clay, 525.9 miles of untreated gravel, 8.3 miles of treated gravel, 28.7 miles of untreated macadam, 0.6 mile of bituminous macadam, 151 miles of bituminous concrete, 861.4 miles of Portland cement concrete, and 8.9 miles of block pavement, in addition to which there are bridges and approaches with a total length of 15.2 miles.

The total cost of all Federal-aid roads on which final payment has been made during the year, including 69 miles of stage construction and 2.7 miles of reconstruction, was \$4,649,555.48, of which the Federal share was \$2,130,091.91. The disbursement of Federal funds to the State was \$4,502,041.08. The unobligated balance available on June 30, 1931, of all appropriations authorized and apportioned up to that date was \$8,011.61.

OREGON

The Federal-aid highway system includes 3,247 miles, of which 1,267.7 miles have been improved with Federal aid. Of the improved mileage, 146.5 miles were added during the year. At the close of the year 337.1 miles were under construction and 57.5 miles had been approved.

The mileage improved with Federal aid consists of 304.3 miles of graded and drained earth roads, 717 miles of untreated gravel, 13.1 miles of treated gravel, 25.6 miles of untreated macadam, 46.1 miles of bituminous macadam, 54.9 miles of bituminous concrete, and 100.5 miles of Portland cement concrete, in addition to which there are bridges and approaches with a total length of 6.2 miles.

The total cost of all Federal-aid roads on which final payment has been made during the year, including 10.6 miles of stage construction, was \$1,999,595.51, of which the Federal share was \$1,037,287.34. The disbursement of Federal funds to the State was

\$2,873,047.97. The unobligated balance available on June 30, 1931, of all appropriations authorized and apportioned up to that date was \$442,216.97.

PENNSYLVANIA

The Federal-aid highway system includes 6,335 miles, of which 2,664.4 miles have been improved with Federal aid. Of the improved mileage, 322.5 miles were added during the year. At the close of the year 251.7 miles were under construction and 96.4 miles had been approved.

The mileage improved with Federal aid consists of 166.9 miles of graded and drained earth roads, 24.4 miles of untreated macadam, 10.6 miles of treated macadam, 7.8 miles of bituminous macadam, 98.4 miles of bituminous concrete, 2,312.6 miles of Portland cement concrete, and 40.3 miles of block pavement, in addition to which there are bridges and approaches with a total length of 3.4 miles.

The total cost of all Federal-aid roads on which final payment has been made during the year, including 14.1 miles of stage construction, was \$30,204,188.07, of which the Federal share was \$8,248,571.56. The disbursement of Federal funds to the State was \$6,965,100.41. The unobligated balance available on June 30, 1931, of all appropriations authorized and apportioned up to that date, was \$1,151,378.69.

RHODE ISLAND

The Federal-aid highway system includes 452 miles, of which 215.4 miles have been improved with Federal aid. Of the improved mileage, 30.7 miles were added during the year. At the close of the year 42.1 miles were under construction and 0.1 mile had been approved.

The mileage improved with Federal aid consists of 1.8 miles of treated macadam, 69.7 miles of bituminous macadam, 48.1 miles of bituminous concrete, and 93.7 miles of Portland cement concrete, in addition to which there are bridges and approaches with a total length of 2.1 miles.

The total cost of all Federal-aid roads on which final payment has been made during the year was \$1,847,694.03, of which the Federal share was \$723,239.22. The disbursement of Federal funds to the State was \$950,985.01. The unobligated balance available on June 30, 1931, of all appropriations authorized and apportioned up to that date, was \$98,072.80.

SOUTH CAROLINA

The Federal-aid highway system includes 3,232 miles, of which 1,853.5 miles have been improved with Federal aid. Of the improved mileage, 157.4 miles were added during the year. At the close of the year 231 miles were under construction.

The mileage improved with Federal aid consists of 52.9 miles of graded and drained earth roads, 1,036.9 miles of untreated sand-clay, 101.1 miles of untreated gravel, 0.3 mile of bituminous macadam, 185 miles of bituminous concrete, and 454.4 miles of Portland cement concrete, in addition to which there are bridges and approaches with a total length of 22.9 miles.

The total cost of all Federal-aid roads on which final payment has been made during the year, including 23.5 miles of stage construction, was \$3,035,805.26, of which the Federal share was \$1,001,305.10. The disbursement of Federal funds to the State was \$2,680,153.70. The unobligated balance available on June 30, 1931, of all appropriations authorized and apportioned up to that date was \$242,641.12.

SOUTH DAKOTA

The Federal-aid highway system includes 6,193 miles, of which 3,741.6 miles have been improved with Federal aid. Of the improved mileage, 539.6 miles were added during the year. At the close of the year 607.8 miles were under construction and 62.2 miles had been approved.

The mileage improved with Federal aid consists of 117.4 miles of graded and drained earth roads, 20.8 miles of untreated sand-clay, 15.7 miles of treated sand-clay, 3,532.5 miles of untreated gravel, 9.5 miles of low-cost bituminous mixed surface, and 41.1 miles of Portland cement concrete, in addition to which there are bridges and approaches with a total length of 4.6 miles.

The total cost of all Federal-aid roads on which final payment has been made during the year, including 187.7 miles of stage construction, was \$3,726,469.50, of which the Federal share was \$1,910,950.80. The disbursement of Federal funds to the State was \$2,024,617.07. The unobligated balance available on June 30, 1931, of all appropriations authorized and apportioned up to that date was \$383,082.29.

TENNESSEE

The Federal-aid highway system includes 3,733 miles, of which 1,461.4 miles have been improved with Federal aid. Of the improved mileage, 266.5 miles were added during the year. At the close of the year 211.1 miles were under construction and 26 miles had been approved.

The mileage improved with Federal aid consists of 117 miles of graded and drained earth roads, 106.3 miles of untreated gravel, 61.5 miles of untreated macadam, 356.1 miles of bituminous macadam, 164.9 miles of bituminous concrete, and 647.5 miles of Portland cement concrete, in addition to which there are bridges and approaches with a total length of 8.1 miles.

The total cost of all Federal-aid roads on which final payment has been made during the year, including 61 miles of stage construction, was \$6,075,905.11, of which the Federal share was \$2,595,549.58. The disbursement of Federal funds to the State was \$3,664,142.24. The unobligated balance available on June 30, 1931, of all appropriations authorized and apportioned up to that date was \$1,838,996.09.

TEXAS

The Federal-aid highway system includes 11,722 miles, of which 6,979.5 miles have been improved with Federal aid. Of the improved mileage, 584.4 miles were added during the year. At the

close of the year 1,182.8 miles were under construction and 138.8 miles had been approved.

The mileage improved with Federal aid consists of 725.5 miles of graded and drained earth roads, 29.3 miles of untreated sand-clay, 2,785.4 miles of untreated gravel, 309.9 miles of treated gravel, 72.7 miles of untreated macadam, 119.7 miles of treated macadam, 19.8 miles of low-cost bituminous mixed surface, 534.8 miles of bituminous macadam, 766.1 miles of bituminous concrete, 1,550.3 miles of Portland cement concrete, and 30.2 miles of block pavement, in addition to which there are bridges and approaches with a total length of 35.8 miles.

The total cost of all Federal-aid roads on which final payment has been made during the year, including 261.6 miles of stage construction, was \$16,271,159.08, of which the Federal share was \$7,143,590.29. The disbursement of Federal funds to the State was \$7,366,218.34. The unobligated balance available on June 30, 1931, of all appropriations authorized and apportioned up to that date was \$3,256,872.24.

UTAH

The Federal-aid highway system includes 1,751 miles, of which 1,041.5 miles have been improved with Federal aid. Of the improved mileage, 197.1 miles were added during the year. At the close of the year 172.8 miles were under construction and 124 miles had been approved.

The mileage improved with Federal aid consists of 90.8 miles of graded and drained earth roads, 251.5 miles of untreated gravel, 3.4 miles of treated gravel, 463.3 miles of untreated macadam, 111.5 miles of low-cost bituminous mixed surface, 0.8 mile of bituminous macadam, 10.6 miles of bituminous concrete, and 106.6 miles of Portland cement concrete, in addition to which there are bridges and approaches with a total length of 3 miles.

The total cost of all Federal-aid roads on which final payment has been made during the year, including 59.8 miles of stage construction, was \$898,959.29, of which the Federal share was \$617,349.55. The disbursement of Federal funds to the State was \$1,452,586.86. The unobligated balance available on June 30, 1931, of all appropriations authorized and apportioned up to that date was \$524,243.32.

VERMONT

The Federal-aid highway system includes 1,036 miles, of which 301.6 miles have been improved with Federal aid. Of the improved mileage, 50.7 miles were added during the year. At the close of the year 35.2 miles were under construction and 2.3 miles had been approved.

The mileage improved with Federal aid consists of 102.3 miles of untreated gravel, 2 miles of treated gravel, 1.2 miles of untreated macadam, 53.4 miles of bituminous macadam, and 136.4 miles of Portland cement concrete, in addition to which there are bridges and approaches with a total length of 6.3 miles.

The total cost of all Federal-aid roads on which final payment has been made during the year, including 1.2 miles of stage construction

and 1.4 miles of reconstruction, was \$2,007,419.18, of which the Federal share was \$740,678.27. The disbursement of Federal funds to the State was \$750,693.40. The unobligated balance available on June 30, 1931, of all appropriations authorized and apportioned up to that date was \$52,345.06.

VIRGINIA

The Federal-aid highway system includes 3,650 miles, of which 1,624.7 miles have been improved with Federal aid. Of the improved mileage, 202.6 miles were added during the year. At the close of the year, 307.1 miles were under construction and 19 miles had been approved.

The mileage improved with Federal aid consists of 140.9 miles of graded and drained earth roads, 253.4 miles of untreated sand-clay, 95.5 miles of untreated gravel, 203 miles of untreated macadam, 5.7 miles of treated macadam, 383.1 miles of bituminous macadam, 40.6 miles of bituminous concrete, and 493.2 miles of Portland cement concrete, in addition to which there are bridges and approaches with a total length of 9.3 miles.

The total cost of all Federal-aid roads on which final payment has been made during the year, including 12 miles of stage construction, was \$4,264,542.94, of which the Federal share was \$1,897,292.76. The disbursement of Federal funds to the State was \$2,883,737.89. The unobligated balance available on June 30, 1931, of all appropriations authorized and apportioned up to that date was \$578,394.71.

WASHINGTON

The Federal-aid highway system includes 3,033 miles, of which 1,001.4 miles have been improved with Federal aid. Of the improved mileage, 93.6 miles were added during the year. At the close of the year 202.5 miles were under construction and 29.8 miles had been approved.

The mileage improved with Federal aid consists of 193.5 miles of graded and drained earth roads, 456.7 miles of untreated gravel, and 345.6 miles of Portland cement concrete, in addition to which there are bridges and approaches with a total length of 5.6 miles.

The total cost of all Federal-aid roads on which final payment has been made during the year, including 10.4 miles of stage construction, was \$3,665,180.85, of which the Federal share was \$1,522,825.01. The disbursement of Federal funds to the State was \$2,002,370.88. The unobligated balance available on June 30, 1931, of all appropriations authorized and apportioned up to that date was \$893,899.52.

WEST VIRGINIA

The Federal-aid highway system includes 2,216 miles, of which 772.6 miles have been improved with Federal aid. Of the improved mileage, 83.3 miles were added during the year. At the close of the year 142.4 miles were under construction and 22 miles had been approved.

The mileage improved with Federal aid consists of 243.1 miles of graded and drained earth roads, 30.6 miles of untreated gravel, 19.5

miles of untreated macadam, 0.6 mile of treated macadam, 181.4 miles of bituminous macadam, 28.2 miles of bituminous concrete, 256.4 miles of Portland cement concrete, and 10.6 miles of block pavement, in addition to which there are bridges and approaches with a total length of 2.2 miles.

The total cost of all Federal-aid roads on which final payment has been made during the year, including 45.4 miles of stage construction, was \$3,823,054.57, of which the Federal share was \$1,536,418.05. The disbursement of Federal funds to the State was \$1,039,698.29. The unobligated balance available on June 30, 1931, of all appropriations authorized and apportioned up to that date was \$334,335.98.

WISCONSIN

The Federal-aid highway system includes 5,493 miles, of which 2,414.8 miles have been improved with Federal aid. Of the improved mileage, 263.4 miles were added during the year. At the close of the year 303.4 miles were under construction and 66.5 miles had been approved.

The mileage improved with Federal aid consists of 162.3 miles of graded and drained earth roads, 23.5 miles of untreated sand-clay, 977.4 miles of untreated gravel, 19.9 miles of treated gravel, 13.7 miles of bituminous macadam, 0.5 mile of bituminous concrete, and 1,208.5 miles of Portland cement concrete, in addition to which there are bridges and approaches with a total length of 9 miles.

The total cost of all Federal-aid roads on which final payment has been made during the year, including 60.2 miles of stage construction, was \$8,206,234.14, of which the Federal share was \$3,628,159.37. The disbursement of Federal funds to the State was \$3,778,494.29. The unobligated balance available on June 30, 1931, of all appropriations authorized and apportioned up to that date was \$82,080.01.

WYOMING

The Federal-aid highway system includes 3,498 miles, of which 1,629 miles have been improved with Federal aid. Of the improved mileage, 182.2 miles were added during the year. At the close of the year 593.4 miles were under construction and 54.6 miles had been approved.

The mileage improved with Federal aid consists of 444.7 miles of graded and drained earth roads, 10.2 miles of untreated sand-clay, 1,013 miles of untreated gravel, 114.8 miles of low-cost bituminous mixed surface, 22.1 miles of bituminous concrete, and 17.2 miles of Portland cement concrete, in addition to which there are bridges and approaches with a total length of 7 miles.

The total cost of all Federal-aid roads on which final payment has been made during the year, including 89.8 miles of stage construction, was \$881,389.43, of which the Federal share was \$564,881.76. The disbursement of Federal funds to the State was \$1,450,238.37. The unobligated balance available on June 30, 1931, of all appropriations authorized and apportioned up to that date was \$162,707.71.

HAWAII

The Federal-aid highway system includes 217 miles, of which 47.6 miles have been improved with Federal aid. Of the improved mileage, 6.3 miles were added during the year. At the close of the year 41.1 miles were under construction and 1.5 miles had been approved.

The mileage improved with Federal aid consists of 1.7 miles of graded and drained earth roads, 13 miles of bituminous macadam, 13.3 miles of bituminous concrete, and 19 miles of Portland cement concrete, in addition to which there are bridges and approaches with a total length of 0.6 mile.

The total cost of all Federal-aid roads on which final payment has been made during the year was \$23,114.35, of which the Federal share was \$11,557.17. The disbursement of Federal funds to the State was \$298,198.65. The unobligated balance available on June 30, 1931, of all appropriations authorized and apportioned up to that date was \$1,579,975.17.

FEDERAL-AID STATISTICS

Statistical information relative to the apportionment, obligation, and disbursement of Federal aid during the fiscal year 1931, the cost of roads completed and the estimated cost of roads under construction, and the type of the roads completed and under construction, etc., is given in Tables 17 to 32, inclusive.

TABLE 17.—Mileage of the designated Federal-aid highway system in each State and mileage improved with Federal aid to June 30, 1931

State	Mileage of designated Federal-aid highway system	Mileage completed with Federal aid to June 30, 1931	State	Mileage of designated Federal-aid highway system	Mileage completed with Federal aid to June 30, 1931
Alabama.....	3,931	2,115.8	New Hampshire.....	988	392.9
Arizona.....	1,979	841.9	New Jersey.....	1,315	555.2
Arkansas.....	4,953	1,737.7	New Mexico.....	3,616	1,927.9
California.....	4,889	1,928.0	New York.....	6,732	2,684.0
Colorado.....	3,584	1,343.3	North Carolina.....	4,374	1,970.6
Connecticut.....	904	256.9	North Dakota.....	7,439	4,363.2
Delaware.....	608	306.0	Ohio.....	5,899	2,553.6
Florida.....	1,926	540.0	Oklahoma.....	5,769	1,981.3
Georgia.....	5,557	2,795.0	Oregon.....	3,247	1,267.7
Idaho.....	3,116	1,281.9	Pennsylvania.....	6,335	2,664.4
Illinois.....	6,772	2,267.7	Rhode Island.....	452	215.4
Indiana.....	4,740	1,579.0	South Carolina.....	3,232	1,853.5
Iowa.....	7,214	3,153.1	South Dakota.....	6,193	3,741.6
Kansas.....	7,920	3,148.8	Tennessee.....	3,733	1,461.4
Kentucky.....	3,699	1,519.0	Texas.....	11,722	6,979.5
Louisiana.....	2,725	1,418.9	Utah.....	1,751	1,041.5
Maine.....	1,576	603.2	Vermont.....	1,036	301.6
Maryland.....	1,828	707.0	Virginia.....	3,650	1,624.7
Massachusetts.....	1,437	724.2	Washington.....	3,033	1,001.4
Michigan.....	5,242	1,864.8	West Virginia.....	2,216	772.6
Minnesota.....	6,885	3,987.3	Wisconsin.....	5,493	2,414.8
Mississippi.....	3,661	1,772.7	Wyoming.....	3,498	1,629.0
Missouri.....	7,530	2,659.5	Hawaii.....	217	47.6
Montana.....	5,127	1,835.1			
Nebraska.....	5,574	3,848.9	Total.....	196,877	88,713.1
Nevada.....	1,560	1,092.0			

TABLE 18.—Total cost, Federal aid and mileage, of Federal-aid roads, initial and stage construction and reconstruction completed and paid for during the fiscal year 1931

State	Total cost	Federal aid	Mileage			
			Initial	Stage	Recon-struction	Total
Alabama.....	\$2,768,507.17	\$1,327,018.44	147.5	.....	.....	147.5
Arizona.....	3,018,902.92	2,209,372.79	128.9	107.2	.....	236.1
Arkansas.....	4,143,719.74	1,944,640.71	85.1	24.6	.....	109.7
California.....	7,125,403.83	3,188,503.15	159.9	27.7	.....	187.6
Colorado.....	4,539,021.87	2,404,028.79	195.7	37.3	.....	233.0
Connecticut.....	1,387,635.17	478,982.62	27.6	.....	.....	27.6
Delaware.....	1,739,411.96	761,114.65	61.4	.....	.....	61.4
Florida.....	1,626,884.27	650,708.39	35.8	.....	.....	35.8
Georgia.....	2,890,924.75	1,311,145.58	80.2	51.6	.....	131.8
Idaho.....	1,564,466.12	899,067.70	101.7	66.7	.....	168.4
Illinois.....	7,373,346.03	3,173,832.47	221.5	3.7	.....	225.2
Indiana.....	6,969,639.24	3,206,979.94	222.3	.....	.....	222.3
Iowa.....	8,440,583.54	3,784,337.44	93.7	219.7	.....	313.4
Kansas.....	7,507,055.66	3,543,998.02	442.4	165.3	.....	607.7
Kentucky.....	7,403,584.13	3,181,640.29	222.1	169.8	.....	391.9
Louisiana.....	2,497,574.06	1,108,436.27	100.0	17.4	.....	117.4
Maine.....	2,626,753.53	1,043,761.64	76.1	.....	1.6	77.7
Maryland.....	2,321,767.52	1,080,340.41	74.8	6.7	.....	81.5
Massachusetts.....	4,002,184.04	1,336,894.86	79.9	8	2.6	83.3
Michigan.....	10,460,190.17	4,048,668.07	217.1	27.3	.....	244.4
Minnesota.....	10,843,062.76	4,275,605.31	241.5	240.6	.....	482.1
Mississippi.....	1,324,571.81	467,179.27	30.0	.....	.....	30.0
Missouri.....	11,764,495.20	4,742,406.56	222.7	138.2	.....	360.9
Montana.....	3,774,599.56	2,278,439.12	229.2	25.1	.....	254.3
Nebraska.....	2,141,382.57	1,012,980.95	118.1	116.2	.....	234.3
Nevada.....	1,280,385.50	1,117,988.62	74.5	173.2	.....	247.7
New Hampshire.....	1,688,554.45	566,971.66	34.0	.....	3.7	37.7
New Jersey.....	4,334,773.53	1,216,111.48	58.6	.....	.....	58.6
New Mexico.....	2,613,662.63	1,780,453.18	134.8	35.7	.....	170.5
New York.....	10,125,403.76	3,157,104.88	217.5	.....	.....	217.5
North Carolina.....	3,798,790.84	1,797,835.64	194.5	28.8	.....	223.3
North Dakota.....	2,551,573.01	1,288,488.22	464.5	458.2	.....	922.7
Ohio.....	16,809,335.96	6,223,666.28	377.0	34.0	.....	411.4
Oklahoma.....	4,649,555.48	2,130,091.91	144.9	69.4	2.7	216.6
Oregon.....	1,999,595.51	1,037,287.34	150.2	10.6	.....	160.8
Pennsylvania.....	30,204,188.07	8,248,571.56	498.2	14.1	.....	512.3
Rhode Island.....	1,847,694.03	723,239.22	34.9	.....	.....	34.9
South Carolina.....	3,035,805.26	1,001,305.10	84.4	23.5	.....	107.9
South Dakota.....	3,726,469.50	1,910,950.80	335.6	187.7	.....	523.3
Tennessee.....	6,075,905.11	2,595,549.58	208.3	61.0	.....	269.3
Texas.....	16,271,159.08	7,143,590.29	531.1	261.6	.....	792.7
Utah.....	898,959.29	617,349.55	37.2	59.8	.....	97.0
Vermont.....	2,007,419.18	740,678.27	40.0	1.2	1.4	42.6
Virginia.....	4,264,542.94	1,897,292.76	199.5	12.0	.....	211.5
Washington.....	3,665,180.85	1,522,825.01	119.1	10.4	.....	129.5
West Virginia.....	3,823,054.57	1,536,418.05	70.7	45.4	.....	116.1
Wisconsin.....	8,206,234.14	3,628,159.37	257.3	60.2	.....	317.5
Wyoming.....	881,389.43	564,881.76	56.6	89.8	.....	146.4
Hawaii.....	23,114.35	11,557.17	2	.....	.....	2
Total.....	255,088,414.09	105,918,451.14	7,938.8	3,082.5	12.0	11,033.3

TABLE 19.—Total cost, Federal aid and mileage, of Federal-aid roads, initial and stage construction and reconstruction completed, but final payment not made, as of June 30, 1931

State	Estimated total cost	Federal aid allotted	Mileage			
			Initial	Stage	Recon-struction	Total
Alabama.....	\$1,195,281.39	\$595,171.57	29.0	26.1	.....	55.1
Arizona.....	1,183,305.96	862,350.59	40.2	42.7	.....	82.9
Arkansas.....	3,683,706.29	1,782,496.58	82.3	37.0	.....	119.3
California.....	1,335,414.23	641,815.88	34.1	1.8	.....	35.9
Colorado.....	1,029,963.21	527,588.61	30.0	6.3	.....	36.3
Connecticut.....	1,072,403.38	521,200.63	1.6	.....	.....	1.6
Florida.....	1,640,582.91	756,810.96	31.5	5.5	.....	37.0
Georgia.....	3,826,478.51	1,877,964.27	103.3	63.9	.....	167.2
Idaho.....	224,089.40	135,173.97	15.2	.....	.....	15.2
Illinois.....	2,998,506.82	1,368,817.20	81.0	25.2	.....	106.2
Indiana.....	2,195,778.21	1,064,461.20	68.9	.....	.....	68.9
Kansas.....	876,442.04	412,859.62	67.8	.....	.....	67.8
Kentucky.....	1,437,803.29	619,173.07	35.7	28.7	.....	64.4

TABLE 19.—Total cost, Federal aid and mileage, of Federal-aid roads, initial and stage construction and reconstruction completed, but final payment not made, as of June 30, 1931—Continued

State	Estimated total cost	Federal aid allotted	Mileage			
			Initial	Stage	Recon-struction	Total
Louisiana.....	\$2,543,880.29	\$1,298,637.03	49.3			49.3
Maine.....	242,168.53	117,632.15	7.1			7.1
Maryland.....	642,561.97	312,286.50	2.6		11.7	14.3
Massachusetts.....	2,676,897.23	702,264.97	34.4			34.4
Michigan.....	1,341,344.99	587,198.00	32.5			32.5
Minnesota.....	27,775.99					
Mississippi.....	85,915.16	42,957.57	5.4			5.4
Missouri.....	2,102,328.51	770,571.37	27.7	26.3		54.0
Montana.....	782,798.04	438,845.29	56.1	7.8		63.9
Nebraska.....	5,768,736.24	2,674,861.77	226.0	127.4		353.4
Nevada.....	370,009.47	328,753.35		44.1		44.1
New Hampshire.....	269,454.44	110,709.88	7.3			7.3
New Mexico.....	1,495,199.18	945,982.25	75.9	16.9		92.8
New York.....	4,868,931.43	1,148,325.00	75.0			75.0
North Carolina.....	1,365,426.37	667,402.24	43.5	11.0		54.5
North Dakota.....	747,024.13	373,512.00	103.6	83.6		187.2
Ohio.....	2,839,740.36	1,033,556.28	56.5	8.7		65.2
Oklahoma.....	3,028,276.50	1,466,175.42	124.4	24.5	5.8	154.7
Oregon.....	961,790.72	617,221.68	56.4	13.3		69.7
Pennsylvania.....	3,381,740.73	1,090,430.17	43.1			43.1
Rhode Island.....	479,395.02	223,002.97	6.0			6.0
South Carolina.....	3,619,240.53	1,433,961.58	43.3	90.5		133.8
South Dakota.....	556,770.15	305,711.30	61.1	17.1		78.2
Tennessee.....	1,271,410.06	563,036.51	34.8	17.6		52.4
Texas.....	4,024,400.94	1,695,824.67	140.6	71.4		212.0
Utah.....	930,521.47	646,704.16	60.0	48.9		108.9
Vermont.....	411,964.11	153,064.08	8.8			8.8
Virginia.....	1,782,837.22	851,935.15	80.2	5.2		85.4
West Virginia.....	746,011.04	247,943.30	16.2	6.7		22.9
Wisconsin.....	20,805.43	10,398.00	.3			.3
Wyoming.....	433,754.24	274,762.93	27.0	23.2		50.2
Hawaii.....	329,748.81	130,498.88	6.2			6.2
Total.....	72,848,614.94	32,430,050.60	2,131.9	881.4	17.5	3,030.8

TABLE 20.—Total cost, Federal aid and mileage, of Federal-aid roads, initial and stage and reconstruction improvement, under construction on June 30, 1931, by States

State	Estimated total cost	Federal aid allotted	Mileage			
			Initial	Stage	Recon-struction	Total
Alabama.....	\$7,537,014.55	\$3,671,288.23	236.7	114.8		351.5
Arizona.....	6,419,231.92	4,295,941.88	260.0	229.3		489.3
Arkansas.....	9,139,166.13	4,354,305.88	235.6	102.1		337.7
California.....	12,395,686.82	5,206,186.73	293.4	103.5		396.9
Colorado.....	5,781,305.19	3,115,215.63	206.2	89.0		295.2
Connecticut.....	4,952,568.48	1,794,286.20	49.0			49.0
Delaware.....	1,041,247.28	519,869.13	52.6			52.6
Florida.....	6,424,859.85	3,007,205.42	175.5			175.5
Georgia.....	9,004,537.69	4,302,305.86	303.1	113.8		416.9
Idaho.....	4,085,734.91	2,297,771.02	271.2	32.9		304.1
Illinois.....	25,622,268.77	11,785,892.09	769.3	41.1		810.4
Indiana.....	9,209,958.89	4,536,328.72	281.3			281.3
Iowa.....	7,386,346.86	3,144,075.10	167.3	72.1		239.4
Kansas.....	8,883,373.59	4,247,356.40	505.6	55.8		561.4
Kentucky.....	7,439,643.91	3,259,483.02	294.4	131.1		415.5
Louisiana.....	8,422,172.79	4,005,813.00	245.9	19.3		265.2
Maine.....	4,337,397.40	1,642,395.30	101.0			101.0
Maryland.....	1,652,189.40	759,448.81	47.9	2.4	1.8	52.1
Massachusetts.....	9,210,169.31	2,276,626.32	78.9			78.9
Michigan.....	10,793,690.64	4,466,907.21	314.4	7.8	16.1	338.3
Minnesota.....	7,643,473.34	3,237,288.25	74.3	284.5		358.8
Mississippi.....	4,089,403.10	2,013,896.18	182.0	80.5		262.5
Missouri.....	9,829,670.52	3,905,276.93	246.8	65.0		311.8
Montana.....	11,719,226.48	6,597,231.21	888.2	157.9		1,046.1
Nebraska.....	9,110,895.80	4,268,494.24	245.9	199.7		445.6
Nevada.....	2,946,231.13	1,983,134.43	108.0	239.4	9.2	356.6
New Hampshire.....	1,343,033.46	515,208.60	26.1	1.0		27.1
New Jersey.....	6,209,545.44	1,794,968.33	74.7			74.7
New Mexico.....	6,820,755.52	4,117,269.64	251.5	145.5		397.0
New York.....	39,415,270.33	13,701,573.50	690.9	7.0		697.9
North Carolina.....	6,565,115.87	3,126,179.57	213.1	35.4		248.5
North Dakota.....	4,377,946.70	2,233,117.38	453.3	457.4		910.7

TABLE 20.—Total cost, Federal aid and mileage, of Federal-aid roads, initial and stage and reconstruction improvement, under construction on June 30, 1931, by States—Continued

State	Estimate total cost	Federal aid allotted	Mileage			
			Initial	Stage	Recon-struction	Total
Ohio.....	\$15,298,336.93	\$4,780,217.25	231.1	21.6	.....	252.7
Oklahoma.....	7,764,820.32	3,678,809.67	298.4	109.3	8.4	416.1
Oregon.....	7,564,517.07	4,175,255.21	246.8	90.3	.....	337.1
Pennsylvania.....	12,715,867.36	5,194,853.56	251.7	.....	.....	251.7
Rhode Island.....	2,621,715.53	976,610.80	42.1	.....	.....	42.1
South Carolina.....	5,423,297.93	2,457,109.74	78.2	152.8	.....	231.0
South Dakota.....	6,206,502.83	3,334,679.87	419.4	188.4	.....	607.8
Tennessee.....	4,542,803.15	2,237,133.62	193.7	17.4	.....	211.1
Texas.....	20,038,372.56	9,178,199.78	858.4	324.4	.....	1,182.8
Utah.....	2,204,486.97	1,284,752.41	133.9	38.9	.....	172.8
Vermont.....	1,291,829.51	529,907.38	30.5	4.7	.....	35.2
Virginia.....	6,193,760.18	2,810,606.22	260.9	46.2	.....	307.1
Washington.....	5,833,992.87	2,590,959.02	175.7	26.8	.....	202.5
West Virginia.....	5,156,102.15	2,037,767.87	129.9	12.5	.....	142.4
Wisconsin.....	8,618,261.82	3,763,295.04	228.9	74.5	.....	303.4
Wyoming.....	4,684,178.27	2,794,003.06	351.0	242.4	.....	593.4
Hawaii.....	1,429,014.40	580,743.37	41.1	.....	.....	41.1
Total.....	387,396,991.92	172,587,244.08	12,305.8	4,138.5	35.5	16,479.8

TABLE 21.—Total cost, Federal aid and mileage, of Federal-aid roads, initial and stage improvement, approved for construction, as of June 30, 1931, by States

State	Estimated total cost	Federal aid allotted	Mileage		
			Initial	Stage	Total
Alabama.....	\$93,312.53	\$46,656.26	1.4	2.7	4.1
Arizona.....	84,143.72	54,813.77	2.4	5.1	7.5
Arkansas.....	1,491,745.71	713,622.89	23.7	29.9	53.6
California.....	1,804,148.84	663,854.92	60.4	.....	60.4
Colorado.....	328,975.27	184,752.46	15.9	21.4	37.3
Connecticut.....	377,652.56	176,946.82	5.5	.....	5.5
Delaware.....	180,024.00	90,012.00	7.4	.....	7.4
Florida.....	102,816.84	51,408.41	13.3	.....	13.3
Georgia.....	1,555,393.35	730,085.16	77.7	18.2	95.9
Idaho.....	987,824.36	574,435.01	58.3	55.9	114.2
Illinois.....	8,257,424.68	3,778,078.65	271.9	4.7	276.6
Indiana.....	3,030,777.18	1,453,338.00	129.5	.....	129.5
Iowa.....	549,700.61	182,458.80	.....	17.4	17.4
Kansas.....	1,804,249.75	868,140.63	113.0	46.2	159.2
Kentucky.....	880,912.21	428,092.95	60.8	19.8	80.6
Louisiana.....	120,355.82	58,515.39	5.1	.6	5.7
Maine.....	1,084,671.79	470,583.82	19.9	.....	19.9
Maryland.....	405,155.40	202,577.69	17.7	.....	17.7
Massachusetts.....	1,467,104.61	563,500.20	17.0	.....	17.0
Michigan.....	2,142,332.29	1,024,613.00	81.7	27.3	109.0
Minnesota.....	1,278,434.70	546,474.69	5.6	49.6	55.2
Mississippi.....	402,117.91	201,058.94	2.5	18.3	20.8
Missouri.....	1,979,887.13	846,926.77	61.2	25.8	87.0
Montana.....	438,573.99	243,222.95	36.9	29.2	66.1
Nebraska.....	1,653,248.55	759,179.23	54.9	68.9	123.8
Nevada.....	628,107.07	395,796.58	18.8	24.8	43.6
New Hampshire.....	465,120.12	127,744.36	3.4	7.3	10.7
New Jersey.....	144,716.24	3,420.00	.2	.....	.2
New Mexico.....	107,277.63	67,700.35	.2	.....	.2
New York.....	6,191,200.00	2,428,525.00	115.9	.....	115.9
North Carolina.....	1,023,035.04	503,233.00	29.0	36.4	65.4
North Dakota.....	877,431.89	438,715.84	90.4	194.9	285.3
Ohio.....	5,056,660.86	1,964,856.48	95.9	23.4	119.3
Oklahoma.....	1,078,316.17	579,499.44	39.0	13.9	52.9
Oregon.....	728,600.13	362,847.87	49.1	8.4	57.5
Pennsylvania.....	2,700,355.73	1,295,663.77	96.4	.....	96.4
Rhode Island.....	91,465.74	45,732.86	.1	.....	.1
South Dakota.....	512,582.94	254,606.69	15.1	47.1	62.2
Tennessee.....	380,641.70	190,320.84	26.0	.....	26.0
Texas.....	2,777,023.12	1,226,795.58	87.6	51.2	138.8
Utah.....	819,142.92	483,403.55	31.2	92.8	124.0
Vermont.....	99,416.46	25,868.93	2.3	.....	2.3
Virginia.....	497,760.77	246,236.51	18.4	.6	19.0
Washington.....	774,880.71	326,442.43	12.7	17.1	29.8
West Virginia.....	626,633.87	274,083.33	9.1	12.9	22.0
Wisconsin.....	1,690,746.84	552,719.04	48.9	17.6	66.5
Wyoming.....	311,033.86	155,516.00	10.7	43.9	54.6
Hawaii.....	82,324.99	22,869.00	1.5	.....	1.5
Total.....	60,165,458.60	26,885,946.86	1,945.6	1,033.3	2,978.9

TABLE 23.—Mileage of Federal-aid roads initially completed and paid for during the fiscal year 1931, by types of construction, by States—Con.

State	Graded and drained	Sand-clay, un-treated		Gravel		Macadam		Low-cost bituminous mix	Bituminous macadam	Bituminous concrete	Portland cement concrete	Block	Bridges and approaches	Total
		Un-treated	Treated	Un-treated	Treated	Un-treated	Treated							
North Carolina.....	21.0			28.2				35.5			67.5		0.9	194.5
North Dakota.....	416.0			44.5				.2				82.9	.4	464.5
Ohio.....	15.9			21.4		0.1			15.1	2.9	235.8		2.9	377.0
Oklahoma.....	77.4										66.2		1.3	144.9
Oregon.....	105.7			28.7					3.5		10.4		1.9	150.2
Pennsylvania.....	42.1					24.4			22.7		421.8	8.6	1.3	498.2
Rhode Island.....										1.5	51.0		.9	34.9
South Carolina.....	14.5		15.4	1.3									.7	84.4
South Dakota.....	2.7			327.2									.6	335.6
Tennessee.....	53.6									43.3	110.9		.5	208.3
Texas.....	297.8			.6			12.0			17.3	196.2		7.2	531.1
Utah.....	6.1			25.2				5.3					.7	37.2
Vermont.....				.8					1.8		36.7		.7	40.0
Virginia.....	65.7		29.6			67.9			28.8		6.3		1.2	199.5
Washington.....	38.9			60.2							19.3		.7	119.1
West Virginia.....	4.4			3.3									.7	70.7
Wisconsin.....	18.4			67.0					14.4	5.7	42.2		2.4	257.3
Wyoming.....	21.3			34.8				.3			169.5		.2	56.6
Hawaii.....													.2	.2
Total.....	1,854.4		387.8	1,522.5		92.5		256.8	208.4	207.4	3,160.3	97.7	56.4	7,938.8

TABLE 24.—Mileage of Federal-aid roads, initial construction, completed but final payment not made, by types of construction, by States, as of June 30, 1931

State	Graded and drained	Sand-clay		Gravel		Macadam		Low-cost bituminous mix	Bituminous macadam	Bituminous concrete	Portland cement concrete	Block	Bridges and approaches	Total
		Un-treated	Treated	Un-treated	Treated	Un-treated	Treated							
Alabama.....														29.0
Arizona.....											29.0			40.2
Arkansas.....	5.8			22.6				15.4			1.7		0.5	82.3
California.....	21.0			27.0							46.4		3.1	34.1
Colorado.....				1.7							3.7		.7	30.0
Connecticut.....				23.3									1.3	1.6
Florida.....									3.6		27.5		.4	31.5

Georgia.....	16.0	9.7	15.1	23.6	8.7	44.6	7.7	103.3
Idaho.....								15.2
Illinois.....						80.9	.1	81.0
Indiana.....						68.9	.1	68.9
Iowa.....								67.8
Kansas.....	9.9	31.8	12.0	6.9		6.6	.6	35.7
Kentucky.....	10.5		9.1			13.9	.2	40.3
Louisiana.....			38.6			4.5	6.2	40.3
Maine.....			5.6	.4			1.1	7.1
Maryland.....						2.6	.6	2.6
Massachusetts.....						12.9	.3	34.4
Michigan.....	2.6		13.8		18.8	2.4	.3	32.5
Mississippi.....	8.7					18.4	.3	27.7
Missouri.....						2.8		5.4
Montana.....			42.6			19.0	.6	56.1
Nebraska.....	.2	181.0	22.5			21.1	1.0	226.0
New Hampshire.....				1.3		6.0		7.3
New Mexico.....			51.5		23.6		.8	75.9
New York.....	6.6		2.9			65.5		75.0
North Carolina.....	65.7	8.6	37.8			34.7	.2	43.5
North Dakota.....			3.5				.1	103.6
Ohio.....					7.4	22.0	.8	56.5
Oklahoma.....	65.2					54.1	.9	124.4
Oregon.....	26.0				10.6		.7	56.4
Pennsylvania.....	15.7			13.1		20.8	.6	43.1
Rhode Island.....						5.7	.3	6.0
South Carolina.....						43.0	.3	43.3
South Dakota.....			61.0				.1	61.1
Tennessee.....	27.0					7.4	.4	34.8
Texas.....	92.7		7.5		6.6	32.5	1.3	140.6
Utah.....			59.7				.3	60.0
Vermont.....						8.7	.1	8.8
Virginia.....	8.3	23.9		29.5	4.4	12.9	.3	80.2
West Virginia.....					7.8	8.4		16.2
Wisconsin.....			12.4				.2	16.2
Wyoming.....	5.8				7.5	1.2	.1	27.0
Hawaii.....					6.1		.1	6.2
Total.....	387.7	255.0	447.8	36.8	76.4	735.7	25.2	2,131.9

TABLE 25.—Mileage of Federal-aid roads under initial construction on June 30, 1931, by types of construction, by States

State	Graded and drained		Sand-clay		Gravel		Macadam		Low-cost bituminous mix	Bituminous macadam	Bituminous concrete	Portland cement concrete	Block	Bridges and approaches	Total
	Un-treated	Treated	Un-treated	Treated	Un-treated	Treated	Un-treated	Treated							
Alabama	125.8				1.0				92.9			107.8		2.1	236.7
Arizona	32.5				131.9							45.9		2.7	200.0
Arkansas	172.0				13.0				160.1			25.5		2.7	235.6
California	23.4				27.8	2.4			88.0	10.4		38.7		3.1	293.4
Colorado	8.2				96.0							45.7		4.8	206.2
Connecticut														3.1	49.0
Delaware	4.3											48.0		.3	52.6
Florida	40.4				7.5			49.6				65.4		5.2	175.5
Georgia	80.5				176.7			101.3				85.1		1.4	303.1
Idaho	49.2	1.6							14.7			11.0		1.8	271.2
Illinois	75.3								43.5					6.8	769.3
Indiana	19.1											687.2		5.5	769.3
Iowa	373.8	36.4										256.7		2.1	281.3
Kansas	148.0		3.7		12.9	8.6			11.7			167.3		3.8	505.6
Kentucky	18.9				50.3				10.5			54.7		1.2	284.4
Louisiana					85.9							138.8		2.3	243.9
Maine															101.0
Massachusetts					7.4					11.6		36.6		.6	101.0
Michigan	89.2											26.8		.1	47.9
Minnesota	36.4				32.3							34.7		3.4	78.9
Mississippi	145.6											179.3		1.5	314.4
Missouri	43.7				67.7							37.9			74.3
Montana	109.9				609.2							133.6		2.8	182.0
Nebraska		194.4							166.6					1.9	888.2
Nevada									6.9					1.8	245.9
New Hampshire					79.5				28.5			35.1			108.0
New Jersey						4.0						19.2		1.1	23.1
New Mexico	77.5											73.5		1.2	74.7
New York	46.1				95.6				74.9					3.5	251.5
North Carolina	6.5				20.9				40.5			505.0		1.7	690.9
North Dakota	426.5	17.0			21.3				.3			103.5		1.2	213.1
Ohio	9.0				6.1							4.7		.5	453.3
Oklahoma	158.5				7.4			6.3				189.8		4.9	231.1
Oregon	47.1				26.8							131.2		1.3	298.4
Pennsylvania	1.4								11.5			6.8		1.6	246.8
Rhode Island												39.0		.4	42.1
South Carolina	222.4				195.5							50.6		.4	78.2
South Dakota	121.4													1.5	419.4
Tennessee	640.6				14.0	11.4						16.9		1.8	193.7
Texas					88.7							153.8		9.7	858.4
Utah									44.6			.1		.5	133.9

