PUBLIC ROADS

By

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Bureau of Public Roads

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Project	Allotment
San Joaquin River, Calif.	$ 105,500.00
Sacramento River, Calif.	60,000.00
Coquille River, Ore.	20,000.00
Coos Bay, Ore.	120,500.00
Columbia and Lower Willamette Rivers below Vancouver, Wash., and Portland, Ore.	590,160.00
Willamette River above Portland and Yamhill River, Ore.	86,000.00
Examinations, surveys, and contingencies (general), Portland district	38,600.00
Willapa River and Harbor, Wash.	55,800.00
Grays Harbor and Bar Entrance, Wash.	215,000.00
Puget Sound and tributary waters, Wash.	18,000.00
Seattle Harbor, Wash.	32,000.00
Wrangell Narrows, Alaska	63,000.00
Nome Harbor, Alaska	60,560.00
Harbor of Refuge, Seward, Alaska	20,000.00
Examinations, surveys, and contingencies (general), Seattle district	36,500.00
Honolulu Harbor, Hawaii	336,000.00
Kahului Harbor, Hawaii	15,000.00
Nawiliwili Harbor, Hawaii	36,000.00
Survey, northern and northwestern lakes	235,000.00

ROADS, Public, Bureau of, a branch of the United States Department of Agriculture, is engaged in the administration of Federal-aid highway construction and other related activities including the construction of roads in the national forests, in public parks, on public lands and Indian reservations; research in the design and construction of roads; and economic investigations to determine the value of roads and the service they render.

Supplementing this work, the National Industrial Recovery Act provided for the construction of public works highways by the Bureau of Public Roads including, in addition to Federal aid on rural roads, the construction of Federal-aid highway extensions within municipalities, and work on secondary or feeder roads. This work is in progress under an appropriation by Congress of $400,000,000 made with a view to reducing unemployment through highway building.

The bureau is headed by the chief of bureau under whom at Washington are the chief engineer and several staff divisions in charge of various phases of the work. Eleven districts, each including a group of States and each headed by a district engineer, maintain contact with the State highway departments in the administration of Federal-aid road work. Another district office handles the forest road work in Alaska. The four western districts and the Alaska district report to Washington headquarters through a deputy chief engineer with office in San Francisco.

Federal-aid Legislation.—The application of the Federal-aid principle to road improvement goes back to the Federal-aid road act of 1916. This act provided $75,000,000 for the fiscal years of 1917–21, and laid down the principles of Federal-aid administration which have since been continued with only slight modifications. The designation of the Federal-aid highway system was one of the requirements of the Federal Highway Act of 1921. Appropriations have been made each year since 1916 and for the fiscal years 1931, 1932, 1933 were at the annual rate of $125,000,000. The fiscal year 1933 ended, however, without definite provision by Congress for the continuance of Federal-aid highway building. In place of the usual authorization, provision was made in the National Industrial Recovery Act, approved 16 June 1933, for the construction of highways as a means of furnishing employment.

Federal-aid Highways.—The outstanding features of the Federal-aid principle as applied to highway construction are as follows: The Federal appropriations are apportioned among the 48 States and Hawaii in proportion to the three factors: land area, population and mileage of rural post roads and star routes. The funds thus apportioned to each State, when matched by State funds, are expendable under the immediate direction of the State highway department and the general supervision of the Secretary of Agriculture, acting through the Bureau of Public Roads, for the construction of roads included in the designated Federal-aid highway system. Projects for the expenditure of apportioned funds are initiated by the State highway departments and are subject to the approval of the Secretary of Agriculture.