TABLE 26.—Mileage of Federal-aid roads approved for initial construction on June 30, 1921, by types of construction, by States—Continued

State	Graded and drained	Sand-clay, untreated	Gravel		Macadam		Low-cost bituminous mix	Bituminous macadam	Bituminous concrete	Portland cement concrete	Block	Bridges and approaches	Total
			Untreated	Treated	Untreated	Treated							
North Dakota	88.7		1.6							48.2		.1	90.4
Ohio			3.3					15.9	17.6	22.7	9.1	1.8	95.9
Oklahoma	16.3												39.0
Oregon	14.1		21.6			13.3				14.2		.1	49.1
Pennsylvania					82.1							.1	96.4
Rhode Island													.1
South Dakota	15.1												15.1
Tennessee	25.8											.2	26.0
Texas	68.0		20.3						.9	16.8		1.9	87.6
Utah			.1					3.3	3.3	7.5		.1	31.2
Vermont					10.0				2.1	2.1		.4	2.3
Virginia	4.8	3.2											18.4
Washington			3.9							8.8			12.7
West Virginia										8.9		.2	9.1
Wisconsin	21.0		8.1							18.2		1.6	48.0
Wyoming	10.7												10.7
Hawaii								1.5					1.5
Total	532.7	50.7	194.5	31.2	92.1	256.	110.6	48.8	80.6	754.4	9.1	15.3	1,945.6

TABLE 27.—Mileage of Federal-aid-road stage construction completed and paid for during the fiscal year 1931, by types of construction, by States

State	Graded and drained	Sand-clay, untreated	Gravel		Macadam		Low-cost bituminous mix	Bituminous macadam	Bituminous concrete	Portland cement concrete	Block	Bridges and approaches	Total
			Untreated	Treated	Untreated	Treated							
Arizona.....							106.8			24.5		0.4	107.2
Arkansas.....										16.0		.1	24.6
California.....	9.2		2.3							27.7		.2	27.7
Colorado.....			6.4				19.9			10.4		.6	37.3
Georgia.....			7.7			5.6		4.7		33.5		.1	51.6
Idaho.....			3.7				57.7			5.3			66.7
Illinois.....										3.7			3.7
Iowa.....										219.7			219.7
Kansas.....	.1	66.5	53.9	1.0			3.0			40.5		.3	165.3
Kentucky.....			59.9				2.6	34.5		72.6		.2	169.8
Louisiana.....										17.3		.1	17.4
Maryland.....	1.0									5.7			6.7
Massachusetts.....												.8	.8
Michigan.....										27.3			27.3
Minnesota.....	11.3							.1		229.1		.1	240.6
Missouri.....										138.1			138.2
Montana.....							24.8					.3	25.1
Nebraska.....		81.1								35.1			116.2
Nevada.....							173.0					.2	173.2
New Mexico.....			6.3				29.4			9.6			35.7
North Carolina.....		2.9	6.9			6.2		3.1				.1	29.8
North Dakota.....			407.0	45.5			5.7			25.2	8.5	.7	458.2
Ohio.....										61.1			61.1
Oklahoma.....								4.0					4.0
Oregon.....			6.6										6.6
Pennsylvania.....										14.1			14.1
South Carolina.....										1.3			1.3
South Dakota.....	.2		158.5					22.2		28.8		.2	187.7
Tennessee.....	19.4					7.6				60.9		.1	61.0
Texas.....								13.1	17.5	203.6		.4	234.6
Utah.....							59.5			.3			60.8
Vermont.....												1.2	1.2
Virginia.....						.8		3.7		6.4			10.4
Washington.....			10.4									1.1	11.5
West Virginia.....						15.3				30.1			45.4
Wisconsin.....										60.2			60.2
Wyoming.....	.8		41.9				46.9					.2	89.8
Total.....	42.0	150.5	771.5	54.1	22.3	5.6	529.3	20.8	90.0	1,380.4	8.5	7.5	3,082.5

TABLE 28.—Mileage of Federal-aid roads, stage construction, completed but final payment not made, by types of construction, by States, as of June 30, 1931

State	Graded and drained	Sand-clay, untreated	Gravel, untreated	Macadam, treated	Low-cost, bituminous mix	Bituminous macadam	Bituminous concrete	Portland cement concrete	Bridges and approaches	Total
Alabama.....							10.9	15.0	0.2	26.1
Arizona.....					42.5				.2	42.7
Arkansas.....								37.0		37.0
California.....	1.7				6.3				.1	1.8
Colorado.....										6.3
Florida.....				5.4					.1	5.5
Georgia.....				11.9			16.5	35.5		63.9
Illinois.....								25.2		25.2
Kentucky.....					10.3			18.4		28.7
Missouri.....								26.2		26.3
Montana.....					7.8					7.8
Nebraska.....	.3	53.6						72.9	.6	127.4
Nevada.....					44.1					44.1
New Mexico.....					15.9				1.0	16.9
North Carolina.....			7.3				1.2	2.5		11.0
North Dakota.....	8.3		75.3							83.6
Ohio.....										8.7
Oklahoma.....								24.5		24.5
Oregon.....	2.0					11.3				13.3
South Carolina.....							5.6	84.8	.1	90.5
South Dakota.....			17.1					17.1		17.6
Tennessee.....								17.6		17.6
Texas.....							43.5	27.5	.4	71.4
Utah.....			41.4		7.5					48.9
Virginia.....	.5		.5							1.0
West Virginia.....						4.1				4.1
Wyoming.....			13.7		9.5			6.7		23.2
Total.....	12.8	53.6	155.3	17.3	143.9	15.4	77.7	402.4	3.0	881.4

TABLE 29.—Mileage of Federal-aid roads under stage construction on June 30, 1931, by types of construction, by States

State	Graded and drained	Sand-clay, untreated	Gravel		Macadam		Low-cost bituminous mix	Bituminous macadam	Bituminous concrete	Portland cement concrete	Block	Bridges and approaches	Total
			Untreated	Treated	Untreated	Treated							
Alabama	2.9		0.5					18.5	92.7			0.2	114.8
Arizona	1.7		9.4				0.3		5			1.1	229.3
Arkansas	19.3								82.6			1.2	102.1
California	7.0		12.7					22.5	20.8			1.8	103.5
Colorado			.3						29.4			.2	89.0
Georgia							34.9		76.1		2.5	.3	113.8
Idaho	1.3		3.5						41.0			.1	32.9
Illinois									72.1			.1	41.1
Iowa									19.3			.7	55.8
Kansas	11.6		8.6					20.0	61.9			.4	131.1
Kentucky			26.1						17.2			.1	19.3
Louisiana	2.0								2.4			.1	2.4
Maryland									7.7			.1	7.8
Michigan									185.3			.2	284.5
Minnesota	99.0								38.6			.2	80.5
Mississippi	41.7								54.4			.1	65.0
Missouri	10.4								153.3			2.4	199.7
Montana			60.2						1.0			.8	143.5
Nebraska		45.3	7.4						1.7			.1	7.0
Nevada									84.3				35.4
New Hampshire	3.8		94.9						10.7			.1	437.4
New Mexico									6.9				21.6
New York	13.2								19.7			1.3	109.3
North Carolina	62.3		294.9					.2	89.7		.4	.1	90.3
North Dakota									6.1			.1	152.3
Ohio	13.8		5.7						54.2			.5	188.4
Oklahoma	11.9		5.5						7.9			.8	17.4
Oregon			58.2						165.8			.8	324.4
South Carolina	46.3								1.1			.1	38.9
South Dakota	5.5								23.5			.8	46.2
Tennessee	44.2		41.8						16.1			.3	12.5
Texas	15.9		7.8						3.3			.3	73.5
Utah									71.0			.1	242.4
Vermont													
Virginia		7.9							1.1			.1	4.7
Washington			10.7						23.5			.8	46.2
West Virginia	7.4								16.1			.3	26.8
Wisconsin	1.4		57.1						3.3			.3	12.5
Wyoming	1.0								71.0			.1	73.5
Total	423.6	53.2	603.4	72.9	75.4	1,103.0	68.7	119.3	1,581.2	2.9	14.2	4,138.5	

TABLE 30.—Mileage of Federal-aid roads approved for stage construction on June 30, 1931, by types of construction, by States

State	Graded and drained		Sand-clay		Gravel		Macadam, treated	Low-cost bituminous mix	Bituminous macadam	Bituminous concrete	Portland cement concrete	Block	Bridges and approaches	Total
	Untreated	Treated	Untreated	Treated	Untreated	Treated								
Alabama											2.7			2.7
Arizona								5.1						5.1
Arkansas	0.7							21.3			28.9		0.3	29.9
Colorado							9.7						.1	21.4
Georgia								53.3			8.5			18.2
Idaho					2.6									55.9
Illinois										4.7				4.7
Iowa										17.4				17.4
Kansas	1.0	10.3				21.8				12.9			.2	46.2
Kentucky					13.7					4.4				19.8
Louisiana									1.7					1.7
Michigan									19.0					19.0
Minnesota	7.0										8.3			27.3
Mississippi	.7										42.6			49.6
Missouri											17.6			18.3
Montana					11.5			17.7			25.7		.1	25.8
Nebraska			46.9											29.2
Nevada					10.6			13.6						68.9
New Hampshire											21.5			24.8
New Carolina				4.0				16.2			7.3			24.8
North Dakota					183.3			11.6			9.9			194.9
Ohio									0.9		13.6		.8	23.4
Oklahoma					6.9						6.8		.2	13.9
Oregon											1.8			1.8
South Dakota	11.6					27.7					7.8			47.1
Texas	13.2						11.1				26.6		.3	51.2
Utah								92.3			.5			92.8
Virginia														.6
Washington											17.1			17.1
West Virginia											12.9			12.9
Wisconsin	5.0										12.2		.4	17.6
Wyoming					17.9			28.0						43.9
Total	39.2	57.2	4.0	49.5	246.8	49.5	20.8	257.1	7.5	26.7	312.9	8.1	3.5	1,033.3

TABLE 31.—Net changes in the types of Federal-aid improvements on the Federal-aid highway system during the fiscal year 1931—Cont.

State	Graded and drained		Sand-clay		Gravel		Macadam		Low cost bituminous mix	Bituminous macadam	Bituminous concrete	Portland cement concrete	Block	Bridges and approaches	Total
	Un-treated	Treated	Un-treated	Treated	Un-treated	Treated	Un-treated	Treated							
Utah.....	-20.1				104.7				72.3			.7		.3	60.3
Vermont.....					-4.3					1.8		46.8		1.7	46.0
Virginia.....	55.9		37.1		-5.8			-3.7		9.0	.8	-8.9		3.2	156.8
Washington.....	14.1				36.3							15.8		.6	68.8
West Virginia.....	-6.5				2.3							66.2			62.5
Wisconsin.....	18.1				-52.8			5.3				201.4		2.1	168.6
Wyoming.....	-86.9				-47.2				52.9			1.3		.6	-79.7
Hawaii.....										6.1				.3	6.4
Total.....	-1,200.7		69.1	22.5	38.1	127.6	-32.9	20.8	831.9	138.7	222.0	4,316.5	88.9	57.8	4,700.3

TABLE 32.—Federal-aid apportionment, and amounts paid to the States for the fiscal year 1931, and the unobligated balance of the total apportionment on June 30, 1931

State	Apportionment fiscal year 1931	Paid to States during the fiscal year 1931	Unobligated balances of total apportionment on June 30, 1931
Alabama.....	\$2,595,620	\$2,468,137.03	\$3,291,396.79
Arizona.....	1,770,317	3,034,289.82	92,674.36
Arkansas.....	2,155,143	3,202,880.66	114,579.53
California.....	4,168,617	3,726,979.36	926,385.10
Colorado.....	2,317,540	2,970,121.22	1,968,342.74
Connecticut.....	796,489	826,494.20	4,388.65
Delaware.....	609,375	699,494.71	73,516.71
Florida.....	1,533,930	1,572,336.43	1,604,812.74
Georgia.....	3,309,387	4,322,392.40	1,049,771.28
Idaho.....	1,554,323	1,660,581.47	395,029.73
Illinois.....	5,167,968	5,337,535.29	279,005.33
Indiana.....	3,182,508	1,640,813.75	755,222.13
Iowa.....	3,343,240	4,358,844.68	4,059.10
Kansas.....	3,414,308	3,798,165.71	386,026.70
Kentucky.....	2,357,683	3,197,038.96	183,559.55
Louisiana.....	1,733,658	1,396,140.88	253,076.15
Maine.....	1,125,177	1,130,502.21	612,261.07
Maryland.....	1,053,185	1,498,370.57	91,940.51
Massachusetts.....	1,816,704	1,665,230.28	1,597,158.35
Michigan.....	3,666,962	2,947,103.22	1,973,791.60
Minnesota.....	3,504,977	3,669,096.61	27,432.47
Mississippi.....	2,206,495	699,603.25	3,759,645.69
Missouri.....	3,970,638	5,225,783.52	30,847.48
Montana.....	2,588,108	3,161,355.93	2,120,118.98
Nebraska.....	2,644,210	2,409,323.05	904,033.63
Nevada.....	1,601,408	1,393,804.29	204,157.11
New Hampshire.....	609,375	728,122.94	94,801.98
New Jersey.....	1,560,390	1,619,943.80	1,177,568.27
New Mexico.....	1,983,827	3,138,928.76	86,735.38
New York.....	6,009,941	3,669,032.26	15,421.72
North Carolina.....	2,871,122	3,366,945.86	1,608,127.62
North Dakota.....	2,005,100	1,580,470.90	1,087,249.83
Ohio.....	4,589,213	6,542,722.17	1,236,446.47
Oklahoma.....	2,918,358	4,502,041.08	8,011.61
Oregon.....	1,996,112	2,873,047.97	442,216.97
Pennsylvania.....	5,524,512	6,965,100.41	1,151,378.69
Rhode Island.....	609,375	950,985.01	98,072.80
South Carolina.....	1,775,175	2,680,153.70	242,641.12
South Dakota.....	2,054,937	2,024,617.07	383,082.29
Tennessee.....	2,681,337	3,664,142.24	1,838,996.09
Texas.....	7,576,384	7,366,218.34	3,256,872.24
Utah.....	1,417,920	1,452,586.86	524,243.32
Vermont.....	609,375	750,693.40	52,345.06
Virginia.....	2,382,088	2,883,737.89	578,394.71
Washington.....	1,927,031	2,002,370.88	893,899.52
West Virginia.....	1,321,376	1,039,698.29	334,335.98
Wisconsin.....	3,081,949	3,778,494.29	82,080.01
Wyoming.....	1,570,758	1,450,238.37	162,707.71
Hawaii.....	609,375	298,198.65	1,579,975.17
Total.....	121,875,000	133,340,910.64	39,638,888.04

NATIONAL-FOREST ROAD CONSTRUCTION

During the past year improvements have been completed on 280.9 miles of the forest-road system, bringing the total mileage improved to date with Federal funds to 4,638.4 miles. Of the mileage improved during the year, 254.9 miles were in the Western States and Alaska and the remaining 26 miles were in the forests of six Eastern States. Of the total mileage improved to date, 4,281.6 miles are in the West and 356.8 in the East.

The mileage of forest-highway projects completed during the year and to date by States is shown in Table 33.

TABLE 33.—Mileage of completed forest-highway projects, by States

State	Mileage of forest-highway projects completed		State	Mileage of forest-highway projects completed	
	During 1931	Total to June 30, 1931		During 1931	Total to June 30, 1931
Western:			Eastern:		
Alaska.....	8.9	230.9	Alabama.....		5.1
Arizona.....	22.5	358.7	Arkansas.....	9.7	74.9
California.....	53.7	437.4	Florida.....	1.0	65.2
Colorado.....	26.1	365.8	Georgia.....		21.4
Idaho.....	34.5	542.9	Michigan.....	0.8	8.9
Montana.....	17.8	409.5	Minnesota.....	8.2	68.8
Nevada.....	12.3	126.8	New Hampshire.....		5.2
New Mexico.....	8.4	198.8	North Carolina.....		36.3
Oregon.....	28.3	705.8	South Carolina.....		16.0
South Dakota.....		46.2	Tennessee.....	3.9	37.4
Utah.....	32.6	340.5	Virginia.....	2.4	17.6
Washington.....	6.2	233.9	Total.....	26.0	356.8
Wyoming.....	9.6	284.4	Grand total.....	280.9	4,638.4
Total.....	254.9	4,281.6			

In the forest-highway system as approved to date there are 15,024.1 miles, of which 12,538.5 miles are in the Western States and Alaska and 2,485.6 miles are in the Eastern States and Porto Rico. Class 1 highways, which are necessary sections or extensions of the Federal-aid highway system lying wholly within the forest areas, total 1,384.6 miles, of which 923.1 miles are in the Western States. Class 2 highways, which also extend the Federal-aid system, total 7,402.5 miles, of which 7,074.1 miles are in the West. The class 3 highways, those that serve communities within the forests, total 6,237 miles, of which 4,541.3 miles are in the Western States.

The mileage of each of the three classes of highways and the total mileage of the forest-highway system in each State are shown in Table 34.

TABLE 34.—Classified mileage of forest-highway system, by States

State	Mileage of forest-highway system			
	Class 1	Class 2	Class 3	Total
Western:				
Alaska.....			443.9	443.9
Arizona.....	263.3	491.0	265.0	1,019.3
California.....	320.5	985.0	976.0	2,281.5
Colorado.....		1,240.0	483.0	1,723.0
Idaho.....	4.0	792.7	247.5	1,044.2
Montana.....	147.4	687.5	363.0	1,197.9
Nevada.....		373.8	95.4	469.2
New Mexico.....	115.0	219.0	226.5	560.5
Oregon.....	66.2	782.4	591.2	1,439.8
South Dakota.....	2.0	217.0	86.0	305.0
Utah.....		457.9	290.2	748.1
Washington.....	4.7	472.8	321.6	799.1
Wyoming.....		355.0	152.0	507.0
Total.....	923.1	7,074.1	4,541.3	12,538.5

TABLE 34.—Classified mileage of forest-highway system, by States—Continued

State	Mileage of forest-highway system			
	Class 1	Class 2	Class 3	Class 4
Eastern:				
Alabama.....			41.0	41.0
Arkansas.....	169.8	34.0	14.0	217.8
Florida.....		0.7	106.0	106.7
Georgia.....	31.6	10.2	85.5	127.3
Maine.....			11.0	11.0
Michigan.....	49.9		272.5	322.4
Minnesota.....	41.0	38.5	166.0	245.5
Nebraska.....			28.8	28.8
New Hampshire.....	30.0	50.0	49.0	129.0
North Carolina.....	78.7	50.0	108.9	237.6
Oklahoma.....			40.0	40.0
Pennsylvania.....	24.5	16.0	157.0	197.5
Porto Rico.....			9.0	9.0
South Carolina.....		6.0	40.0	46.0
Tennessee.....	36.0	81.0	167.0	284.0
Virginia.....		38.0	269.0	307.0
West Virginia.....		4.0	131.0	135.0
Total.....	461.5	328.4	1,695.7	2,485.6
Grand total.....	1,384.6	7,402.5	6,237.0	15,024.1

For several years prior to the past year the annual authorization for forest roads and trails had been \$7,500,000, of which \$4,500,000 was reserved for the more important roads designated as forest highways. For this year the total appropriation authorized was \$12,500,000, of which \$9,500,000 was made available for forest highways, an increase of \$5,000,000, more than doubling the annual sums formerly available.

In addition there was appropriated by the act of December 20, 1930, the sum of \$3,000,000 for the purpose of increasing employment. Altogether, the funds available for expenditure this year have been nearly three times as great as the previous authorizations.

An increase of the program of work so great as these additional appropriations required would normally involve a considerable period of preparation. A greater number of surveys must be made, and this, under the conditions that surround much of the forest road work, is a task that can not be dispatched in a moment. Plans in greater numbers must be prepared; contracts advertised and let and contractors' outfits moved to the remote places in which many of these projects are located, all with the additional handicap imposed by the short working season. And, first of all, so great a relative increase in the program can not be handled at all without some increase in the engineering force.

It is, therefore, gratifying to be able to report that, notwithstanding the readjustments necessary to meet the increased demands, the mileage of forest highways placed under construction during the fiscal year to be financed with the regular funds was about 75 per cent greater than in the previous year, and the entire amount of the \$3,000,000 emergency appropriation was obligated as required by the

end of the year. Several projects to be paid for with these funds were let to contract within a month of the date of the appropriation.

Most of the additional improvements made possible by the increase of \$5,000,000 in the regular appropriation have been located on the Federal-aid system or its more important extensions, that is class 1 and class 2 roads, and the type of improvement required has been higher than that which is adequate for class 3 roads. Because of this fact the costs have been somewhat above the average and the mileage that could be improved somewhat reduced. However, there has been a noticeable reduction in the level of prices for road work during the year and especially during the latter half. Bids received during this period encourage the belief that the low costs will permit adding to the 1932 program a number of projects which it had not been thought possible to include. To do so necessitates a number of additional surveys, but it is believed that these can be completed and the new work begun in time to allow the greater portion of it to be completed before it is necessary to suspend operations for the winter.

ROAD CONSTRUCTION IN THE NATIONAL PARKS

Appropriations authorized by Congress for the construction and improvement of highways in the national parks have steadily increased. For the fiscal year 1930 the expenditure authorized was \$3,500,000. For the year 1931 the amount of the regular appropriation was increased to \$5,000,000 and the emergency act of December 20, 1930, provided an additional \$1,500,000 for further relief of unemployment. For each of the fiscal years 1932 and 1933 appropriations of \$7,500,000 have been authorized. Of these latter sums Congress, by a recent act, has authorized the expenditure each year of \$1,500,000 for the improvement of roads outside of the parks but serving as approaches thereto.

The construction work of the past year, which by agreement with the National Park Service is supervised by the Bureau of Public Roads, has brought to completion 68.5 miles, making the total thus far improved 370.6 miles, all of which is in the system of major park roads that has been designated, including a total of 1,509.7 miles.

As required by the emergency appropriation act, all of the \$1,500,000 provided by it was obligated to definite projects by the end of the fiscal year in spite of the fact that it was necessary to make location surveys for the greater portion of the work before the projects could be advertised for bids.

The considerable increase in funds available for the last fiscal year accounts for the fact that the construction in progress at the end of the year covers 327.9 miles as compared with the program a year ago, involving only 67 miles. Of the current construction program 182.7 miles is stage construction.

The mileage included in the designated system in the several parks and the record of completion during the last year and to date are shown in Table 35.

TABLE 35.—*The program of national-park road improvement and the mileage of roads improved under the supervision of the Bureau of Public Roads*

National park	Mileage of the program	Mileage completed under the supervision of the bureau		National park	Mileage of the program	Mileage completed under the supervision of the bureau	
		During the fiscal year 1931	Total to June 30, 1931			During the fiscal year 1931	Total to June 30, 1931
Crater Lake.....	70.5	-----	23.3	Yellowstone.....	369.2	10.6	34.5
Glacier.....	145.9	-----	32.5	Zion.....	22.4	.4	9.1
Mount Rainier.....	122.1	7.4	49.1	Hawaii.....	83.6	-----	11.2
Grand Canyon.....	156.7	15.7	75.2	Mesa Verde.....	47.3	-----	6.0
Yosemite.....	218.6	10.9	47.4	Acadia.....	4.5	3.3	3.3
Sequoia.....	84.5	-----	25.2	Wind Cave.....	5.4	1.0	5.3
General Grant.....	-----	-----	4.0	Mount McKinley..	73.5	-----	-----
Lassen Volcanic.....	39.5	19.2	35.5				
Rocky Mountain.....	64.4	-----	8.7	Total.....	1,509.7	68.5	370.6
Devil's Tower.....	1.6	-----	.3				

Probably the most interesting of the projects under construction is the Wawona Road in Yosemite National Park, which includes the construction of a tunnel approximately 4,200 feet in length. Contract for this work was awarded on October 1, 1930, and the project is now about 30 per cent complete. It is anticipated that all work will be completed in advance of the time stated in the contract.

The problem of ventilating the tunnel on this project has required considerable study, in which the bureau has received invaluable assistance from the United States Bureau of Mines. The preliminary report of that bureau indicates that mechanical ventilation will be required, and the Bureau of Mines will be asked to assist in the preparation of the plans for this.

Of outstanding interest among the projects completed during the past year are the south approach to Grand Canyon National Park and the Bright Angel Springs Road in Grand Canyon. In Mount Rainier Park the White River Road and sections A and B of the West Side Highway are among the most important grading projects completed during the past year. In Yellowstone Park the Artist Point section of the Grand Canyon Rim was completed. In the East the grading of the Cadillac Mountain Road in Acadia National Park, Me., was completed. The surfacing of this project is now in progress and covers a length of approximately 3.5 miles.

The most important bridge structure completed was Klickitat Creek Bridge on the White River Road in Mount Rainier National Park. This is a reinforced concrete barrel arch with cement-rubble masonry facing.

The end of the fiscal year found plans under way for road construction in the proposed Shenandoah National Park and Colonial National Monument, both in Virginia. Two contracts were awarded for grading approximately 45 miles of roadway in Shenandoah Park at a cost of approximately \$700,000. This is all pioneer road construction of the heavy mountain type. Road construction in that section of Virginia is extremely difficult. All grades were kept under 6 per cent wherever practicable and at one point the plans call for a tunnel about 600 feet long. In Colonial National Monument two projects will be put under construction this year. One covers the grading of a section of the proposed highway from Yorktown to

Jamestown Island and the other involves about 1,000,000 cubic yards of hydraulic fill. The length of this fill is about 5,600 feet and is composed of two major fills, one across Indian Field Creek, a distance of approximately 4,400 feet and one across Felgates Creek, a distance of approximately 1,200 feet. The National Park Service has allotted the bureau approximately \$527,000 for the construction of these two projects.

RESTORATION OF FLOOD-DAMAGED ROADS

In the last annual report record was made of the passage of acts appropriating various sums as reimbursements or contributions in aid of several States, these appropriations induced by the extraordinary conditions of necessity and emergency resulting from the unusually serious financial losses by such States through damage to or destruction of roads and bridges by floods in 1927 and 1929.

The States to which such aid had been offered at the time of submission of the last report were Vermont, New Hampshire, Kentucky, Arkansas, Louisiana, Mississippi, Missouri, Alabama, Georgia, and South Carolina.

To the first three a total of \$5,197,294 was made available expendable only upon work undertaken with the approval of the Secretary of Agriculture after the passage of the act.

To Arkansas, Louisiana, Mississippi, and Missouri a total of \$3,654,000 was made available not only for work done subsequent to the passage of the act but also for reimbursement of expenditures made by the States before the act was passed. In every case it is necessary that the State shall have expended or made available for expenditure State funds in an amount equal to the Federal reimbursement or contribution.

To the third group of States—Alabama, Georgia, and South Carolina—separate acts appropriated sums totaling \$2,971,628.50, from which a deduction of 2½ per cent was authorized to cover the cost of Federal administration. The total amount actually available to these States is, therefore, \$2,897,338. The expenditure of this money is authorized in the same manner as described in the cases of Arkansas, Louisiana, Mississippi, and Missouri.

Since the submission of the last report there has been appropriated by the second deficiency act for the fiscal year 1931, approved March 4, 1931, a fund of \$80,307 for similar relief of the State of Florida. The appropriation in this case is not subject to the 2½ per cent administrative deduction and, in the language of the act, is made as "a complete contribution and reimbursement in aid from the United States * * *."

The amounts of these several appropriations (less the 2½ per cent allowed for Federal administration in the case of Alabama, Georgia, and South Carolina), the amounts paid the States up to June 30, 1931, and the unobligated balance for each State are shown in Table 36. The amounts paid during the past year are reported in Table 37.

The mileage of road improved under these acts up to the end of the last fiscal year and the corresponding total cost and Federal payment are given in Table 38. Similar information for roads completed during the past year is presented in Table 39, and for roads under construction at the end of the year and approved for construction in Tables 40 and 41, respectively.

The mileage of the several types of flood-relief roads completed in the several States during the fiscal year 1931 is given in Table 42, and the total mileages completed, under construction, and approved for construction on June 30, 1931, classified by types and by States, are given in Tables 43, 44, and 45, respectively.

TABLE 36.—*Flood relief appropriated, amounts paid to States, and the unobligated balance of the appropriation on June 30, 1931*

State	Appropriated	Paid to the States to June 30, 1931	Unobligated balance
Vermont.....	\$2,654,000	\$2,654,000.00	.....
New Hampshire.....	653,300	624,142.44	.....
Kentucky.....	1,889,994	556,338.50	\$1,242,784.76
Total.....	5,197,294	3,834,480.94	1,242,784.76
Arkansas.....	1,800,000	1,052,178.29	592,971.26
Louisiana.....	967,582	533,668.20	143,811.18
Mississippi.....	628,000	345,266.57	282,733.43
Missouri.....	258,418	.....	130,865.95
Total.....	3,654,000	1,931,113.06	1,150,381.82
Alabama.....	¹ 1,618,500	430,282.33	1,132,283.11
Georgia.....	¹ 493,416	.....	389,830.93
South Carolina.....	¹ 785,422	.....	44,180.64
Florida.....	80,307	.....	80,307.00
Total.....	2,977,645	430,282.33	1,646,601.68
Grand total.....	11,828,939	6,195,876.33	4,039,768.26

¹ Does not include fund allowable for administration.

TABLE 37.—*Flood relief paid to the States during the fiscal year 1931*

State	Flood relief paid during fiscal year 1931	State	Flood relief paid during fiscal year 1931
Vermont.....	\$163,258.00	Mississippi.....	\$3,563.66
New Hampshire.....	60,796.55	Total.....	1,589,410.15
Kentucky.....	162,742.85	Alabama.....	430,282.33
Total.....	386,797.40	Grand total.....	2,406,489.88
Arkansas.....	1,052,178.29		
Louisiana.....	533,668.20		

TABLE 38.—*Total cost, flood relief, and mileage of roads improved to June 30, 1931*

State	Total cost	Flood relief	Mileage
Vermont.....	\$5,651,965.83	\$2,654,000.00	61.2
New Hampshire.....	1,412,316.37	653,300.00	29.0
Kentucky.....	1,225,402.88	539,156.95	64.5
Total.....	8,289,685.08	3,846,456.95	154.7
Arkansas.....	586,181.70	283,087.73	47.2
Mississippi.....	11,433.59	3,563.66	.3
Total.....	597,615.29	286,651.39	47.5
Alabama.....	280,250.82	137,971.44	32.8
Grand total.....	9,167,551.19	4,271,079.78	235.0

TABLE 39.—*Total cost, flood relief, and mileage of roads which were completed and final payment made during the fiscal year 1931*

State	Total cost	Flood relief	Mileage
Vermont.....	\$1,016,599.46	\$437,051.28	14.0
New Hampshire.....	77,546.44	38,773.22	2.2
Kentucky.....	646,773.47	261,528.13	38.6
Total.....	1,740,919.37	737,352.63	54.8
Arkansas.....	532,780.42	256,387.09	46.0
Mississippi.....	11,433.59	3,563.66	.3
Total.....	544,214.01	259,950.75	46.3
Alabama.....	53,278.72	24,485.41	3.1
Grand total.....	2,338,412.10	1,021,788.79	104.2

TABLE 40.—*Total cost, flood relief, and mileage of roads under construction on June 30, 1931*

State	Estimated total cost	Flood relief allotted	Mileage
Alabama.....	\$41,929.57	\$20,964.87	8.7
Arkansas.....	65,489.09	28,405.38	.2
Kentucky.....	175,131.12	49,152.29	2.8
South Carolina.....	739,655.96	330,241.34	6.6
Total.....	1,022,205.74	428,763.88	18.3

TABLE 41.—*Total cost, flood relief, and mileage of roads approved for construction on June 30, 1931*

State	Estimated total cost	Flood relief allotted	Mileage
Alabama.....	\$3,624.03	\$1,812.01	0.1
Arkansas.....	201,046.13	99,744.43	2.6
Georgia.....	207,169.78	103,584.88	3.7
Kentucky.....	128,234.67	58,900.00	15.4
South Carolina.....	1,008,511.62	411,000.00	14.3
Total.....	1,548,586.23	675,041.32	36.1

TABLE 42.—*Mileage of the various types of flood-relief roads completed and final payment made during the fiscal year 1931*

State	Graded and drained	Sand-clay, untreated	Gravel, untreated	Macadam, treated	Bituminous macadam	Portland cement concrete	Bridges and approaches	Total
Vermont.....			0.8		2.6	9.9	0.7	14.0
New Hampshire.....				2.2				2.2
Kentucky.....	38.2						0.4	38.6
Arkansas.....	15.8		28.8			.3	1.1	46.0
Mississippi.....						.3		.3
Alabama.....	2.2	0.8					.1	3.1
Total.....	56.2	.8	29.6	2.2	2.6	10.5	2.3	104.2

TABLE 43.—Mileage of the various types of flood-relief roads improved to June 30, 1931

State	Graded and drained	Sand-clay, untreated	Gravel, untreated	Gravel surface treated	Macadam surface treated	Bituminous macadam	Portland cement concrete	Bridges and approaches	Total
Vermont.....			7.0	9.2		6.1	32.5	6.4	61.2
New Hampshire.....				2.9	4.9	2.3	18.3	.6	29.0
Kentucky.....	63.8							.7	64.5
Total.....	63.8		7.0	12.1	4.9	8.4	50.8	7.7	154.7
Arkansas.....	15.8		30.0				.3	1.1	47.2
Mississippi.....							.3		.3
Total.....	15.8		30.0				.6	1.1	47.5
Alabama.....	19.1	0.8	12.3					.6	32.8
Grand total.....	98.7	.8	49.3	12.1	4.9	8.4	51.4	9.4	235.0

TABLE 44.—Mileage of the various types of flood-relief roads under construction on June 30, 1931

State	Graded and drained	Sand-clay untreated	Portland cement concrete	Bridges and approaches	Total
Alabama.....	8.6			0.1	8.7
Arkansas.....				.2	.2
Kentucky.....	2.6			.2	2.8
South Carolina.....	.1	0.4	5.0	1.1	6.6
Total.....	11.3	.4	5.0	1.6	18.3

TABLE 45.—Mileage of the various types of flood-relief roads approved for construction on June 30, 1931

State	Graded and drained	Gravel untreated	Macadam surface treated	Portland cement concrete	Bridges and approaches	Total
Alabama.....				0.1		0.1
Arkansas.....		1.7			0.9	2.6
Georgia.....			3.3		.4	3.7
Kentucky.....	15.4					15.4
South Carolina.....	12.1			.3	1.9	14.3
Total.....	27.5	1.7	3.3	.4	3.2	36.1

MOUNT VERNON MEMORIAL HIGHWAY

Construction of the Mount Vernon Memorial Highway, begun in September, 1929, has proceeded rapidly during the last fiscal year and it is now virtually assured that the road will be ready for travel throughout when it is dedicated as a memorial to George Washington in 1932. The ceremony, which is a part of the program of the United States Commission for the Celebration of the Two Hundredth Anniversary of the Birth of George Washington, will be held on April 30, 1932.

With the exception of the construction of about $2\frac{1}{4}$ miles of hydraulic fill forming part of the grade of the highway, all work

has been done under contract. The hydraulic fill construction has been done by the Corps of Engineers of the United States Army, in a highly efficient manner, and at a cost but little exceeding the estimate, a result which is especially gratifying because the subsurface conditions proved to be unfavorable and the work of constructing the fills rather difficult. The soft, unstable material in the bed of the streams at the points where the fills were constructed ranged from 12 to 30 feet in depth. But, despite the unanticipated difficulties encountered, and the extra yardage which has been placed in the fills, the work—virtually completed at the close of this fiscal year—has been done at little more than half the cost for the same work on the basis of the one complete contract bid received and rejected before the work was undertaken by the Corps of Engineers. Up to June 30 the expenditure for this work was approximately \$1,200,000 and this amount is estimated to be within \$100,000 of the final cost.

On other portions of the work for which contracts have been awarded the progress up to June 30 was as follows:

Unit 1. Construction of a sea wall and cofferdam and supply of stone for bridge facing. Contract awarded September 12, 1929. Work completed and accepted May 11, 1931.

Unit 2. Dry-land grading, drainage, and incidental construction: Contract awarded February 11, 1930. Work completed and accepted May 9, 1931.

Unit 3. Bridges: Contract awarded April 17, 1930. This contract involves the construction of 11 bridges and a new abutment for the existing Highway Bridge over the Potomac River. Progress on these structures has been as follows:

Boundary Channel bridge, approximately 70 per cent complete on June 30.

New abutment for Potomac River Highway Bridge, approximately 90 per cent complete on June 30.

Highway underpass at south end of Potomac River Highway Bridge, approximately 95 per cent complete on June 30.

Highway underpass at Richmond, Fredericksburg & Potomac Railroad, approximately 97 per cent complete on June 30.

Bridge over Roaches Run, complete on June 30.

Bridge over Four Mile Run, complete on June 30, except for final pointing and cleaning.

Airport overpass, complete on June 30.

Southern Railway overpass, completed on June 30, except for final pointing and cleaning.

Bridge over Hunting Creek, approximately 97 per cent complete on June 30.

Wellington underpass, practically completed on June 30.

Fort Hunt overpass, complete on June 30.

Bridge over Little Hunting Creek, approximately 98 per cent complete on June 30.

Unit 4, section 1. Paving and incidental structures from Columbia Island to the south side of Hunting Creek: Contract awarded March 11, 1931. Paving begun May 12. Progress satisfactory.

Section 2. Paving and incidental structures beginning at the south side of Hunting Creek and terminating at Mount Vernon. Contract awarded March 20, 1931. Paving begun April 21. Progress satisfactory.

In addition to the above major contracts others awarded before the close of the fiscal year provided for the construction and operation of a concession building at the highway terminus at Mount Vernon, and for the drilling and casing of a well at the terminus. The former was awarded on June 23; the latter on June 25.

Other contracts to be awarded shortly will provide for construction incident to a water supply at the terminus and for the erection of lighting fixtures along the highway.

The landscaping and planting work which forms an important part of the project is being done mainly by force account under the direction of the Bureau of Public Roads and is progressing satisfactorily.

Provision for the construction of the highway from Washington to Mount Vernon as a memorial to George Washington was made by the act of Congress, approved May 23, 1928, which authorized the United States Commission for the Celebration of the Two Hundredth Anniversary of the Birth of George Washington to survey, select, construct, and maintain the road in cooperation with the Secretary of Agriculture.

The appropriation originally authorized for the work was \$4,500,000. By act of March 4, 1931 there was authorized an additional appropriation of \$2,700,000. All funds authorized have since been appropriated.

INTER-AMERICAN HIGHWAY

Work on the reconnaissance surveys of the proposed inter-American highway from Panama to the United States progressed materially during the past year. Engineers of this bureau, cooperating with the several governments which have requested such surveys, have inspected possible locations of the highway through the countries of Panama, Costa Rica, Honduras, and Guatemala. A similar survey will be made in Nicaragua during the coming fiscal year.

This important activity had its inception in recommendations of the Sixth International Conference of American States, held at Habana, Cuba, in 1928, and the Pan American Congress of Highways which met in Rio de Janeiro in 1929, for consideration and adoption of agreements looking to the construction of a pan-American highway connecting North America, Central America, and South America. More specific action was taken at an inter-American highway conference in Panama October 7-12, 1929, when a resolution was adopted recommending the creation of a commission to carry on the work of determining the most feasible route of an inter-American highway. By act of Congress, approved March 26, 1930, the United States Government appropriated \$50,000 to defray the cost of reconnaissance surveys to develop the facts, and to report to Congress on the feasibility of possible routes, the probable cost, the economic service, and such other information as would be pertinent to the building of an inter-American highway or highways.

Under this authority three bureau engineers took up their duties in Central America in June, 1930, headquarters having been provided at Panama through the courtesy of the Panamanian Government. These engineers have continued their work throughout the fiscal year just ended, as previously outlined. In March, 1931, the Inter-American Highway Commission met again at Panama to learn of the progress of the work, with the chief of this bureau and the chief of the bureau's division of highway transport, which is in direct charge of the reconnaissance operations, in attendance.

Field work on the reconnaissance survey will be completed during the coming fiscal year, it is expected, and a comprehensive report will then be made for submission to Congress.

SIXTH INTERNATIONAL ROAD CONGRESS

The Sixth International Road Congress which was held at Washington from October 6 to 11, 1930, proved to be one of the most interesting and important meetings of the Permanent International Association of Road Congresses.

The congress was held in the United States at the invitation of this Government, which holds membership in the association. The chief of this bureau, by appointment of the Secretary of State, served as the secretary-general of the American organizing commission, an agency of the State Department created to administer the appropriation of \$55,000 made by Congress to defray the expense of the sessions.

Because of its close association with road work in the United States this bureau was called upon by the Department of State for advice and assistance in preparation for the congress and in assisting and informing the engineers who were in attendance from 64 countries.

TRANSPORTATION AND ECONOMIC AND STATISTICAL INVESTIGATIONS

WESTERN STATES TRAFFIC SURVEY

The survey of traffic on the Federal-aid highway system in 11 Western States, which was begun during the autumn of 1929, was completed in October, 1930, after one year's field work. A complete report on this project, including many tables and maps with explanatory text, is now being compiled.

The States in which the survey was conducted were: Arizona, California, Colorado, Idaho, Nebraska, New Mexico, Nevada, Oregon, Utah, Washington, and Wyoming. In each State the work was done in cooperation with the State highway department.

This project has been the largest of the kind yet undertaken by the bureau, although numerous surveys covering single States or municipal regional areas have previously been made. It has developed the first accurate information available in regard to the flow of traffic on the principal highways of nearly the entire western half of the United States, thus forming the basis for a broad plan of highway improvement in this area.

Among the important data obtained through this survey may be cited the following: Daily average of traffic on all Federal-aid roads in the States surveyed, and traffic data on numerous other roads connecting with the Federal-aid system; estimates of probable future growth of traffic at 5 and 10 year intervals; analysis of the types of vehicles which comprise these totals—passenger automobiles, trucks, or buses; number of persons transported by the passenger-carrying vehicles, and the various capacities of trucks; average daily length of trip of various types of trucks and of passenger cars; number of common-carrier and contract-hauler trucks; origin and destination of vehicles; and percentages of interstate and intrastate traffic.

The scope of the survey is indicated by the fact that more than 20,000,000 vehicles were observed during the year of field work.

MICHIGAN TRAFFIC SURVEY

Another type of traffic survey was conducted in Michigan in cooperation with the highway department of that State, primarily for the purpose of determining facts regarding the character and distribution of traffic on State and local roads and city streets, which may have a bearing upon the future distribution of the cost of highway improvement within the State. Field work on this project began in July, 1930, and its completion, including an extra month of intensive traffic counts in seven leading cities of the State, was scheduled for the end of August, 1931, after which a report is to be compiled and published.

Important facts relating to current problems of highway finance will be produced by this survey, it is expected. The relationship between the use of primary and secondary roads and city streets by various classes of traffic and the source of the funds employed in their improvement and maintenance has never been accurately determined. The assumption generally made is that traffic on the main intercity roads is a comparatively far-ranging traffic, mostly of city-owned vehicles, and that local roads serve a traffic that is predominantly of intracounty origin.

In recent years, however, increasing demands that a larger portion of State-collected revenue be applied to the improvement of local roads have been made by county and township authorities, their claims being predicated upon the assumption that the local roads are required to serve a considerable traffic from outside the local taxing jurisdiction and that the State as a whole should compensate the local government in greater measure for the highway service thus afforded to other than local vehicles. The purpose of the survey in typical townships of Michigan is to ascertain the facts that will indicate whether there is just and reasonable basis for these demands. Cities also claim a share of State revenues in consideration of the use of their streets by rural vehicles, and the special intensive survey in seven representative cities during August bears particularly upon this phase of the problem.

STUDY OF TAXATION IN WISCONSIN

A study, somewhat similar to the investigation in Michigan, but differing in method, was conducted and completed during the year in Wisconsin, the bureau cooperating with the University of Wisconsin.

This investigation was undertaken to determine the facts of highway financing in the State as a whole, with special reference to the true incidence of highway taxation by classes of governmental units and the relationship of highway taxation to taxation for all other purposes. Special effort was made to ascertain where highway funds of all classes were expended, both by road systems and by groups of units of government, and also to establish approximately by a questionnaire method the distribution of highway travel both by road systems and groups of governmental units.

The study, which is later to be extended to other States, was undertaken first in Wisconsin because of the excellence and completeness

of that State's fiscal and tax records. A full report of the work in this first State has been prepared and will shortly be ready for publication.

HIGHWAY TRAFFIC-CAPACITY INVESTIGATIONS

The cooperative agreement with the University of Maryland for a study of highway capacity has been renewed for a second year. The continuation is for the principal purpose of accumulating additional field data to verify that previously compiled. Analysis of last year's observations leads to the tentative conclusion that there is no serious amount of congestion on 2-lane roads up to a traffic rate of about 1,000 per hour, nor on 3-lane roads up to a rate of about 1,600 per hour. In these studies the formation of queues, indicating that the density of traffic is such as to prevent prompt passing of overtaking vehicles, is taken as the criterion of a condition of congestion.

STUDY OF COMMERCIAL TRUCK OPERATION

In cooperation with the Bureau of Foreign and Domestic Commerce of the United States Department of Commerce, an investigation of commercial motor-truck operation, initiated during the preceding year, has been brought nearly to completion. Personal interviews with motor-truck operators in all parts of the United States have yielded a valuable body of detailed data, covering equipment in use, radius of haul, and cost of service. Other general information essential to a clear description of the industry has also been assembled for incorporation in a report.

GENERAL HIGHWAY STATISTICS

General statistics relating to road mileage, annual construction programs, State and local highway funds and disbursements, motor-vehicle registration, proceeds from motor-vehicle and gas taxes, motor-vehicle and gas-tax rates, gasoline consumption, State highway bond issues, and highway-bond financing are regularly collected and published in a series of annual tabulations. This material is assembled by no other agency of the Federal Government or States, and its collection is essential to the proper administration of Federal-aid road work. The information is in constant demand by other agencies of the Government, by the States, and by the public.

PRODUCTION COST STUDIES

Unit costs in most lines of highway-construction work are very largely controlled by the rate of production. This is because the daily or hourly cost of operating a modern road-building plant is practically independent of the rate of production so long as the crew and plant are on the job. Consequently, the most effective way to reduce unit operating costs is to increase the rate of production, for as the rate of production increases the unit cost of the work decreases in very nearly the same ratio.

In order to determine definitely how much the rate of concrete road production with standard 27-E pavers could be increased by increasing the size of the batch without any injury to the quality of the concrete, a series of extensive field tests was conducted in cooperation with the highway departments of several States. These tests show conclusively that the more modern 27-E concrete pavers can handle without difficulty a batch at least as large as 35 cubic feet without any sacrifice of either strength or uniformity. The tests further demonstrated that a 33-cubic-foot batch, when mixed during the period indicated by a batchmeter setting of 50 seconds, produced as strong and uniform concrete as did the standard batch when mixed either 50, 60, or even 80 seconds. On the basis of these studies, the State highway department of Wisconsin adopted as its standard a 33-cubic-foot batch with a mixing time of 50 seconds. These specifications make possible an increase in actual production of approximately 27 per cent over the previous specifications, which required a mixing time of 60 seconds and a batch of not to exceed 30 cubic feet. Wisconsin is the second State to adopt officially a mixing time of 50 seconds, California being the first.

But the so-called "mixing time" or time during which all the materials must be in the mixer and subject to the mixing action is not all of the mixing cycle. Time is also required to get the batch into the mixer and out of it. In controlling the rate of production this charge and discharge time is proportionately just as important as the mixing time. For some time it had been noticed that the discharge time of the larger "pugmill" type of mixers generally used in sheet asphalt and bituminous concrete work was very long. Recent improvements, based largely on the bureau's studies and suggestions, have not only improved the mixing action of this type of mixer, but have reduced the discharge time by more than half, thus materially increasing the possible rate of production. Other improvements, long advocated by the bureau's division in charge of this work, include a positive control of the length of the mixing time, and a faster and more uniform method of operation and control of the charging of the batch. These have been added to the new mixers.

The general aim in this work is to find and develop means and methods which will increase production without impairing the quality of the finished product. Quality is always held to be the first essential. No methods, however promising as to speed or unit cost, are tolerated if they show any indication of reducing the quality of the finished product below the specified standards.

The field studies of direct production problems have been continued with gratifying results. These studies relate, (1) to the elimination or reduction of time losses in the performance of all direct operation, (2) to the coordination and synchronization of the rate of production of the various subsidiary or dependent operations with that of the key equipment, and (3) to eliminating unnecessary operations and expediting those which are really necessary. To give these studies immediate practical value to the highway industry the engineers of the bureau work almost entirely on selected, typical construction projects and in close cooperation with the contractor, his superintendent, and the various highway officials in charge of the work. Nothing is permitted which might in any way reduce the quality below the standards called for in the contract. But with the main-

tenance of quality established as the first essential, all other conditions are studied and analyzed in order to determine the causes which are operating to hold down production and then to devise means for their reduction or elimination.

The extent to which the construction industry can and does profit from these studies is well illustrated by the following example: In the fall of 1929 two engineers were assigned to study a large asphaltic construction project in Monterey County, Calif. This organization was already known for its excellent methods, skilled supervision, and high rates of production, and when the engineers were assigned it was the intention that they should observe and study the possibility of adapting these methods to more general use. However, a thorough analysis of the production processes disclosed opportunities for still further improvement. The management, which was especially alert, at once seized these opportunities with the result that what was then a State-wide record of 802 tons of asphaltic concrete placed per 8-hour day was established as an average for the entire job. But the engineers felt sure that this was not the limit of what this organization was capable of producing. Consequently, this same organization was again studied on another job early in 1930. On this job a more thorough elimination of all time losses and a better synchronization of the various operations resulted in raising the average rate of production to 927 tons per 8-hour day.

Neither the engineers nor the management yet felt that the final production limit of this organization had been reached, and a third study was undertaken during the fall of 1930. Opportunities to increase the rate of production were again found and utilized, with the result that the average rate of production per 8-hour day for the entire period from August 18 to October 8 was raised to what was then, so far as is known, a world record of 1,204 tons per day.

The really significant thing about these studies, however, is not the fact that the rate of production of an already highly efficient organization was increased 50 per cent, but that it was found possible to obtain this increased production without any appreciable increase in the daily operating costs. Consequently, the decrease in unit operating costs was of real moment.

Of course, not all jobs on which studies have been conducted have yielded such gratifying improvement in the rate of production. On the other hand, very few projects have been found on which some definite increase could not be obtained without corresponding increase in the cost of operation. The possibilities can be appreciated from the fact that on what might be called average jobs, nearly half of the time of the crew is unproductive as measured by the possible output of the mixer, while on the above-mentioned project on which asphaltic concrete was placed at an average rate of over 150 tons an hour, less than 3 per cent of the crew's time on the job was unproductive.

The number of contractors with whom the bureau can cooperate in actual demonstrations of this kind is limited, but the benefits are nevertheless very far-reaching. The better methods of operation developed during the studies at once become the standard practice of the individual contractor on his future work, and under the prevailing keenly competitive conditions existing in the highway industry, improved methods are quickly noted and copied by others.

Definite information on the methods and principles developed in this work is also disseminated from time to time through reports and papers read before meetings of highway engineers, contractors, and technical societies, or published in the technical journals. In these ways the benefits of these studies are being widely extended and the principles and methods developed are being put into successful operation by an increasing proportion of the most progressive road builders.

HIGHWAY ACCOUNTING METHODS

During the past year the bureau has assisted several State highway departments in the development and installation of uniform accounting and statistical procedures designed to supply full and complete records of income, expenditures, and accomplishments in construction, maintenance, and administration. Standard definitions have been developed which cover the various activities in which the several highway departments are engaged. These serve as a basis for setting up a system of accounts and records which will fully meet all the accounting requirements of the department and at the same time provide in readily available and practical form complete statistical information on any desired line of activity. These accounts and records are based on the use of the most modern bookkeeping and tabulating equipment in order to give prompt and accurate service at the lowest possible cost. The general adoption of such uniform systems of accounts and records will not only be of great value to the individual State in planning and carrying on its various activities, but will also make possible an intelligent comparison of the cost of various methods and kinds of road construction and maintenance as carried on in the several States, a comparison which is not at present possible because of the dissimilar form of the available records. During the year assistance of this kind has been given to the States of Florida, Georgia, Indiana, Mississippi, Oklahoma, and Tennessee.

Assistance was also given to the State of North Carolina in formulating a more efficient and economical method of administrative and financial control of all the more important former county or township roads of the State. The background for this plan included a survey of the financial records of every county with special regard to road revenues, road expenditures, and road indebtedness. A map of each county was also prepared showing all the public roads divided into three classes according to their traffic importance. This information was laid before the State legislature, which enacted a new highway law placing all the more important former county roads under the direct control of the State highway department.

PHYSICAL RESEARCH

SUBGRADE INVESTIGATIONS

Previous reports have described the general problems involved in the subgrade investigations and the steady progress which has been made in their solution. During the last year these investigations have been continued, as in the past, with the cooperation of the Bureau of Chemistry and Soils and various State highway departments and educational institutions.

The work which has been done has been confined in large part to studies of the underlying physical and chemical laws which control the characteristics of soils, and the identification and classification of soils with respect to their performance in highway subgrades. As progress has been made it has become increasingly apparent that the identification of soils with respect to their performance as subgrades and the application of this knowledge in practical road construction constitutes a specialized branch of highway engineering which is extensive in scope and intricate in character. It includes the classification of soils according to the requirements of various kinds of service and the development of tests which disclose the degree to which soils may perform the service required. It has practical application in the solution of a wide range of problems varying, for instance, from the design of satisfactory sand-clay road surfaces to the methods of constructing massive fills.

In one case the answer to a specific subgrade problem may be furnished merely by visual inspection of the soil in the field. In other cases, comprehensive investigations of the soil both in the field and in the laboratory may be required to furnish the desired information.

The manner of making cuts and constructing fills, the degree to which the subgrade should be compacted or otherwise manipulated, the means which will best furnish the required degree of compaction or manipulation, the proper proportions in which soils of different character may be combined to produce stable subgrades, the decision as to whether a subgrade soil shall be treated or replaced with a better material and the depth of treatment or replacement, all depend on fundamental characteristics of the soil.

In addition, specific subgrade problems are influenced to a large degree by local climatic conditions and the arrangement of soils in the soil profile. This is illustrated by the requirements for the design of adequate drainage systems. The failure of subdrains to furnish the desired stability of subgrade soils may be attributed in many instances to the practice of placing them according to arbitrary standards of spacing and depth, without due regard to such factors as the source of water to be removed, the character of soils in the several soil layers and the arrangement of these layers in the soil profile. As research in soils has progressed the hopelessness of standardizing drainage design, on the basis of such simple requirements as the spacing and depth of underdrains, has become evident.

The various problems relating to the best utilization of soils in highway construction are so complex as to require for their solution the services of men specially trained in this work. Moreover, the most effective application of the knowledge which has been developed can best be secured by the various State departments charged with the responsibility for highway construction, by assigning the study of subgrades and the solution of subgrade problems to specially trained men in the State organizations.

One of the important services now rendered by the bureau is the assistance which is being given to State highway departments which desire it, in training men for the subgrade work, and helping to organize intensive subgrade study by the departments themselves. From time to time special courses of instruction in field and labora-

tory procedures and the interpretation of test results are given at the subgrade laboratory of the bureau at the Arlington Experiment Farm, at Rosslyn, Va., to employees of State highway departments authorized to attend and, when requested, subgrade specialists of the bureau are assigned to cooperate with State highway departments in the organization of subgrade divisions. The number of States which have taken advantage of this assistance, and have organized independent subgrade investigations, is very gratifying.

Much of the previous work, such as studies of frost heaving, loss of stability, and detrimental volume-change of soils, has been of a general nature for the purpose of determining fundamental properties. The investigations are being broadened gradually as circumstances warrant to include more specific problems, such as the warping of concrete pavements which has been observed on certain types of heavy soils, the disintegration of concrete in pavements as it may be affected by subgrade constituents, and the methods most suitable for compacting earth fills of various types of material. The aim of these later studies is to determine preventive measures or methods of construction best suited to the local conditions encountered.

During the year instructive reports have been published and others have been prepared for publication during the coming year.

LOW-COST ROAD INVESTIGATIONS

The construction of satisfactory road surfaces of low cost to serve the lighter traffic of the secondary roads has been an increasing activity of State highway departments for several years. The bureau has been active in investigations designed to produce additional information on the most effective use of available materials in roads of this character and these studies are being continued.

An experimental project in California, conducted in cooperation with the division of highways of the California Department of Public Works, has been described in previous reports. Construction of the experimental road was completed during the summer of 1930, and the various sections are now under observation. Publication of a progress report during the next year is contemplated.

Construction of an experimental road in the sand-hill area of Nebraska, also described in previous reports, was completed during the summer of 1930. A progress report describing the construction and the early behavior of the experimental sections will be prepared for publication during the coming year.

Observations have been continued on three projects in South Carolina which were constructed and are maintained by the State highway department in cooperation with the bureau. These projects have a total length of about 32 miles and include 55 experimental sections. One of the projects was discontinued at the close of the fiscal year on account of partial relocation of the road and reconstruction with a higher type of surfacing. A final report on this project will be prepared for publication next year. A progress report on one of the remaining projects is ready for publication, and an early report on the other project is contemplated.

The cooperation with the Asphalt Institute in the study of the uses of asphalt in low-cost road construction, described in some detail in previous reports, has been continued. During the year

cooperative arrangements have been made with representatives of the tar industry for a similar study of the uses of tar, and a field survey of tar-treated roads in North Carolina has been completed.

A most important cooperative study, having as its object the ultimate simplification and standardization of specifications for the liquid asphaltic materials which are used so extensively in low-cost road work, and involving the Bureau of Public Roads, the State highway departments, and the asphalt industry, has been inaugurated during the past year. For materials of this character, the great number of specifications for products intended for similar purposes, and the lack of agreement regarding methods of testing and test requirements, has created a confusion which is detrimental to the best interests of both producer and consumer. By means of cooperative tests of a great number of samples of liquid asphalts of all classes, made in accordance with a common scheme of analysis and also in accordance with the specification requirements of the various State highway departments, there is being accumulated a mass of data relative to the fundamental properties of these materials. These data will be used as a basis for future agreements on uniform test procedures and uniform specification requirements.

MOTOR VEHICLE IMPACT INVESTIGATIONS

From the standpoint of road design two important changes in the character of heavy motor vehicle traffic are taking place. The first of these is the general adoption of pneumatic-tire equipment and the second is the general increase in operating speeds.

To determine what impact reactions may be expected from heavy, high-speed trucks and buses an investigation has been conducted in which a modern bus chassis, carrying certain loads and equipped with various types of tires, was driven at speeds up to 55 miles per hour over definite conditions of pavement roughness and the impact reactions measured. From these tests definite information concerning the magnitude of the impact reactions developed by vehicles of this type was obtained and the effect of such variables as road roughness, load, speed, tire type, rim width, and inflation pressures was established. This valuable material has been made available in a published report.

The three reports of various other phases of this work, which were described in the last annual report as having been prepared for publication, were published also during the past year.

INVESTIGATION OF CONCRETE PAVEMENT DESIGN

Because of the great amount of money being expended for the construction of concrete pavement, possible improvement in the structural design of pavement slabs is a matter of considerable economic importance. The proper cross section to be used has never been established with precision and there is very little reliable information for the design of effective longitudinal and transverse joints.

In order to provide information on these features of pavement design, 10 concrete slabs, 20 by 40 feet, have been constructed at the Arlington Experiment Farm. These are of various shapes of cross

section and include various joint designs. On these slabs known loads are being placed and the effectiveness of the different designs determined by observation of the stresses and deflections which result from these loads. A comparison is being made between the observed behavior of these slabs under load and that which should theoretically occur. A study of the effect of temperature on the size and shape of the sections is also being made. The data which are being obtained should be of considerable assistance in developing a rational method of concrete pavement slab design.

INVESTIGATIONS OF CONCRETE AND CONCRETE AGGREGATES

The investigation of paving concrete involving the construction of an experimental road one-half mile in length, to which reference was made in the annual reports for the preceding two years, has been completed and a report issued. These studies are of special interest because they have made it possible for the first time to base conclusions upon tests of the actual pavement as well as upon tests of small-size specimens. In this way valuable information has been obtained regarding the significance of certain routine tests which have been applied to concrete for many years and which have so far been the only basis upon which it has been possible to proportion concrete mixtures.

Certain of the more important conclusions derived from this investigation follow:

For a constant sand-cement ratio, both the average strength and the uniformity in strength of a concrete pavement slab will be decreased by increasing the percentage of coarse aggregate in the mixture beyond the amount ordinarily used in practice.

When very dry mixtures are used (less than 2-inch slump) the strength of the pavement slab will be lower and the amount of honeycomb in the concrete will be greater than when concrete of medium consistency is employed (2 to 3 inch slump).

Tests made on small molded specimens are a reasonably satisfactory measure of the strength of the concrete in the pavement provided the concrete is of medium consistency. For very dry mixtures the strengths obtained on molded specimens are apt to be higher than the strength of the pavement.

The amount of honeycombing observed in cores drilled from the pavement does not necessarily measure the amount of honeycombing in the pavement itself.

Investigations of paving concrete will be continued during the coming year and will include a study of the effect of using high-speed electric vibrators for compacting the concrete; a study of the effect of continued surface manipulation of the concrete by hand for the purpose of removing excess water; and, a study of the effect of hydraulic lime on the strength and workability of concrete.

Investigations of factors affecting the durability of concrete are being continued. As stated in the report of last year, studies of this character are of long duration because of the time necessary to produce in the laboratory conditions which are comparable with actual weathering. The problem has likewise been complicated because of lack of information on the proper methods of testing to be employed. For this reason the first experiments conducted by the bureau along this line have proved of value chiefly in throwing light on the

problem of a standardized test procedure. It is hoped that, as a result of these preliminary tests, it will be possible to establish in the near future a standard method of test which may be used in investigating the resistance of concrete to weathering action.

During the year a study of methods of testing sand to be used in concrete was conducted in cooperation with technical committees of the American Society for Testing Materials and the American Association of State Highway Officials. This study has resulted in the development of a method of test, based on the well-known water-cement ratio law, which has been adopted as a tentative standard by both of these organizations.

The increasing use of the flexure test for determining the strength of concrete has called for standardization of a laboratory method of test. An investigation of a method proposed as a standard by the American Society for Testing Materials has recently been completed by the bureau and the results will be reported during the coming year. These tests were for the purpose of determining the effect of certain variables, such as size of test specimen, method of loading, etc., upon the test results.

A series of tests involving the construction of concrete test walls of various heights, for the purpose of determining the effect of segregation during placing, was also concluded during the year. This problem is of importance in bridge construction, as well as in other concrete works where it is necessary to fill deep forms in a continuous operation, and where there is a tendency of the water in the concrete to rise to the top as the form is filled, resulting in concrete of nonuniform composition. In this series of tests concrete of a single proportion was used and the sand was rather fine. The forms varied in depth up to 12 feet. Under these conditions it was found that segregation or water gain was negligible even when mixes having slumps as high as 8 inches were used. It is probable that further tests, using forms of considerably larger cross section and with a coarser sand, will reveal a more pronounced tendency toward segregation.

This investigation presented an opportunity to obtain a limited amount of data on the effect of vibration, for the consolidation of fresh concrete, on the pressures developed against the formwork. This is of particular importance in the design of deep forms, such as those for the spandrel columns of arch bridges, when the use of vibratory methods of consolidation are contemplated. The indications of the data are very definite and a report of this phase of the investigation has been published.

HIGHWAY BRIDGE INVESTIGATIONS

In cooperation with the authorities of Allegheny County, Pa., an investigation has been made of two lightweight steel and concrete bridge-floor slabs of similar type. Slabs of this type have shown satisfactory structural strength under static loads, but the question arose as to the effect of impact of motor vehicles on the structural behavior. Floor slabs about 15 feet square, supported by typical steel beam and stringer construction, were subjected to a very complete series of static and impact loadings. A report of this project will be published during the coming year.

The program of bridge-floor slab tests carried on in cooperation with the Port of New York Authority and described in the last two annual reports has been completed and the report approved for publication.

In the last annual report mention was made of the investigation of the Freyssinet method of concrete-arch construction to be made in cooperation with the Oregon State Highway Commission. The field work in connection with this project will have been completed by the end of the construction season of 1931 and it is anticipated that a report will be available for publication before the close of the next fiscal year.

DIVISION OF AGRICULTURAL ENGINEERING

IRRIGATION INVESTIGATIONS

DUTY OF WATER

All of the Western States are interested in utilizing to greatest advantage the available supplies of irrigation water, and most of them have been cooperating with the Bureau of Public Roads in studies relating to duty of water. These involve particularly investigations as to the amounts of water required for most economical production of crops, the prevention of waste in applying the water to the crops, and net irrigation requirements of lands under various physical, climatic, and agricultural conditions.

The investigations of water losses by evaporation and transpiration of plants in the delta of the San Joaquin and Sacramento Rivers, in cooperation with the Department of Public Works of California, have been continued. The field work has been completed, except for some special tank experiments to observe certain transpiration phenomena in weed and tule areas. The results of these investigations are to be published by the department of public works. A manuscript on Research into Rainfall and Evaporation and Transpiration Losses and their Relation to Irrigation in the Santa Ana Basin was prepared, in cooperation with the same State department.

A bulletin on Cost of Irrigation Water in California was issued during the year by the department of public works of the State, making available the results of studies carried on cooperatively by that department, the College of Agriculture of the University of California, and the Bureau of Public Roads. The costs to farmers are shown to have ranged in 1929 from 37 cents to \$84.33 per acre, and from 30 cents to \$116.45 per acre-foot. Costs generally were lowest in central California and were highest in the southern part of the State, particularly for isolated tracts in the Sierra foot hills.

A new study to determine the effect of certain types of irrigation and of various applications on cotton and rice was begun in cooperation with the College of Agriculture of the University of California. Growers of these crops also cooperated, informally. Owing to the extreme shortage of irrigation water, it is doubtful if any definite data will be forthcoming before another irrigation season has passed.

In southern California the duty-of-water studies embrace the use of water by both cultivated and native wild plants; evaporation from

soil and water surfaces; rainfall penetration on the valley floor; and other phases of the most economical use of water. In cooperation with the Bureau of Plant Industry and the Forest Service, studies have been begun to determine the water requirements of types of trees and shrubbery growing in canyon bottoms or stream beds. Results so far indicate that water losses through use by river-bottom vegetation in two summer months may equal the annual irrigation requirement of an orange grove of equal area.

The study of duty of water in the Rogue River Valley in Oregon, with special reference to pears, which was started during the fiscal year 1930, has been continued through this fiscal year, and has been considerably enlarged because of developments resulting from the earlier studies. This project is maintained cooperatively by the division of agricultural engineering, the Oregon Agricultural Experiment Station, and Jackson County. The last named has just purchased a completely equipped orchard for use in these experiments. Arrangements have been made for participation of the Bureau of Plant Industry in these studies during the coming year.

WATER SPREADING FOR UNDERGROUND STORAGE

Long before the present cycle of dry years which has resulted in a serious shortage of irrigation water, underground storage of water had been considered an urgent problem, but it had been treated in only a casual way. In many parts of southern California, in one region of central California, and in certain small areas in Arizona, Colorado, and Utah some work had been done toward conserving surface run-off by spreading it to percolate to the underground water table where it could be stored and pumped back to the surface when required. In 1930 the division established its first experimental plot and in 1931 completed two check plots at the mouth of San Gabriel Canyon in Los Angeles County, Calif. These are to be operated simultaneously in order to obtain data on methods of applying the water to the percolation areas, and particularly on the relative rates of percolation into ground, in its natural condition, when cleared of vegetation, and after the surface has been plowed.

CUSTOMS, REGULATIONS, AND LAWS RELATING TO IRRIGATION

During the year Technical Bulletin No. 254, *Irrigation Districts, Their Organization, Operation, and Financing*, was issued, superseding an earlier publication of similar title. The irrigation district has become the dominant type of irrigation organization in many sections of the West. It has been found, on the whole, better adapted to the improvement and extension of existing communities than to entirely new development. At the end of 1928, 407 such districts were actually operating and in that year supplied water to approximately 4,060,000 acres. Of the 398 districts that had issued bonds, 65 per cent had not failed in payment of principal or interest to the end of 1928. Of the bonds that had been sold up to that time, 71 per cent were then in good standing, but 18 months later the percentage had dropped to 67. Experience has shown that in determining the economic feasibility of enterprises prior to their financing

greater allowance should be made for unfavorable economic conditions during the period that the bonds will be retired.

A Summary of Irrigation-District Statutes of the Western States has been printed as Miscellaneous Publication No. 103, bringing together the provisions of the different States to permit comparison of the various requirements and obligations imposed and rights conferred.

FLOW OF WATER IN IRRIGATION CONDUITS

Hydraulic investigations of irrigation ditches and other conduits, the results of which have been made available in a series of department publications on flow of water in irrigation channels, wood-stave pipe, concrete pipe, and steel pipe have been continued this year. Measurements of the carrying capacities of certain flumes and tunnels have been made. The accuracy of the formulas developed from these studies gives them great value in designing irrigation conduits of sufficient size to carry the required quantities of water without wasting funds in constructing works larger than necessary. The collection of such data is being continued.

SEWAGE IRRIGATION

The study of sewage irrigation at Vineland, N. J., has been continued. The amount of sewage applied to the fields has been measured and samples are sent weekly to the laboratory of the New Jersey Agricultural Experiment Station for analysis to determine its fertilizer value. From the results of these analyses the approximate amounts of fertilizer applied to the fields may be determined. Water from wells at different points on the sewage farm has been analyzed bacteriologically and found unpolluted.

Experiments on the distribution of sewage have shown a system of underground terra-cotta pipes with concrete outlets located 3 feet apart to be superior to ditches as a distribution system. Application through furrows has proved best for very open soils, and application in alternate furrows appeared to be as efficient as application in every furrow, if not more efficient.

In order to compare the effects of irrigation with sewage and with well water, 1 acre has been equipped with overhead irrigation piping.

DRAINAGE INVESTIGATIONS

RUN-OFF AND DITCH CAPACITIES

The rainfall and run-off on nine watersheds in Ohio are being measured to determine drainage coefficients to be used in determining channel requirements. In eight of the channels values of n in Kutter's formula are being determined.

Some 30 stream-gagings were made, mostly of low-flow stages owing to the extensive drought. These low-stage measurements are of assistance in determining the trend of a series of phenomena extending from minimum to maximum flow. The division collaborated with the United States Geological Survey, which is making a study of minimum flow to determine water-power resources and sewage-disposal facilities.

The chief factors apparently influencing the concentration of the run-off are topography, rainfall intensity, and seasonal changes in soil and surface covering. A study has been in progress to determine whether there can be included in the run-off formula a factor which will be representative of the influences of topographic features alone. The rainfall is measured directly. The only unknown variable is, then, the seasonal change in soil and surface covering. Results of this study have been very encouraging but more intensive tests are needed, requiring very accurate rainfall measurements. To this end the standard rain gages have been replaced by automatic weighing and recording instruments. The automatic instruments not only afford a more accurate sample of rainfall intensities, but also permit a more exact determination of periods of concentration.

Experiments have been made on methods and costs of cleaning drainage ditches with dynamite and a report has been prepared.

The investigations of the run-off from the Ralston Creek watershed, Iowa, were continued and a report covering five years' work on this project is in preparation.

OPERATION AND MAINTENANCE OF DRAINAGE PUMPING PLANTS

Studies have been conducted for several years at pumping plants along the Illinois and Mississippi Rivers to determine the costs of pumping with different types of power and how such costs can be reduced. The manuscript for a department bulletin has been prepared. It has been found that the average costs of pumping with Diesel engines and with electric motors do not differ greatly. Many small and medium-sized steam plants, having been found inefficient, have been abandoned. Operating costs have been reduced by employing a competent engineer to supervise the operation of the plant; by properly regulating the speed of the pumps; by adjusting, cleaning, or repairing pumping equipment; and by installing more economical equipment. In some districts maintaining a lower water level in the suction bay would provide better drainage for the low lands.

A manuscript has also been prepared relating to the design and operation of pumping plants. The investigations have shown that screw-type impellers operate efficiently at low lifts, and that synchronous motor units with two motors on the shaft, direct-connected to the pump, operate efficiently.

Some promising experiments have been started on observation wells in one Illinois drainage district to determine the effect on the ground water of lowering the drainage water by pumping. In addition, on a number of plots a study is being made to determine the effect of different depths of the ground water table on crop yields.

HYDRAULIC EXPERIMENTS AT UNIVERSITY OF IOWA

The experiments on the obstruction of pile trestles to the flow of water, noted in previous annual reports, were completed during the year and a report on them prepared. It was found that a double-track pile trestle with the piles in line offered about twice as much resistance to flow as a single-track trestle. A double-track trestle with the bents offset offered a little more obstruction than a similar trestle with the bents in line. When a trestle crosses a stream

obliquely, bents set in echelon cause less backwater than bents set at right angles to the axis of the bridge.

The investigations of the obstruction of bridge piers to the flow of water were continued.

The Ramser silt-measuring apparatus in combination with a 2-foot Parshall measuring flume was calibrated in the hydraulic laboratory. Various modifications of the apparatus were tried. The apparatus was found to be sufficiently accurate from a hydraulic standpoint to warrant its use on the bureau's soil-erosion experiment farms.

DURABILITY OF DRAINTILE

The investigations at University Farm, Minn., on the durability of draitile under exposure to various conditions of soil and frost action have been continued, in cooperation with the Minnesota department of Agriculture and the Minnesota department of drainage and waters. The results of the studies relating to frost resistance of clay tile have been issued in a mimeographed report. These studies have made possible a general correlation between absorption and freezing tests of tile from various clay-tile plants in Minnesota and Iowa.

In the concrete-alkali work, 5-year tests have now been completed for 309 series of concrete specimens exposed to the action of sulphate water. Much of value has been learned about the use of certain admixtures in connection with curing temperatures only slightly higher than those used at commercial plants.

SOIL-EROSION CONTROL

Eight experiment farms have now been established where soil-erosion-control and moisture-conservation studies are being conducted in cooperation with the Bureau of Chemistry and Soils and the State agricultural experiment stations. These are located at Guthrie, Okla.; Temple and Tyler, Tex.; Bethany, Mo.; Hays, Kans.; Pullman, Wash.; Clarinda, Iowa; and Statesville, N. C.

On the soil-erosion experiment farm near Guthrie, Okla., it was found that from 3 to 24 inches of soil had been removed from a badly eroded and gullied area which has been under cultivation for about 30 years, as compared with no appreciable erosion on the virgin land. A careful record of crop yields from two comparable areas of virgin and badly eroded land showed a yield of 75 per cent more cotton on the virgin land, the average yields being 156 and 89 pounds per acre, respectively. At 14 cents a pound for cotton, there would be a difference of \$9.38 per acre in favor of the virgin land. The cost of constructing the terraces on the virgin land was about \$2.50 per acre and on the gullied land about \$14.50 per acre. These results demonstrate conclusively the advisability of starting the control of erosion when the land is first broken, rather than waiting until it has become badly gullied.

The effectiveness of terraces in controlling erosion is demonstrated by an experiment in which the soil losses from an unterraced and a level-terraced area were measured. As the result of a rain of 1.22 inches, 5.38 tons of soil per acre were lost from the unterraced area and only 0.21 ton per acre from the terraced area. The importance

of giving proper grades to the terraces is indicated by the fact that about three times as much soil was carried off the field by a terrace with a grade of 6 inches per 100 feet as by a terrace with a grade of 4 inches per 100 feet. Concerning the required height of terraces it was found, for terraces up to 700 feet long on ground having a slope of $5\frac{1}{2}$ per cent, that with vertical spacings of 2, $3\frac{1}{2}$, and 5 feet, heights of 12, 15, and 18 inches, respectively, were required to carry away the water from a fairly heavy rain.

Experience with level terraces having closed ends, designed to retain all of the rain that falls on the land above the terrace, indicates that this kind is not advisable for regions of high annual rainfall and for soils that can not absorb water rapidly. While level terraces have resulted in increases of 30 to 40 per cent in crop yields in west Texas and Oklahoma where the annual rainfall is light and the soil absorbs a large part of the rainfall, it was found on the Guthrie farm that an oat crop was decreased in yield nearly 60 per cent by water standing in the terrace channel.

It has been found that much of the tractor equipment now being manufactured is not sufficiently flexible to operate satisfactorily over terraces. The operation of several machines has been studied and suggestions made to the manufacturers for improving their equipment. The manufacturers realize that ultimately much of the land in the United States must be terraced and that their equipment must be designed to operate successfully over terraced land.

Data thus far obtained seem to indicate that the broad-base Mangum terrace can be constructed most economically by building from both sides on gentle slopes and from the upper side on steep slopes. It has also been found that where terraces are built from both sides the furrow below the terrace should be obliterated, otherwise this furrow fills with water after heavy rains, overflows at the low points, and thus causes the formation of small gullies down the slope between the terraces.

The use of large machinery designed for building and maintaining roads, borrowed without cost except for the labor and fuel required in its operation, has in many cases effected a considerable saving in the cost of building farm terraces. A recent statute in Oklahoma permits counties and townships to loan such equipment for this purpose, on the terms stated.

For check dams in small gullies experiments at the Guthrie farm indicate that a height of about 2 feet is most satisfactory from the standpoint of economy and successful operation; that some sort of anchorage is needed for brush dams, even where the gully has a very limited drainage area; that the sides of the gully above the dam should be protected against erosion; that the dam should not reduce the cross section of the gully so much as to cause overflowing of its banks; and that a more rapid filling above a brush dam occurs when care is taken to pack the brush closely so as to reduce the size of the interstices.

FARM MACHINERY INVESTIGATIONS

CORN-BORER CONTROL

Because of the drought during the corn-growing season of 1930, the regular spread and normal increase in intensity of the European

corn borer was considerably retarded. For the same reason stalk growth was stunted and much more fodder was cut for feed than ordinarily. Therefore, certain activities connected with the development and testing of corn-borer machinery were slowed up and others had to be postponed. Shredding and baling tests could not be conducted because of scarcity of stalks that even approximated normal growth, and heavily infested stalks were difficult to find. Nevertheless, considerable progress was made.

The high-pressure field burner developed in previous years for combating the European corn borer has been converted into a low-pressure burner, and the rigid hood has been replaced by a flexible hood in three sections to facilitate burning on uneven ground. Field tests in borer-infested fields showed this burner to effect a high mortality of the borers, but indicated that the initial and operating costs for the burner will be considerably greater than for other control machinery now available. No further work with burners is planned for the near future.

The 3-row stalk shaver attachment for a single-row corn cultivator, developed last year, has been reconstructed so as to fit each of six of the principal makes of cultivator. A similar attachment for cutting four rows was developed for two makes of 2-row cultivators.

The 4-bar, side-delivery rake was further improved. Field tests were conducted on experimental rakes made by three manufacturers. These rakes performed satisfactorily when tested in corn; they are still in the field for test in alfalfa, timothy hay, and soybeans. In order to cover two rows the reel on the side-rake stalk loader with 2-row shaver attachment had to be lengthened 2 feet. Plans are under way to change the angle of the reel so that two rows can be raked without lengthening the reel.

A down-stalk lifting-finger attachment was developed for corn binders, and probably can be made adaptable to other row-crop harvesters.

A 2-furrow, 21-inch plow was built at Toledo, Ohio, and performed very creditably on three different soil types. A floating trash shield, for scraping the stalks into the open furrow from part of the furrow slice as it is turned, promises to be an aid in clean plowing for borer control. Careful studies have been made of the characteristics affecting the draft of plows. Further draft tests will be made to determine the most important factors involved.

Cooperative work has been undertaken with most of the New England agricultural experiment stations and with those of Illinois and Pennsylvania. Headquarters for the New England work have been established at South Norwalk, Conn.

A new experimental farm has recently been acquired near Toledo, Ohio, which will be operated jointly with the Bureau of Entomology.

ARTIFICIAL DRYING OF FORAGE CROPS

In some of the Southern States a large variety of forage crops can be grown, but weather conditions during the harvest season cause improper curing and in some instances total loss of the crop. An experimental forage dryer has been installed on the Iberia Livestock Farm near Jeanerette, La., and tests are being made to determine some of the mechanical and economic factors involved in

artificial drying of such crops. Feeding tests were made with the artificially dried product to determine its nutrient value in comparison with field-cured forage. This project is being conducted in cooperation with the Bureaus of Animal Industry and Plant Industry.

DIRECT HARVESTING AND ARTIFICIAL DRYING OF RICE

The combined harvester-thresher has been used to a limited extent in harvesting rice in Arkansas, Louisiana, and Texas, but use of this machine has been successful only when accompanied by artificial drying of the threshed grain. The structure of the rice kernel is such that it may crack or rupture as a result, in part, of changes in temperature and moisture content. Tests were made during the 1930 harvest season to determine the maximum air temperature at which rice may be dried without injury to its milling properties. It was found that a temperature much in excess of 120° F. would cause appreciable injury. This work was conducted in cooperation with the grain division of the Bureau of Agricultural Economics.

SUGAR-BEET MACHINERY

The production of sugar beets involves much hard labor, under present practices, particularly in thinning the stand of young beets and in harvesting the crop, including removal of the tops before the beets are delivered to the sugar factory. The cost of these operations and the difficulties in seasonal employment of large amounts of labor have resulted in a demand from the growers for equipment that will reduce the labor requirements of this crop. Investigation of this subject was undertaken at the beginning of the fiscal year.

A blocking machine has been developed and tested in cooperation with the California and Colorado Agricultural Experiment Stations. The use of this implement has resulted in a saving of 25 per cent of the cost of hand labor in thinning beets. The three most distinctive types of beet harvesters also are being studied under field conditions in California and Colorado, in an effort to develop a more efficient machine for this purpose.

COTTON-PRODUCTION MACHINERY

The first year's work under this project has been of a preliminary nature, in analyzing the problems of cotton production with reference to the use of labor-saving machinery, in developing methods of research procedure, and in formulating plans for cooperative investigations. Projects have been established in cooperation with the Alabama and Mississippi experiment stations, dealing with methods of soil preparation, factors affecting planting and the final stand of cotton, methods of weed control, the use of labor-saving machinery, the control of large machine units on hillsides, and the efficiency of field machinery and mechanical cotton pickers.

Detailed research studies as to the factors affecting rolling resistance have been made with six wheels upon two soil types under different physical conditions. Definite correlations have been determined between the weight of wheel and the rolling resistance, the percentage of slip, and the depth to which the wheel sinks into the

soil. New correlations were made between the apparent specific gravity and moisture content of the soil and the rolling resistance of a wheel.

COTTON GINNING AND CONDITIONING

With funds appropriated by Congress for cotton ginning investigations, a cotton-ginning laboratory has been constructed and equipped at the Delta Branch Experiment Station, Stoneville, Miss. Cotton was first ginned at the laboratory in January, 1931. The studies there are for the purpose of improving cotton-ginning methods, and are carried on in cooperation with the Division of Cotton Marketing of the Bureau of Agricultural Economics. Several old cotton gins have been obtained, one built in 1844, and these will be used for purposes of comparison.

Approximately 1,000 tests were made during the year with cotton obtained from Georgia, Alabama, Mississippi, Missouri, and Texas. Complete soil and agronomic data were obtained for each lot of cotton. The tests covered various moisture conditions of the cotton, and various speeds of the saws from 300 to 1,000 revolutions per minute. Loose and tight rolls were obtained at each speed.

The tests so far indicate the necessity for a complete analysis of the fiber effects caused by present combinations of cleaners and extractors, and show the benefits to be derived from conditioning or drying seed cotton before it is ginned. Tests are being made to find a method of removing the green-leaf trash from cotton harvested with mechanical pickers.

A new type of cotton drier has been developed by the division for the use of growers who can not afford to buy the more expensive types. It has no moving parts and can be built at small expense.

MECHANICAL APPLICATION OF FERTILIZERS

Investigations of the mechanical application of fertilizers have been carried on cooperatively with the Bureau of Chemistry and Soils, the State experiment stations, the joint committee on fertilizer application, and the National Fertilizer Association.

Fertilizer-placement studies on cotton have been continued and expanded at the Pee Dee, Sandhill, and Clemson College experiment stations in South Carolina. Similar studies have been started in nine other representative cotton growing areas in the States of North Carolina, Georgia, Mississippi, Louisiana, Texas, Arkansas, and Oklahoma. The results to date indicate that highly significant differences in germination and yield result from different placements of the fertilizer in relation to the seed, when application is made at planting time. Disturbance of the soil below the seed in obtaining certain placements of the fertilizer is known to delay germination, particularly when rains do not immediately follow the planting. Irregular distribution of fertilizer gives somewhat lower yields than uniform distribution.

Cooperative fertilizer-placement studies have been started on canning crops, including sweet corn and beans, at Geneva, N. Y., and on potatoes in New Jersey, Ohio, and Michigan.