In general, the Federal contribution is limited to not more than 50 per cent of the cost of the work done and to not more than $15,000 a mile, exclusive of expenditures for bridges more than 20 feet in span. Federal payment on bridges may be a full 50 per cent of the cost. In States which have more than 5 per cent of their area in public lands under the control of the Federal Government the limits of Federal expenditure are increased, both in percentage and contribution per mile, by amounts proportional to the percentage of public lands they contain. Exception to the general rule may also be made in the case of roads added after completion of the initially designated Federal-aid system, and where it can be shown that a larger Federal contribution will be in the interest of economy. In such cases, the Federal funds may be used to the extent of $25,000 per mile. The Federal contribution under the regular Federal-aid plan must be matched by funds under the direct control of the State highway departments, which are required to insure the adequate maintenance of the roads built without expense to the Federal Government.

Should any State fail in the duty of maintaining any aided road, the Secretary of Agriculture is authorized to suspend further payments of Federal funds and to perform the necessary work under his own direction using for the purpose any Federal funds remaining to the credit of the State. As a condition of further Federal aid the State is then required to refund the money thus expended which, when it is received, is reapportioned among all States, so that the offending State would lose all but its pro rata share. Fortunately, it has never been necessary to enforce this provision of the law. Federal funds authorized for any fiscal year are available for expenditure until the end of the second succeeding year. If not expended in this three-year period, the balance is reapportioned among the States.

Public Works Highways.—Procedure is different under the National Industrial Recovery Act modifying the regular Federal-aid procedure in the following particulars for the construction of public works highways: Federal grants of money do not have to be matched by funds from other Government agencies. In addition to grants of money to the States for building roads on the regular Federal-aid system, provision is made for the extension of Federal-aid system roads into municipalities, and for the construction of secondary or feeder roads. The apportionment of funds to the States is seven-eighths in accord-

ance with the Federal Highway Act of 1921 and one-eighth according to population. Apportioned funds may be used also to match regular Federal-aid appropriations.

Not more than 50 per cent of the funds apportioned to any State may be applied to projects on the Federal-aid highway system outside the corporate limits of municipalities; not less than 25 per cent must be applied to the extension of Federal-aid roads to and through municipalities; and not more than 25 per cent may be allotted to secondary or feeder roads until provision has been made for the satisfactory completion of at least 90 per cent of the initial limiting Federal-aid highway system in each State.

Maintenance of public works improvements of roads included in the Federal-aid highway system is an obligation of the States, in the case of municipal extensions of the system and secondary or feeder roads, the maintenance responsibility may by agreement be transferred to the appropriate municipal or county authorities.

Federal-aid Highway System.—The Federal Highway Act approved 9 Nov. 1921, provided that all Federal-aid appropriations subsequently apportioned should be applied only to a limited system of main interstate and intercounty roads which it directed the Secretary of Agriculture and the State highway departments to select in co-operation. The system, known as the Federal-aid highway system, was originally restricted to 7 per cent of the total mileage of roads existing in each State on the date of the passage of the act, until such mileage had been improved to the satisfaction of the Secretary. The amendment of 21 May 1928, permits addition of mileage in excess of the original limit equal to the mileage of the designated system lying within national forests, Indian reservations, and on other Federal reservations. Whenever provision has been made for the completion of 90 per cent of the system in any State, the system may be extended by additional mileage equal to not more than 1 per cent of the total mileage in the State. The system, as approved on 30 June 1933, includes 206,277 miles, distributed by States as shown in Table 1.

Table 1.—Mileage of the Designated Federal-Aid Highway System in Each State and Mileage Improved with Federal Aid to 30 June 1933