Two special machines for the fertilizer experimental work have been built under the general specifications of the division of agri-

cultural engineering. These machines apply the fertilizer and plant the seed simultaneously, giving accurate control of the application rate and placement of the fertilizer.

A laboratory in which the temperature and relative humidity of the air will be under control is under construction at Arlington Experiment Farm, Rosslyn, Va. The operation of various types of fertilizer distributors will be studied in the laboratory, and fundamental information will be obtained for use in the further development of distributing equipment.

FARM-LAND DEVELOPMENT

The experimental work on the use of poisons for killing trees and stumps was completed. The investigation brought out the fact that while many poisons may be used successfully for killing trees, arsenical poisons are most effective in hastening decay, and hence are best for use in land-clearing operations. Different species of trees show various degrees of resistance to the action of the poison; softwoods usually decay more rapidly than hardwoods. No sure method of killing stumps, effective on all species and under all conditions, was developed.

Methods of clearing land of brush and stones have been studied largely in cooperation with the University of Minnesota. A report has been prepared showing the comparative costs of clearing land on the four principal types of soil found in northern Minnesota. The data upon which this report is based were secured from records of operations carried on by 150 farmers and are given in sufficient detail to determine the number of man-hours and horse-hours, and the amount of explosives required for each operation involved in clearing and plowing land. Studies of soils producing heavy forest growth are being made to determine whether the crops that can be obtained from such soils are sufficiently larger than those from soil producing light timber to justify the greater cost of clearing the heavy timber.

The study in arranging farms for the most efficient production of crops, begun in 1930, has been continued. Each farm will be treated as a unit in which the cropping program, livestock, field arrangement, machinery, and buildings will all be properly coordinated. Co-operative projects along this line have been undertaken in North Carolina, Georgia, and Minnesota, and a number of farms have been surveyed in preparation for these studies. On 13 farms surveyed in North Carolina the average size of the field was 3.7 acres; on 20 farms in Georgia the average size was 5.6 acres; and on 11 farms in Minnesota the average size was 12.2 acres. The plans made for farms in North Carolina and Minnesota increase the average size of field to 10.8 and 28 acres, respectively. After the farmers have made the changes recommended, records will be kept to determine the increased income resulting.

FARM-STRUCTURE INVESTIGATIONS

SURVEY OF RESEARCH IN FARM STRUCTURES

This survey, for which the field work was nearly completed last year, made apparent the need for coordination of efforts. While

20 State experiment stations reported more than 50 projects as active, it seems that a large number of these are directed at securing comparative data on building problems in which there is a present and perhaps temporary interest. There has been a tendency toward duplication of effort in such phases of the field, while other phases equally or more important have been neglected. It appears that comparatively few accurate and basic data on the shelter factors which various farm buildings should furnish, or the best structural means of meeting those requirements, are being developed. Such information is needed to guide the judgment of owners and builders, who are continually striving to make new buildings more useful, economical, and convenient than those built previously.

The need for coordinated national and regional programs of research was made very evident. The State workers in this subject generally suggested that the Federal department take the lead in formulating such programs.

The report of the survey has been prepared for publication, and plans have been made for organization of all available agencies for effective conduct of the coordinated research program.

ORCHARD HEATERS

A preliminary study was made of the operation of oil-burning orchard heaters such as are in general use in California to prevent frost damage. The heaters tested were of the distilling type. This type produces smoke, particularly at high rates of combustion, and the clouds of smoke from large numbers of the heaters operating simultaneously is very objectionable to the aesthetic and economic interests of neighboring property owners. The object of the study was to determine the cause of excessive objectionable smoke arising from the heaters, and what preventive measures—such as proper selection of fuel or improvement in design of the heater—might be economically feasible. The data obtained have been analyzed and a report is in preparation.

CROP STORAGES

A study of the storage of corn and small grains in the Corn Belt was completed and a report prepared for publication. The need for increased facilities for farm storage has become important, because of economic changes in marketing and the growing use of machine harvesters. Structures satisfactory where hand husking is employed have proved inadequate in strength of buildings and in means of handling the crop with dispatch, when corn is harvested by machinery.

TEMPERATURES IN DAIRY BARNs

A study of the relation of stable air conditions to milk production was begun in cooperation with the Bureau of Dairying and with the agricultural college of the University of Wisconsin. The purpose is to determine the effect of sudden changes in stable temperatures on the production of milk by the cow of medium capacity, and the consequent necessity of insulation in the construction of dairy barns as a factor in temperature maintenance. The aim is also to determine the air conditions under which cows will produce the maximum

quantity of milk consistent with their health and comfort. The results of one season's observations are not considered conclusive, particularly as the winter was unusually mild, and the study is to be continued.

SERVICE WORK

The value of the services that have been rendered to other bureaus of the department is made evident by the greatly increasing demands for assistance of varied character. Work of this nature performed during the past year has included the preparation of plans and specifications as follows:

For the animal husbandry experiment farm at Beltsville, Md., a 3-story poultry laboratory building and a building for housing small animals employed in zoological investigations.

For the Arlington Experiment Farm at Rosslyn, Va., a combined drug-plant laboratory and storage building, a threshing shed, a building for experimental work on fertilizer machinery, and two headhouses.

For the Bureau of Plant Industry at Guayama, P. R., a laboratory and an office building.

For this bureau and the Bureau of Agricultural Economics, a cotton-ginning laboratory erected at the Delta Branch Experiment Station, Stoneville, Miss.

For the National Zoological Park, cold-storage rooms, remodeling of the general heating system, and an eagle flight cage.

For the extensible building of the department, now under construction; a refrigerating plant, vacuum pumps, air compressors, etc.

Also, specifications were prepared for a number of refrigerating, heating, plumbing, and electrical installations at field experiment stations of the Department of Agriculture, and plans for an equipment depot to be erected at Ogden, Utah, for the use of the Bureau of Public Roads in storing and caring for road-building equipment.

Designs for a cheese factory and three creameries were prepared for general distribution.

The division supervised the construction and preliminary operation of the Bear River Migratory-Bird Refuge established by the Bureau of Biological Survey in Box Elder County, Utah, which was nearing completion at the end of the fiscal year. It also supervised construction of a dam and irrigation layout constructed near Cheyenne, Wyo., for the Bureau of Plant Industry.

Service is being rendered to the Bureau of Biological Survey in collection and compilation of data on water rights acquired or to be acquired for the Malheur Lake Bird Refuge in Oregon; to the War Department in the appraisal of lands and acquisition of flowage rights for the Mississippi River flood-control project; and to the State Department in estimating damages that would be caused to lands along Kootenai River in Idaho by the construction of a proposed power development in British Columbia.

- 8 -

REPORT OF THE CHIEF OF THE BUREAU OF PUBLIC ROADS

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF PUBLIC ROADS,
Washington, D. C., September 1, 1932.

SIR: I submit herewith the report of the Bureau of Public Roads for the fiscal year ended June 30, 1932.

Respectfully,

THOMAS H. MACDONALD,
Chief of Bureau.

HON. ARTHUR M. HYDE,
Secretary of Agriculture.

The record of Federal-aid road construction in the fiscal year 1932 is distinguished by the addition of a greater mileage of improved roads than in any previous year. The 15,997 miles on which improvements were completed is nearly a sixth of the total mileage improved with Federal aid during the entire period since the passage of the Federal-aid road act in 1916.

Similar report may be made of the year's work in improvement of the national-forest highways. In both cases the great increase in mileage of improvements completed is mainly the realization of the results of the increased appropriations that have been authorized since 1930. In the Federal-aid work the result was also influenced strongly by action taken in the same year to relieve unemployment.

THE EMERGENCY ADVANCE APPROPRIATION AND EMPLOYMENT

On December 20, 1930, the President approved an appropriation of \$80,000,000, to be apportioned among the 48 States and Hawaii in the manner prescribed for the apportionment of Federal aid, to be used by the States to match the regular Federal-aid funds available. The fund was made available only for expenditure on work actually completed by September 1, 1931, and it was stipulated that the amounts actually expended by each of the States were to be reimbursed to the Federal Treasury by deduction from anticipated future Federal-aid apportionments over a period of five years beginning with the fiscal year 1933. This was an emergency measure to supply deficiencies of State revenue and permit increased employment on road work during the early road-building season of 1931.

Partial report on the expenditure of this appropriation was made in my annual report for the fiscal year 1931, but it was not possible at that time to report finally upon the expenditure or its effects.

The final auditing of all vouchers for work done has since been completed, and it has been determined that the actual total expenditure upon Federal-aid roads was \$79,203,719.20. The distribution of this expenditure by States and the corresponding State apportionments are shown in Table 1.

TABLE 1.—Emergency advance-fund apportionment and the final statement of the amounts paid to the States for work done to August 31, 1931

State	Apportionment of \$80,000,000 emergency advance fund, under the act of Dec. 20, 1930	Final statement of the amounts paid to the States for work done to Aug. 31, 1931	State	Apportionment of \$80,000,000 emergency advance fund, under the act of Dec. 20, 1930	Final statement of the amounts paid to the States for work done to Aug. 31, 1931
Alabama.....	\$1,698,645	\$1,692,051.39	New Hampshire.....	\$400,000	\$400,000.00
Arizona.....	1,170,481	1,170,481.00	New Jersey.....	1,107,807	1,107,807.00
Arkansas.....	1,388,157	1,388,157.00	New Mexico.....	1,303,288	1,303,288.00
California.....	3,108,233	3,008,827.35	New York.....	4,050,566	4,050,566.00
Colorado.....	1,507,832	1,507,832.00	North Carolina.....	1,296,775	1,296,775.00
Connecticut.....	520,491	520,491.00	North Dakota.....	1,298,532	1,298,532.00
Delaware.....	400,000	400,000.00	Ohio.....	2,998,538	2,998,538.00
Florida.....	1,086,438	1,086,438.00	Oklahoma.....	1,926,351	1,926,351.00
Georgia.....	2,077,996	2,077,996.00	Oregon.....	1,320,287	1,299,211.00
Idaho.....	1,008,035	1,008,035.00	Pennsylvania.....	3,512,943	3,512,943.00
Illinois.....	3,400,116	3,400,116.00	Rhode Island.....	400,000	400,000.00
Indiana.....	2,045,929	2,045,929.00	South Carolina.....	1,114,636	1,114,636.00
Iowa.....	2,116,369	2,116,369.00	South Dakota.....	1,337,973	1,337,973.00
Kansas.....	2,192,301	2,192,301.00	Tennessee.....	1,741,882	1,741,882.00
Kentucky.....	1,504,715	1,504,715.00	Texas.....	5,038,080	4,883,760.81
Louisiana.....	1,147,927	987,776.65	Utah.....	926,521	925,708.57
Maine.....	715,799	715,799.00	Vermont.....	400,000	400,000.00
Maryland.....	678,752	678,752.00	Virginia.....	1,505,502	1,505,502.00
Massachusetts.....	1,141,460	1,141,460.00	Washington.....	1,270,933	1,270,933.00
Michigan.....	2,521,382	2,521,382.00	West Virginia.....	875,384	875,384.00
Minnesota.....	2,249,993	2,249,993.00	Wisconsin.....	1,992,410	1,992,410.00
Mississippi.....	1,434,736	1,434,736.00	Wyoming.....	1,029,383	1,029,383.00
Missouri.....	2,526,823	2,367,575.60	Hawaii.....	400,000	400,000.00
Montana.....	1,671,930	1,671,930.00			
Nebraska.....	1,708,031	1,708,031.00	Total.....	80,000,000	79,203,719.20
Nevada.....	1,049,638	904,961.83			

The effect of this appropriation upon employment in highway work is shown in Table 2, which lists the average number of men directly employed by months on various classes of Federal and State work. The table shows that in January, 1931, the first month after the appropriation of the emergency funds, total direct road employment on all classes of work administered by the Federal and State Governments averaged 148,600 men. Federal-aid construction employed directly in that month only 30,944 men, other classes of Federal work only 335 men, and State construction and maintenance operations only 117,321 men.

TABLE 2.—Average number of persons employed directly on various classes of road work under the supervision of Federal and State agencies, by months, January, 1931, to June, 1932, inclusive

Month	Persons employed on construction of roads						Persons employed on maintenance of roads by States	Total persons employed
	National-forest roads	National-park roads	Federal-aid roads	Total Federal and Federal aid	State and State aid	Total on construction		
1931								
January.....	228	107	30,944	31,279	48,621	79,900	68,700	148,600
February.....	548	172	36,867	37,587	53,787	91,374	80,186	171,560
March.....	1,278	172	53,402	54,852	58,701	113,553	91,334	204,887
April.....	2,663	350	94,547	97,560	72,212	169,772	93,732	263,504
May.....	3,808	1,002	121,905	126,715	89,764	216,479	94,452	310,931
June.....	4,722	2,168	147,625	154,515	101,275	255,790	107,692	363,482
July.....	6,617	2,625	155,466	164,708	112,638	277,346	108,003	385,349
August.....	6,219	2,895	142,304	151,418	121,172	272,590	117,359	389,949
September.....	6,048	3,189	106,863	116,100	123,404	239,504	117,113	356,617
October.....	5,183	2,842	80,844	88,869	116,752	205,621	124,483	350,104
November.....	3,550	2,054	56,862	62,466	103,198	165,664	123,652	289,316
December.....	1,193	920	33,878	35,991	74,543	110,534	134,437	244,971
1932								
January.....	888	528	28,102	29,518	58,590	88,108	141,081	229,189
February.....	649	440	25,584	26,673	53,607	80,280	137,938	218,218
March.....	644	448	26,916	28,008	50,699	78,707	132,842	211,549
April.....	1,243	497	40,465	42,205	62,056	104,261	141,582	245,843
May.....	1,763	634	56,611	59,008	70,834	129,842	129,773	259,615
June.....	2,386	1,341	68,045	71,772	79,845	151,617	129,019	280,636

This was a lower level of employment than has existed at any time since. It was due primarily to the exhaustion of State highway revenues during the preceding active construction season and to the fact that State revenues for the new year were not yet available in a large number of States. It was this condition that the emergency advance was designed to correct, and the rapid increase in direct employment on Federal-aid work up to the peak of 155,466 men, reached in July, 1931, is evidence of the degree to which the desired result was obtained. In very large part this rapidly increasing employment on Federal-aid construction in the spring and early summer of 1931 was financed with regular Federal-aid funds and the Federal funds advanced to match them.

The effect of the time limit set on the utilization of the funds advanced is shown by the decline in Federal-aid employment after July, 1931. In September, when the advance funds were no longer available, employment dropped sharply to 106,863, and the drop continued to midwinter, 1932. This does not mean, however, that the Federal emergency measure was not effective after September, 1931. On the contrary it is certain that much of increased employment provided by the States in the winter of 1931-32 was made possible by the substitution of Federal advance funds for regular State funds in early-season work and the saving of the States' own funds for expenditure during the cold months.

While employment on Federal and Federal-aid road work was considerably less during the last winter and spring than in the corresponding seasons a year before, the States were able to maintain employment on independent State work considerably above the level of the previous year until June. Their ability to do so was an indirect consequence of the Federal advance which permitted the saving of State funds for later expenditure than would ordinarily have been possible.

As shown by Table 2, a large part of the total highway employment provided during the last winter was on maintenance work administered by the States. The increase in the amount of such employment, shown by comparison with the statistics for the previous year, is evidence of the special effort made to aid the unemployed.

PROGRESS IN FEDERAL-AID ROAD CONSTRUCTION

Initial improvements were completed during the fiscal year on 11,036.9 miles of the Federal-aid highway system; advanced stages of construction were completed on 4,925.1 miles; and 35.2 miles previously improved were reconstructed. The total mileage upon which improvements were completed was therefore 15,997.2 miles. This exceeds by more than 4,000 miles the mileage completed in any previous year; and it is desired to emphasize that these improvements, classed as completed, were not only physically completed but had also been paid for by the Federal Government to the full extent of its obligation.

In addition to these projects, there were others on which at the end of the year all improvements were physically completed in a manner which the bureau was willing to approve, and only the final payment of Federal money remained to discharge the Government's full obligation. In accordance with the practice begun last year these projects are separately classified because, until the final voucher has been paid, it is not possible to report exactly the total cost and Federal payment.

In projects of this class there were at the end of the fiscal year 2,269.5 miles of initial construction, 652.1 miles of stage construction, and 9.3 miles of reconstruction, a total of 2,930.9 miles.

At the close of the year construction of initial improvements was in progress on 7,885.4 miles, and other initial improvements had been approved for 2,110.9 miles. Stage construction was in progress on 2,616 miles already initially improved with Federal aid and similar advanced improvements had been approved for 1,951.6 miles. In addition, 10.5 miles previously improved were in process of reconstruction and projects for the reconstruction of 13.7 miles had been approved.

The total mileage on which initial improvements had been completed and final payment made by the Federal Government up to the end of the fiscal year 1932 was 101,389.1. In addition, there were 2,269.5 miles which were physically completed and opened to traffic but not yet completely paid for on the part of the Federal Government. Initial improvements had, therefore, been physically completed with Federal aid on 103,658.6 miles of the system on June 30. At that time, however, 2,626.5 miles included in the above were undergoing stage construction or reconstruction and were temporarily removed from the mileage open to travel, so that the bureau classifies as completed on June 30, 1932, only 101,032.1 miles, a net increase of 12,319 miles over the corresponding mileage

on June 30, 1931. The location of this mileage by States is shown in Table 16. Its classification by types, as built with Federal aid, and its location is shown in Table 21.

STAGE CONSTRUCTION

The steady increase in the ratio of stage construction to initial construction, to which attention has been directed in several previous annual reports, continued during the past year. Although the mileage of initial improvements completed and paid for was the greatest ever recorded in a single year, the stage construction completed increased in greater proportion. The 4,925.1 miles completed represented 44.6 per cent of the mileage of initial construction completed, as compared with 38.8 per cent, the corresponding ratio of the year immediately preceding. By reference to Table 3 it will be seen that this ratio has grown steadily since it was first recorded in 1923, when it was only 1.2 per cent.

TABLE 3.—Mileage of initial construction, stage construction, and reconstruction completed and final payment made, by fiscal years, 1923-1932, inclusive

Fiscal year	Mileage of initial construction completed and paid for	Stage construction completed and paid for		Reconstruction completed and paid for		Mileage of total construction
		Mileage	Percentage of initial construction	Mileage	Percentage of initial construction	
1923	9,940.5	117.8	1.2			10,058.3
1924	9,145.6	280.7	3.1			9,426.3
1925	9,437.1	495.3	5.3			9,932.4
1926	10,533.3	783.9	7.4			11,317.2
1927	8,413.5	1,376.6	16.4			9,790.1
1928	8,532.2	2,088.8	24.5			10,621.0
1929	7,267.4	2,069.7	28.5			9,337.1
1930	6,675.4	1,988.0	29.8	18.8	0.3	8,682.2
1931	7,938.8	3,082.5	38.8	12.0	.2	11,033.3
1932	11,036.9	4,925.1	44.6	35.2	.3	15,997.2

As previously explained, works classified as stage construction are supplementary improvements, paid for in part with Federal aid, of roads previously improved to lesser degree as Federal-aid projects. In most instances it is work deliberately deferred at the time of original improvement, and definitely forecast and agreed upon as a future necessity in the original agreements with the States. Many such projects involve the deferred surfacing of roads previously graded and drained. The additional Federal aid allotted does not in any case raise the total Federal expenditure on the project beyond the limit per mile fixed by the law.

Such work is deferred in the first instance mainly for the reason that it is desired to extend the benefits of some degree of improvement as rapidly as the limited annual funds will permit to all parts of the system, and a form of improvement less complete than that regarded as ultimately desirable may be tolerated for a short time in view of the partial benefits conferred.

The increase in the amount of the supplementary work from year to year is the natural result of the shrinkage of unimproved mileage within the system and the development of the occasion and the opportunity for further improvement of the previously improved mileage.

Detailed information in regard to stage construction completed, in progress, and approved will be found in Tables 17 to 20 and 26 to 29. The mileage of improvement classified as graded and drained in Tables 26 to 29 consists almost wholly of partial relocations of previously improved roads on which surfacing has not yet been added. The relocations are in nearly all instances occasioned by the necessity of reducing curvature of the original improvements in consequence of the increased speed of traffic.

The effect of stage construction as a means of raising the standard of improvement of the system is evident from a comparison of Tables 22 and 30, the former showing the mileage of the several types of construction completed as initial improvements during the past year and the latter the net change in the character of the total improved mileage as influenced by stage construction. It will be seen

that the net addition of mileage of the several types is greater than the year's initially improved mileage in the case of the higher types and less in the case of the lower types.

EFFECT OF SUBSEQUENT UNAIDED IMPROVEMENTS

All the works referred to above as stage construction are supplementary improvements made with Federal financial assistance on roads previously improved with Federal aid. In addition to the betterments thus made with Federal help the State highway departments have independently made similar improvements of the roads initially improved with Federal aid.

The volume of such work is not so great as that of the Federally aided stage construction and, since there is no Federal participation its results have not been previously reported by this bureau. The mileage affected by such work has now grown, however, to nearly 20,000 miles, and it is thought desirable to report the character and amount of it to date and the effect that it has had on the general character of the roads on which Federal aid has been granted. The mileage on which independent State work of this character has been completed up to June 30, 1932, is shown in Table 4 classified by types of construction. A type comparison of the total mileage on which Federal aid has been granted, as improved with Federal assistance and as such improvements have been modified by independent State construction is furnished by Table 5. It will be apparent that the independent State work has an effect similar to that of the Federal-aid stage construction and tends further to elevate the standard of improvement of the system as a whole.

TABLE 4.—*Net changes in mileage of the types of Federal-aid projects on which additional improvements have been made by the States without Federal participation, June 30, 1932*

Types as improved with Federal aid	Miles of roads of indicated types as further improved by the States without Federal aid											
	Graded and drained	Sand-clay, and topsoil		Gravel		Macadam, treated	Low-cost bituminous mix	Bituminous macadam	Bituminous concrete	Portland cement concrete	Block	Total
		Untreated	Treated	Untreated	Treated							
Graded and drained.....	1,053.8	109.9	2,579.4	1,566.8	159.5	523.1	105.0	111.1	1,519.0	18.2	7,745.8	
Sand-clay and topsoil, untreated.....		683.5	96.3	70.6		161.2	48.9	174.5	532.8		1,767.8	
Gravel, untreated.....	39.9			5,618.7	68.5	1,351.8	168.3	340.0	1,201.7	15.6	8,804.5	
Gravel, treated.....						14.9		15.1	4.4		34.4	
Macadam, untreated.....					1,092.6	20.9	29.2	51.9	11.7		1,206.3	
Macadam, treated.....						22.9	2.7	18.6	1.8		46.0	
Low-cost bituminous mixture.....									3.9		3.9	
Bituminous macadam.....								43.3	26.8		70.1	
Bituminous concrete.....									17.8		17.8	
Portland cement concrete.....								105.6		35.3	140.9	
Block.....								5.3	1.3		6.6	
Total.....	39.9	1,053.8	793.4	2,675.7	7,256.1	1,320.6	2,094.8	354.1	865.4	3,321.2	69.1	19,844.1

¹ Relocations not yet surfaced.

TABLE 5.—Type classification of Federal-aid roads as improved with Federal aid, and as modified by subsequent improvements by the States without Federal aid, June 30, 1932

Type	Federal-aid improvements by types		Actual existing mileage by types due to further improvements by the States	
	Mileage	Per cent of total	Mileage	Per cent of total
Graded and drained.....	12,222.4	12.1	4,516.5	4.5
Sand-clay and topsoil, untreated.....	7,395.8	7.3	6,681.8	6.6
Sand-clay and topsoil, treated.....	36.0	-----	829.4	.8
Gravel, untreated.....	30,545.9	30.2	24,417.1	24.2
Gravel, treated.....	862.8	.9	8,084.6	8.0
Macadam, untreated.....	1,983.5	2.0	777.2	.7
Macadam, treated.....	916.4	.9	2,191.0	2.2
Low-cost bituminous mixtures.....	3,582.2	3.6	5,673.0	5.6
Bituminous macadam.....	4,468.2	4.4	4,752.2	4.7
Bituminous concrete.....	3,841.6	3.8	4,689.2	4.6
Concrete.....	33,671.6	33.3	36,851.9	36.5
Block.....	1,021.5	1.0	1,084.0	1.1
Bridges and approaches.....	484.2	.5	484.2	.5
Total.....	101,032.1	100.0	101,032.1	100.0

Its effect is especially noticeable in the surfacing of graded and drained roads and the surface treatment of roads constructed with Federal aid as plain water-bound macadam, gravel, and sand-clay roads.

As previously indicated, the Federal-aid projects under which improvement is limited to grading and drainage are approved subject to definite agreement on the part of the States to lay surfaces adequate for the traffic as early as possible either with or without additional Federal aid. Such of the roads involved as are subsequently surfaced without Federal aid remain in the official records of this bureau, which refer only to work done with Federal participation, as graded and drained roads, and the record, therefore, does not accurately reflect the true existing condition. Thus Table 5 shows that of the 12,222.4 miles which remain in the bureau's records as graded and drained with Federal aid, there are only 4,516.5 miles that actually are still unsurfaced, more than 7,700 miles having been subsequently surfaced by the States without Federal participation. The 4,516.5 miles actually remaining unsurfaced is less than the mileage of that type constructed with Federal aid in the last two years.

There is a similar situation in respect to the roads constructed with Federal aid as water-bound macadam and so classified in the bureau's records. Under modern conditions there are few cases in which a plain water-bound macadam surface is adequate. In nearly all cases such roads require surface treatment with bituminous material or other protection to prevent damage by motor vehicles. But such treatments can not ordinarily be applied until the plain water-bound surface has passed through a season of curing to acquire firmness under traffic.

Wherever, in the judgment of the bureau, such treatment is required the construction of a water-bound macadam surface is approved only upon the definite understanding that it will be surface-treated either with or without Federal aid at the proper time. In the interim, however, the project remains on the bureau's records as water-bound macadam; and if the treatment is applied without Federal aid the original project remains permanently in the Federal records as of the original type. This, as previously explained, is because the bureau's records reflect only the amount and character of work done with Federal aid. Table 5 also shows that the roads classified in the bureau's official record as untreated water-bound macadam have a length of 1,983.5 miles, whereas the mileage of that type built with Federal aid and actually remaining untreated on July 30, 1932 was only 777.2 miles, the rest having been treated independently by the States. The remaining untreated mileage is slightly greater than the untreated mileage completed in the last two fiscal years.

RECONSTRUCTION

Reconstruction was completed during the year and final payment was made therefor on a total of 35.2 miles of Federal-aid roads constructed in previous years. In addition there were 9.3 miles upon which reconstruction was physi-

cally complete at the end of the year but which had not been fully paid for by the Federal Government.

Full information in regard to reconstruction of Federal-aid projects will be found in Tables 6 to 12 and 17 to 20.

TABLE 6.—Federal-aid projects on which reconstruction had been completed and paid during fiscal year 1932

State	Total cost	Federal aid	Miles
Maryland.....	\$832,258.64	\$329,771.88	13.5
Michigan.....	590,274.81	150,030.00	10.0
Nevada.....	268,290.65	170,463.14	9.2
Oklahoma.....	57,578.68	25,000.00	2.5
Total.....	1,748,402.78	675,265.02	35.2

TABLE 7.—Federal-aid projects on which reconstruction had been completed, but final payment not made, June 30, 1932

State	Estimated total cost	Federal aid allotted	Miles
Michigan.....	\$189,000.00	\$93,345.00	6.1
Oklahoma.....	101,693.62	37,846.59	3.2
Total.....	290,693.62	131,191.59	9.3

TABLE 8.—Federal-aid projects on which reconstruction was in progress June 30, 1932

State	Estimated total cost	Federal aid allotted	Miles
Oklahoma.....	\$185,963.65	\$102,767.15	8.3
Rhode Island.....	81,305.62	40,652.81	2.2
Total.....	267,269.27	143,419.96	10.5

TABLE 9.—Federal-aid projects by types of construction on which reconstruction had been completed June 30, 1932

State	Age (years)	Original type							
		Gravel, untreated		Bituminous macadam		Bituminous concrete		Portland-cement concrete	
		New type	Miles	New type	Miles	New type	Miles	New type	Miles
Louisiana.....	4	Bituminous concrete.	7.5						
Maine.....	7			Concrete	1.9				
Do.....	9			do	1.6				
Maryland.....	13			do	5.1				
Do.....	11			do	6.5				
Do.....	13			Bituminous concrete.	2.6				
Do.....	13							Concrete.....	5.8
Massachusetts.....	10					Bituminous macadam.	2.6		
Do.....	8			Concrete	2.8				
Michigan.....	12					Concrete	10.0		
Do.....	10	Concrete	6.1						
Nevada.....	13							Bituminous concrete.	9.2
New Hampshire.....	12					Concrete	1.2		
Do.....	12					do	.5		
Do.....	10					do	2.0		
Oklahoma.....	11	Concrete	2.5						
Do.....	9	do	2.7						
Do.....	11	do	3.2						
Do.....	9	Bridges	.1						
Vermont.....	5	Concrete	1.4						

TABLE 10.—Federal-aid projects, by types of construction, on which reconstruction had been completed and paid for during the fiscal year 1932

State	Age (years)	Original type							
		Gravel, untreated		Bituminous macadam		Bituminous concrete		Portland-cement concrete	
		New type	Miles	New type	Miles	New type	Miles	New type	Miles
Maryland.....	13			Bituminous concrete.	2.6				
Do.....	13			Concrete.....	5.1				
Do.....	13							Concrete.....	5.8
Michigan.....	12					Concrete..	10.0		
Nevada.....	13							Bituminous concrete.	9.2
Oklahoma.....	11	Concrete..	2.5						

TABLE 11.—Federal-aid projects, by types of construction, on which reconstruction had been completed, but final payment not made, June 30, 1932

State	Age (years)	Original type—gravel, untreated		
		New type		Miles
Michigan.....	10	Portland cement concrete.....		6.1
Oklahoma.....	11	do.....		3.2

TABLE 12.—Federal-aid projects, by types of construction, on which reconstruction was in progress June 30, 1932

State	Age (years)	Original type			
		Gravel, untreated		Bituminous macadam	
		New type	Miles	New type	Miles
Oklahoma.....	11	Concrete.....	8.3	Concrete.....	
Rhode Island.....	13			Concrete.....	2.2

CHANGES IN THE FEDERAL-AID HIGHWAY SYSTEM

In the last annual report the mileage of the Federal-aid system within the boundaries of national forests, Indian reservations, and other Federal reservations was reported as 5,580.07 miles, as determined up to the close of the fiscal year 1931. During the past year further determinations have increased this mileage to 5,785.19, located, by States, as shown in Table 13.

TABLE 13.—Mileage of Federal-aid highway system within Federal reservations, being the amounts by which the 7 per cent limiting mileage may be exceeded in each State

State	Mileage within Federal reservations	State	Mileage within Federal reservations	State	Mileage within Federal reservations
Arizona.....	547.20	Minnesota.....	74.80	Pennsylvania.....	108.21
Arkansas.....	119.70	Mississippi.....	10.40	South Dakota.....	474.50
California.....	457.00	Montana.....	920.92	Tennessee.....	66.04
Colorado.....	423.50	Nebraska.....	11.25	Utah.....	68.90
Georgia.....	57.80	Nevada.....	21.77	Virginia.....	30.72
Idaho.....	468.40	New Hampshire.....	33.42	Washington.....	439.66
Illinois.....	4.50	New Mexico.....	368.88	West Virginia.....	29.06
Iowa.....	2.00	New York.....	16.47	Wisconsin.....	45.50
Kansas.....	14.70	North Carolina.....	176.34	Wyoming.....	325.90
Kentucky.....	6.00	North Dakota.....	23.39		
Maine.....	4.50	Oklahoma.....	16.25	Total.....	5,785.19
Michigan.....	57.41	Oregon.....	360.10		

Under the amendment of the Federal highway act approved May 21, 1928, the original 7 per cent system in the several States may be increased by these mileages within Federal reservations, and such addition, together with an increase in the mileage of the system in Hawaii authorized by a special act approved February 23, 1931, raises the permissible mileage of the initial system to 206,666 miles. The act mentioned set aside the 7 per cent limitation upon the initial system with respect to Hawaii and authorized the selection of a system on which Federal-aid apportionments to the Territory shall be expended by agreement between the Governor of the Territory and the Secretary of Agriculture. The former 7 per cent limitation for Hawaii was 213 miles. This limitation is abolished, and under authority of the act above mentioned the Secretary of Agriculture and Governor of Hawaii have agreed upon a system embracing 532 miles.

By addition to the system during the past year, made possible in part by the provisions of the amendment of May 21, 1928, and in part by the change in Hawaii, the mileage of the initial system has been increased to 196,677 miles. This mileage has been further increased by extension of the system in seven States in which the initial 7 per cent system has been improved to the satisfaction of the Secretary of Agriculture. The States in which such extensions have been approved are: Connecticut, in which the extension is 118.37 miles; Delaware, 408.72 miles; Maryland, 921.29 miles; Massachusetts, 49.72 miles; New Jersey, 165.23 miles; New York, 1,373.59 miles; and Rhode Island, 298.20 miles. The sum of these extensions, 3,335.12 miles, added to the initial system thus far designated, raises the mileage of the total system to 200,013 miles as of June 30, 1932, an increase of 3,136 miles in the last year.

The mileage of the designated Federal-aid system in each State, including the authorized extensions in the seven States mentioned and the mileage within Federal reservations, is given in Table 16, which also shows the distribution, by States, of the 101,032.1 miles classified as completed on June 30, 1932.

The mileage classified as completed with Federal aid still includes some roads improved before 1921 and not since included in the designated Federal-aid system. These roads, if found not sufficiently important to be added to the designated system, are being gradually dropped and the Federal money invested in them transferred as a credit to the improvement of other roads in the system.

A year ago it was reported that the Federal aid originally paid for the improvement of 1,011.3 miles of such roads outside the system had been transferred to other roads within the system. Continuation of this procedure during the past year has returned to the Government the amount originally expended on other roads outside the system totaling 300 miles, and this money has been allotted to the initial or stage construction of other roads within the system.

The mileage classified as improved has also been reduced this year, by reductions in the length of previously improved roads by relocations effected in stage construction and by correction of records, in the amount of 103 miles.

CONSTRUCTION OF ROADS THROUGH PUBLIC LANDS AND FEDERAL RESERVATIONS

The emergency employment act of December 20, 1930, appropriated \$3,000,000 to be expended for the survey, construction, reconstruction, and maintenance of main roads through unappropriated or unreserved public lands, nontaxable Indian lands, or other Federal reservations except national forests. The Secretary of Agriculture had previously been authorized, by act approved June 24, 1930, to cooperate in such work with State highway departments and the Department of the Interior.

After deduction of the 2½ per cent administrative allowance the balance of the \$3,000,000 appropriation, amounting to \$2,925,000 was apportioned among 13 States having more than 5 per cent of their area in lands of the kind described. The apportionment was made in the proportion that the area of such lands in each State bears to their total area in all States, as required by law.

The sums apportioned to the several eligible States and the status of expenditure are shown in Table 14.

TABLE 14.—*Status of appropriation for roads through public lands and Federal reservations June 30, 1932*

State	Sum apportioned	Sums allotted to projects—				Total
		Not yet under construction	Under construction	Completed and finally inspected	Completed and final payment made	
Arizona.....	\$416,328		\$173,972.91	\$242,355.09		\$416,328
California.....	230,614	\$230,614.00				230,614
Colorado.....	130,197		130,197.00			130,197
Idaho.....	174,316			101,200.93	\$73,115.07	174,316
Montana.....	164,521	37,245.93			127,275.07	164,521
Nevada.....	588,914	12,351.84	576,562.16			588,914
New Mexico.....	256,790		195,343.60	61,446.40		256,790
Oklahoma.....	41,464	11,028.77	30,435.23			41,464
Oregon.....	193,377	10,400.00	182,977.00			193,377
South Dakota.....	65,715		65,715.00			65,715
Utah.....	326,683	18,095.58			308,587.42	326,683
Washington.....	55,165				55,165.00	55,165
Wyoming.....	280,916		126,608.60		154,307.40	280,916
Total.....	2,925,000	319,736.12	1,481,811.50	405,002.42	718,449.96	2,925,000

By June 30, 1932, as shown by Table 14, the entire sum apportioned had been allotted to definite road-construction projects, including surveys in a few instances. Projects involving more than \$1,100,000 had been completed; others involving nearly \$1,500,000 were under construction; and the balance of nearly \$320,000 had been allotted to projects that were not yet under construction.

FEDERAL-AID FUNDS APPORTIONED, OBLIGATED, AND EXPENDED

The Federal-aid appropriation authorized for the fiscal year 1932 was \$125,000,000. The balance of \$121,875,000 remaining after deduction of 2½ per cent allowed for administration was apportioned by the Secretary of Agriculture on September 1, 1930. The amounts credited to the several States are shown in Table 31.

On July 1, 1931, at the beginning of the fiscal year, the unobligated balance of all funds previously apportioned, including the sum apportioned for 1932, was \$39,638,888.04. This indicates that there had been obligated to projects at the beginning of the fiscal year the equivalent of all funds apportioned for prior fiscal years and more than \$82,000,000 of the funds for the new fiscal year.

On October 15, 1931, the appropriation authorized for the fiscal year 1933 was apportioned. In this apportionment the amounts regularly due the several States were reduced as required by law by the amount of the first of five annual deductions on account of the emergency advance of \$80,000,000 made during the preceding fiscal year.

The act appropriating the emergency funds provided for reimbursement by deduction of the amounts actually expended by each of the States from their respective apportionments of future Federal-aid authorizations over a period of five years beginning with the fiscal year 1933. When the apportionment of the 1933 funds was made it was not possible to determine precisely how much of the emergency funds advanced to them had been actually expended because of the normal delay in submission of vouchers. Therefore, in determining the amounts of the 1933 funds due the States, deductions were made from the amounts that would have been regularly apportioned to them equal to one-fifth of the emergency funds advanced to them, with the proviso that if it should be found that any State had failed to expend the entire amount of emergency funds advanced to it, a revision of the apportionment would be made.

The total appropriation authorized for the fiscal year 1933 was \$125,000,000. After deduction of the 2½ per cent allowed for administration and one-fifth of the \$80,000,000 advance, the balance available for apportionment was \$105,875,000. This amount added to the \$39,638,888.04 unobligated at the beginning of the fiscal year 1932 increased the sum available for allotment to projects during the year to \$145,513,888.04.

The amount obligated during the fiscal year was \$83,793,787.44 and the balance unobligated on June 30, 1932 was \$61,720,100.60. The amount actually paid to the States during the fiscal year was \$127,367,119.74. By reference to Table 15 it will be seen that the amount obligated during the fiscal year 1932 was little more than half of the sum obligated during the preceding year. The amount expended was only slightly less than the previous year's expenditure.

TABLE 15.—Federal-aid funds apportioned to the States, obligated to projects and paid to the States each fiscal year, 1923 to 1932, inclusive

Fiscal year	Apportioned amount of appropriation authorized for the year	Amount of Federal-aid funds obligated during the year	Amount of Federal-aid funds paid to States during the year
1923.....	\$48,750,000	\$77,461,559	\$69,677,241.86
1924.....	63,375,000	89,866,864	79,217,397.90
1925.....	73,125,000	87,294,396	95,749,998.11
1926.....	73,125,000	79,608,897	87,754,534.57
1927.....	73,125,000	77,453,046	81,371,013.03
1928.....	73,125,000	88,922,185	80,802,232.55
1929.....	73,125,000	70,428,896	82,097,380.38
1930.....	73,125,000	102,498,084	75,880,862.84
1931.....	121,875,000	157,952,903	133,340,910.64
1932.....	121,875,000	83,793,787	127,367,119.74
Total.....	¹ 794,625,000	915,280,617	¹ 913,258,691.62
Average.....	79,462,500	91,528,062	91,325,869.16

¹ The excess of total payments over total apportionments for these years was possible because from 1917 to 1922, inclusive, the appropriations exceeded the payments by more than an equal amount.

COST OF THE ROADS

The total cost of the 11,036.9 miles of initial construction, the 4,925.1 miles of stage construction, and the 35.2 miles of reconstruction completed and completely paid for during the year was \$317,216,271.78, of which the Federal Government paid \$144,720,610.07, or 45.6 per cent, and the States the balance. These expenditures were made over the period required to construct the roads, and additional expenditures were made during the same period for other projects under construction and not yet completed.

As previously stated, the total of Federal funds disbursed during the year on all active projects was \$127,367,119.74, as shown in Table 31. Of this sum, 1 State, New York, received more than \$11,000,000; 1, Texas, received more than \$8,000,000; 3, California, Illinois, and Pennsylvania, received more than \$5,000,000; 3, Indiana, Michigan, and Ohio, received more than \$4,000,000; and 5, Georgia, Kansas, Minnesota, Montana, and Nebraska, received more than \$3,000,000. With the exception of 6 States—Delaware, Maryland, New Hampshire, New Jersey, Rhode Island, and Vermont, and the Territory of Hawaii—every State received for work done during the year in excess of \$1,000,000.

FEDERAL-AID STATISTICS

Statistical information relative to the apportionment, obligation, and disbursement of Federal aid during the fiscal year 1932, the cost of roads completed, the estimated cost of roads under construction, and the types of roads completed and under construction, etc., is given in Tables 16 to 31, inclusive.

TABLE 16.—*Mileage of the designated Federal-aid highway system in each State, and mileage improved with Federal aid to June 30, 1932*

State	Mileage of designated Federal-aid highway system	Mileage completed with Federal aid to June 30, 1932	State	Mileage of designated Federal-aid highway system	Mileage completed with Federal aid to June 30, 1932
Alabama.....	3,931	2,393.9	New Hampshire.....	988	421.0
Arizona.....	1,979	1,220.1	New Jersey.....	1,364	616.5
Arkansas.....	4,953	1,960.2	New Mexico.....	3,616	2,250.1
California.....	4,889	2,328.6	New York.....	7,121	3,273.4
Colorado.....	3,584	1,603.2	North Carolina.....	4,355	2,226.4
Connecticut.....	968	281.7	North Dakota.....	7,439	5,062.7
Delaware.....	675	345.7	Ohio.....	5,914	2,858.4
Florida.....	1,912	638.0	Oklahoma.....	5,982	2,298.2
Georgia.....	5,610	3,068.4	Oregon.....	3,247	1,522.8
Idaho.....	3,116	1,460.3	Pennsylvania.....	6,374	3,012.6
Illinois.....	6,771	2,649.2	Rhode Island.....	464	255.6
Indiana.....	4,964	1,822.0	South Carolina.....	3,255	2,013.6
Iowa.....	7,220	3,350.2	South Dakota.....	6,256	4,039.4
Kansas.....	7,933	3,643.0	Tennessee.....	3,866	1,682.4
Kentucky.....	3,699	1,911.0	Texas.....	12,797	7,802.7
Louisiana.....	2,725	1,566.8	Utah.....	1,743	1,203.5
Maine.....	1,576	720.4	Vermont.....	1,036	339.1
Maryland.....	1,958	778.9	Virginia.....	3,748	1,922.9
Massachusetts.....	1,456	817.3	Washington.....	3,177	1,197.9
Michigan.....	5,215	2,071.5	West Virginia.....	2,223	893.3
Minnesota.....	6,880	3,956.1	Wisconsin.....	5,493	2,593.8
Mississippi.....	3,562	1,809.0	Wyoming.....	3,525	1,894.3
Missouri.....	7,530	2,922.0	Hawaii.....	532	76.3
Montana.....	5,238	2,724.3	Total.....	200,013	101,032.1
Nebraska.....	5,574	4,255.2			
Nevada.....	1,560	1,281.2			

TABLE 17.—*Total cost, Federal aid and mileage of Federal-aid roads, initial and stage construction and reconstruction completed and paid during the fiscal year 1932*

State	Total cost	Federal aid	Mileage			
			Initial	Stage	Recon-struction	Total
Alabama.....	\$6,632,377.81	\$3,254,107.34	178.2	141.4	-----	319.6
Arizona.....	4,592,313.37	2,997,498.86	163.4	260.6	-----	424.0
Arkansas.....	10,013,059.31	4,456,690.96	228.9	99.4	-----	328.3
California.....	11,201,066.65	4,485,886.08	311.9	84.9	-----	396.8
Colorado.....	3,447,804.58	1,694,598.24	126.3	31.8	-----	158.1
Connecticut.....	1,867,636.38	878,020.33	26.2	-----	-----	26.2
Delaware.....	1,134,643.28	560,157.40	39.2	-----	-----	39.2
Florida.....	3,610,613.72	1,636,690.21	86.0	5.5	-----	91.5
Georgia.....	12,771,811.73	5,996,705.60	438.7	185.9	-----	624.6
Idaho.....	3,522,448.95	1,926,478.79	252.6	12.3	-----	264.9
Illinois.....	12,797,517.97	5,933,485.69	393.6	34.3	-----	427.9
Indiana.....	6,012,180.66	2,836,159.83	234.6	-----	-----	234.6
Iowa.....	7,301,368.36	3,450,553.00	172.8	94.9	-----	267.7
Kansas.....	8,645,189.65	4,090,582.58	534.9	80.0	-----	614.9
Kentucky.....	6,542,441.54	2,841,986.71	204.9	174.8	-----	379.7
Louisiana.....	6,197,247.26	2,845,033.17	198.7	9.6	-----	208.3
Maine.....	3,907,936.98	1,630,960.17	109.9	-----	-----	109.9
Maryland.....	2,104,954.35	915,829.37	48.2	2.4	13.5	64.1
Massachusetts.....	2,127,903.58	718,153.25	32.3	-----	-----	32.3
Michigan.....	6,529,407.71	2,505,034.65	175.7	29.3	10.0	215.0
Minnesota.....	6,988,206.20	3,134,677.95	76.9	288.7	-----	365.6
Mississippi.....	1,215,289.64	580,441.10	24.2	29.5	-----	53.7
Missouri.....	10,963,758.56	4,692,498.85	322.3	117.1	-----	439.4
Montana.....	8,814,187.67	4,954,604.16	734.4	195.3	-----	929.7
Nebraska.....	11,050,135.87	4,919,538.59	395.9	286.5	-----	682.4
Nevada.....	2,610,230.36	1,753,355.65	92.8	216.3	9.2	318.3
New Hampshire.....	1,258,769.77	500,610.26	30.1	5.7	-----	35.8
New Jersey.....	2,424,799.76	843,003.18	42.1	-----	-----	42.1
New Mexico.....	4,868,755.39	2,926,337.86	152.5	154.4	-----	306.9
New York.....	23,079,122.35	9,566,262.30	537.0	-----	-----	537.0
North Carolina.....	8,075,429.64	3,924,537.34	263.0	77.2	-----	340.2
North Dakota.....	3,971,186.11	2,020,516.18	552.0	718.2	-----	1,270.2
Ohio.....	15,202,321.86	5,316,423.89	325.2	26.6	-----	351.8
Oklahoma.....	4,782,563.77	2,417,603.74	236.3	53.7	2.5	292.5

TABLE 17.—Total cost, Federal aid and mileage of Federal-aid roads, initial and stage construction and reconstruction completed and paid during the fiscal year 1932—Continued

State	Total cost	Federal aid	Mileage			
			Initial	Stage	Recon-struction	Total
Oregon.....	5,044,059.26	2,712,369.05	229.2	62.9	.....	292.1
Pennsylvania.....	14,225,833.65	5,577,855.61	373.4	.....	.....	373.4
Rhode Island.....	2,434,647.26	1,088,088.58	48.2	.....	.....	48.2
South Carolina.....	7,206,238.21	3,108,948.33	90.1	214.7	.....	304.8
South Dakota.....	4,634,538.92	2,538,254.19	342.4	182.8	.....	525.2
Tennessee.....	5,966,504.20	2,816,329.72	238.5	39.0	.....	277.5
Texas.....	18,660,872.18	8,576,426.20	712.4	382.8	.....	1,095.2
Utah.....	3,561,558.52	2,097,825.15	198.0	180.0	.....	378.0
Vermont.....	1,468,264.59	656,249.12	41.6	4.8	.....	46.4
Virginia.....	5,860,425.66	2,626,607.86	263.9	37.9	.....	301.8
Washington.....	6,264,501.27	2,640,753.51	172.6	43.7	.....	216.3
West Virginia.....	3,573,588.79	1,370,430.44	91.1	21.2	.....	112.3
Wisconsin.....	6,970,072.08	3,032,890.78	189.4	82.7	.....	272.1
Wyoming.....	3,749,014.50	2,158,661.99	269.5	256.3	.....	525.8
Hawaii.....	1,331,466.90	513,956.26	34.9	.....	.....	34.9
Total.....	317,216,271.78	144,720,610.07	11,036.9	4,925.1	35.2	15,997.2

TABLE 18.—Total cost, Federal aid and mileage of Federal-aid roads, initial and stage construction and reconstruction completed but final payment not made, June 30, 1932

State	Estimated total cost	Federal aid allotted	Mileage			
			Initial	Stage	Recon-struction	Total
Alabama.....	\$578,077.61	\$246,770.80	14.8	3.4	.....	18.2
Arizona.....	1,578,764.61	1,103,669.67	95.0	28.3	.....	123.3
Arkansas.....	1,928,887.35	913,774.12	44.1	26.0	.....	70.1
California.....	3,013,966.78	1,409,192.32	82.4	1.0	.....	83.4
Colorado.....	3,229,021.50	1,714,992.81	125.4	46.6	.....	172.0
Connecticut.....	77,426.08	38,713.04	.2	.....	.....	.2
Delaware.....	13,896.00	6,948.00	.5	.....	.....	.5
Florida.....	1,606,558.69	692,419.44	43.7	.....	.....	43.7
Georgia.....	668,968.44	324,964.67	1.3	29.2	.....	30.5
Idaho.....	330,035.93	162,473.62	3.7	12.1	.....	15.8
Illinois.....	2,578,118.88	1,110,131.48	64.7	3.2	.....	67.9
Indiana.....	2,823,800.18	1,383,456.85	97.9	.....	.....	97.9
Kansas.....	1,143,973.06	538,855.16	53.4	3.7	.....	57.1
Kentucky.....	1,808,222.75	854,900.14	95.8	.....	.....	95.8
Louisiana.....	128,679.81	64,339.90	16.1	.....	.....	16.1
Maine.....	386,120.90	163,689.03	14.4	.....	.....	14.4
Maryland.....	779,309.75	389,654.86	24.1	.....	.....	24.1
Massachusetts.....	10,217,252.90	2,442,676.90	96.0	.....	.....	96.0
Michigan.....	4,628,263.68	1,949,452.18	131.6	7.5	6.1	145.2
Mississippi.....	444,619.95	217,882.68	5.8	8.5	.....	14.3
Missouri.....	837,589.56	331,845.03	20.0	.....	.....	20.0
Montana.....	1,109,913.73	626,012.85	90.2	.....	.....	90.2
Nebraska.....	3,367,213.68	1,617,516.52	82.5	93.7	.....	176.2
Nevada.....	669,728.89	480,857.05	12.9	32.7	.....	45.6
New Hampshire.....	532,867.32	205,620.18	8.6	.....	.....	8.6
New Jersey.....	1,542,935.62	637,765.75	19.9	3	.....	20.2
New Mexico.....	2,304,393.35	1,479,028.57	121.6	.....	.....	121.6
New York.....	8,494,202.83	1,971,869.98	117.1	7.0	.....	124.1
North Carolina.....	185,758.87	84,110.27	8.2	.....	.....	8.2
North Dakota.....	710,748.40	355,374.14	79.5	104.8	.....	184.3
Ohio.....	4,499,564.74	1,650,524.44	40.8	19.6	.....	60.4
Oklahoma.....	4,041,351.09	2,088,763.36	128.7	54.9	3.2	186.8
Oregon.....	1,088,710.14	603,258.36	39.7	15.9	.....	55.6
Pennsylvania.....	4,404,756.10	1,844,826.32	17.9	.....	.....	17.9
South Carolina.....	635,046.04	290,317.76	21.5	6.3	.....	27.8
South Dakota.....	727,708.13	352,387.95	13.5	25.5	.....	39.0
Tennessee.....	251,140.36	123,435.52	9.5	4.3	.....	13.8
Texas.....	5,347,469.11	2,420,142.95	250.7	80.2	.....	330.9
Utah.....	182,856.02	110,885.58	12.9	5	.....	13.4
Virginia.....	1,769,338.18	784,928.90	75.0	20.4	.....	95.4
Washington.....	375,039.77	198,800.00	11.7	.....	.....	11.7
West Virginia.....	1,845,277.70	817,877.27	47.3	3	.....	47.6
Wisconsin.....	438,441.22	171,335.38	16.7	.....	.....	16.7
Wyoming.....	182,681.38	99,989.27	12.2	16.2	.....	28.4
Total.....	83,508,697.08	35,076,431.07	2,269.5	652.1	9.3	2,930.9

14 ANNUAL REPORTS OF DEPARTMENT OF AGRICULTURE, 1932

TABLE 19.—Total cost, Federal aid and mileage of Federal-aid roads, initial and stage and reconstruction improvement, under construction, by States, June 30, 1932

State	Estimated total cost	Federal aid allotted	Mileage			
			Initial	Stage	Recon-struction	Total
Alabama.....	\$1,812,011.04	\$884,109.47	74.1	-----	-----	74.1
Arizona.....	2,782,928.26	2,014,700.15	104.9	61.7	-----	166.6
Arkansas.....	2,452,768.24	1,127,328.92	64.7	45.1	-----	109.8
California.....	10,475,483.57	4,985,605.01	211.3	52.0	-----	263.3
Colorado.....	4,355,182.99	2,276,199.42	171.4	50.8	-----	222.2
Connecticut.....	4,362,762.05	1,613,060.26	30.2	-----	-----	30.2
Delaware.....	870,529.25	435,264.62	41.2	-----	-----	41.2
Florida.....	3,563,837.58	1,659,559.53	102.1	-----	-----	102.1
Georgia.....	6,410,060.34	2,999,196.48	160.3	166.8	-----	327.1
Idaho.....	2,573,893.23	1,517,125.45	123.5	93.7	-----	217.2
Illinois.....	25,384,659.55	11,764,654.34	751.9	36.8	-----	788.7
Indiana.....	10,326,406.44	5,114,814.33	352.4	20.5	-----	372.9
Iowa.....	3,512,604.68	1,639,295.18	178.3	40.4	-----	218.7
Kansas.....	5,160,560.54	2,521,332.53	293.4	68.2	-----	361.6
Kentucky.....	2,439,460.44	1,079,480.86	144.2	4.0	-----	148.2
Louisiana.....	7,471,657.46	3,511,759.18	87.0	10.6	-----	97.6
Maine.....	3,348,521.01	1,423,360.93	82.9	-----	-----	82.9
Maryland.....	701,917.80	255,754.94	23.4	.6	-----	24.0
Massachusetts.....	7,129,265.67	2,897,641.92	71.3	.2	-----	71.5
Michigan.....	9,062,647.19	4,162,775.75	395.4	31.9	-----	427.3
Minnesota.....	11,284,587.17	3,749,501.38	204.9	296.8	-----	501.7
Mississippi.....	3,910,633.74	1,915,689.81	171.2	68.8	-----	240.0
Missouri.....	7,031,555.37	3,036,644.01	191.0	88.3	-----	279.3
Montana.....	4,576,181.82	2,572,131.43	397.7	31.5	-----	429.2
Nebraska.....	3,329,003.58	1,650,271.38	151.9	26.1	-----	178.0
Nevada.....	1,576,562.30	1,289,906.62	21.2	163.0	-----	184.2
New Hampshire.....	339,864.67	140,869.77	9.5	2.5	-----	12.0
New Jersey.....	4,716,807.19	1,770,638.23	34.3	.5	-----	34.8
New Mexico.....	1,469,046.56	1,028,823.23	61.9	17.8	-----	79.7
New York.....	14,125,400.00	6,352,125.00	334.3	-----	-----	334.3
North Carolina.....	1,152,326.37	567,278.11	67.6	5.0	-----	72.6
North Dakota.....	3,316,919.40	1,680,534.96	383.7	283.5	-----	667.2
Ohio.....	6,314,566.20	2,097,263.73	101.7	26.4	-----	128.1
Oklahoma.....	3,478,222.78	1,625,741.63	157.3	36.7	8.3	202.3
Oregon.....	4,145,699.29	2,305,513.64	128.0	47.1	-----	175.1
Pennsylvania.....	5,021,298.77	2,322,443.57	181.7	-----	-----	181.7
Rhode Island.....	926,504.32	459,140.00	16.7	-----	2.2	18.9
South Carolina.....	3,131,546.27	1,409,414.06	73.2	59.7	-----	132.9
South Dakota.....	3,318,617.13	1,909,863.38	266.1	183.8	-----	449.9
Tennessee.....	1,427,533.89	697,948.21	48.7	6.4	-----	55.1
Texas.....	13,843,539.36	6,348,479.78	605.0	223.6	-----	828.6
Utah.....	1,109,608.87	797,552.81	84.9	27.7	-----	112.6
Vermont.....	1,408,800.97	630,501.86	45.6	-----	-----	45.6
Virginia.....	1,915,279.75	957,639.81	113.5	6.2	-----	119.7
Washington.....	2,915,547.20	1,432,094.35	106.2	14.5	-----	120.7
West Virginia.....	1,783,964.32	708,721.07	44.5	10.5	-----	55.0
Wisconsin.....	7,833,923.20	3,203,398.32	204.8	75.4	-----	280.2
Wyoming.....	3,630,824.26	2,232,041.40	192.4	230.9	-----	423.3
Hawaii.....	811,202.36	395,047.85	22.0	-----	-----	22.0
Total.....	234,042,724.44	109,230,238.67	7,885.4	2,616.0	10.5	10,511.9

TABLE 20.—Total cost, Federal aid and mileage of Federal-aid roads, initial and stage and reconstruction improvement, approved for construction, by States, June 30, 1932

State	Estimated total cost	Federal aid allotted	Mileage			
			Initial	Stage	Recon-struction	Total
Arizona.....	\$4,594.57	\$3,459.24		0.3		0.3
Arkansas.....	404,816.95	201,796.90	17.4			17.4
California.....	1,475,029.90	645,642.39	44.4	7.0		51.4
Colorado.....	73,822.81	41,458.88	7.5			7.5
Connecticut.....	563,726.40	263,977.96	7.7			7.7
Delaware.....	86,524.00	43,262.00	4.7			4.7
Florida.....	655,632.89	327,766.42	17.3			17.3
Georgia.....	174,461.46	87,230.72	6.5	1.2		7.7
Idaho.....	1,302,449.66	781,761.33	30.8	228.7		259.5
Illinois.....	3,495,560.26	1,569,434.05	125.4	5.2		130.6
Indiana.....	1,609,394.59	792,712.22	73.7			73.7
Iowa.....	2,294,536.74	1,072,924.03	106.9	25.4		132.3
Kansas.....	2,324,281.14	1,126,345.63	72.3	304.6		376.9
Kentucky.....	1,399,504.67	525,166.87	17.3	107.8		125.1
Louisiana.....	1,103,383.51	538,516.32	29.8	13.3		43.1
Maine.....	887,397.91	431,757.49	34.3			34.3
Maryland.....	1,633,360.88	691,459.64	60.4	5.6		66.0
Michigan.....	655,889.46	325,630.00	21.4	20.1		41.5
Minnesota.....	842,326.55	229,800.00	15.7	20.2		35.9
Mississippi.....	116,017.23	58,008.61	16.1			16.1
Missouri.....	689,291.30	329,813.03	25.1	11.9		37.0
Montana.....	67,501.64	36,033.68	5.7	4.2		9.9
Nebraska.....	1,817,311.97	845,048.85	28.1	111.6		139.7
Nevada.....	859,152.00	693,501.34	26.8	19.6	13.7	60.1
New Jersey.....	1,023,047.07	496,650.88	.9			.9
New Mexico.....	998,601.99	618,039.80	41.1	42.3		83.4
New York.....	6,402,600.00	2,462,500.00	135.9			135.9
North Carolina.....	300,312.76	150,156.36	7.1	4.0		11.1
North Dakota.....	1,931,160.99	973,516.22	183.5	478.4		661.9
Ohio.....	6,292,605.00	2,240,240.53	153.0	46.4		199.4
Oklahoma.....	1,713,059.54	877,359.08	112.5	17.6		130.1
Oregon.....	1,590,510.22	864,268.36	46.9	74.8		121.7
Pennsylvania.....	6,392,381.18	2,851,912.07	196.7			196.7
South Carolina.....	101,152.78	50,000.00	5.2			5.2
South Dakota.....	233,615.05	157,987.24	30.8	12.0		42.8
Tennessee.....	733,446.20	356,461.69	17.1	21.8		38.9
Texas.....	3,980,124.61	1,802,196.04	232.1	185.1		417.2
Utah.....	847,650.66	635,771.92	37.6	108.5		146.1
Vermont.....	7,618.95	3,809.47				
Virginia.....	754,053.46	298,883.54	22.9	21.5		44.4
Washington.....	519,265.07	213,800.00	11.5	5.3		16.8
West Virginia.....	283,803.60	132,744.79	6.2			6.2
Wisconsin.....	1,110,874.93	432,400.00	29.6	23.5		53.1
Wyoming.....	205,019.30	134,595.13	26.2	20.1		46.3
Hawaii.....	740,008.72	598,548.44	18.8	3.6		22.4
Total.....	60,696,780.57	28,014,349.16	2,110.9	1,951.6	13.7	4,076.2

TABLE 22.—*Mileage of Federal-aid roads, by types of construction, by States, initially completed and paid for during fiscal year 1932*

State	Graded and drained	Sand-clay		Gravel		Macadam		Low-cost bituminous mix	Bituminous macadam	Bituminous concrete	Portland cement concrete	Block	Bridges and approaches	Total
		Untreated	Treated	Untreated	Treated	Untreated	Treated							
Texas.....	1,008.7	26.2	357.6	83.4	187.2	19.8	528.8	\$10.8	2,028.9	30.2	47.1	7,802.7		
Utah.....	108.0	.....	320.0	7.4	348.4	285.9	.....	13.9	115.3	.....	3.8	1,203.5
Vermont.....	.....	.....	108.1	2.0	1.1	.....	88.1	.....	163.0	.....	6.8	1,439.1
Virginia.....	158.4	338.5	543.8	5.2	284.1	37.5	387.9	40.9	426.3	.....	11.4	1,922.0	
Washington.....	221.5	.....	34.3	.....	19.5	1.7	199.5	28.1	341.2	10.6	6.3	1,197.9
West Virginia.....	254.1	19.6	938.9	.....	.....	.....	13.8	22.1	1,428.5	.....	2.9	1,893.3
Wisconsin.....	166.4	.....	1,006.7	15.8	.....	381.0	37.7	.....	.....	.....	10.3	2,568.8
Wyoming.....	456.6	.1	.....	.....	.....	.....	39.7	13.3	19.0	.....	8.7	1,894.3
Hawaii.....	3.6	.....	.....	.....	.....	.....	.....	.....	.....	.....	.7	76.3
Total.....	12,222.4	7,395.8	36.0	30,545.9	862.8	1,983.5	916.4	3,582.2	4,468.2	3,841.6	1,021.5	484.2	101,032.1	

TABLE 22.—*Mileage of Federal-aid roads, by types of construction, by States, initially completed and paid for during fiscal year 1932—Con.*

State	Graded and drained		Sand-clay		Gravel		Macadam		Low-cost bituminous mix	Bituminous macadam	Bituminous concrete	Portland cement concrete	Block	Bridges and approaches	Total
	Untreated	Treated	Untreated	Treated	Untreated	Treated									
New Hampshire.....										1.9	1.2	20.1		.3	30.1
New Jersey.....										.2		41.5		.4	42.1
New Mexico.....	11.4		93.2						46.0	25.7	58.4	444.2		1.9	152.5
New York.....	4.2		4.5								23.6	140.3			263.0
North Carolina.....	414.7		131.7	20.9					60.5	18.9	1.4	4.7	47.4	2.6	552.0
North Dakota.....	7.5		9.8					6.5			4.2	229.9			236.3
Ohio.....	155.0		7.4					11.0	11.5	60.0	.8	6.8		1.5	239.2
Oregon.....	69.1		23.9	28.1			16.7	279.3			.8	73.0	2.1	1.7	373.4
Pennsylvania.....	16.5									23.3	.8	23.4	2.1	1.7	48.2
Rhode Island.....												74.2		.5	90.1
South Carolina.....	7.5		332.8									5		1.6	342.4
South Dakota.....	141.3										16.9	78.3		2.0	238.5
Tennessee.....	427.4		9.7	.4			14.5				19.5	232.2		8.7	712.4
Texas.....			114.8						72.1		3.3	7.0		.8	198.0
Utah.....			5.8												
Vermont.....															
Virginia.....	29.0		15.6							2.1	1.2	35.3			41.6
Washington.....	36.8		82.2	5.2			26.0					30.5		1.9	263.9
West Virginia.....	8.3		4.4									52.9		.7	172.6
Wisconsin.....	7.1		49.7				1.1		1.4	24.5		51.2		.2	91.1
Wyoming.....	109.0		63.6						92.5			131.2		1.4	189.4
Hawaii.....	1.9									32.8		1.5		1.2	269.5
Total.....	2,162.6	481.4	2,342.7	191.9	389.5	213.9	767.2	237.0	236.6	3,863.2	49.5	82.0	11,036.9		

TABLE 23.—Mileage of Federal-aid roads, by types of construction, by States, initial construction completed but final payment not made June 30, 1932

State	Graded and drained	Sand-clay, untreated	Gravel		Macadam		Low-cost bituminous mix	Bituminous macadam	Bituminous concrete	Portland-cement concrete	Block	Bridges and approaches	Total
			Untreated	Treated	Untreated	Treated							
Alabama	14.2											0.6	14.8
Arizona			49.9				42.1			1.7			93.0
Arkansas	13.8								29.8				44.1
California	4.6		20.7				37.2		12.0	6.7			82.4
Colorado	8.2		102.8				8.3			4.1			125.4
Connecticut													
Delaware	.5												
Florida									3.7	39.1			43.7
Georgia	.8									.4			1.3
Idaho			2.5				1.2						3.7
Illinois	2.0												
Indiana										62.2			64.7
Iowa										1.1			97.9
Kansas	17.6		21.5						96.8				115.9
Kentucky	56.1		13.3						14.0				53.4
Louisiana	16.1								26.0				95.8
Maine				11.3									16.1
Maryland													
Massachusetts										6.3			24.1
Michigan	26.0		6.6						4.5	43.7			96.0
Minnesota									12.1	86.6			131.0
Mississippi										5.5			5.8
Missouri	4.2									3.3			20.0
Montana	20.0		33.5				36.5			15.5			90.2
Nebraska		76.7								4.8			82.5
Nevada			11.6				1.3						12.9
New Hampshire										8.1			8.6
New Jersey										19.7			19.9
New Mexico			77.8				39.6			3.0			121.6
New York	24.2		2.3							74.3			117.1
North Carolina									7.1	6.0			8.2
North Dakota	57.3		22.1										79.5
Ohio	2.8		.4										40.8
Oklahoma	35.8									25.0			128.7
Oregon										92.3			39.7
Pennsylvania	.8		11.2				7.7			7.7			17.9
South Carolina													
South Dakota			13.1							21.5			21.5
Tennessee										5.2			13.5
Texas	150.1		8.2	11.0			.5		4.3	78.8			250.7

TABLE 23.—Mileage of Federal-aid roads, by types of construction, by States, initial construction completed but final payment not made June 30, 1932—Continued

State	Graded and drained	Sand-clay, untreated	Gravel		Macadam		Low-cost bituminous mix	Bituminous macadam	Bituminous concrete	Portland-cement concrete	Block	Bridges and approaches	Total
			Untreated	Treated	Untreated	Treated							
Utah.....	1.3	38.5	10.7		24.7			7.3		.6		.3	12.9
Virginia.....	4.1											.4	75.0
Washington.....			11.6									.1	11.7
West Virginia.....	15.1									31.8		.4	47.3
Wisconsin.....	6.4									10.3			16.7
Wyoming.....			10.7				1.4					.1	12.2
Total.....	482.0	115.2	430.5	22.3	39.5	7.7	167.6	92.1	48.0	830.4	8.7	25.5	2,269.5

TABLE 24.—Mileage of Federal-aid roads by types of construction, by States, under initial construction, June 30, 1932

State	Graded and drained	Sand-clay		Gravel		Macadam		Low-cost bituminous mix	Bituminous macadam	Bituminous concrete	Portland-cement concrete	Block	Bridges and approaches	Total
		Untreated	Treated	Untreated	Treated	Untreated	Treated							
Alabama.....	73.8							41.4					0.3	74.1
Arizona.....	3.5		59.3								36.9		.7	104.9
Arkansas.....	23.5		4.2					68.9			58.2		3.1	64.7
California.....	52.0		.9					80.6			6.1		2.7	211.3
Colorado.....			82.0								26.4		3.6	171.4
Connecticut.....														30.2
Delaware.....	4.9		10.2								25.5		.6	41.2
Florida.....	57.5					20.1		4.1			20.0		4.1	102.1
Georgia.....	86.5	10.8		8.2		23.4		.9			29.7		.8	160.3
Idaho.....		1.4		103.2				18.4					.5	123.5
Illinois.....	81.7										661.9		8.3	751.9
Indiana.....	32.1										314.9		5.4	352.4
Iowa.....	4.9		81.5		11.4						70.9		6.6	178.3
Kansas.....	193.6	8.0		31.5				41.0			16.8		2.5	293.4
Kentucky.....	92.7		13.1								37.8		.6	144.2
Louisiana.....	4.0		3.4								76.7		2.9	87.0
Maine.....				24.1					26.4		31.2		1.2	82.9

TABLE 25.—Mileage of Federal-aid roads, by types of construction, by States, approved for initial construction, on June 30, 1932

State	Graded and drained	Sand-clay, untreated		Gravel		Macadam		Low-cost bituminous mix	Bituminous macadam	Bituminous concrete	Portland-cement concrete	Block	Bridges and approaches	Total
		Untreated	Treated	Untreated	Treated									
Arkansas.....	7.8										9.2		0.4	17.4
California.....	11.8							25.1			7.3		.2	44.4
Colorado.....				7.5										7.5
Connecticut.....											7.5		.2	7.7
Delaware.....							14.0				4.7			4.7
Florida.....											2.4		.9	17.3
Georgia.....											6.5			6.5
Idaho.....				14.6				16.2			96.9		.8	30.8
Illinois.....	27.7										66.5			125.4
Indiana.....	7.2										68.2			73.7
Iowa.....	30.5			8.1							12.1		.1	106.9
Kansas.....	59.5			3.5							7.7		.6	72.3
Kentucky.....	13.0										2.2		.1	17.3
Louisiana.....											29.7		.1	33.8
Maine.....				3.2	21.5				9.6					34.3
Maryland.....									23.6		21.6		.2	60.4
Michigan.....	9.8								11.1		15.7			21.4
Minnesota.....											15.7			15.7
Mississippi.....	16.0										24.3		.1	16.1
Missouri.....	.8										7.1			25.1
Montana.....				5.7				14.3					.1	5.7
Nebraska.....			6.6	3.3				23.5						28.1
Nevada.....									.1		.6		.2	.9
New Jersey.....				40.8					20.6		48.0		.3	41.1
New Mexico.....				53.0									.4	135.9
New York.....								3.0					.6	7.1
North Carolina.....	3.3													183.5
North Dakota.....	168.8		.2	14.6					2.8		82.0		.7	158.0
Ohio.....	4.2			5.4							21.1		.8	112.5
Oklahoma.....	90.6							4.8					.7	46.9
Oregon.....				10.1					30.4		66.1		1.5	196.7
Pennsylvania.....						129.1					5.2			5.2
South Carolina.....											5.0			17.1
South Dakota.....	24.6			5.1					4.1		6.1		.1	30.8
Tennessee.....	7.9										5.0		2.3	232.1
Texas.....	194.8				28.0						7.2		.1	37.6
Utah.....				37.5										11.5
Virginia.....						22.8					4.1		.2	6.2
Washington.....				4.3							6.9		.7	29.6
West Virginia.....	1.0													26.2
Wisconsin.....	12.4			9.6										26.2
Wyoming.....	10.5			9.7										18.8
Hawaii.....														
Total.....	709.1	6.8	236.0	49.5	151.9	14.0	86.9	75.5	107.8	633.8	26.3	13.3		2,110.9

TABLE 26.—Mileage of Federal-aid road stage construction, by types of construction, by States, completed and paid for during the fiscal year 1932

State	Graded and drained	Sand-clay, untreated	Gravel		Macadam		Low-cost bituminous mix	Bituminous macadam	Bituminous concrete	Portland-cement concrete	Block	Bridges and approaches	Total
			Untreated	Treated	Untreated	Treated							
Alabama	2.9		0.5						30.6	107.0		0.4	141.4
Arizona			2.9				255.7	0.3				1.2	260.6
Arkansas							37.0			99.2		.2	99.4
California	7.0		1.9				16.7		18.7	19.6		.7	84.9
Colorado			3.4							11.2		.5	31.8
Florida							5.4					.1	5.5
Georgia							46.2		16.5	115.2	2.5	.5	185.9
Idaho	1.3		6.4				4.6						12.3
Illinois										34.3			34.3
Iowa										94.9			94.9
Kansas		6.5	1.7	15.7			19.9			33.0		.6	80.0
Kentucky			26.5				19.9		35.0	93.3		.1	174.8
Louisiana								.1		9.5		.1	9.6
Maryland										2.3			2.4
Michigan									11.7	16.2		1.4	29.3
Minnesota	82.0									206.5		.2	288.7
Mississippi	5.5									28.9		.1	29.5
Missouri	10.4									106.3		.2	117.1
Montana			46.7				148.4						286.5
Nebraska	.3	121.7								163.5		.6	216.3
Nevada			10.6				205.1			5.7			5.7
New Hampshire										1.7			1.7
New Mexico			58.0				91.9			27.6		2.2	154.4
North Carolina	2.9		4.5				23.6		18.6				77.2
North Dakota	8.7		647.3				55.3			6.9			718.2
Ohio										23.4		1.1	26.6
Oklahoma	10.8		5.7							36.9		.3	53.7
Oregon	11.9		9.5			1.2		38.5		1.8			62.9
South Carolina									5.6	208.5		.6	214.7
South Dakota	13.8		56.6	7.6			41.7			62.8		.3	182.8
Tennessee	5.5						1.1		3.9	29.5			39.0
Texas	50.0					32.1			64.1	188.1		1.2	382.8
Utah	15.9		49.2				113.7			1.1		.1	180.0
Vermont										4.8			4.8
Virginia	.6		.5				5.7			4.0		.4	37.9
Washington			10.7							33.0			43.7
West Virginia	1.6									33.0			34.6
Wisconsin	1.5		1.2							17.8		.4	21.2
Wyoming	1.0		67.2							79.6		.1	82.7
Total	228.6	128.2	1,011.6	60.0	15.5	89.4	1,226.5	49.5	204.7	1,893.4	2.6	15.1	4,925.1

TABLE 27.—Mileage of Federal-aid roads, by types of construction, by States, stage construction, completed but final payment not made, June 30, 1932

State	Graded and drained	Sand-clay, untreated	Gravel, untreated	Macadam		Low-cost bituminous mix	Bituminous macadam	Bituminous concrete	Block	Bridges and approaches	Total
				Untreated	Treated						
Alabama.....								3.4			3.4
Arizona.....			3.9			23.8		0.3		0.3	28.3
Arkansas.....								25.9			26.0
California.....			.4					31.8		.6	46.6
Colorado.....						14.6		29.2		.2	44.0
Georgia.....						8.7		3.4			12.1
Idaho.....								3.2			3.2
Illinois.....								2.6		.1	3.7
Kansas.....	1.0							7.2			8.2
Michigan.....								3.3			3.3
Mississippi.....								8.4		.1	8.5
Nebraska.....		14.8						78.4		.5	93.7
Nevada.....						32.3		4.4		.4	37.1
New Jersey.....								7.0		.3	7.3
New York.....			104.8								104.8
North Dakota.....			.2					8.8	9.5	1.1	19.6
Ohio.....	.5							54.3		.1	54.9
Oregon.....	1.9		.7		3.4			4.4			10.4
South Carolina.....								6.3			6.3
South Dakota.....	2.7		5.1					17.7			25.5
Tennessee.....								4.3			4.3
Texas.....	5.7				20.9			9.2		.4	36.2
Utah.....								44.0			44.0
Virginia.....		15.2			5.2			.5			20.9
West Virginia.....											0
Wyoming.....			4.7			11.5		.3			16.2
Total.....	11.8	30.0	119.8	5.2	24.3	90.9	3.3	33.2	9.5	4.3	652.1

TABLE 28.—Mileage of Federal-aid roads, by types of construction, by States, under stage construction on June 30, 1932

State	Graded and drained	Sand-clay untreated	Gravel		Macadam		Low-cost bituminous mix	Bituminous macadam	Bituminous concrete	Portland-cement concrete	Bridges and approaches	Total
			Untreated	Treated	Untreated	Treated						
Arizona.....							61.4				0.3	61.7
Arkansas.....	18.6								26.3			45.1
California.....							14.3		4.0		1.4	52.0
Colorado.....			3.7				42.3			4.3	.5	50.8
Georgia.....				3.4				61.7		101.3	.4	166.8
Idaho.....	3.2	5.4	14.1				70.9			36.7	.1	93.7
Illinois.....										20.1	.4	36.8
Indiana.....										31.0		20.5
Iowa.....	1.5		8.5							13.8	.6	40.4
Kansas.....	4.0			.6			51.8			8.3	.3	68.2
Kentucky.....	2.0									.6		4.0
Louisiana.....												10.6
Maryland.....												
Massachusetts.....	23.2									5.2	.2	31.9
Michigan.....	36.5							3.4		260.2	.1	296.8
Minnesota.....	41.8									26.8	.2	68.8
Mississippi.....			3.4							84.7	.2	88.3
Missouri.....												
Montana.....			.5				31.0			25.5	.5	26.1
Nebraska.....		.1					182.1			2.5	.1	163.0
Nevada.....			.8									2.5
New Hampshire.....												
New Jersey.....							8.2				.1	17.8
New Mexico.....			9.5				5.0					5.0
North Carolina.....							116.5		.1			283.5
North Dakota.....			166.9							24.9	.2	26.4
Ohio.....								1.3		23.7	.3	36.7
Oklahoma.....	6.9							33.2			.3	47.1
Oregon.....			13.6							59.6	.1	59.7
South Carolina.....							79.1			4.9	.3	183.8
South Dakota.....	42.2		28.0	25.3						4.0	.3	6.4
Tennessee.....	5.3			77.3			23.5			104.7	.9	223.6
Texas.....			6.4				21.1				.2	27.7
Utah.....											.1	6.2
Virginia.....	3.9							2.2				14.5
Washington.....			1.3							13.2		4.7
West Virginia.....	5.8											10.5
Wisconsin.....	6.6		2.5							72.2	.1	75.4
Wyoming.....	28.8		76.0				125.8				.3	230.9
Total.....	224.3	5.5	335.2	106.6	2.2	85.2	789.5	34.5	30.7	993.5	8.8	2,616.0

TABLE 29.—Mileage of Federal-aid roads, by types of construction, by States, approved for stage construction, June 30, 1932

State	Graded and drained	Sand-clay, treated	Gravel		Macadam		Low-cost bituminous mix	Bituminous macadam	Bituminous concrete	Portland cement concrete	Block	Bridges and approaches	Total
			Un-treated	Treated	Un-treated	Treated							
Arizona.....							0.1			2.6		0.2	0.3
California.....							4.4						7.0
Georgia.....							228.6	1.2					228.7
Idaho.....										5.1		.1	5.2
Illinois.....										25.4			25.4
Iowa.....										7.2		.4	304.6
Kansas.....	3.2						281.8			56.8			107.8
Kentucky.....			38.5				12.4			13.3		.1	13.3
Louisiana.....										1.0			5.6
Maryland.....										12.6			20.1
Michigan.....	4.3									15.9			20.2
Minnesota.....										11.9			11.9
Missouri.....							4.2						4.2
Montana.....							70.9			40.5	0.1	.1	111.6
Nebraska.....							19.4						19.6
Nevada.....			.4				41.6					.3	42.3
New Mexico.....													4.0
North Carolina.....		4.0											4.0
North Dakota.....			430.9				47.5						478.4
Ohio.....											5.4	.1	46.4
Oklahoma.....	5.2									18.7			17.6
Oregon.....			15.0							12.4			74.8
South Dakota.....	5.3		6.7							3.2			12.0
Tennessee.....										16.5		.1	21.8
Texas.....	53.6									71.1		.5	185.1
Utah.....							108.5					.4	108.5
Virginia.....	.7									7.5			21.5
Washington.....										5.3			5.3
Wisconsin.....	5.1		3							17.3		.8	23.5
Wyoming.....			5.8				14.3						20.1
Hawaii.....													3.6
Total.....	77.4	4.0	497.6	49.2	8.9	17.5	833.7	52.5	65.1	336.8	5.5	3.4	1,951.6

TABLE 30.—*Net changes of mileage in the types of Federal-aid improvement on the Federal-aid highway system during the fiscal year 1932—Con.*

State	Graded and drained		Sand-clay		Gravel		Macadam		Low-cost bituminous mix	Bituminous macadam	Bituminous concrete	Portland cement concrete	Block	Bridges and approaches	Total
	Un-treated	Treated	Un-treated	Treated	Un-treated	Treated	Un-treated	Treated							
Utah.....		17.2			68.5	4.0	-114.9		174.4	4.6	3.3	8.7		.8	162.0
Vermont.....					5.8					4.8		26.6		.5	37.5
Virginia.....		17.5			15.6	5.2	81.1	31.8		4.8	.3	41.0		2.1	298.2
Washington.....		28.0		13.7	87.1							80.7		.7	196.5
West Virginia.....		11.0			3.6			1.1	1.4	18.1		84.8			120.7
Wisconsin.....		4.1			-38.5	-4.1						220.1		1.3	179.0
Wyoming.....		11.9			-6.3				266.2	1.7		.2		1.7	265.3
Hawaii.....		1.9								26.7				.1	28.7
Total.....	974.5		160.7	-3.0	1,899.9	252.6	262.2	292.2	2,008.4	272.3	414.9	5,661.8	28.0	94.5	12,319.0

TABLE 31.—Federal-aid apportionment, and amounts paid to the States for fiscal year 1932, and unobligated balance of the total apportionment June 30, 1932

State	Apportionment fiscal year 1932	Paid to States during the fiscal year 1932	Unobligated balances of total apportionment on June 30, 1932
Alabama.....	\$2,615,434	\$1,449,558.66	\$5,469,694.24
Arizona.....	1,768,023	2,445,249.48	742,533.48
Arkansas.....	2,174,786	2,443,071.02	2,162,507.23
California.....	4,181,212	5,013,452.92	32,946.23
Colorado.....	2,315,948	2,814,478.24	2,057,603.69
Connecticut.....	792,359	1,126,049.01	390,452.51
Delaware.....	609,375	512,060.63	167,140.82
Florida.....	1,543,232	1,245,206.16	2,541,174.33
Georgia.....	3,316,029	3,838,366.77	1,345,949.03
Idaho.....	1,554,594	1,682,385.02	345,018.54
Illinois.....	5,150,396	5,788,526.83	1,310,641.51
Indiana.....	3,172,253	4,134,264.18	381,104.02
Iowa.....	3,330,593	2,546,601.73	87,585.99
Kansas.....	3,397,874	3,291,566.93	567,001.31
Kentucky.....	2,356,367	1,949,897.63	1,182,786.01
Louisiana.....	1,745,445	2,049,281.07	321,408.48
Maine.....	1,121,860	1,664,568.68	137,272.92
Maryland.....	1,051,714	895,565.36	8,964.30
Massachusetts.....	1,813,916	2,492,975.93	602,611.77
Michigan.....	3,652,393	4,423,552.30	2,452,326.98
Minnesota.....	3,497,306	3,008,442.80	-----
Mississippi.....	3,209,509	1,372,689.21	5,152,976.98
Missouri.....	3,957,287	2,943,232.61	567,602.87
Montana.....	2,580,405	3,429,106.02	3,465,267.40
Nebraska.....	2,644,726	3,772,318.33	1,849,946.51
Nevada.....	1,598,987	1,708,195.22	86,974.21
New Hampshire.....	609,375	490,588.14	553,268.42
New Jersey.....	1,565,749	889,185.74	698,945.91
New Mexico.....	1,984,363	1,878,853.65	897,851.56
New York.....	6,002,475	11,167,966.22	2,250,042.54
North Carolina.....	2,871,722	2,366,819.85	3,728,867.35
North Dakota.....	2,001,841	1,931,074.18	821,723.31
Ohio.....	4,584,440	4,238,550.62	1,682,314.29
Oklahoma.....	2,922,569	2,086,708.87	1,276,063.13
Oregon.....	1,997,569	1,828,565.82	875,392.92
Pennsylvania.....	5,517,738	5,179,419.90	775,956.02
Rhode Island.....	609,375	976,232.74	325,565.85
South Carolina.....	1,769,848	1,409,926.16	744,636.09
South Dakota.....	2,054,077	2,486,985.52	1,085,351.79
Tennessee.....	2,687,123	1,494,839.91	3,157,110.04
Texas.....	7,620,239	8,447,826.24	3,333,824.82
Utah.....	1,416,493	1,276,689.88	520,628.78
Vermont.....	609,375	539,752.15	-----
Virginia.....	2,379,788	1,841,802.21	1,817,277.70
Washington.....	1,940,922	2,100,875.62	1,007,069.51
West Virginia.....	1,324,680	1,758,953.68	998,160.51
Wisconsin.....	3,075,234	2,739,618.37	283,938.52
Wyoming.....	1,568,607	1,804,001.52	120,711.31
Hawaii.....	609,375	391,220.01	1,335,908.87
Total.....	121,875,000	127,367,119.74	61,720,100.60

NATIONAL-FOREST-ROAD CONSTRUCTION

The appropriation authorized for forest-road and trail construction in the fiscal year 1932 was \$12,500,000, of which \$3,000,000 was for forest-development roads and \$9,500,000 for forest highways.