State	Mileage of designated Federal-aid highway system	Mileage completed with Federal aid to 30 June 1933
Alabama	3,933	2,344.3
Arizona	1,979	1,270.4
Arkansas	4,953	1,932.8
California	5,151	2,500.1
Colorado	3,659	1,863.7
Connecticut	978	296.8
Delaware	744	381.1
Florida	2,478	661.1
Georgia	5,610	3,238.8
Idaho	3,219	1,592.4
Illinois	7,394	3,110.9
Indiana	4,935	2,109.4
Iowa	7,404	3,540.0
Kansas	7,919	4,052.9
Kentucky	3,701	1,933.6
Louisiana	2,742	1,619.6
Maine	1,588	823.0
Maryland	2,154	872.7
Massachusetts	1,494	875.9
Michigan	5,237	2,339.2
Minnesota	6,880	4,309.6
Mississippi	3,672	1,863.8
Missouri	7,789	3,233.2
Montana	5,409	2,973.2
Nebraska	5,594	4,259.7
Nevada	1,677	1,352.1
New Hampshire	988	448.0
New Jersey	1,378	637.9
New Mexico	3,678	2,300.9
New York	7,936	3,516.6
North Carolina	5,329	2,358.8
North Dakota	7,420	5,432.1
Ohio	5,914	3,057.9
Oklahoma	6,089	2,502.2
Oregon	3,800	1,630.5
Pennsylvania	6,971	3,276.8
Rhode Island	484	271.7
South Carolina	3,327	1,962.5
South Dakota	6,279	4,305.3
Tennessee	3,979	1,723.5
Texas	12,797	8,113.8
Utah	1,743	1,286.3
Vermont	1,036	393.8
Virginia	3,782	1,994.3
Washington	3,177	1,330.7
West Virginia	2,223	925.6
Wisconsin	5,557	2,760.1
Wyoming	3,565	2,179.8
Hawaii	532	109.4
Total	206,277	107,868.8

Federal-aid Road Improvement.—The mileage of Federal-aid road construction during the fiscal year 1933 was less than the mileage built in the preceding year but greater than the construction of any other year. The aggregate length of the projects completed was 13,255 miles, of which 8,503 miles were improved with Federal aid for the first time, 4,700 miles previously improved with Federal aid were further improved, and 52 miles previously surfaced were reconstructed. 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.

The Federal Government has participated in the improvement of 107,869 miles of the Federal-aid system. This improvement is composed of 47,328 miles of bituminous macadam and higher types, 11,777 miles of graded earth, and 543 miles of bridges and approaches. The system is now, in large part, surfaced but by no means nearing completion. While construction has progressed rapidly in recent years, it has not kept pace with the demands of traffic. There is a large mileage of roads where the traffic requires a higher type of surface, or widening or other improvement.

Stage Construction.—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 more adequate improvement as funds become available. Although the mileage of stage construction was 225 miles less during the past year than in the preceding year, the ratio of stage construction to initial construction increased sharply. The 4,700 miles on which stage construction operations were completed represented 55 per cent of the mileage of initial construction, as compared with 45 per cent, the corresponding ratio of the preceding year.

Reconstruction.—During the year, 52 miles of road previously improved with Federal aid were reconstructed, with 16 additional miles in process of reconstruction as the year closed. The total reconstructed mileage is now 118, about 0.1 per cent of the total mileage built with Federal aid.

Of the total 118 miles rebuilt, 45 miles had a gravel surface which was replaced with concrete on 38 miles and bituminous concrete on 7 miles. Of the 23 miles originally of bituminous macadam construction, 20 miles have been resurfaced with concrete and 3 miles with bituminous concrete. Of the 16 miles of bituminous concrete, 3 miles were resurfaced with bituminous macadam and 13 miles with concrete. Of the 29 miles originally surfaced with concrete, 6 miles have been rebuilt of the same material and 23 miles have been topped with bituminous concrete using the old concrete as a base. A brick pavement 5 miles long was reconstructed with a concrete pavement.

Type of Improvement of Federal-aid System.—The mileage of road on the Federal-aid system completed with Federal aid to 30 June 1933, is classified as follows:

Graded and drained	11,777
Sand-clay, treated and untreated	7,191
Gravel, treated and untreated	32,230
Macadam, treated and untreated	3,150
Low-cost bituminous mix	5,650
Bituminous macadam	4,703
Bituminous concrete	3,985
Portland cement concrete	37,584
Block	1,056
Bridges and approaches	543
Total	107,869

Emergency Appropriations and Employment.—Under the provisions of the Emergency Relief and Construction Act of 21 July, 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.

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 per cent 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 two 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.

Table 2.—Comparison by Months of Employment During the Fiscal Years 1932 and 1933

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

Public Works Highways.—The National Industrial Recovery Act in Section 204 authorized a grant of $400,000,000 to be expended under the direction of the Bureau of Public Roads. This grant of money, less the expense of Federal administration, was apportioned to the various States, Hawaii and the District of Columbia for road construction, as indicated in Table 3. An additional appropriation of $50,000,000 also was made for highway construction in the national forests, parks, public lands, and on Indian reservations to be expended under the plan previously provided for the improvement of roads in such areas. The public works highways authorized under the act were to be built in such a way as to relieve unemployment as much as possible. The act and the rules and regulations adopted for carrying out the provisions of the act contain requirements as to labor, wages, hours of employment, and the extent to which hand labor methods are required. In general, a 30-hour week is required, minimum wage rates are prescribed in all contracts, and labor is obtained through local agencies designated by the United States Employment Service.

To get projects under way as quickly as possible with due regard to safety of public funds, procedure was reduced by shortening the time of advertisement for bids on work, approval of projects in the field, abbreviated plans in certain cases, and other expedients to hasten construction. Funds are advanced to States that experience difficulty in paying the cost of work done pending reimbursement by the Federal Government. These advanced funds are placed in a special trust and are used as a revolving fund by replacement of amounts withdrawn after payments have been made for work performed. The public works highway building program began in the summer of 1933 and expanded rapidly.

National-Forest Road Construction.—The appropriations made for improvement of roads in the national forests provide separately for two principal classes of road, designated: forest highways and forest-development roads. Forest-development roads serve primarily for the development and for the protection and administration of the forests. In the main they are lightly traveled and entail no large expense for their

Table 3.—Approved Assignment of the Apportionment of Public Works Highway Funds

[As of 30 Nov. 1933]