In accordance with the rules and regulations promulgated by the Secretary of Agriculture, the Bureau of Public Roads supervises the work on major forest-road projects, which, by definition, include all projects in the forest-highway system except those which do not require the technical services of a highway-engineering organization, and those whose estimated average cost is less than \$2,000 per mile. The term also includes forest-development road projects whose average cost exceeds \$5,000 per mile or which require the technical services of a highway-engineering organization.

Forest highways, the more important from the traffic viewpoint of the two main classes of roads, have for several years been classified according to importance as of three classes defined by the rules and regulations. The class definitions included in the original rules and regulations have lately been found in need of amendment to bring them into better harmony with the development of the

State and Federal-aid systems and new definitions promulgated by the Secretary on June 30, 1931, establish three classes as follows:

- (1) Any forest road in the Federal-aid highway system, either wholly within or, when so designated by the Forester and Chief of the Bureau of Public Roads, partly without and adjacent to the national forests.
- (2) Any forest road, not of class 1, on an approved State highway system, when so designated by the Forester and the Chief of Bureau.
- (3) All other forest roads, of primary importance to counties or communities.

The roads which, according to these definitions, have been classified as forest highways have an aggregate length of 16,274.68 miles, classified as shown in Table 32.

TABLE 32.—*Classification of the mileage of the forest-highway system as revised*

State	Mileage of forest-highway system			
	Class 1	Class 2	Class 3	Total
Western:				
Alaska.....			459.94	459.94
Arizona.....	320.6	192.7	525.10	1,038.4
California.....	563.7	814.1	969.9	2,347.7
Colorado.....	473.0	1,150.0	104.0	1,727.0
Idaho.....	584.21	215.0	244.7	1,043.91
Montana.....	628.3	335.8	238.0	1,202.1
Nevada.....	107.0	190.6	167.1	464.7
New Mexico.....	164.0	511.0	6.0	681.0
Oregon.....	527.13	340.38	506.43	1,373.94
South Dakota.....	219.0		86.0	305.0
Utah.....	57.65	539.30	139.2	736.15
Washington.....	386.5	124.3	259.0	769.8
Wyoming.....	387.3	37.0	217.7	642.0
Total.....	4,418.39	4,450.18	3,923.07	12,791.64
Eastern:				
Alabama.....	4.0	0	31.0	35.0
Arkansas.....	192.33	144.32	90.5	427.15
Florida.....	0.70	103.5	25.0	129.2
Georgia.....	41.8	0	106.2	148.0
Louisiana.....	36.3	105.7	12.0	154.0
Maine.....	0	0	11.0	11.0
Michigan.....	49.91	108.5	150.3	308.71
Minnesota.....	89.50		205.8	295.30
Nebraska.....			28.8	28.8
New Hampshire.....	41.5	60.5	49.0	151.0
North Carolina.....	78.0	129.3	48.3	255.6
Oklahoma.....	31.48		70.5	101.98
Pennsylvania.....	134.0	248.0	19.0	401.0
Puerto Rico.....			9.0	9.0
South Carolina.....		26.0	11.0	37.0
Tennessee.....	75.8	105.0	88.0	268.8
Vermont.....	7.0		12.0	19.0
Virginia.....	65.0	103.0	210.0	378.0
West Virginia.....	41.0	137.0	62.0	240.0
Wisconsin.....	5.0	48.5	31.0	84.5
Total.....	893.32	1,319.32	1,270.40	3,483.04
Grand total.....	5,311.71	5,769.50	5,193.47	16,274.68

During the past year improvements have been completed on 602.9 miles of the forest-highway system, bringing the total mileage improved to date with Federal funds to 5,242.2 miles. Of the mileage improved during the year, 571.2 miles were in the Western States and Alaska, and the remaining 31.7 miles were in the forests of six Eastern States. Of the total mileage improved to date, 4,852.8 miles are in the West and 389.4 in the East.

The mileage of forest-highway projects completed during the year and to date by States is shown in Table 33.

TABLE 33.—*Mileage of completed forest-highway projects, by States*

State	Mileage of forest-highway projects completed		State	Mileage of forest-highway projects completed	
	During 1932	Total to June 30, 1932		During 1932	Total to June 30, 1932
Western:			Eastern:		
Alaska.....	12.0	242.9	Alabama.....	.....	5.1
Arizona.....	95.9	454.6	Arkansas.....	.....	74.9
California.....	102.0	539.4	Florida.....	9.2	77.1
Colorado.....	50.4	416.2	Georgia.....	.....	21.4
Idaho.....	47.8	590.7	Michigan.....	7.2	16.2
Montana.....	47.1	456.6	Minnesota.....	.....	68.9
Nevada.....	15.9	142.7	New Hampshire.....	2.9	8.1
New Mexico.....	35.0	233.8	North Carolina.....	7.0	43.3
Oregon.....	102.3	808.1	South Carolina.....	.....	15.6
South Dakota.....	1.6	47.8	Tennessee.....	.....	37.4
Utah.....	13.8	354.3	Virginia.....	.....	16.0
Washington.....	6.2	240.1	Pennsylvania.....	1.8	1.8
Wyoming.....	41.2	325.6	West Virginia.....	3.6	3.6
Total.....	571.2	4,852.8	Total.....	31.7	389.4
			Grand total.....	602.9	5,242.2

On June 30, 1932, work was in progress under the supervision of the Bureau of Public Roads on 608.7 miles of road at a total estimated cost of \$6,180,196. Work estimated to cost \$1,624,332 had been programmed but not yet started; and there was a balance of authorized funds not yet obligated to definite projects amounting to \$894,393.

Standards of forest-highway work have been materially improved in the past two or three years. This has been necessitated by increases in traffic resulting from the improvement of adjoining State and Federal-aid roads. The new work is marked especially by super-elevated curves of larger radii and by wider grades, and roads built earlier when a lower standard was permissible have been widened and reconstructed according to the modern standards. The use of light asphaltic residual oils and cutback asphalts has been found necessary to eliminate dust and reduce wear of the fine crushed-rock and gravel surfaces which have been laid on many of the roads built.

ROAD CONSTRUCTION IN THE NATIONAL PARKS

Road construction in the national parks, by agreement with the National Park Service is supervised by the Bureau of Public Roads, and 142 miles of such construction were completed during the past year, making the total thus far improved 512 miles, all of which is in the system of major park roads.

The mileage completed during the fiscal year and to date in the several parks is shown in Table 34.

TABLE 34.—*Mileage of national-park roads improved under the supervision of the Bureau of Public Roads*

National park	Mileage completed under supervision of the bureau		National park	Mileage completed under supervision of the bureau	
	During fiscal year 1932	Total to June 30, 1932		During fiscal year 1932	Total to June 30, 1932
Acadia.....	0.3	3.6	Mount Rainier.....	1.2	50.3
Colonial National Monument.....	10.0	10.0	Petrified Forest, N. Mex.....	16.3	16.3
Crater Lake.....	.....	23.3	Rocky Mountain.....	.....	8.7
Devils Tower.....	.....	.3	Sequoia.....	3.6	28.7
General Grant.....	.....	4.0	Wind Cave.....	.....	5.3
Glacier.....	4.4	36.9	Yellowstone.....	54.9	89.5
Grand Canyon.....	18.6	93.8	Yosemite.....	7.2	54.6
Hawaii.....	.....	11.2	Zion.....	5.8	14.9
Lassen Volcanic.....	9.1	44.6			
Mesa Verde.....	12.2	18.2	Total.....	143.6	514.2

The Wawona Tunnel project in Yosemite National Park is rapidly nearing completion. This project which includes a tunnel approximately 4,200 feet in length, is being constructed at a cost of approximately \$750,000. Several incidental contracts involving adit enlargement and tunnel ventilation have been awarded.

Of outstanding interest among the projects completed during the past year is the Babb-Many Glacier Highway in Glacier National Park. Two sections of this project were recently completed, covering a total distance of 4.4 miles. The Halstead Meadow section of the General's Highway in Sequoia National Park was also completed. In Lassen Volcanic National Park one section of the Loop route, a total distance of 7.7 miles, was also completed. This, together with the North Approach Road connection, which was also completed, virtually completes the Lassen Volcanic Park highway system. In Petrified Forest National Monument the Main North and South Highway, a distance of 16 miles, was graded during the past year. A contract is at present operative for the construction of two large bridges in this monument.

In Yellowstone National Park the East Entrance Highway, the Obsidian Cliff-Firehole Cascade section, and the Canyon Junction-Tower Junction section of the Grand Loop Highway are some of the more important projects completed.

Several bridge contracts were also completed during the past year. In Mount Rainier National Park the Frying Pan Creek bridge on the White River Road was completed at a cost of approximately \$60,000.

In Sequoia National Park the Clover Creek, Lodge Pole, and Silliman Creek bridges were all completed under one contract. The cost of these bridges was approximately \$90,000. In Yosemite National Park the Merced River bridge was completed at a cost of \$35,000.

In the eastern parks two projects were completed during the past year. These projects were in Colonial National Monument, Va. One included a 9-mile stretch of graded earth road, another a mile of hydraulic fill. Two large projects which were let to contract in the proposed Shenandoah National Park, Va., are rapidly nearing completion. These contracts involve the grading of approximately 45 miles of pioneer road of the heavy mountain type. The estimated cost of this work is approximately \$700,000. All work on these contracts is expected to be completed during September, 1932.

RESTORATION OF FLOOD-DAMAGED ROADS

No further appropriations for the relief of States on account of damage of roads by flood have been made since the date of the last annual report.

The amounts of the several appropriations made to date (less 2½ per cent allowed for Federal administration in the case of Alabama, Georgia, and South Carolina), the amounts paid the States up to June 30, 1932, and the unobligated balance for each State are shown in Table 35. The entire amounts appropriated for relief of Vermont and New Hampshire have been paid to the States, and all work has been completed. Only small parts of the appropriations made in aid of Georgia and South Carolina remained unexpended on June 30, and no part of the appropriation to either State was unobligated at the end of the year. Work under the appropriations is virtually completed in these States. The amounts paid during the year are reported in Table 36.

TABLE 35.—*Flood relief appropriated, amounts paid to States, and the unobligated balance of the appropriation June 30, 1932*

State	Appropriated	Paid to the States to June 30, 1932	Unobligated balance
Vermont.....	\$2,654,000	\$2,654,000.00	.....
New Hampshire.....	653,300	653,300.00	.....
Kentucky.....	1,889,994	667,751.49	\$1,040,719.67
Total.....	5,197,294	3,975,051.49	1,040,719.67
Arkansas.....	1,800,000	1,477,693.56	322,306.44
Louisiana.....	967,582	786,271.13	181,310.87
Mississippi.....	628,000	345,266.57	282,733.43
Missouri.....	253,418	.....	130,865.95
Total.....	3,654,000	2,609,231.26	917,216.69
Alabama.....	¹ 1,618,500	481,083.81	1,137,416.19
Georgia.....	1,493,416	418,208.01	.....
South Carolina.....	¹ 785,422	734,022.23	.....
Florida.....	80,307	76,052.83	1,350.99
Total.....	2,977,645	1,709,366.88	1,138,797.18
Grand total.....	11,828,939	8,293,649.63	3,096,733.54

¹ Does not include fund allowable for administration.

TABLE 36.—*Flood relief paid to the States, fiscal year 1932*

State	Amount	State	Amount
New Hampshire.....	\$29,157.56	Alabama.....	\$50,801.48
Kentucky.....	111,412.99	Georgia.....	418,208.01
Total.....	140,570.55	South Carolina.....	734,022.23
Arkansas.....	425,515.27	Florida.....	76,052.83
Louisiana.....	252,002.93	Total.....	1,279,084.55
Total.....	678,118.20	Grand total.....	2,097,773.30

The mileage of road improved under the relief acts up to the end of the fiscal year and the corresponding total cost and Federal payment are given in Table 37. Similar information for roads completed during the past year is presented in Table 38, and for roads under construction at the end of the year and approved for construction in Tables 39 and 40, respectively.

TABLE 37.—*Total cost, flood relief, and mileage of roads improved to June 30, 1932*

State	Total cost	Flood relief	Miles
Vermont.....	\$5,651,965.83	\$2,654,000.00	61.2
New Hampshire.....	1,408,479.45	653,300.00	29.1
Kentucky.....	1,412,004.52	588,215.41	67.4
Total.....	8,472,449.80	3,895,515.41	157.7
Arkansas.....	\$43,914.04	405,711.21	49.8
Mississippi.....	11,433.59	3,563.66	.3
Total.....	\$55,347.63	409,274.87	50.1
Alabama.....	319,797.49	155,615.15	41.7
Georgia.....	121,246.85	60,378.19	.8
South Carolina.....	1,212,313.25	541,421.98	18.0
Total.....	1,653,357.59	757,415.32	60.5
Grand total.....	10,981,155.02	5,062,205.60	268.3

TABLE 38.—*Total cost, flood relief, and mileage of roads which were completed and final payment made during the fiscal year 1932*

State	Total cost	Flood relief	Miles
New Hampshire.....	\$196,063.55	\$51,180.89	4.
Kentucky.....	222,666.22	67,090.75	3.1
Total.....	418,729.77	118,271.64	7.6
Arkansas.....	311,133.62	149,324.12	3.7
Alabama.....	266,518.77	131,129.74	38.5
Georgia.....	41,208.21	20,358.88	.1
South Carolina.....	894,427.33	403,421.98	14.5
Total.....	1,202,154.31	554,910.60	53.1
Grand total.....	1,932,017.70	822,506.36	64.4

TABLE 39.—*Total cost, flood relief, and mileage of roads under construction June 30, 1932*

State	Estimated total cost	Flood relief allotted	Miles
Georgia.....	\$256,137.87	\$123,524.70	3.6
Kentucky.....	332,320.08	156,426.19	30.0
South Carolina.....	569,884.21	244,000.00	4.3
Total.....	1,158,342.16	523,950.89	37.9

TABLE 40.—*Total cost, flood relief, and mileage of roads approved for construction June 30, 1932*

State	Estimated total cost	Flood relief allotted	Miles
Georgia.....	\$129,601.70	\$56,304.01	2.1
Kentucky.....	222,220.91	104,632.73	21.7
Total.....	351,822.61	160,936.74	23.8

The mileage of the several types of flood-relief roads completed in the several States during the fiscal year 1932 is given in Table 41, and the total mileages completed, under construction, and approved for construction on June 30, 1932, classified by types and by States, are given in Tables 42, 43, and 44, respectively.

TABLE 41.—*Mileage of the various types of flood-relief roads completed for which final payment was made during the fiscal year 1932*

State	Graded and drained	Sand-clay, untreated	Gravel, untreated	Portland cement concrete	Bridges and approaches	Total
New Hampshire.....				4.5		4.5
Kentucky.....	2.9				0.2	3.1
Arkansas.....	.2		2.3		1.2	3.7
Alabama.....	15.2	15.0	7.5	.1	.7	38.5
Georgia.....					.1	.1
South Carolina.....	10.0	.1		2.6	1.8	14.5
Total.....	28.3	15.1	9.8	7.2	4.0	64.4

TABLE 42.—*Mileage of the various types of flood-relief roads improved to June 30, 1932*

State	Graded and drained	Sand-clay, untreated	Gravel, untreated	Gravel, surface treated	Macadam, surface treated	Bituminous macadam	Portland cement concrete	Bridges and approaches	Total
Vermont.....			7.0	9.2		6.1	32.5	6.4	61.2
New Hampshire.....				2.9	4.9	2.3	18.4	.6	29.1
Kentucky.....	66.5							.9	67.4
Total.....	66.5		7.0	12.1	4.9	8.4	50.9	7.9	157.7
Arkansas.....	16.1		31.1				.3	2.3	49.8
Mississippi.....							.3		.3
Total.....	16.1		31.1				.6	2.3	50.1
Alabama.....	17.4	15.9	7.6					.8	41.7
Georgia.....							.4	.4	.8
South Carolina.....	10.1						5.3	2.6	18.0
Total.....	27.5	15.9	7.6				5.7	3.8	60.5
Grand total.....	110.1	15.9	45.7	12.1	4.9	8.4	57.2	14.0	268.3

TABLE 43.—*Mileage of the various types of flood-relief roads under construction, June 30, 1932*

State	Graded and drained	Sand-clay, untreated	Macadam, surface treated	Bridges and approaches	Total
Georgia.....			3.3	0.3	3.6
Kentucky.....	29.9			.1	30.0
South Carolina.....	2.9	0.3		1.1	4.3
Total.....	32.8	.3	3.3	1.5	37.9

TABLE 44.—Mileage of the various types of flood-relief roads approved for construction, June 30, 1932

State	Graded and drained	Sand-clay, untreated	Macadam, surface treated	Portland cement concrete	Bridges and approaches	Total
Georgia.....		0.4	0.3	1.2	0.2	2.1
Kentucky.....	21.6				.1	21.7
Total.....	21.6	.4	.3	1.2	.3	23.8

MOUNT VERNON MEMORIAL HIGHWAY

All construction and landscape work on the Mount Vernon Memorial Highway, except a few unimportant details, was completed during the fiscal year. The entire road was opened to Saturday afternoon and Sunday traffic on January 16, 1932. The section from Alexandria to Mount Vernon had previously been opened to traffic without restriction. The section from Washington to Alexandria was opened to daylight traffic late in March and to 24-hour traffic May 3, upon completion of the lighting installations.

Provision for the construction of the highway as a memorial to George Washington was made by act of Congress, approved May 23, 1928. The act authorized the United States Commission for the Celebration of the Two Hundredth Anniversary of the Birth of George Washington to survey, select, construct, and maintain the road in cooperation with the Secretary of Agriculture.

The appropriation originally authorized was \$4,500,000. By act of March 4, 1931, an additional sum of \$2,700,000 was authorized. All authorized funds have been expended or obligated.

The surveys and plans for the highway were made by the Bureau of Public Roads, which also has supervised the entire construction. The important work of constructing the hydraulic fills was efficiently performed by the Corps of Engineers of the United States Army. All other construction work was performed by private contractors. The landscaping and planting was done mainly by force account under the direction of the bureau.

INTER-AMERICAN HIGHWAY

A reconnaissance survey of the proposed inter-American highway from Panama to the United States was practically completed by bureau engineers during the past year. Ground surveys have been made through Panama, Costa Rica, Nicaragua, Honduras, and Guatemala, supplemented by aerial photographic surveys. Salvador is the only country among the six Republics of Central America in which survey operations have not yet been conducted.

The field force of the bureau engaged on this project has been reduced to three persons, a senior highway engineer, an assistant, and a clerk. Their headquarters have remained in the Palacio Nacional at Panama City, in quarters kindly provided by the Panamanian Government. Their work at the end of the fiscal year was centered in the preparation of a comprehensive report upon the entire reconnaissance survey.

This important project, the first step in the plan to provide continuous communication by highway between Panama and the United States, has been made possible by an act of Congress appropriating funds for a reconnaissance survey. Each of the Central American Republics in which surveys thus far have been made has officially requested that this work be performed, transmitting their requests through the Pan American Union as provided by law.

TRANSPORTATION AND ECONOMIC AND STATISTICAL INVESTIGATIONS

WESTERN STATES TRAFFIC SURVEY

Publication in March, 1932, of a Report of a Survey of Traffic on the Federal-aid Highway Systems of Eleven Western States marked the conclusion of what is probably the most extensive traffic survey ever made in the United States. The report, issued in the form of an 85-page book with a separate appendix of 13 maps in color, covers the States of Arizona, California, Colorado, Idaho, Nebraska, New Mexico, Nevada, Oregon, Utah, Washington, and Wyoming

In each of these States the survey was made with the cooperation of the State highway department.

The area of the States in this survey represents more than 37 per cent of the entire area of the United States, and includes more than 35,000 miles of Federal-aid highways. More than 20,000,000 vehicles using these highways were observed and recorded during the year of field work, the important data thus obtained including the following: Daily average of traffic, estimates of probable future growth of traffic as of the years 1935 and 1940, classification of the different types of vehicles observed, numbers of persons transported by the passenger-carrying vehicles, the capacities of trucks, average daily length of trips, number of common-carrier and contract-carrier trucks, origin and destination of vehicles, percentages of interstate and intrastate traffic, and numerous other important facts.

The investigation achieved its objective of obtaining essential facts about the present density, type, capacities, and distribution of traffic units over a wide area, as a basis for planning highway development to serve present and future traffic.

MICHIGAN TRAFFIC SURVEY

Field work on a somewhat different type of survey, confined to the State of Michigan and designed to provide information regarding the character and distribution of traffic on State and local roads and on city streets, was terminated at the end of August, 1931. The work of analysis and preparation of the report is now nearing completion. Determination of the true relationship between the use of primary and secondary roads and city streets by various classes of traffic, and the source of funds employed in their improvement and maintenance, is one of the chief objectives of this survey. The observation of traffic was in progress for an entire year in 80 typical townships of Michigan, and for an additional month in 7 principal cities. The State highway department cooperated in this work.

WASHINGTON REGIONAL-AREA TRAFFIC SURVEY

At the request of numerous important groups, the bureau began in September, 1931, a 12-month survey of traffic throughout the area surrounding the District of Columbia. The agencies cooperating in this project include the National Capital Park and Planning Commission, the Maryland National Capital Park and Planning Commission, the State Roads Commission of Maryland, the Department of Highways of Virginia, the cities of Washington, D. C., and Alexandria, Va., and the counties of Arlington and Fairfax in Virginia, and Prince Georges and Montgomery in Maryland.

The purpose of this survey is to obtain information which will enable the cooperating agencies to develop a comprehensive and connected system of main highways in the Washington regional area, and a priority program of highway construction and betterment which may include suitable belt lines, relief roads, or necessary relocations and extensions of existing highways. Periodic counts of traffic are being made at approximately 250 different points.

Field work will end in September, 1932, and the work of analysis and compiling of a report will follow.

NEW HAMPSHIRE TRAFFIC SURVEY

An interesting comparison of actual present traffic with forecast estimates made five years ago was made possible by a 3-month "check" survey of traffic on the Federal-aid and State highway systems of New Hampshire between July 15 and October 15, 1931. This survey duplicated a study made at exactly the same period of the year in 1926. Results were promptly compiled. They show in brief that the classification of highways upon the basis of present and projected use is closely accurate. For the State as a whole, traffic in 1931 was 15 per cent greater than that forecast in 1926, while for routes carrying 1,500 or more vehicles per day, the actual traffic exceeded the forecast by less than 3 per cent, thus indicating the more rapid growth of traffic upon the lightly traveled routes. A statement of the factors affecting traffic growth is included in the report.

This survey was made in cooperation with the State Highway Department of New Hampshire and at its request.

INDIANA TRAFFIC SURVEY

At the request of the Indiana State Highway Commission, a sample traffic count of two weeks' duration was made in Boone County in April, 1932, to determine whether or not such information would be of value to the State legislature. The results of this trial operation were conclusive, and decision was made to conduct a 12-month survey in 11 counties of the State, field work on this extensive project being scheduled to start in August, 1932. The primary objective in this work is to ascertain the relative proportions of foreign and domestic traffic on township, county, and State roads. It will be the first extensive traffic census ever made in Indiana, although counts have been made on a few of the roads approaching Chicago in the extreme northwest corner of the State.

NEW JERSEY TRAFFIC SURVEY

Toward the end of the fiscal year, the State Highway Commission of New Jersey completed arrangements with the bureau to direct a 12-month traffic census throughout the State, and field work was scheduled to start in August, 1932. The survey is designed to obtain data on the flow of traffic over the entire State highway system, and on a limited mileage of principal county roads as well. Incorporated with it will be a special study of truck traffic which is expected to provide the most detailed and accurate information thus far available on this important portion of highway traffic. The data sought will include origin and destination of trucks, their nominal capacities and body types, their classification as private operators, contract carriers and common carriers, and whether operating interstate or intrastate. A supplementary feature of the survey will be a time study of delays to traffic on the present route across the meadows between Jersey City and Newark, in order to furnish an accurate comparison with delays after the opening of a new viaduct now being constructed to serve the same route and traffic.

TRAFFIC CAPACITY AND INTERSECTION STUDIES

A study of highway capacity, made under a cooperative agreement with the University of Maryland, was completed during the year, and the results were printed in Public Roads for May, 1932. Observations extended through 1930 and 1931, and covered numerous heavy traffic routes along the eastern seaboard between Massachusetts and Virginia. The conclusions, in general, were to the effect that the traffic capacity of a 3-lane road is twice that of a 2-lane road, and the 4-lane road has a capacity at least three times that of a 2-lane road; or, expressed in figures, traffic capacities of 2-lane, 3-lane, and 4-lane roads are, respectively, about 1,000, 2,000, and 3,000 vehicles per hour. Adding one lane to a 2-lane road increases its width 50 per cent and its capacity 100 per cent; and doubling the width of a 2-lane road triples its capacity.

The bureau is actively interested in the design of intersections to reduce traffic congestion and in the efficiency of various types of traffic control devices at intersections.

During the year a digest of a report on intersection designs was prepared for publication and appeared in the July, 1932, issue of Public Roads. This report was prepared by bureau representatives at the Albert Russel Erskine Bureau for Street Traffic Research, Harvard University.

At the request of the city of Alexandria, Va., a traffic survey was conducted in June, 1932, to determine means of relieving the congestion on Washington Street, which now carries the traffic of the recently completed Mount Vernon Memorial Highway through Alexandria. A plan for suitable control at intersections, proper timing of traffic signals, and necessary regulations was prepared, based upon detailed traffic counts at a number of intersections on Washington Street.

A study is now in progress to determine the delay to vehicles caused by various types of traffic control, and to ascertain the conditions to which the common types of control are best adapted. By means of an electrical time recorder observations of time loss have been completed at several intersections where traffic was controlled by officers, fixed time signals, coordinated signals, and traffic-actuated signals. During the coming year these studies will be continued to include numerous other intersections and a variety of traffic conditions.

STUDIES OF TAXATION IN WISCONSIN, MICHIGAN, ILLINOIS

Tax studies in cooperation with the department of economics of the University of Wisconsin have been continued during the year. The Wisconsin study has been completed and the report is ready for publication. The field work for Michigan has been finished and the report is well advanced. In Illinois field work should be completed early in the new fiscal year. In all these studies the purpose is to establish the relation of the highway taxes paid from different sources and by different groups of citizens based on local administrative units and the highway service furnished. The studies will establish a broad basis for adjustment of highway taxes on a rational plan.

STUDY OF COMMERCIAL-TRUCK OPERATION

An investigation of commercial-truck operation in all parts of the United States, conducted in cooperation with the Bureau of Foreign and Domestic Commerce of the United States Department of Commerce, was completed and the resulting report delivered to the printer. Publication is scheduled for August, 1932.

Data regarding various factors of motor-truck operation were supplied by 217 operators of intercity common-carrier and contract-carrier trucks in 41 States and the District of Columbia. The average rated capacity of the vehicles covered by the survey was found to be 2.88 tons, 60 per cent being rated at $1\frac{1}{2}$ to 3 tons capacity and 29 per cent at $3\frac{1}{2}$ tons or over. Only $2\frac{1}{2}$ per cent of the 1929 and 1930 model trucks were equipped with solid tires. Regularly scheduled trips were reported over fixed routes exceeding 500 miles in length, but the average length of route was only 70 miles, with 75 per cent of the routes less than 110 miles. Tabulations of motor-truck unit and fleet operating costs were also presented, accompanied by a general discussion of motor-transportation costs.

TESTS OF HIGHWAY SIGNS

In an effort to determine the comparative efficiency of various types of highway signs, a series of tests has been conducted with the cooperation of the Bureau of Standards, United States Department of Commerce. Photometric tests are in progress on numerous types of "reflector buttons" with reference to percentages of reflection under standard automobile headlights of given candle power, the angle of reflected arc, and the general efficiency of the buttons when inserted in sign legends, having regard to minimum impairment of daylight values. Standard highway signs with various color combinations of yellow, black, and white are also being tested by means of personal visual observation to establish the relative values of colors, legend, and background. These tests will continue into the next fiscal year, and results will be published upon their conclusion.

PRODUCTION COST STUDIES

It has been well established that under ordinary conditions the daily or hourly cost of operating almost any of our modern road-building plants is practically independent of the rate of operation. The most effective way to reduce unit operating costs is to increase the rate of production; for, as the rate of production increases, the unit cost of the work decreases in nearly the same ratio. Studies have therefore been carried on during the past year to determine more definitely the lines along which production rates can be still further increased without injury to the quality of the product.

EXPERIMENTS WITH ROLLED CONCRETE

This work must necessarily be limited almost entirely to field studies and analysis of going projects and to occasional practical field demonstrations of the means and methods giving most definite promise of practical value. One of these newer methods is the experimental development of rolled concrete in the production of which an ordinary tandem road roller of about 5 or 6 tons weight is utilized to consolidate a very dry and lean concrete mix laid as a pavement. In point of density, beam strength, and surface smoothness, the result compares favorably with present standard mixes containing a far greater proportion of cement and sand. In this way, satisfactory results have been obtained from concrete in the proportioning of which from 0.85 to 0.95 cubic yard of gravel or broken stone was utilized for each cubic yard of consolidated concrete pavement.

This development, while still only in the experimental stage, may be described as essentially a practical method of handling and placing a mix in which the

mortar, of about normal richness and of low water content, is only sufficient to fill the voids of the coarse aggregate when the aggregate is thoroughly consolidated by repeated rolling with a 5 or 6 ton tandem road roller. The only additions to the regular and customary equipment generally used in concrete pavement construction are the tandem road roller and an extra finishing machine. The usual methods of proportioning, mixing, and handling are identical until after the pavement has been struck off by the first finisher. This strike off is sufficiently higher than normal so that the roller will just compact the remaining concrete to the height of the forms.

Immediately after spreading, the rolling is begun and carried on in much the same manner as in the construction of macadam surfaces. This rolling is continued until the surface is perfectly smooth and unyielding and all particles are firmly interlocked and the mortar is just flushing to the surface.

The second finishing machine is then used to screed the surface, distributing the local excess mortar and removing minor roller markings in the surface mortar, and thus producing a surface similar in general appearance to that obtained by the usual methods.

BITUMINOUS LOW-COST ROAD STUDIES

Considerable attention has also been devoted to the low-first-cost bituminous types of construction. In respect to the plant-mix types work has been devoted largely to finding means of maintaining production rates in the face of the tendency to add to these types of construction much the same refinements as are required in the standard asphaltic or bituminous concretes. Further work should be done to determine the cost of many of these requirements and also what value, if any, they impart to the finished product. Otherwise there is danger of gradually removing this type of construction from the low-first-cost field and adding another type to the large field of standard or medium priced types.

Studies of bituminous road-mix types have been devoted largely to finding ways and means of simplifying and standardizing construction procedures and to the development of more effective and efficient mixing equipment. Progress in these efforts has been gratifying and gives promise of definite results.

An extensive field study of the size of the batch of Portland-cement concrete which can be mixed in standard 27E pavers without detriment to the quality of the product or uniformity of the mix was concluded and reported in Public Roads for January, 1932.

GRADING STUDIES

To aid bidders on grading projects in analyzing the exact nature of the work involved, complete field studies were made of two large grading projects and complete advance plans of construction operations were prepared and distributed to prospective bidders with copies of the usual construction plans. Present indications are that these advance construction plans were of definite value not only to the contractors but also to the State and Federal Government, and that further studies should be made to determine fully whether or not such plans should form a part of the regular procedure in the preparation of the usual construction plans for all grading projects before bids are called for.

Studies extending over a period of nearly eight years have shown that in highway-grading work involving the removal of solid rock the drilling and blasting is usually organized and conducted with less efficiency than other operations. To aid in remedying this condition a careful study was made of the bureau's experiences, and the conclusions and suggestions were published in Public Roads for February, 1932.

LABOR'S SHARE OF ROAD-BUILDING EXPENDITURES

For years the question has been raised as to the extent to which labor profits from the construction of high-type pavements in which mechanical equipment plays an important part. During the past two years answer to this question has been needed in formulating legislation and planning construction programs. A thorough study was therefore made, in which the money paid out by States and communities for the construction of concrete pavements was traced through its various exchanges. The concrete pavement was chosen because it represents not only one of the most highly mechanized forms of construction but is also one of the more widely used of the higher types of pavement. This study, of which a report was published in Public Roads for April, 1932, shows that, although only about 15 per cent of each dollar expended by the State or com-

munity is paid directly to the labor on the job, from 80 to 90 per cent eventually reaches labor in the form of wages and salaries.

When highway expenditures were thus traced through all the ramifications of sand and gravel pits, stone quarries, cement and steel mills; of manufacturers of equipment, repair parts, explosives, gasoline, lubricating oils, and supplies; of railroad and transportation companies, and those who furnish their equipment, repairs, and supplies from coal and ore mines through mills and factories, not only was it found that about 90 per cent of the taxpayer's dollar had been returned to labor in wages and salaries, but also that a very large part of the industry of the country had taken an active part in the work and had received a definite financial stimulus.

The regular collection of information in regard to the number of persons employed on Federal and State highway construction and maintenance was continued.

HIGHWAY ACCOUNTING METHODS

During the year cooperation was continued with the State highway departments in the further development or installation of more efficient and uniform accounting and statistical procedures in order to provide the administrative and engineering organizations with full and complete records of current income, expenditures, and accomplishments in highway construction, maintenance, and administration. Based on the use of modern bookkeeping and tabulating equipment and guided by standard definitions of the various activities in which the several highway departments are engaged, the aim is to provide a system of accounts and records which will not only fully meet all the accounting requirements of the department but will also provide quickly and in practical form complete statistical information on any desired activity in which the department is engaged. The general adoption of a uniform system of accounts and records should be of great value not only to the individual States in planning and carrying on their activities but should also be of still greater value in making possible an intelligent comparison of the cost of various methods and kinds of road construction and maintenance as carried on in the several States. Such a comparison is as yet largely impossible, except in a few States, because of the dissimilar form of the available records and the lack of a uniform nomenclature and procedure.

During the year such work has been carried on in cooperation with the highway departments of Georgia, Indiana, North Carolina, and Ohio.

PHYSICAL RESEARCH

MOTOR-VEHICLE-IMPACT INVESTIGATIONS

The motor-vehicle-impact research which has been carried on for the past several years in cooperation with the Rubber Manufacturers' Association and the Society of Automotive Engineers was continued during the past year. A comprehensive study was made of the impact reactions produced by a modern, long-wheel-base vehicle, equipped with balloon tires, particularly when traveling at high speeds. This vehicle, a powerful bus chassis, was driven over both artificial obstructions and natural road roughness at speeds up to about 70 miles per hour. The purpose of this part of the tests was to determine not only the magnitude of the impact reactions developed at these high speeds but also to determine the trend of the relation between vehicle speed and the magnitude of the reaction. Definite data were obtained on both of these questions.

In addition, a comprehensive study was made of the relation between the magnitude of the impact reaction and the frequency of occurrence on typical road surfaces. For this purpose two groups of road surfaces were selected which covered, for both the bituminous and concrete types of construction, the range from the smoothest to the roughest to be found in service in the vicinity of Washington, D. C. The test vehicle was driven over each of these at certain specified speeds and actual counts made of the number of reactions of each magnitude which occurred. These data present a clear picture of the number and magnitude of the principal impact forces which road surfaces of different degrees of roughness are called upon to withstand. A report of these studies has been prepared for publication at an early date.

This investigation virtually completes the researches which had for their object the determination of the magnitude of motor-vehicle-impact reactions and

of the major influencing factors. Attention is now being turned to the equally important question of the effect on road surfaces of the suddenly applied forces of motor-vehicle impact.

INVESTIGATION OF CONCRETE PAVEMENT DESIGN

The study of the behavior of the 10 full-size concrete pavement slabs, described in last year's report, has been carried on continuously throughout the year.

The investigation divides naturally into three main parts: (1) A comparison between theoretical and observed behavior of slabs of uniform thickness subjected to static loads; (2) a comparison of the relative load-carrying capacity of the several cross-section and joint designs which are included; and (3) a study of the effects of temperature on the size, shape, and load resistance of pavement slabs.

Several years ago a theoretical analysis of the stresses in road slabs by H. M. Westergaard was published by the bureau. This analysis is now being subjected to the test of physical research. A very careful study of the theory is being made in the hope that a perfected rational method of design may result. Definite data are being obtained on the relative load resistance of the different slab designs, and information concerning temperature effects is nearly complete. It is planned to make the information which is being obtained available in separate reports, each covering completely one part of the investigation.

INVESTIGATIONS OF CONCRETE AND CONCRETE AGGREGATES

The studies of the quality of paving concrete, mixed and placed under actual working conditions, have been continued by including (1) an investigation of the effect of using high-speed vibrators for compacting concrete, (2) the effect of continued surface manipulation of the concrete in order to remove excess water and to consolidate the mass, and (3) the effect of using hydraulic lime as an admixture.

The test procedure was substantially the same as that employed in connection with the investigation of concrete proportions and consistency reported last year and involved the construction of a test pavement 9 feet in width and approximately 1,700 feet in length. The tests have been completed, and a report will be issued during the coming year. A preliminary analysis of data indicates that under certain conditions the strength and density of paving concrete is somewhat improved by the use of vibrators of the type employed in these tests and that the strength and density of paving concrete is quite materially improved by the continued manipulation of the surface in order to eliminate excess water. On the other hand, the use of hydraulic lime as employed in these tests did not produce any beneficial effects. In general, the tests substantiate to a marked degree the conclusion given in last year's report regarding the relationship between the consistency of the concrete and the strength and uniformity of the pavement slab. This conclusion was to the effect that

when very dry mixtures are used (less than 2-inch slump) the strength of the pavement slab will be lower and the amount of honeycomb in the concrete will be greater than when concrete of medium consistency is employed (2 to 3-inch slump).

Some progress may be noted in connection with the general study of factors affecting the durability of concrete. One investigation, which was designed primarily to study the effect of type and character of coarse aggregate upon the resistance of concrete to frost action, has been completed and a report issued. Data obtained from this and other investigations of a similar nature conducted by the bureau substantiate the conclusions reached by other investigators that the resistance of concrete to weathering is very materially affected by the amount of water used in the mixture. The tests indicate further that, within a wide range of aggregate types and characteristics, the quantity of water used in the mixture is of more importance than the kind of aggregate.

The investigation of methods of making flexure tests of concrete, to which reference was made in last year's report, has been completed and a report prepared. The data show conclusively that, if comparable results are to be obtained by various laboratories, certain variables, such as size of specimen, method of loading, etc., must be standardized. Recommendations for the use primarily of committees of the American Association of State Highway Officials working on this problem are made in the report.

Question has been raised as to whether, due to increased chemical activity, the new high-early-strength cements now being extensively used in highway construction will not deteriorate if kept in storage for a considerable time before use. In order to determine this point an investigation was started by the bureau in

which three well-known examples of this type of cement were tested in concrete after being subjected to storage conditions closely paralleling ordinary warehouse storage for various periods ranging from 1 to 11 months. The results indicate that, under ordinary conditions, this type of cement may be safely stored for several months without impairing the high-early-strength characteristics.

HIGHWAY BRIDGE INVESTIGATIONS

The report of the bridge-floor-slab tests carried on in cooperation with the Port of New York Authority, mentioned in last year's report, was published during the past fiscal year.

The report of the impact and static load tests of two bridge-floor slabs of a special type conducted in cooperation with Allegheny County, Pa., which was noted in the last annual report, has been prepared for publication in *Public Roads* in September, 1932.

An investigation has been started which has for its object the determination of the relative resistance to sliding of bridge bearing plates of various metals.

The field work on the investigation of the Freyssinet method of concrete-arch construction in cooperation with the Oregon Highway Commission was completed in November, 1931, when the Rogue River bridge was opened to traffic. The superstructure of the bridge was begun in May, and jacking operations were started on the first two spans in September after the spandrel structure had been in place 30 days.

The actual behavior of the arches, as determined from accurate measurements of deformations and strains, did not agree with the theoretical behavior of the structure because the spandrel structure offered considerable restraint to the ribs even though it was completely articulated for the purpose of eliminating this restraint. However, by the proper combination of moment and thrust introduced with the jacks at the crown, the stresses were made to conform approximately to the theoretical stresses. Tests on plain concrete specimens indicated that an eventual shrinkage of about seven ten-thousandths inch per inch could be expected in the ribs if complete drying of the concrete should occur. The effect of this shortening of the axis was compensated by the introduction of bending of an opposite sense at the points of maximum stress.

The problems of technic of the application of the method were studied and solved and much valuable data on the behavior of an arch during and immediately following decentering were gathered.

A complete report on the results of this investigation will be available in the near future.

LOW-COST ROAD INVESTIGATIONS

During the past year the bureau has continued to observe the experimental highways previously constructed in cooperation with the State highway departments of California, Nebraska, and South Carolina, and described in previous reports. Although no new construction of experimental sections has been undertaken by the bureau, the development of satisfactory surfaces of low cost for secondary roads is still considered a subject of foremost importance, and such information as is being obtained from the observation of these cooperative projects and other surveys of low-cost types should prove of value in the selection of satisfactory materials and methods of construction for roads of this character.

The experimental project in California, conducted in cooperation with the California Department of Public Works, has now been in service for a length of time sufficient to warrant a report in the near future on its construction and behavior and the information obtained from the sections included in this project should be of considerable value in the design of future construction of these types.

The experimental road constructed by the mixed-in-place method in the sand-hill area of Nebraska has been under particularly close observation to determine the type of construction best adapted to very sandy soils. A report on the construction and early behavior of the various sections will be prepared for publication in *Public Roads* in the near future.

Of the three projects constructed and maintained by the South Carolina Highway Department in cooperation with the bureau, one has been discontinued. A final report on the behavior of the various sections of this project has been prepared for early publication. A progress report on the construction and early behavior of various bituminous surfacings on marl and sand-clay bases was published during the past year. The mixed-in-place construction, which involved the use of fine-graded material, is still under observation and a report on the construction, maintenance, and behavior is being prepared.

The cooperative investigation of low-cost tar-treated roads by the bureau and representatives of the tar industry has been continued. A final report on this work in North Carolina is being prepared. In this report an attempt has been made to correlate the service behavior of the surface-treatment type of construction with laboratory analyses of the widely different types of subgrades and base materials on which these treatments were built.

A field survey and necessary laboratory work in connection with the tar-bound roads in Pennsylvania have been completed. A report on this work will be prepared during the coming year.

In studying the behavior and relative value of the low-cost roads it has been found exceedingly difficult to compare work done in various States because of the dissimilarity of the bituminous materials used and the lack of uniformity in specifications for these bituminous products. With the cooperation of the States and the asphalt industry, the bureau has undertaken the task of simplification of tests and standardization of specifications for those liquid asphaltic products which are extensively used in low-cost construction.

During the past year all States and many producers cooperated in testing a large number of fluid asphaltic products by the methods prescribed in their own various specifications and also by methods proposed for use in a common simplified scheme. The data obtained were assembled by the bureau and presented to the States and producers. At a series of regional meetings of State and producer representatives the data were considered and the simplified scheme was generally adopted, with some retention of the old tests, by those who were not as yet willing to discard them for the proposed scheme of analysis. However, satisfactory progress in the elimination of unnecessary tests has been made, and this important work will be continued during the coming year.

SUBGRADE INVESTIGATIONS

Work of the past year has completed the first phase of the subgrade investigations, and a second phase has been inaugurated. A series of reports has been published covering the following basic subjects: (1) A discussion of soil properties of importance in respect to subgrade performance; (2) the significance of the simplified soil tests as means of disclosing the presence of important soil properties; (3) the methods of making soil tests; and (4) the importance of the soil profile in the solution of subgrade problems, as revealed by field surveys.

Activities are now being centered on the practical application of the information thus far gained. The utilization of locally available materials for the construction of stable topsoil, sand-clay, and gravel surfaces or foundations for bituminous treatments is a problem receiving major attention. A theoretical conception of the composition and the properties of the component parts of satisfactory stable mixtures has been formulated. On the basis of this theory, supplemented by laboratory investigations of samples of known constructional value, specifications are now being prepared which are comprehensive in scope and will permit the utilization of roadside materials to the best advantage.

The possibility of improving combinations of natural soil materials by admixtures which by their physical composition or chemical reaction will furnish the necessary balance of soil properties has long been apparent. A series of investigations is now being made to determine the extent of the possibilities in this direction. In choosing the admixtures experience as well as theory has been drawn upon. Thus, the cemented ferruginous gravels suggested a precipitated-iron compound. The manufacture of artificial stone suggested the addition of calcium chloride subsequent to a treatment with sodium silicate. Very lean bituminous emulsions and Portland cement also may prove beneficial as admixtures in many instances.

These investigations are not confined to the laboratory but will include outdoor models to indicate the behavior under climatic changes as well as the construction methods required to produce the proper admixture.

To furnish the designer with tangible evidence of the drainage properties of soils a device known as a drainage indicator has been developed. The drainage indicator discloses among other data the following: (1) Relative portions of soil particles, capillary moisture, gravitational moisture and air in either disturbed or undisturbed soil samples; (2) the rate of capillary rise at any distance above ground-water elevation; (3) the rate of gravitational flow under any head; and (4) the maximum capillary rise.

Present practice in connection with soils known to be associated with detrimental frost heave is to excavate to the depth of frost penetration and back fill

with selected material. In some localities such a procedure would be so expensive as to become prohibitive. As frost heave may occur only upon loss of heat from the subgrade through the pavement, and as many inexpensive substances have lower coefficients of thermal conductivity than materials used in pavement construction, plans have been made for a series of controlled, large-scale, outdoor experiments in the northern parts of the country to determine the value of insulating layers for the prevention of the heat loss and resulting heave.

In connection with the disintegration of certain concrete pavements a field survey has been made and microchemical investigations of the subgrade soil, soil water, and concrete have been conducted.

The number of subgrade samples submitted for analysis from active Federal-aid projects has increased materially during the past year. Further indication of growing appreciation of the importance of a proper utilization of soil support in road building may be found in the fact that 13 State highway departments have sent representatives to the subgrade laboratory of the bureau at Arlington, Va., to take advantage of the courses of instruction in field and laboratory procedures and the interpretation of tests which the bureau there provides.

Ten State departments have indicated that they are, at least in some instances, making subgrade surveys prior to construction, while six others have laboratories equipped to make the simplified soil tests. Subgrade specialists of the bureau have visited eight States to assist in the organization of subgrade divisions in the highway departments:

**REPORT OF THE CHIEF OF THE BUREAU
OF PUBLIC ROADS, 1933**

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF PUBLIC ROADS,
Washington, D.C., September 1, 1933.

SIR: I submit herewith the report of the Bureau of Public Roads for the fiscal year ended June 30, 1933.

Respectfully,

THOMAS H. MACDONALD, *Chief.*

Hon. HENRY A. WALLACE,
Secretary of Agriculture.

The mileage of Federal-aid road construction during the fiscal year 1933 was less than the mileage constructed in the preceding year but greater than in any other year. The aggregate length of the projects completed was 13,255.3 miles, of which 8,503.3 miles were included in initial-construction projects, 4,700.5 miles in stage construction, and 51.5 miles in reconstruction projects.

The projects inaugurated during the year reduced to little more than \$15,000,-000 the unobligated balance of all Federal-aid appropriations thus far authorized, and to slightly more than \$3,000,000 the special emergency appropriation of \$120,000,000 made less than a year previous.

For the first time in 17 years the fiscal year ended without definite provision by Congress for the continuance of the program of Federal-aid road construction. In place of the usual authorization, provision was made in the National Industrial Recovery Act, approved June 16, 1933, for the construction of highways as a means of furnishing employment during the fiscal year 1934. For this purpose there was appropriated \$400,000,000 to be expended on Federal-aid roads and extensions thereof into and through cities and on secondary and feeder roads in all States, and an additional sum of \$50,000,000 for forest and park roads and roads in Indian reservations and through public lands.

Rules and regulations governing the expenditure of the \$400,000,000 appropriation were issued June 23, 1933.

EMERGENCY APPROPRIATIONS AND EMPLOYMENT

Under the provisions of the Emergency Relief and Construction Act of July 21, 1932, \$120,000,000 was made available for emergency-construction work on the Federal-aid highway system. The act required apportionment of the appropriation among the several States and Hawaii in accordance with the regular Federal-aid formula, to be used as a temporary advance, and in lieu of State funds, to match the regular annual Federal-aid funds available to the States. It was further provided that the sums advanced should be reimbursed to the Federal Government by deduction from future Federal-aid appropriations over a period of 10 years commencing with the fiscal year 1938.

The construction season of 1932 was far advanced when these funds became available. As a result the rate of expenditure was at first considerably slower than it would have been had the appropriation been provided earlier in the year. With the object of insuring prompt expenditure and quickly increased employment the act stipulated that the money should be advanced only for work performed before July 1, 1933. It soon became apparent that expenditure of the entire appropriation by the date set would be virtually impossible, and the time of availability was extended to January 1, 1934, by an amendment in the Agricultural Appropriation Act, approved March 3, 1933.

As shown by table 1, actual disbursements of these funds to the States to June 30, 1933, the original terminal date, amounted to \$62,131,961.24. An additional amount, estimated at \$23,122,000, had been earned by the completion of work, which will be paid on receipt of the vouchers of the State highway departments.

TABLE 1.—*Emergency construction apportionment, and amounts paid to States for fiscal year 1933, and unobligated balance of apportionment, June 30, 1933*

State	Emergency construction apportionment	Paid to States during the fiscal year 1933	Unobligated balance of apportionment on June 30, 1933
Alabama.....	\$2,558,229	\$1,463,650.73	\$115.57
Arizona.....	1,760,771	1,227,945.74	22,765.87
Arkansas.....	2,101,182	798,562.89	54,222.91
California.....	4,667,188	3,396,566.14	190,944.52
Colorado.....	2,258,613	1,178,167.24	288,368.28
Connecticut.....	778,806	199,301.99	5,822.36
Delaware.....	600,000		
Florida.....	1,624,752	999,893.39	2,417.96
Georgia.....	3,123,298	2,383,353.97	95,528.97
Idaho.....	1,505,912	759,959.46	101,608.12
Illinois.....	5,082,847	1,378,516.99	9,583.51
Indiana.....	3,058,980		252,947.45
Iowa.....	3,171,504	2,403,987.98	84,421.60
Kansas.....	3,265,048	2,064,898.57	268,110.53
Kentucky.....	2,264,637	965,178.40	45,581.41
Louisiana.....	1,745,559	1,158,469.56	
Maine.....	1,067,079	390,016.06	29,067.60
Maryland.....	1,019,570	427,495.73	
Massachusetts.....	1,716,612	767,048.69	
Michigan.....	3,779,706	1,798,198.57	89,446.58
Minnesota.....	3,368,559	1,736,320.72	
Mississippi.....	2,190,164	658,279.26	55,479.51
Missouri.....	3,753,453	1,370,921.22	4,458.66
Montana.....	2,525,071	1,637,171.24	2,840.77
Nebraska.....	2,544,773	2,076,085.45	20,553.11
Nevada.....	1,575,756	959,697.77	265,660.66
New Hampshire.....	600,000	226,423.26	89,000.48
New Jersey.....	1,657,733	859,687.32	
New Mexico.....	1,965,473	1,669,349.87	38,274.28
New York.....	6,059,238	2,527,212.34	
North Carolina.....	2,888,251	1,628,859.21	
North Dakota.....	1,933,901	873,888.73	124,186.74
Ohio.....	4,490,175	2,079,240.12	254,412.21
Oklahoma.....	2,888,723	1,184,770.09	337,047.03
Oregon.....	2,001,740	946,288.34	246.54
Pennsylvania.....	5,267,040	2,249,237.37	22,800.00
Rhode Island.....	600,000	388,068.04	
South Carolina.....	1,666,755	1,062,821.18	14,070.08
South Dakota.....	2,004,573	1,217,751.66	1,349.19
Tennessee.....	2,605,160	1,741,663.14	45,000.00
Texas.....	7,664,621	3,369,028.47	25,434.93
Utah.....	1,395,331	628,690.11	8,812.78
Vermont.....	600,000	258,344.56	200.00
Virginia.....	2,256,178	1,163,685.76	234,125.19
Washington.....	1,920,470	1,206,890.62	117,757.76
West Virginia.....	1,323,912	869,397.98	43,927.28
Wisconsin.....	2,991,076	2,003,172.96	1,252.96
Wyoming.....	1,541,561	1,084,939.98	9,682.73
Hawaii.....	600,000	492,862.37	492.31
Total.....	120,000,000	62,131,961.24	3,258,018.49

Of the total appropriation only \$3,258,018.49 remained unobligated at the end of the year, and three fourths of this amount was credited to 11 States. Nine States—Delaware, Louisiana, Maryland, Massachusetts, Minnesota, New Jersey, New York, North Carolina, and Rhode Island—had obligated the total amounts of their apportionments, and several other States had negligible balances.

Of the funds obligated, \$4,502,467.38 had been paid on projects completed and fully paid for; \$9,032,380.76 had been allotted to projects which had been completed, but for which the final payment had not been made; \$98,477,405.61 was obligated to projects that were under construction at the end of the year, and \$4,729,727.76 to projects that had been approved for construction.

The effect of the emergency appropriation upon employment afforded by highway work is shown in table 2. The table shows in adjoining columns the numbers of men employed in each month of the fiscal years 1932 and 1933 on all Federal and Federal-aid construction and on all Federal and State road work including

State-maintenance operations. The Federal-employment figures include the relatively small numbers of men employed on national-forest and national-park road construction in addition to much larger numbers employed on Federal-aid and emergency Federal-aid projects.

TABLE 2.—Comparison of employment during the fiscal years 1932 and 1933 on all Federal and Federal-aid highway construction and on all Federal and State road work, including State maintenance operations, by months

Month	Men employed on all Federal and Federal-aid highway construction		Total men employed on all Federal and State highway construction and maintenance	
	Fiscal year 1932	Fiscal year 1933	Fiscal year 1932	Fiscal year 1933
July.....	164,708	81,042	385,349	305,372
August.....	151,418	89,346	389,949	333,403
September.....	116,100	122,193	356,617	374,405
October.....	88,869	124,106	330,104	373,246
November.....	62,466	129,933	289,316	371,667
December.....	35,991	98,271	244,971	290,465
January.....	29,518	75,498	229,189	266,443
February.....	26,673	78,215	218,218	255,256
March.....	28,008	95,704	211,549	279,213
April.....	42,205	122,256	245,843	299,882
May.....	59,008	139,831	259,615	330,138
June.....	71,772	152,276	280,636	359,605

The effects of two emergency appropriations are noticeable in table 2. In July and August 1931—the first 2 months of the fiscal year 1932—the \$80,000,000 emergency appropriation of December 20, 1930, was still in course of expenditure. In the corresponding months of the fiscal year 1933, the expenditure of the \$120,000,000 emergency appropriation of July 21, 1932, had not begun, and the regular Federal-aid appropriations were the only Federal funds available. A comparison of the employment on Federal projects in these 2 months of one fiscal year with the same months of the other shows that employment in the fiscal year 1932 period when the first emergency appropriation was being expended, was almost twice that of the similar 1933 period when only the regular Federal-aid appropriation was available.

The figures for total Federal and State employment in the last two columns of the table show that the additional employment made possible by the Federal emergency appropriation in the 2 months of the fiscal year 1932 was effective in increasing total employment. In July 1931, employment on Federal projects exceeded the similar employment in July 1932 by 83,666 men. The corresponding difference in total employment was 79,977. In August 1931 the Federal employment exceeded similar employment in August 1932 by 62,072, and the corresponding difference in total employment was 56,546. It is apparent that the greater total employment on all Federal and State highway work in July and August 1931, as compared with the same months of 1932, was due very largely to the Federal emergency appropriation.

In the remaining months of the 2 years the situation is reversed, and the greater employment figures are without exception recorded in the fiscal year 1933. In this connection, it will be recalled that the availability of the \$80,000,000 emergency appropriation terminated on September 1, 1931, and that the \$120,000,000 appropriation became available on July 21, 1932. Federal employment fell off sharply after August 1931 and increased markedly in September 1932. For every month after the latter month the effect of the \$120,000,000 appropriation is clearly indicated by the excess of employment over the corresponding month of the preceding year when no emergency appropriation was available; and the average increase on Federal and Federal-aid work was reflected in large part in an increase in total employment.

During the last 10 months of the fiscal year 1932 the total Federal employment was 560,610 man-months. In the corresponding period of the fiscal year 1933 there was a total employment of 1,138,283 man-months, a gain, due mainly to the \$120,000,000 emergency appropriation, of 577,673 man-months, or more than 100 percent of the 1932 total.

In the same two 10-month periods the total Federal and State employment was 2,666,058 man-months in 1932 and 3,200,320 man-months in 1933. The 1933 gain, 534,262 man-months, is slightly less than the gain in Federal and Federal-aid work, indicating that the employment increase provided for by the Federal emergency appropriation may have been partly offset by a drop in the employment possible with State funds.

Table 2 shows that Federal and Federal-aid work gave employment throughout the winter of 1932-33 to more than twice as many men as had been employed on the same kind of work the preceding winter, and it also shows that this additional Federal employment had the effect of raising the total winter employment on highway work. From the sharp increase in Federal employment in September 1932, less than 2 months after the passage of the Emergency Relief and Construction Act, it is apparent that the benefits of the emergency funds were very quickly felt by labor.

PROGRESS IN FEDERAL-AID ROAD CONSTRUCTION

Initial improvements were made during the fiscal year on 8,503.3 miles of the Federal-aid highway system; advanced stages of improvement were constructed on 4,700.5 miles; and 51.5 miles previously improved were reconstructed. The total mileage constructed was therefore 13,255.3 miles. This is less than the 15,997.2 miles constructed during the preceding year but exceeds the mileage constructed in any other year.

As explained in the report for the fiscal year 1932 the improvements classed as completed and included in the above total mileage figures are not only physically completed but have also been paid for by the Federal Government to the full extent of its obligation. In addition to these projects, there were others on which at the end of the year all construction work was completed to the satisfaction of the Bureau, and only the final payment by the Federal Government remained to be made before classifying them as completed. They are separately classified only because, until the final voucher has been paid, it is not possible to report exactly the total cost and Federal payment. In projects of this class there were at the end of the fiscal year 1933, 2,171.6 miles of initial construction, and 1,166.9 miles of stage construction, a total of 3,338.5 miles, exceeding by 407.6 miles the total similarly classified in the fiscal year 1932.

At the close of the year, construction of initial improvements was in progress on 8,397.4 miles, and other initial improvements had been approved for 522.5 miles. Stage construction was in progress on 3,970.3 miles already initially improved with Federal aid, and similar advanced improvements had been approved for 236.7 miles. In addition, 15.9 miles previously improved were in process of reconstruction.

The active construction program at the close of the year involved a total of 12,383.6 miles, as compared with a total of 10,511.9 miles the year previous. The increase this year is attributable to the \$120,000,000 appropriation made by the Emergency Relief and Construction Act of 1932. On the other hand, the additional mileage on which improvements have been approved, totaling only 759.2 miles at the close of last year, is much smaller than the 4,076.2 miles at the corresponding stage of the year before. This is explained by the near approach to complete obligation of all available Federal-aid and emergency advance funds at the close of last year.

The total mileage on which initial improvements had been constructed and final payment made by the Federal Government up to the end of the fiscal year 1933 was 109,683.4. In addition there were 2,171.6 miles which were constructed and opened to traffic but not yet completely paid for on the part of the Federal Government. Initial improvements had, therefore, been physically constructed with Federal aid on 111,855 miles of the system on June 30. At that time, however, 3,986.2 miles included in the above were undergoing stage construction or reconstruction and were temporarily removed from the mileage open to travel, so that the mileage classed as completed on June 30, 1933, was only 107,868.8 miles, which is a net increase of 6,836.7 miles over the corresponding mileage on June 30, 1932. The location of this mileage by States is shown in table 12. Its classification by types, as built with Federal aid, and its location are shown in table 17.

STAGE CONSTRUCTION

Although the mileage of stage construction during the year was less than the mileage during the preceding year by about 225 miles, the ratio of stage construction to initial construction increased sharply. The 4,700.5 miles on which stage construction operations were completed represented 55.3 percent of the mileage of initial construction, as compared with 44.6 percent, the corresponding ratio of the year immediately preceding.

As explained in previous reports, works classified as stage construction are supplementary improvements, paid for in part with Federal aid, of roads previously improved to lesser degree as Federal-aid projects. In most instances it is work deliberately deferred at the time of original improvement, and definitely forecast and agreed upon as a future necessity in the original agreements with the State highway departments. Many such projects involve the deferred surfacing of roads previously graded and drained. In no case is the total Federal expenditure on any project increased by the additional allotment beyond the limit of payment per mile fixed by law.

It may be necessary to explain again, as in previous reports, that the plan of stage construction is a considered policy designed to permit extension of some degree of improvement as rapidly as possible with the funds annually available to the entire Federal-aid system with provision for further and more adequate improvement as funds subsequently are made available. As shown by table 3, the ratio of such supplementary work to initial improvements has steadily increased since it was first recorded in 1923, when it was only 1.2 percent. This increase from year to year is the natural result of the shrinkage of unimproved mileage within the system and the development of the occasion and opportunity for further improvement of the previously constructed mileage.

TABLE 3.—Mileage of initial construction, stage construction, and reconstruction projects completed and final payment made, by fiscal years 1923-33

Fiscal year	Mileage of initial construction completed and paid for	Stage construction completed and paid for		Reconstruction completed and paid for		Mileage of total construction
		Mileage	Percentage of initial construction	Mileage	Percentage of initial construction	
1923.....	9,940.5	117.8	1.2	.....	.....	10,058.3
1924.....	9,145.6	280.7	3.1	.....	.....	9,426.3
1925.....	9,437.1	495.3	5.3	.....	.....	9,932.4
1926.....	10,533.3	783.9	7.4	.....	.....	11,317.2
1927.....	8,413.5	1,376.6	16.4	.....	.....	9,790.1
1928.....	8,532.2	2,088.8	24.5	.....	.....	10,621.0
1929.....	7,267.4	2,069.7	28.5	.....	.....	9,337.1
1930.....	6,675.4	1,988.0	29.8	18.8	0.3	8,682.2
1931.....	7,938.8	3,082.5	38.8	12.0	.2	11,033.3
1932.....	11,036.9	4,925.1	44.6	35.2	.3	15,997.2
1933.....	8,503.3	4,700.5	55.3	51.5	.6	13,255.3

Detailed information in regard to stage-construction work completed, in progress, and approved will be found in tables 13 to 16 and 22 to 25. The mileage classified as graded and drained consists mainly of partial relocations of previously improved roads on which surfacing has not yet been added. Such relocations are in nearly all instances needed to reduce curvature permitted in the original improvements.

The effect of stage construction as a means of raising the standard of improvement of the system will be seen by comparing tables 18 and 26, the former showing the mileage of the several types of construction completed as initial improvements during the past year and the latter the net change in the character of the total improved mileage as influenced by stage construction. Whereas, in the initial improvements completed surface construction of bituminous macadam and higher types constituted only 42 percent of the total road mileage, exclusive of

bridges and their approaches, the same high types constituted nearly 64 percent of the net increase in improved mileage. It will also be noted that the low-cost bituminous mixed surfaces and surface-treated macadam and gravel, which are intermediate types and which constituted 37 percent of the net increase, made up less than 10 percent of the mileage initially improved during the year. On the other hand, graded and drained roads and low-type untreated surfaced roads, which made up almost half of the year's initially improved mileage, appear in the table of net changes as an aggregate negative quantity, i. e., the mileage of these low types at the close of the year, in consequence of supplementary stage improvements, was less than at the end of the preceding year.

RECONSTRUCTION

During the year 51.5 miles of road previously improved with Federal aid were reconstructed and final payment of the Federal share of the cost made. As the year closed there were 15.9 miles additional in course of reconstruction. The work just completed brings the total of mileage reconstructed with Federal assistance to 117.5 miles, about 0.1 percent of the total mileage built with Federal aid.

Of the total mileage thus far rebuilt with Federal aid 45.2 miles was originally of gravel surface construction. In the reconstruction 37.6 miles of these roads have been surfaced with concrete, and 7.5 miles have been improved with bituminous concrete pavements. The remaining tenth of a mile was involved in the reconstruction of a bridge and its approaches.

Of 22.7 miles, originally of bituminous-macadam surface construction, 20.1 miles have been resurfaced with concrete and 2.6 miles with bituminous concrete. Of the rebuilt sections of bituminous concrete, totaling 16.3 miles, 2.6 miles were newly surfaced with bituminous macadam and 13.7 miles with concrete; and of the 28.7 miles originally paved with concrete, 5.8 miles have been rebuilt of the same material and 22.9 miles have been topped with bituminous concrete, the old concrete being used as a base. The single project originally paved with brick on which reconstruction has been necessary is 4.6 miles in length, and the reconstruction substituted a concrete pavement for the original surface.

Full information relative to reconstruction on Federal-aid projects will be found in tables 4 to 8 and 13 to 16.

TABLE 4.—Federal-aid projects on which reconstruction had been completed and paid during fiscal year 1933

State	Total cost	Federal aid	Miles
Michigan.....	\$518,260.71	\$235,352.17	19.8
Nevada.....	362,399.44	319,009.34	13.7
Ohio.....	161,397.10	68,976.64	4.6
Oklahoma.....	296,061.07	138,515.37	11.2
Rhode Island.....	63,881.28	31,940.64	2.2
Total.....	1,401,999.60	793,794.16	51.5

TABLE 5.—Federal-aid projects on which reconstruction was in progress on June 30, 1933

State	Estimated total cost	Federal aid allotted	Emergency construction funds allotted	Miles
Rhode Island.....	\$144,716.30	\$30,000.00	\$114,716.30	4.3
Tennessee.....	322,251.95	161,125.97	161,125.98	11.6
Total.....	466,968.25	191,125.97	275,842.28	15.9

TABLE 6.—Federal-aid projects, by types of construction, on which reconstruction had been completed, June 30, 1933

State	Old construction		New construction	
	Age (years)	Type	Type	Miles
Louisiana.....	4	Gravel, untreated.....	Bituminous concrete.....	7.5
Maine.....	7	Bituminous macadam.....	Concrete.....	1.9
	9	do.....	do.....	1.6
	10	do.....	do.....	3.6
	11	do.....	do.....	3.0
Maryland.....	13	do.....	Bituminous concrete.....	2.6
	12	do.....	Concrete.....	3.2
	13	Portland cement concrete.....	do.....	5.8
Massachusetts.....	12	Bituminous macadam.....	do.....	1.8
	10	Bituminous concrete.....	Bituminous macadam.....	2.6
	8	Bituminous macadam.....	Concrete.....	2.8
Michigan.....	12	Bituminous concrete.....	do.....	10.0
	7	Gravel, untreated.....	do.....	4.8
	8	do.....	do.....	15.0
Nevada.....	13	Portland cement concrete.....	Bituminous concrete.....	9.2
	11	do.....	do.....	10.2
	10	do.....	do.....	3.5
New Hampshire.....	12	Bituminous concrete.....	Concrete.....	1.7
	10	do.....	do.....	2.0
Ohio.....	13	Brick.....	do.....	4.6
	11	Gravel, untreated.....	do.....	2.5
Oklahoma.....	9	do.....	do.....	2.7
	12	do.....	do.....	11.2
	9	do.....	Bridge.....	.1
Rhode Island.....	12	Bituminous macadam.....	Concrete.....	2.2
Vermont.....	5	Gravel, untreated.....	do.....	1.4

TABLE 7.—Federal-aid projects, by types of construction, on which reconstruction had been completed and paid for during the fiscal year 1933

State	Old construction		New construction	
	Age (years)	Type	Type	Miles
Michigan.....	8	Gravel, untreated.....	Concrete.....	15.0
	7	do.....	do.....	4.8
Nevada.....	11	Portland cement concrete.....	Bituminous concrete.....	10.2
	10	do.....	do.....	3.5
Ohio.....	13	Brick.....	Concrete.....	4.6
Oklahoma.....	12	Gravel, untreated.....	do.....	11.2
Rhode Island.....	12	Bituminous macadam.....	do.....	2.2

TABLE 8.—Federal-aid projects, by types of construction, on which reconstruction was in progress, June 30, 1933

State	Old construction		New construction	
	Age (years)	Type	Type	Miles
Rhode Island.....	11	Bituminous concrete.....	Concrete.....	4.3
Tennessee.....	13	Bituminous macadam.....	Graded and drained.....	11.2
	13	do.....	Bridge.....	.4

CHANGES IN THE FEDERAL-AID HIGHWAY SYSTEM

In the last annual report the mileage of the Federal-aid system within the boundaries of national forests, Indian reservations, and other Federal reservations was reported as 5,785 miles, as determined up to the close of the fiscal year 1932. During the past year this mileage has been increased to 6,224 miles by the addition to the system of new routes, portions of which lie within the various kinds of reservations. The location, by States, of the mileage within Federal reservations is shown in table 9.

By amendment of the Federal Highway Act, approved May 21, 1928, the original 7-percent system may be increased by these mileages within Federal reservations, and such addition, together with an increase in the mileage of the system in Hawaii authorized by a special act approved February 23, 1931, raises the permissible mileage of the initial system to 207,105 miles.

TABLE 9.—Mileage of Federal-aid highway system within Federal reservations, being the amounts by which the 7-percent limiting mileage may be exceeded in each State as of June 30, 1933

State	Mileage within Federal reservations	State	Mileage within Federal reservations	State	Mileage within Federal reservations
Arizona.....	547	Minnesota.....	75	Pennsylvania.....	108
Arkansas.....	120	Mississippi.....	10	South Dakota.....	475
California.....	465	Montana.....	1,053	Tennessee.....	66
Colorado.....	438	Nebraska.....	21	Utah.....	69
Georgia.....	58	Nevada.....	22	Virginia.....	49
Idaho.....	558	New Hampshire.....	33	Washington.....	440
Illinois.....	5	New Mexico.....	368	West Virginia.....	29
Iowa.....	2	New York.....	16	Wisconsin.....	46
Kansas.....	15	North Carolina.....	176	Wyoming.....	326
Kentucky.....	6	North Dakota.....	23		
Maine.....	5	Oklahoma.....	48	Total.....	6,224
Michigan.....	57	Oregon.....	495		

By section 6 of the Federal Highway Act, the State highway departments were authorized, with the approval of the Secretary of Agriculture, to add to the mileage of the original 7-percent system when provision had been made for completion and maintenance of the entire original system and funds became available for the construction and maintenance of such additional mileage. This provision was amended by section 304 of the Emergency Relief and Construction Act of 1932. Under the amended legislation the State highway departments are authorized, with the approval of the Secretary of Agriculture, to increase the original 7-percent mileage of the Federal-aid system by addition of not more than 1 percent of the total mileage of their respective States when provision has been made for the completion and maintenance of 90 percent of the original 7-percent system, and thereafter to make like increases in the mileage when provision has been made for the completion and maintenance of 90 percent of the mileage previously authorized.

Under the original provision extensions of the Federal-aid system beyond the original 7-percent limit had been made in Connecticut, Delaware, Maryland, Massachusetts, New Jersey, New York, and Rhode Island, the total of such extensions amounting at the close of the fiscal year 1932 to 3,335 miles. Under the new provision the system has been further extended in these States and additions have also been made in Florida, Illinois, Nevada, North Carolina, Oregon, and Pennsylvania. The total permissible extensions in the 13 States amounted at the close of the year 1933 to 9,511 miles.

The mileage of the actually designated Federal-aid system in each State, including the authorized extensions in 13 States and the mileage within Federal reservations, is given in table 12 which also shows the distribution by States of the 107,868.8 miles classified as completed on June 30, 1933.

The mileage classified as completed with Federal aid still includes a small mileage improved before 1921 and not since included in the designated Federal-aid system. These roads, if found not sufficiently important to be added to the system, are being gradually dropped and the Federal money invested in them transferred as a credit to the improvement of other roads in the system. A year

ago it was reported that the Federal-aid money originally paid for the improvement of 1,311 miles of such roads outside the system had been transferred to other roads within the system. Continuation of this procedure during the past year has returned to the Government the amount originally expended on other roads outside the system totalling 215.6 miles, and this money has been allotted to the initial or stage construction of other roads within the system.

The mileage of the Federal-aid system has also been reduced this year by reductions in the length of previously improved roads effected by relocations in the course of stage construction. The total of such reductions during the year was 39 miles.

CONSTRUCTION OF ROADS THROUGH PUBLIC LANDS AND FEDERAL RESERVATIONS

The Emergency Relief and Construction Act of 1932, appropriated an additional \$2,000,000 to be expended for the survey, construction, reconstruction, and maintenance of main roads through unappropriated or unreserved public lands, nontaxable Indian lands, or other Federal reservations except national forests.

After deduction of the 2½-percent administrative allowance, the balance, amounting to \$1,950,000, was apportioned among 14 States having more than 5 percent of their area in lands of the kind described. The apportionment was made in proportion to the area of such lands in the several States, as required by law.

As stated in the last annual report a previous appropriation of \$3,000,000 made by the Emergency Employment Act of December 20, 1930, was apportioned, after deduction of the administrative percentage, among 13 States. In this earlier appropriation North Dakota did not share.

The total of the two apportionments thus far made for this purpose is \$4,875,000, which amount has been apportioned among the several eligible States as shown in table 10. The same table also shows the progress made toward expenditure of the funds in the several States.

TABLE 10.—*Status of appropriations for roads through public lands and Federal reservations, June 30, 1933*

State	Total sum apportioned	Sums allotted to projects				Unobligated balance	
		Not yet under construction	Under construction	Completed and finally inspected	Completed and final payment made		
Arizona.....	\$708,169		\$204,819.58		\$416,328.00	\$621,147.58	\$87,021.42
California.....	416,153	\$416,153.00				416,153.00	
Colorado.....	199,130		130,197.00			130,197.00	68,933.00
Idaho.....	277,896	34,852.78	64,441.37	\$101,200.93	73,115.07	273,610.15	4,285.85
Montana.....	267,181		38,148.54		163,248.25	201,396.79	65,784.21
Nevada.....	1,029,597		410,299.49	140,933.98	357,097.99	908,331.46	121,265.54
New Mexico.....	411,309		102,776.11	137,934.17	170,598.72	411,309.00	
North Dakota.....	24,858		24,858.00			24,858.00	
Oklahoma.....	59,216		30,435.23		11,028.77	41,464.00	17,752.00
Oregon.....	324,082	10,000.00	92,953.90	204,876.46	10,400.00	318,230.36	5,851.64
South Dakota.....	103,034		65,715.00			63,715.00	37,319.00
Utah.....	543,796	92,713.00	124,400.00		326,683.00	543,796.00	
Washington.....	80,429		25,264.00		55,165.00	80,429.00	
Wyoming.....	430,150		79,598.00		344,586.23	424,184.23	5,965.77
Total.....	4,875,000	553,718.78	1,393,906.22	584,945.54	1,928,251.03	4,460,821.57	414,178.43

FEDERAL-AID FUNDS APPORTIONED, OBLIGATED, AND EXPENDED

The appropriation authorized for the fiscal year 1933 was \$125,000,000. From this amount, however, it was necessary to deduct a portion of the amount advanced to the States of the emergency appropriation of \$80,000,000 for work performed before September 1, 1931, as provided by the act approved December 20, 1930. The act required that the sums advanced of the emergency appropriation should be reimbursed to the Federal Government over a period of 5 years, commencing with the fiscal year 1933, by making deductions from the regular Federal-aid apportionments.

In the early fall of 1931 when it was desired to apportion the appropriation authorized for 1933 the amount of the \$80,000,000 appropriation actually advanced was not known with certainty, since in many cases final vouchers for work done prior to September 1 had not been received. Accordingly, in the apportionment made October 15, 1931, the total authorized appropriation was reduced first by the 2½ percent allowed for administration and then by one fifth of the entire emergency appropriation, or \$16,000,000, leaving a balance of \$105,875,000 which was apportioned.

Subsequently, when the amounts of the emergency funds actually paid to the States became known, it was found that Alabama, California, Louisiana, Missouri, Nevada, Oregon, Texas, and Utah had not availed themselves of a part of the money allotted to them. Consequently, the apportionment of the 1933 Federal-aid funds was revised, and a new apportionment was certified on August 22, 1932, under which each of the above-named States received slightly increased sums, and the total apportioned sum was increased to \$106,034,256.14. The amounts finally credited to the several States are shown in table 27.

Of this amount a large part had already been obligated when the fiscal year opened, the States having taken advantage of the provision of law which permits obligation of the authorized appropriation immediately upon its apportionment. In consequence there was available for allotment to new projects on July 1, 1932, only \$61,720,100.60.

By subsequent obligation this balance had been reduced at the end of February 1933 to \$15,745,969, and shortly thereafter it was found desirable to suspend further obligation of the money pending the formulation of a complete program of public works and unemployment relief. With this program definitely provided for by the National Industrial Recovery Act, the State highway departments were authorized to resume submission of projects, and by June 30, 1933, the unobligated balance had been reduced to \$15,190,331.20. As no Federal-aid appropriation has been authorized for the fiscal year 1934, this represents the total sum that, under existing legislation, will be available as Federal aid during the ensuing year.

Of the \$15,190,331 balance unobligated at the end of the year more than half was credited to Alabama, Florida, Mississippi, and North Carolina. Delaware, Louisiana, Maryland, and Utah had completely obligated all funds apportioned to them, and Vermont had virtually no balance. The unobligated funds of other States ranged between these extremes, with balances of less than \$100,000 in each of 18 other States.

The amount obligated during the fiscal year was \$46,689,025.54. The amount actually paid to the States during the year was \$101,266,331.02. By reference to table 11 it will be seen that the amount obligated during the fiscal year 1933 was little more than half of the sum obligated during the preceding year. The amount expended, \$101,266,331.02, was exceeded only by the expenditures of the 2 preceding years.

TABLE 11.—Federal-aid funds apportioned to the States, obligated to projects and paid to the States each fiscal year from 1923 to 1933, inclusive

Fiscal year	Apportioned amount of appropriation authorized for the year	Amount of Federal-aid funds obligated during the year	Amount of Federal-aid funds paid to States during the year
1923.....	\$48,750,000.00	\$77,461,559	\$69,677,241.86
1924.....	63,375,000.00	89,866,864	79,217,397.90
1925.....	73,125,000.00	87,294,396	95,749,998.11
1926.....	73,125,000.00	79,608,897	87,754,534.57
1927.....	73,125,000.00	77,453,046	81,371,013.03
1928.....	73,125,000.00	88,922,185	80,802,232.55
1929.....	73,125,000.00	70,428,896	82,097,380.38
1930.....	73,125,000.00	102,498,084	75,880,862.84
1931.....	121,875,000.00	157,952,903	133,340,910.64
1932.....	121,875,000.00	83,793,787	127,367,119.74
1933.....	¹ 106,034,256.14	46,689,026	101,266,331.02
Total.....	² 900,659,256.14	961,969,643	² 1,014,525,022.64
Average.....	81,878,114.00	87,451,786	92,229,548.00

¹ Apportionment of \$121,875,000 less deduction of one fifth of the emergency advance funds paid to the States.

² The excess of total payments over total apportionments for these years was possible because from 1917 to 1922, inclusive, the appropriations exceeded the payments by more than an equal amount.

COST OF THE ROADS

The total cost of the 8,503.3 miles of initial construction, the 4,700.5 miles of stage construction, and the 51.5 miles of reconstruction, completed and completely paid for during the year was \$234,383,376, of which the Federal Government paid as regular Federal aid \$104,673,505.98, and as emergency advances \$4,502,467.38. These expenditures, with the exception of the emergency-fund payments, were made over the period required to construct the roads, and additional expenditures were made during the same period for other projects under construction and not yet completed. All the emergency fund expenditure was made after approval of the Emergency Relief and Construction Act of 1932.

As previously stated, the total of Federal-aid funds disbursed during the year on all active projects was \$101,266,331.02, as shown in table 27. Of this sum Texas received more than \$6,000,000; New York received more than \$5,000,000; Illinois, Ohio, and Pennsylvania received more than \$4,000,000; and California, Indiana, Michigan, and Missouri received more than \$3,000,000. With the exception of seven States—Arkansas, Connecticut, Delaware, Maryland, New Hampshire, Rhode Island, and Vermont—every State received for work done during the year Federal aid in excess of \$1,000,000.

FEDERAL-AID STATISTICS

Statistical information relative to the apportionment, obligation, and disbursement of Federal aid during the fiscal year 1933, the cost of roads constructed, the estimated cost of roads under construction, and the types of roads completed and under construction, etc., is given in tables 12 to 27, inclusive.

TABLE 12.—Mileage of the designated Federal-aid highway system in each State, and mileage improved with Federal aid to June 30, 1933

State	Mileage of designated Federal-aid highway system	Mileage completed with Federal aid to June 30, 1933	State	Mileage of designated Federal-aid highway system	Mileage completed with Federal aid to June 30, 1933
Alabama.....	3,933	2,344.3	New Hampshire.....	988	448.0
Arizona.....	1,979	1,270.4	New Jersey.....	1,378	637.9
Arkansas.....	4,953	1,932.8	New Mexico.....	3,678	2,300.9
California.....	5,151	2,500.1	New York.....	7,936	3,516.6
Colorado.....	3,659	1,863.7	North Carolina.....	5,329	2,358.8
Connecticut.....	978	296.8	North Dakota.....	7,420	5,432.1
Delaware.....	744	381.1	Ohio.....	5,914	3,057.9
Florida.....	2,478	661.1	Oklahoma.....	6,089	2,502.2
Georgia.....	5,610	3,238.8	Oregon.....	3,800	1,630.5
Idaho.....	3,219	1,592.4	Pennsylvania.....	6,971	3,276.8
Illinois.....	7,394	3,110.9	Rhode Island.....	484	271.7
Indiana.....	4,935	2,109.4	South Carolina.....	3,327	1,962.5
Iowa.....	7,404	3,540.0	South Dakota.....	6,279	4,305.3
Kansas.....	7,919	4,052.9	Tennessee.....	3,979	1,723.5
Kentucky.....	3,701	1,933.6	Texas.....	12,797	8,113.8
Louisiana.....	2,742	1,619.6	Utah.....	1,743	1,286.3
Maine.....	1,588	823.0	Vermont.....	1,036	393.8
Maryland.....	2,154	872.7	Virginia.....	3,782	1,994.3
Massachusetts.....	1,494	875.9	Washington.....	3,177	1,330.7
Michigan.....	5,237	2,339.2	West Virginia.....	2,223	925.6
Minnesota.....	6,880	4,309.6	Wisconsin.....	5,557	2,760.1
Mississippi.....	3,672	1,863.8	Wyoming.....	3,565	2,179.8
Missouri.....	7,789	3,233.2	Hawaii.....	532	109.4
Montana.....	5,409	2,973.2			
Nebraska.....	5,394	4,259.7	Total.....	206,277	107,868.8
Nevada.....	1,677	1,352.1			

TABLE 13.—Total cost, Federal aid, emergency-construction funds and mileage of Federal-aid roads, initial and stage construction and reconstruction completed and paid during the fiscal year 1933

State	Total cost	Federal aid	Emergency-construction fund	Mileage			
				Initial	Stage	Recon-struction	Total
Alabama.....	\$851,589.81	\$416,627.21	\$32,096.81	48.3	2.9	.....	51.2
Arizona.....	2,943,249.17	1,865,813.39	151,038.19	180.2	55.9	.....	236.1
Arkansas.....	1,217,496.66	547,650.99	11,943.65	42.8	13.1	.....	55.9
California.....	12,588,064.71	5,053,787.44	100,204.46	259.1	61.7	.....	320.8
Colorado.....	6,231,801.63	3,245,873.60	39,995.08	261.0	86.1	.....	347.1
Connecticut.....	890,283.84	385,618.19	.....	15.5	.....	.....	15.5
Delaware.....	906,164.10	445,822.00	.....	44.7	.....	.....	44.7
Florida.....	1,631,013.70	655,259.58	.....	46.3	.....	.....	46.3
Georgia.....	5,607,211.60	2,510,750.75	275,916.35	156.0	196.6	.....	352.6
Idaho.....	3,156,383.70	1,716,286.11	105,682.63	142.3	272.6	.....	414.9
Illinois.....	16,893,315.42	7,455,977.97	148,926.69	529.4	18.7	.....	548.1
Indiana.....	7,427,449.90	3,569,069.33	.....	286.9	20.3	.....	307.2
Iowa.....	4,057,333.54	1,963,494.89	50,987.40	198.8	57.1	.....	255.9
Kansas.....	6,640,001.36	3,131,186.23	313,460.23	350.0	504.5	.....	854.5
Kentucky.....	3,606,398.13	1,549,413.51	166,979.73	198.5	78.8	.....	277.3
Louisiana.....	3,012,731.39	1,222,892.52	.....	70.6	6.1	.....	76.7
Maine.....	3,520,877.34	1,596,365.81	.....	113.4	.....	.....	113.4
Maryland.....	2,269,635.36	980,609.52	26,601.80	90.5	3.9	.....	94.4
Massachusetts.....	10,932,943.73	3,512,886.73	.....	124.5	.1	.....	124.6
Michigan.....	13,018,041.46	5,167,271.46	128,676.87	407.0	65.5	19.8	492.3
Minnesota.....	5,317,756.46	2,050,016.98	.....	104.4	195.3	.....	299.7
Mississippi.....	1,433,803.60	697,860.59	.....	64.0	23.9	.....	87.9
Missouri.....	7,604,294.83	3,363,337.14	343,046.76	242.8	98.9	.....	341.7
Montana.....	4,602,094.59	2,596,366.64	339,139.48	462.7	242.3	.....	705.0
Nebraska.....	5,990,719.28	2,860,028.67	49,008.26	199.0	190.9	.....	389.9
Nevada.....	1,551,054.17	1,230,613.97	.....	25.9	152.4	13.7	192.0
New Hampshire.....	967,954.18	415,666.92	15,537.26	24.7	3.0	.....	27.7
New Jersey.....	2,526,737.77	1,125,124.36	.....	27.7	.6	.....	28.3
New Mexico.....	3,020,227.53	1,948,908.43	85,889.00	150.0	74.5	.....	224.5
New York.....	14,595,175.16	6,178,882.72	161,749.60	348.1	9.9	.....	358.0
North Carolina.....	1,274,287.01	613,781.87	64,095.20	87.5	9.0	.....	96.5
North Dakota.....	2,997,722.64	1,424,496.05	250,411.75	451.4	836.3	.....	1,287.7
Ohio.....	14,118,390.17	4,924,980.24	143,981.17	236.3	69.0	4.6	309.9
Oklahoma.....	5,748,040.86	2,807,159.37	50,266.01	199.9	63.7	11.2	274.8
Oregon.....	4,618,655.83	2,482,705.69	15,612.39	163.8	110.2	.....	274.0
Pennsylvania.....	8,053,881.00	3,338,317.63	.....	214.3	.....	.....	214.3
Rhode Island.....	899,371.60	402,014.81	82,719.26	18.8	.....	2.2	21.0
South Carolina.....	2,229,626.74	1,056,781.26	.....	66.4	48.5	.....	114.9
South Dakota.....	3,510,649.41	1,773,670.77	462,206.74	283.5	362.6	.....	646.1
Tennessee.....	2,059,702.60	990,386.73	58,621.76	73.3	27.3	.....	100.6
Texas.....	14,040,148.34	6,385,364.67	133,878.28	728.4	296.8	.....	1,025.2
Utah.....	865,919.56	532,896.50	18,486.38	61.3	44.5	.....	105.8
Vermont.....	1,170,553.66	537,596.26	50,266.01	52.5	.....	.....	52.5
Virginia.....	1,848,006.46	823,207.81	19,626.90	89.9	18.1	.....	108.0
Washington.....	3,737,632.45	1,647,910.51	155,649.35	122.6	20.1	.....	142.7
West Virginia.....	2,602,043.78	1,129,053.28	.....	57.6	10.8	.....	68.4
Wisconsin.....	6,723,170.51	2,669,740.97	365,196.40	215.1	75.0	.....	290.1
Wyoming.....	2,636,836.36	1,489,510.99	134,835.54	163.5	269.4	.....	432.9
Hawaii.....	236,932.90	184,466.92	.....	2.1	3.6	.....	5.7
Total.....	234,383,376.00	104,673,505.98	4,502,467.38	8,503.3	4,700.5	51.5	13,255.3

TABLE 14.—Total cost, Federal-aid and emergency-construction funds, and mileage of Federal-aid roads, initial and stage construction completed but final payment not made, June 30, 1933¹

State	Estimated total cost	Federal aid allotted	Emergency-construction funds allotted	Mileage		
				Initial	Stage	Total
Alabama.....	\$1,022,434.29	\$468,949.14	\$96,120.09	27.2	9.7	36.9
Arizona.....	1,054,277.55	613,947.45	414,926.16	32.5	83.6	116.1
Arkansas.....	802,239.92	395,783.20	62,732.23	16.5	13.3	29.8
California.....	2,143,562.50	601,583.90	1,175,618.52	23.3	15.5	38.8
Colorado.....	2,151,461.56	1,073,298.91	459,395.63	93.1	55.5	148.6
Connecticut.....	101,380.16	41,440.26	59,939.90	5.0	.....	5.0
Delaware.....	200,108.25	56,668.00	112,872.25	7.0	6.0	13.0
Florida.....	818,923.98	407,826.68	.....	20.4	.....	20.4
Georgia.....	1,049,142.26	424,387.40	577,058.27	33.7	25.9	59.6
Idaho.....	283,965.69	141,776.17	66,545.27	15.0	14.5	29.5
Illinois.....	407,987.23	192,330.74	.....	21.1	.....	21.1
Indiana.....	2,117,990.49	1,058,995.21	.....	106.5	.....	106.5
Kansas.....	911,055.05	366,680.08	383,144.10	96.0	12.6	108.6
Kentucky.....	1,223,649.20	522,430.82	148,226.34	38.1	43.7	81.8
Louisiana.....	948,689.27	459,239.53	.....	12.8	1.5	14.3
Maine.....	178,571.26	79,264.98	.....	4.0	.....	4.0
Maryland.....	651,470.10	253,713.22	137,104.80	29.0	.....	29.0
Massachusetts.....	3,769,411.28	1,156,339.54	.....	36.6	.....	36.6
Michigan.....	1,935,002.26	917,200.00	145,210.00	71.4	26.3	97.7
Minnesota.....	5,303,803.37	1,720,347.31	.....	106.2	116.9	223.1
Mississippi.....	1,022,185.17	497,015.24	92,283.94	30.1	18.2	48.3
Missouri.....	632,031.21	152,433.21	253,965.42	23.9	10.8	34.7
Montana.....	929,944.41	526,053.72	177,947.77	69.0	19.2	88.2
Nebraska.....	375,453.00	171,910.99	.....	16.8	7.4	24.2
Nevada.....	800,236.64	510,730.49	197,203.97	25.9	50.4	76.3
New Hampshire.....	352,589.90	150,706.90	153,528.30	9.0	2.9	11.9
New Jersey.....	1,542,436.15	633,999.15	.....	13.1	.3	13.4
New Mexico.....	1,936,681.20	1,053,864.55	346,467.04	119.4	42.0	161.4
New York.....	2,519,410.33	842,080.00	150,780.00	40.0	7.7	47.7
North Carolina.....	517,037.06	258,518.50	258,518.56	76.3	6.8	83.1
North Dakota.....	1,208,311.82	445,490.29	363,853.37	132.9	148.5	281.4
Ohio.....	1,061,500.00	352,454.82	162,500.00	29.5	12.5	42.0
Oklahoma.....	2,767,478.97	1,364,700.23	187,370.55	173.2	22.7	195.9
Oregon.....	919,789.06	447,573.07	68,359.76	14.4	26.6	41.0
Pennsylvania.....	3,888,476.78	1,871,028.43	126,500.00	81.9	.....	81.9
South Carolina.....	309,789.67	147,500.00	.....	1.6	12.0	13.6
South Dakota.....	502,824.50	168,281.15	251,876.15	16.5	21.4	37.9
Tennessee.....	893,015.81	445,802.75	334,786.94	11.8	31.7	43.5
Texas.....	5,583,704.60	2,452,858.80	633,717.23	210.4	145.3	355.7
Utah.....	1,113,743.01	647,896.53	240,196.21	43.4	88.3	131.7
Vermont.....	92,612.13	10,089.30	82,522.83	2.2	.....	2.2
Virginia.....	2,122,902.58	1,026,341.44	332,886.52	104.0	23.8	127.8
Washington.....	442,269.37	227,700.00	39,346.52	17.2	.....	17.2
West Virginia.....	664,908.12	282,086.17	50,900.00	19.0	.1	19.1
Wisconsin.....	856,685.71	264,595.00	179,100.00	17.2	11.1	28.3
Wyoming.....	473,977.52	111,063.11	310,605.36	46.4	32.2	78.6
Hawaii.....	1,055,299.79	492,189.85	198,270.76	31.1	.....	31.1
Total.....	61,660,420.18	26,507,166.23	9,032,380.76	2,171.6	1,166.9	3,338.5

¹ There was no reconstruction in this status.

TABLE 15.—Total cost, Federal-aid and emergency-construction funds of Federal-aid roads, initial and stage, and reconstruction improvement under construction, by States, June 30, 1933

State	Estimated total cost	Federal aid allotted	Emergency-construction funds allotted	Mileage			
				Initial	Stage	Recon-struction	Total
Alabama.....	\$5,032,976.50	\$2,516,488.13	\$2,429,896.53	131.2	110.3	-----	241.5
Arizona.....	2,884,355.53	1,355,008.46	1,156,973.26	68.0	126.7	-----	194.7
Arkansas.....	4,613,104.71	2,192,025.82	1,399,024.25	130.6	89.0	-----	219.6
California.....	7,629,209.24	1,565,804.03	3,164,911.21	130.4	55.1	-----	185.5
Colorado.....	2,900,175.77	1,320,286.76	1,254,035.41	116.6	19.1	-----	135.7
Connecticut.....	4,110,880.78	1,695,978.21	713,043.74	43.7	5.3	-----	49.0
Delaware.....	755,181.00	150,125.44	487,127.75	23.6	15.9	-----	39.5
Florida.....	6,609,972.32	3,168,669.14	1,622,334.04	172.4	-----	-----	172.4
Georgia.....	4,303,700.67	1,748,672.41	2,174,794.41	107.4	180.6	-----	288.0
Idaho.....	2,354,542.60	841,030.70	1,216,551.29	90.6	113.9	-----	204.5
Illinois.....	20,162,768.27	7,703,139.50	4,817,411.34	617.0	60.6	-----	677.6
Indiana.....	7,139,311.52	2,773,730.55	1,675,172.53	228.3	20.7	-----	249.0
Iowa.....	5,321,273.39	803,331.76	3,036,095.00	261.1	38.5	-----	299.6
Kansas.....	3,498,351.61	1,032,386.15	2,223,231.22	190.3	61.0	-----	251.3
Kentucky.....	4,024,383.53	1,395,480.17	1,777,631.46	159.6	122.0	-----	281.6
Louisiana.....	6,392,245.96	2,785,921.90	1,745,559.00	42.3	24.8	-----	67.1
Maine.....	2,203,423.77	508,213.51	1,022,055.05	66.4	.3	-----	66.7
Maryland.....	965,442.17	99,880.77	674,480.80	33.3	1.5	-----	34.8
Massachusetts.....	4,115,901.96	1,742,218.48	1,716,612.00	57.2	4.9	-----	62.1
Michigan.....	6,674,228.20	2,567,439.95	3,056,012.55	283.9	97.1	-----	381.0
Minnesota.....	4,768,398.82	202,728.91	3,368,559.00	150.9	139.9	-----	290.8
Mississippi.....	6,193,724.28	3,072,313.77	1,887,073.87	185.3	97.9	-----	283.2
Missouri.....	4,351,270.58	737,807.32	2,924,482.16	173.8	17.0	-----	190.8
Montana.....	5,616,576.61	3,142,856.07	1,995,179.60	405.9	255.8	-----	661.7
Nebraska.....	6,234,000.11	2,913,882.72	2,475,211.63	156.3	159.9	-----	316.2
Nevada.....	1,975,857.64	721,167.78	1,112,891.37	38.7	127.5	-----	166.2
New Hampshire.....	563,304.16	232,591.90	292,550.93	12.5	.5	-----	13.0
New Jersey.....	5,309,569.73	1,735,318.97	1,657,733.00	55.7	-----	-----	55.7
New Mexico.....	2,532,793.19	975,113.25	1,433,387.86	127.9	103.5	-----	231.4
New York.....	18,271,330.05	5,611,850.00	5,746,708.40	479.1	32.0	-----	511.1
North Carolina.....	5,040,679.02	2,518,674.96	2,418,532.14	513.8	28.1	-----	541.9
North Dakota.....	3,495,612.32	1,451,921.71	1,134,146.39	237.3	410.3	-----	647.6
Ohio.....	8,085,323.09	2,179,738.01	3,881,281.62	177.5	52.3	-----	229.8
Oklahoma.....	3,951,579.57	1,210,698.90	1,941,473.65	191.3	74.7	-----	266.0
Oregon.....	4,104,798.63	1,640,267.03	1,893,331.83	106.6	74.4	-----	181.0
Pennsylvania.....	10,077,698.86	2,532,150.15	5,117,760.00	348.7	14.0	-----	362.7
Rhode Island.....	1,013,905.12	318,007.01	517,280.74	22.5	.2	4.3	27.0
South Carolina.....	3,413,612.84	1,277,642.73	1,652,684.92	161.2	154.7	-----	315.9
South Dakota.....	3,155,035.66	1,288,695.86	1,153,545.62	249.4	201.7	-----	451.1
Tennessee.....	4,645,392.30	2,321,975.19	2,166,751.30	159.6	29.2	11.6	200.4
Texas.....	15,549,620.20	5,086,325.25	6,626,962.65	551.2	502.8	-----	1,054.0
Utah.....	1,877,602.57	774,640.08	981,628.10	127.8	36.3	-----	164.1
Vermont.....	366,965.01	43,473.80	313,523.12	18.6	-----	-----	18.6
Virginia.....	4,026,229.27	1,817,348.27	1,651,770.84	179.6	52.7	-----	232.3
Washington.....	3,045,261.29	916,420.63	1,607,716.37	109.6	9.7	-----	119.3
West Virginia.....	3,071,207.15	1,256,848.11	1,229,084.72	113.8	8.1	-----	121.9
Wisconsin.....	5,384,047.69	966,926.70	2,445,526.64	136.3	101.9	-----	238.2
Wyoming.....	2,606,875.23	859,481.92	1,086,437.37	215.7	137.9	-----	353.6
Hawaii.....	1,687,065.81	1,138,158.71	401,236.93	36.9	-----	-----	36.9
Total.....	242,106,796.30	86,140,857.55	98,477,405.61	8,397.4	3,970.3	15.9	12,383.6

TABLE 16.—Total cost, Federal-aid and emergency-construction funds, and mileage of Federal-aid roads, initial and stage improvement, approved for construction, by States, June 30, 1933¹

State	Estimated total cost	Federal aid allotted	Emergency-construction funds allotted	Mileage		
				Initial	Stage	Total
Arizona.....	\$43,050.08	\$27,982.56	\$15,067.52	-----	5.9	5.9
Arkansas.....	1,187,545.23	593,772.55	573,258.96	102.1	15.7	117.8
California.....	73,760.41	17,153.65	35,509.29	.9	2.0	2.9
Colorado.....	394,215.58	177,396.98	216,818.60	27.9	.2	28.1
Idaho.....	81,908.25	41,788.31	15,524.69	6.2	3.4	9.6
Illinois.....	716,775.42	311,902.26	106,925.46	27.0	-----	27.0
Indiana.....	1,372,003.25	133,528.13	1,130,860.02	65.0	5.3	70.3
Kansas.....	163,196.62	75,935.47	77,101.92	8.6	3.1	11.7
Kentucky.....	283,561.74	126,218.05	126,218.06	10.7	13.9	24.6
Maine.....	38,958.62	3,989.09	15,956.35	-----	1.9	1.9
Maryland.....	251,758.25	25,648.82	181,382.60	5.4	-----	5.4
Michigan.....	602,750.00	196,440.00	360,360.00	39.3	.8	40.1
Mississippi.....	250,653.30	125,326.62	125,326.68	11.6	4.2	15.8
Missouri.....	445,829.85	91,623.60	227,500.00	13.1	16.6	29.7
Montana.....	57,325.91	32,350.96	9,963.38	-----	12.0	12.0
New Hampshire.....	85,798.47	36,415.44	49,383.03	1.6	.7	2.3
New Mexico.....	111,736.03	44,694.41	61,454.82	-----	5.1	5.1
North Carolina.....	324,785.47	162,392.71	147,105.10	43.4	.3	43.7
North Dakota.....	299,625.98	123,677.17	61,302.75	22.8	73.5	96.3
Ohio.....	76,364.00	23,361.08	48,000.00	1.3	3.3	4.6
Oklahoma.....	528,539.65	105,707.88	422,831.77	38.2	-----	38.2
Oregon.....	59,172.74	26,004.62	24,189.48	1.7	1.6	3.3
South Dakota.....	278,850.45	120,075.71	135,595.30	20.3	29.1	49.4
Texas.....	719,256.12	250,336.03	244,627.86	40.8	18.3	59.1
Utah.....	259,868.69	111,261.16	146,207.53	24.7	12.4	37.1
Vermont.....	201,364.63	43,000.00	153,488.04	7.6	6.5	14.1
Virginia.....	35,537.10	17,768.54	17,768.55	2.3	-----	2.3
Wisconsin.....	52,061.50	21,500.00	-----	-----	.9	.9
Total.....	8,996,253.34	3,067,251.80	4,729,727.76	522.5	236.7	759.2

¹ There was no reconstruction in this status.

TABLE 17.—Mileage of Federal-aid roads, improved, by types of construction, by States, June 30, 1933

State	Graded and drained		Sand-clay		Gravel		Macadam		Low-cost bituminous mix	Bituminous macadam	Bituminous concrete	Portland cement concrete	Block	Bridges and approaches	Total
	Un-treated	Treated	Un-treated	Treated	Un-treated	Treated	Un-treated	Treated							
Alabama.....	212.0	507.3	882.6	4.4	14.7	731.7	62.8	135.0	512.8	12.7	2,344.3				
Arizona.....	6.9	31.0	340.1				.9	38.9	110.6	10.3	1,270.4				
Arkansas.....	91.2		882.1		86.2	427.9	110.1	206.0	547.1	19.1	1,932.8				
California.....	403.0	453.3	26.8			300.2		14.3	755.4	17.0	2,500.1				
Colorado.....	177.8	47.4	790.1		5.4		42.7		418.8	26.5	1,863.7				
Connecticut.....	2.0		3.3			11.7		5.5	219.8	5.8	1,296.8				
Delaware.....	1.7		30.4						324.1	1.5	381.1				
Florida.....	4.4	15.5		1.0	122.1		72.5	79.1	290.6	10.2	661.1				
Georgia.....	275.1	783.6	397.1	3.7	331.9	32.9	225.0	118.0	988.0	28.2	3,238.8				
I Idaho.....	166.8		603.6		158.3	494.9	20.3	92.2	49.8	6.5	1,592.4				
Illinois.....	146.7		4				3.4	3.2	2,919.0	6.6	3,110.9				
Indiana.....	3.8		90.2				17.0	12.0	1,970.1	7.7	2,109.4				
Iowa.....	1,106.2		453.9			472.6	129.6	10.7	1,955.4	2.5	3,540.0				
Kansas.....	1,141.8	645.1	337.9	115.1	50.3	38.1	84.3	207.8	1,012.2	24.7	4,052.9				
Kentucky.....	513.3		445.9				3.2	41.8	566.7	7.1	1,933.6				
Louisiana.....	59.9		1,284.4				230.6		214.4	15.9	1,619.6				
Maine.....			238.3	163.6			481.2		187.0	3.5	823.0				
Maryland.....	4.9		38.9		.1	18.7	270.1	55.5	498.5	.8	872.7				
Massachusetts.....			4		.2		27.4	27.4	270.1	10.7	875.9				
Michigan.....	92.6		351.3		16.3		5.4	96.4	1,770.4	6.4	2,339.2				
Minnesota.....	1,061.4	11.1	1,486.7	17.7				32.7	1,697.0	3.0	4,306.6				
Mississippi.....	328.9	15.8	1,141.7		11.1			12.5	329.0	15.3	1,863.8				
Missouri.....	402.4		764.0		19.6			7.5	1,989.4	15.7	3,233.2				
Montana.....	266.3		2,176.3			467.6		13.1	37.4	12.5	2,973.2				
Nebraska.....	363.0	3,261.5	6.6			103.4		14.6	477.4	11.2	4,289.7				
Nevada.....	31.8		432.0	10.2		829.2		34.8		1.8	1,352.1				
New Hampshire.....	11.6			.3	87.4		.7	16.5	141.1	5.3	448.0				
New Jersey.....	246.7	19.1	6.1		.2	353.4		22.5	592.2	4.6	637.9				
New Mexico.....	63.1		1,578.5					91.7	91.7	10.8	2,300.9				
New York.....	81.0	461.9	90.0	46.2	8.9	140.7	461.2	115.4	2,784.0	2.2	3,516.6				
North Carolina.....	630.3	.3	1,263.9		32.8	121.7	35.3	302.5	1,070.2	8.3	2,358.8				
North Dakota.....	125.8		51.1		26.1		1.2	26.1		9.5	5,432.1				
Ohio.....	605.3	.6	519.1	8.3	107.7		373.3	140.3	1,528.4	25.1	3,057.9				
Oklahoma.....	171.0		773.9	30.4	50.9	16.3	245.0	151.0	1,161.1	18.5	2,502.2				
Oregon.....	311.5				476.6		6	43.7	106.1	9.8	1,630.5				
Pennsylvania.....	5.8				1.8		94.4	45.9	2,466.7	6.8	3,276.8				
Rhode Island.....	52.8	876.4	101.0				.3	185.0	120.7	3.1	1,962.5				
South Carolina.....	147.1	20.2	3,790.9	46.1				4.9	722.8	24.2	1,962.5				
South Dakota.....	165.5		106.2		61.5	113.9		3	159.3	7.2	4,306.3				
Tennessee.....	940.0	15.2	2,554.0	505.9	69.0	10.7	341.8	232.7	806.3	10.5	1,723.3				
Texas.....					260.7		519.9	821.5	2,529.4	57.3	8,113.8				

TABLE 18.—Mileage of Federal-aid roads, by types of construction, by States, initially completed and paid for during fiscal year 1933

State	Graded and drained		Sand-clay		Gravel		Macadam		Low-cost bituminous mix	Bituminous macadam	Bituminous concrete	Portland cement concrete	Block	Bridges and approaches	Total
	Un-treated	Treated	Un-treated	Treated	Un-treated	Treated	Un-treated	Treated							
Alabama	47.9													0.4	48.3
Arizona	5.3				75.2				97.8					1.9	180.2
Arkansas	22.5				4.2				98.8			15.8		3.7	42.8
California	21.5				21.6				69.5			70.6		2.3	259.1
Colorado	4				174.7							14.1		6	261.0
Connecticut	2.0							5.3				7.6		6	15.5
Delaware					10.2							33.9		6	44.7
Florida					22.1				9			39.1		2	46.3
Georgia	67.1	6.4			54.8			10.6				48.4		5	156.0
Idaho									87.2					3	142.3
Illinois	43.6											481.1		4.7	529.4
Indiana	18.5											266.3		2.1	286.9
Iowa	60.9				26.0							111.6		3	198.8
Kansas	191.2	.9			28.0				80.8			46.2		2.9	350.0
Kentucky	120.5				25.9			1.0				50.4		7	198.5
Louisiana	19.9				1.2							38.8		1	70.6
Maine					3.2	47.3						22.6		1.2	113.4
Maryland												45.2		1.1	90.5
Massachusetts												29.1		4.9	124.5
Michigan	125.5				29.9							38.1		1.0	407.0
Minnesota	43.2											61.2		5	104.4
Mississippi	41.1											175.8		1.2	242.8
Missouri	17.8				48.0							22.4		1.5	462.7
Montana	187.2				214.7				59.3					1.8	199.0
Nebraska	7.0				132.3				26.5			31.3	.1	25.9	259
Nevada					25.9									5	24.7
New Hampshire								2.9				17.7		6	27.7
New Jersey	11.1				116.2				14.9			27.0		2.4	150.0
New Mexico	17.5				45.3							5.4		1	348.1
New York					20.7				10.1			266.5		6	87.5
North Carolina	346.5				103.3				1.1			7.8		5	451.4
North Dakota					14.9									11.3	236.3
Ohio	6.1											131.4	48.0	1.0	199.9
Oklahoma	17.6				23.5				4.9			137.8		1.2	163.8
Oregon	61.1											78.7	1.1	1.3	214.3
Pennsylvania	17.6				7.2			38.8				7.4		5	18.8
Rhode Island	9											66.3		1	66.4
South Carolina	5.8											2.3		3	283.5
South Dakota	45.1				235.8							34.1		5	73.3
Tennessee	12.4											26.3		6	73.3
Texas	496.6				6.8	49.9		11.0				147.5		8.4	728.4

Texas.....	109.7			33.6		32.3			.2	23.5		3.0	210.4
Utah.....							14.0			6.9		.4	43.4
Vermont.....												.1	2.2
Virginia.....	32.4	27.3			40.9					2.8		.6	104.0
Washington.....												.1	17.2
West Virginia.....										19.0			19.0
Wisconsin.....										10.2		.2	17.2
Wyoming.....	19.6											.3	46.4
Hawaii.....									31.0			.1	31.1
Total.....	689.9	60.9	17.5	388.5	52.7	88.5	125.9	66.3	23.4	566.0	3.8	23.0	2,171.6

TABLE 20.—Mileage of Federal-aid roads, by types of construction, by States, under initial construction, June 30, 1933

State	Graded and drained		Sand-clay		Gravel		Macadam		Low-cost bituminous mix	Bituminous macadam	Bituminous concrete	Portland cement concrete	Block	Bridges and approaches	Total
	Un-treated	Treated	Un-treated	Treated	Un-treated	Treated									
Alabama.....	45.2								14.2		14.5	55.8		1.5	131.2
Arizona.....	22.2		24.9						20.3					.6	68.0
Arkansas.....	3.0		3.7	19.4					27.8			75.9		.8	130.6
California.....	17.9		76.8	6.3					50.8		21.5	32.3		1.6	130.4
Colorado.....	6.8		3.5						13.9	6.9	13.4	27.1		3.0	116.6
Connecticut.....											.2			4.0	43.7
Delaware.....	85.0							34.3			3.2	23.6		5.7	23.6
Florida.....	55.7	0.2		11.7			22.0		3		6.0	10.6		.9	172.4
Idaho.....			80.0						10.2					.4	107.4
Illinois.....	30.2											580.7		6.1	617.0
Indiana.....	27.3											196.4		4.6	228.3
Iowa.....	69.5		56.2						134.2			134.2		1.2	261.1
Kansas.....	172.2		7.0						9.2			190.3		1.9	190.3
Kentucky.....	116.6		10.5									31.0		1.5	159.6
Louisiana.....	8.4		2.1									28.9		2.9	42.3
Maine.....				27.8				8.3				29.5		.8	66.4
Maryland.....	4.3		6.1					6.9			4.6				22.2
Massachusetts.....								22.1			11.4			1.7	33.3
Michigan.....	84.3		53.0					5.8			13.3	126.6		.9	283.9
Minnesota.....	108.5										8.7	42.4			130.9
Mississippi.....	88.8	9.3	4.2									71.7		2.6	185.3
Missouri.....	26.6		75.1						32.4			70.3		1.8	173.8
Montana.....	112.1		259.6						39.5			12.0		1.8	405.9
Nebraska.....	75.6	26.7							10.3			12.0		2.5	156.3
Nevada.....	8.0		19.3									2.7			38.7
New Hampshire.....				1.5			6.6		1.3					.4	12.5
New Jersey.....	12.7								.2					1.3	55.7
New Mexico.....	43.7		75.9	6.8										1.3	127.9
New York.....	52.2		68.6	6.2					31.7		37.0	277.7	1.1	1.6	479.1
North Carolina.....	72.4	51.7	100.9	55.1			31.5		73.1					2.0	513.8
North Dakota.....	218.7		17.6						.4					.6	237.3
Ohio.....	8.0		1.0				1.2							3.5	177.5
Ohiohon.....	162.0										38.6	88.9		3.5	177.5
Oregon.....	31.6		18.1					28.1			1	27.5		1.8	101.3
Pennsylvania.....	24.1						142.1				39.6	127.1		1.4	106.0
Rhode Island.....											3.4	7.1		1.3	348.7
South Carolina.....														.5	161.2
South Dakota.....	135.5	18.0	112.7	20.2					.9			37.1		.3	249.4
Tennessee.....	63.3										37.8	55.5		3.0	159.6
Texas.....	277.4		48.0	72.6			12.2			6.0	5.8	121.7	3.1	4.4	551.2

TABLE 21.—Mileage of Federal-aid roads, by types of construction, by States, approved for initial construction, on June 30, 1933

State	Graded and drained	Sand-clay		Gravel		Macadam		Low-cost bituminous mix	Bituminous macadam	Bituminous concrete	Portland cement concrete	Block	Bridges and approaches	Total
		Un-treated	Treated	Un-treated	Treated	Un-treated	Treated							
Arkansas.....	12.7				11.1		15.0	63.2			0.9		0.1	102.1
California.....														27.9
Colorado.....					27.9									6.2
Idaho.....					6.2								.1	27.0
Illinois.....	17.3													65.0
Indiana.....	1.8				1.2								.1	8.6
Kansas.....	6.7												.1	10.7
Kentucky.....														5.4
Maryland.....	4.0								10.7			0.5		39.3
Michigan.....	11.1				3.7								.3	11.6
Mississippi.....														1.6
Missouri.....														43.4
New Hampshire.....							1.6				.5			22.8
North Carolina.....	22.6				.2	17.4		12.0						1.3
North Dakota.....					.2									38.2
Ohio.....									1.1					1.3
Oklahoma.....	34.7												.5	20.3
Oregon.....														1.7
South Dakota.....	20.3								1.4					40.8
Texas.....	21.3				18.9								.6	24.7
Utah.....					17.1			5.0						7.6
Vermont.....								7.4					.2	2.3
Virginia.....	2.3													52.5
Total.....	154.8	22.8		75.2	11.3	17.4	16.6	87.6	15.1	119.2		.5	2.0	

TABLE 22.—Mileage of Federal-aid road stage construction, by types of construction, by States, completed and paid for during fiscal year 1933

State	Graded and drained		Sand-clay		Gravel		Macadam		Low-cost bituminous mix	Bituminous macadam	Bituminous concrete	Portland cement concrete	Block	Bridges and approaches	Total
	Un-treated	Treated	Un-treated	Treated	Un-treated	Treated	Un-treated	Treated							
Alabama												2.9			2.9
Arizona	0.5				19.4				32.5		3.1	2.9		0.4	55.9
Arkansas					1.3							11.7		.1	13.1
California					.4				20.4		4.1	35.1		1.7	61.7
Colorado					3				50.1			35.3		.4	86.1
Georgia	38.1				12.2			46.3				99.3			196.6
I Idaho					8.8				260.3		3.3			.2	272.6
Illinois												18.7			18.7
Indiana	.9											19.3		1.0	20.3
Iowa												56.2		.1	57.1
Kansas	3.1	127.9			18.5				323.1		7.7	23.2		1.0	504.5
Kentucky					22.4						5.4	50.9		.1	78.8
Louisiana															
Maryland											2.3	1.6			3.9
Massachusetts															
Michigan	7.3										8.0	49.8		.4	65.5
Minnesota	44.9										150.3	150.3		.1	195.3
Mississippi	15.1											8.4		.4	23.9
Missouri					3.5							93.3		.1	98.9
Montana					110.3										242.3
Nebraska					.8				132.0			123.6			190.9
Nevada									51.6					.4	152.4
New Hampshire									151.2			3.0			3.0
New Jersey									63.8					.9	74.5
New Mexico					9.8						6.9	3.0			9.9
New York									5.0						9.0
North Carolina					4.0										
North Dakota	26.4				740.5				69.1		.1	44.6		21.2	836.3
Ohio					.2										60.0
Oklahoma											0.9			1.7	63.7
Oregon					49.3			3.4				63.7			63.7
South Carolina	14.9											3.2			110.2
South Dakota	70.2				145.2				62.6			33.6			48.5
Tennessee					2.8						4.9			.4	362.9
Texas	15.9				2.1			40.5			6.4	20.9			27.3
Utah									41.7		9.2	173.1		1.1	290.8
Virginia					7.9			4.0				.5		.2	44.5
Washington	.1				1.6			5.1				18.4			18.1
West Virginia	6.1											4.7			20.1
Wisconsin	2.1											72.6			10.8
Wyoming	2.3				172.9				93.8					.3	75.0
Hawaii											3.6			.4	269.4
Total	247.9	150.6	4.0	92.7	1,322.3	5.1	94.2	68.0	1,357.2	62.6	1,270.9	21.2	13.8		4,700.5

TABLE 23.—Mileage of Federal-aid roads, by types of construction, by States, stage construction, completed but final payment not made, June 30, 1933

State	Graded and drained		Sand-ehy		Gravel		Macadam		Low-cost bituminous mix	Bituminous macadam	Bituminous concrete	Portland cement concrete	Block	Bridges and approaches	Total
	Un-treated	Treated	Un-treated	Treated	Un-treated	Treated									
Alabama.....									82.8			9.7			9.7
Arizona.....														0.8	83.6
Arkansas.....															13.3
California.....	0.7		3.4						40.3						15.5
Colorado.....															55.5
Delaware.....															6.0
Georgia.....								16.4							25.9
Idaho.....									6.5						14.5
Kansas.....	9.5											3.0			12.6
Kentucky.....									12.4						43.7
Louisiana.....			20.3												43.7
Michigan.....										7.4					1.5
Minnesota.....															26.3
Missisota.....															116.9
Mississippi.....	8.9														9.3
Missouri.....															18.2
Montana.....					9.1				10.1						10.8
Nebraska.....															19.2
Nevada.....					23.5				26.8						7.4
New Hampshire.....															50.4
New Jersey.....															2.9
New Mexico.....															2.9
New York.....									39.7						2.1
North Carolina.....						6.7									7.7
North Dakota.....					140.5										1.1
Ohio.....															6.8
Oklahoma.....										0.4					148.5
Oregon.....	1.9		.7												12.2
South Carolina.....								.6							1.1
South Dakota.....	8.0		1.0							16.5					22.7
Tennessee.....	1.1														4.4
Texas.....	3.6		1.5	24.5											26.6
Utah.....			5.5												12.0
Virginia.....			2.0												11.9
West Virginia.....															12.4
Wisconsin.....															31.7
Wyoming.....	.8														92.7
			7.4						81.3						88.3
															23.8
															1.1
									12.2						11.1
Total.....	34.5		294.4	31.2		27.7	312.1	16.9	49.2	448.7	4.8	1,166.9			

TABLE 25.—Mileage of Federal-aid roads, by types of construction, by States, approved for stage construction, June 30, 1933

State	Graded and drained		Sand-clay		Gravel		Macadam		Low-cost bituminous mix	Bituminous macadam	Bituminous concrete	Portland cement concrete	Block	Bridges and approaches	Total
	Un-treated	Treated	Un-treated	Treated	Un-treated	Treated									
Arizona.....									5.8					0.1	5.9
Arkansas.....									14.3						15.7
California.....				1.4					2.0						2.0
Colorado.....			0.2												2.2
Idaho.....									3.4						3.4
Indiana.....												5.3			5.3
Kansas.....									3.1			7.4			13.9
Kentucky.....			6.5					1.9							1.9
Maine.....											.8				1.8
Michigan.....														.1	4.2
Mississippi.....	4.1														16.6
Missouri.....									4.2						12.0
Montana.....			7.8												7.8
New Hampshire.....															7.7
New Mexico.....															5.1
North Carolina.....				.3											3.3
North Dakota.....			73.5									.8			73.5
Ohio.....															3.3
Oregon.....									1.3			.3			1.6
South Dakota.....									28.8						29.1
Texas.....				.3										.1	18.3
Utah.....	17.9								11.5			.9			12.4
Vermont.....									6.5						6.5
Wisconsin.....												.7		.2	6.9
Total.....	22.0		88.6	1.7				1.9	80.9	1.9	2.5	38.6		.5	236.7

TABLE 26.—*Net changes of mileage in the types of Federal-aid improvement on the Federal-aid highway system during the fiscal year 1933*—
Continued

State	Graded and drained	Sand-clay		Gravel		Macadam		Low-cost bituminous mix	Bituminous macadam	Bituminous concrete	Portland cement concrete	Block	Bridges and approaches	Total
		Un-treated	Treated	Un-treated	Treated	Un-treated	Treated							
Utah.....	-14.0			30.3		-88.3		145.7		.5	8.0		.6	82.8
Vermont.....				9.5				16.1	3.1		25.5		.5	54.7
Virginia.....	25.6			-2.2		33.8	4.0		-1.1	7.6	-30.9		.5	71.4
Washington.....	18.4	34.1		57.0							56.7		.7	132.8
West Virginia.....	4.8			-3.8					.6		30.4		.6	32.3
Wisconsin.....	6.3			-72.3							232.2		.7	166.3
Wyoming.....	-56.5	7.0		199.1				134.3					1.6	285.5
Hawaii.....	-3.0								36.1				.6	33.1
Total.....	-445.8	-285.1	44.1	571.1	250.0	42.9	206.9	2,067.8	235.0	143.4	3,912.8	34.6	59.0	6,836.7

TABLE 27.—Federal-aid apportionment, and the amounts paid to the States for the fiscal year 1933, and the unobligated balance of the total apportionment on June 30, 1933

State	Apportionment fiscal year 1933	Paid to States during the fiscal year 1933	Unobligated balances of total apportionment on June 30, 1933
Alabama.....	\$2,251,487.72	\$1,577,192.89	\$3,199,828.75
Arizona.....	1,556,080.80	1,521,733.57	1,610.68
Arkansas.....	1,846,477.60	929,977.49	663,644.66
California.....	4,140,910.53	3,698,351.31	117,065.88
Colorado.....	1,988,953.60	2,185,645.98	269,439.58
Connecticut.....	687,401.80	370,196.56	183,167.11
Delaware.....	529,375.00	401,968.10	.....
Florida.....	1,437,372.40	1,309,949.87	989,164.32
Georgia.....	2,753,344.80	2,716,911.99	100,636.93
Idaho.....	1,330,448.00	1,315,840.41	73,920.51
Illinois.....	4,476,553.80	4,696,333.40	95,967.25
Indiana.....	2,698,897.20	3,150,523.32	209,145.99
Iowa.....	2,799,805.20	2,535,126.77	59,251.82
Kansas.....	2,889,065.80	2,435,972.62	153,217.33
Kentucky.....	1,994,012.00	1,517,615.33	48,791.33
Louisiana.....	1,569,830.67	1,744,791.99	.....
Maine.....	944,168.20	1,364,815.44	76,304.51
Maryland.....	895,409.60	792,361.75	.....
Massachusetts.....	1,511,244.00	2,481,476.40	351,632.06
Michigan.....	3,338,014.60	3,758,655.13	175,723.01
Minnesota.....	2,976,273.40	2,946,417.36	34,304.16
Mississippi.....	1,907,440.80	1,113,779.63	2,952,041.86
Missouri.....	3,346,264.88	3,020,058.58	8,827.28
Montana.....	2,220,177.00	2,957,527.27	401,817.97
Nebraska.....	2,256,640.80	2,908,956.42	49,318.84
Nevada.....	1,421,688.63	1,382,502.60	117,662.21
New Hampshire.....	529,375.00	419,190.18	64,377.21
New Jersey.....	1,463,483.60	1,151,062.66	109,558.29
New Mexico.....	1,732,343.10	1,245,058.57	85,464.22
New York.....	5,342,506.50	5,297,698.28	355,781.37
North Carolina.....	2,500,007.00	1,830,951.42	977,044.05
North Dakota.....	1,710,936.60	1,463,221.78	416,198.04
Ohio.....	3,971,690.40	4,869,738.14	190,835.32
Oklahoma.....	2,553,034.80	1,703,492.27	433,937.87
Oregon.....	1,767,475.80	1,855,778.01	56,880.55
Pennsylvania.....	4,640,667.40	4,150,584.63	53,641.77
Rhode Island.....	529,375.00	414,113.90	70,834.03
South Carolina.....	1,469,603.80	1,088,720.55	12,443.92
South Dakota.....	1,765,764.40	1,411,030.29	169,101.27
Tennessee.....	2,302,158.60	2,420,799.23	576,790.79
Texas.....	6,811,084.83	6,330,692.65	49,990.22
Utah.....	1,223,723.28	1,181,546.86	.....
Vermont.....	529,375.00	505,130.44	151.97
Virginia.....	1,992,380.60	1,538,556.73	194,541.87
Washington.....	1,681,216.40	1,698,496.48	59,732.72
West Virginia.....	1,162,217.20	1,177,605.05	49,516.08
Wisconsin.....	2,640,713.00	2,614,088.36	265,183.36
Wyoming.....	1,359,009.40	1,043,959.29	151,122.56
Hawaii.....	529,375.00	1,014,353.07	514,689.68
Total.....	106,034,256.14	101,266,331.02	15,190,331.20

NATIONAL-FOREST-ROAD CONSTRUCTION

The appropriations made for improvement of roads in the national forests recognize and provide separately for two principal classes of road, designated, respectively, as forest highways and forest-development roads. Forest-development roads, as the name implies, are roads which serve primarily for the development of the forests and which are needed for the protection and administration of the forests. In the main they are lightly traveled and entail no large expense for their improvement. Forest highways are roads of a higher order of traffic importance, generally those joining sections of the Federal-aid or State highway systems outside the forests or important community-service roads, and requiring, in consequence, types of improvement that are generally more expensive than those required for the forest development roads.

For both classes of roads the act of May 5, 1930, authorized an appropriation of \$12,500,000 to be available in the fiscal year 1933 and thereafter until expended. In accordance with the provisions of the Federal Highway Act \$3,000,000 of this sum was set apart for forest-development roads, and the remainder, \$9,500,000, was available for forest-highway construction.

For the construction of forest highways there was subsequently appropriated by the Emergency Relief and Construction Act of 1932 an additional sum of \$5,000,000 to be available for expenditure during the fiscal year 1933 only; but