State	Date of Original Approval 1933	Federal Aid Highway System Per cent	Federal Aid Highway System Amount	Extension Through Municipalities Per cent	Extension Through Municipalities Amount	Secondary or Feeder Roads Per cent	Secondary or Feeder Roads Amount	Total Apportionment
Alabama	Aug. 1	50.00	$ 4,185,667	25.00	$ 2,092,533	25.00	$ 2,092,533	$ 8,370,133
Arizona	July 21	73.00	3,804,531	15.00	781,794	12.00	625,435	5,211,960
Arkansas	July 18	50.00	3,374,167	25.00	1,687,084	25.00	1,687,084	6,748,335
California	July 24	50.00	7,803,677	25.00	3,901,839	25.00	3,901,838	15,607,354
Colorado	July 29	50.00	3,437,265	25.00	1,718,633	25.00	1,718,632	6,874,530
Connecticut	July 21	49.00	1,544,213	28.00	862,467	23.00	659,120	2,865,800
Delaware	July 14	50.00	909,544	25.00	454,772	25.00	454,772	1,819,088
Florida	July 14	50.00	2,615,917	25.00	1,307,959	25.00	1,307,958	5,231,834
Georgia	Sept. 26	50.00	5,045,592	27.00	2,724,620	23.00	2,320,973	10,091,185
Idaho	July 14	50.00	2,243,125	25.00	1,121,562	25.00	1,121,562	4,486,249
Illinois	Aug. 1	25.22	4,431,348	39.14	6,877,199	35.64	6,262,223	17,570,770
Indiana	July 13	47.00	4,717,786	48.00	4,818,165	5.00	501,892	10,037,843
Iowa	July 17	50.00	5,027,830	28.00	2,815,585	22.00	2,212,245	10,055,660
Kansas	July 17	50.00	5,044,802	25.00	2,522,401	25.00	2,522,401	10,089,604
Kentucky	July 13	48.66	3,608,332	27.00	2,029,687	25.00	1,879,340	7,517,359
Louisiana	July 14	50.00	2,914,295	25.00	1,457,148	25.00	1,457,148	5,828,591
Maine	July 14	50.00	1,684,959	25.00	842,479	25.00	842,479	3,369,917
Maryland	Aug. 5	50.00	1,782,263	25.00	891,132	25.00	891,132	3,564,527
Massachusetts	July 8	29.30	1,932,950	62.70	4,136,382	8.00	527,768	6,597,100
Michigan	July 19	40.00	5,094,491	35.00	4,457,679	25.00	3,184,057	12,736,227
Minnesota	July 18	48.00	5,115,153	32.00	3,410,102	20.00	2,131,314	10,656,569
Mississippi	July 17	50.00	3,488,337	25.00	1,744,669	25.00	1,744,669	6,978,673
Missouri	July 12	50.00	6,090,153	25.00	3,045,077	25.00	3,045,076	12,180,306
Montana	July 14	60.00	4,403,849	15.00	1,115,962	25.00	1,859,937	7,439,748
Nebraska	July 17	59.00	3,914,481	25.00	1,657,240	25.00	1,957,240	7,828,961
Nevada	July 21	64.00	2,909,387	11.00	500,051	25.00	1,136,479	4,545,917
New Hampshire	July 14	50.00	954,919	25.00	477,460	25.00	477,460	1,909,839
New Jersey	July 25	48.30	3,005,137	50.70	3,217,442	1.00	63,460	6,346,037
New Mexico	July 18	50.00	2,896,367	25.00	1,448,234	25.00	1,448,234	5,792,835
New York	June 30	48.50	10,830,099	35.10	7,837,865	16.40	3,662,137	22,330,101
North Carolina	July 20	50.00	4,761,147	25.00	2,380,573	25.00	2,380,573	9,522,293
North Dakota	July 14	50.00	2,902,224	25.00	1,451,112	25.00	1,451,112	5,804,448
Ohio	July 8	45.00	6,968,056	30.00	4,645,378	25.00	3,871,148	15,484,582
Oklahoma	July 12	50.00	4,608,399	25.00	2,304,200	25.00	2,304,169	9,216,798
Oregon	July 12	50.00	3,053,448	25.00	1,526,724	25.00	1,526,724	6,106,896
Pennsylvania	Aug. 1	30.48	5,757,978	28.67	5,416,051	40.85	7,716,975	18,891,004
Rhode Island	July 22	50.00	999,354	25.00	499,677	25.00	499,677	1,998,708
South Carolina	July 13	50.00	2,729,583	25.00	1,364,791	25.00	1,364,791	5,459,165
South Dakota	July 19	50.00	3,005,739	25.00	1,502,870	25.00	1,502,870	6,011,479
Tennessee	July 17	50.00	4,246,309	25.00	2,123,155	25.00	2,123,155	8,492,619
Texas	July 18	50.00	12,122,012	25.00	6,061,006	25.00	6,061,006	24,244,024
Utah	July 8	50.00	2,097,354	25.00	1,048,677	25.00	1,048,677	4,194,708
Vermont	July 13	49.50	931,919	25.20	470,028	25.30	465,026	1,867,573
Virginia	July 12	50.00	3,708,329	25.00	1,854,189	25.00	1,854,189	7,416,757
Washington	July 12	50.00	3,057,934	30.70	1,877,571	19.30	1,180,362	6,115,867
West Virginia	July 14	45.00	2,013,405	30.00	1,342,270	25.00	1,118,559	4,474,234
Wisconsin	July 12	50.00	4,862,441	25.00	2,431,220	25.00	2,431,220	9,724,881
Wyoming	July 19	50.00	2,250,663	25.00	1,125,332	25.00	1,125,332	4,501,327
District of Columbia	July 13	.....	.....	60.00	1,153,081	40.00	767,388	1,918,469
Hawaii	July 24	90.00	1,683,956	.....	.....	10.00	187,106	1,871,062
Totals		47.35	$186,551,646	28.62	$112,771,667	24.03	$94,676,687	$394,000,000

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, that require types of improvement generally more expensive than those required for the forest development roads. For both classes of roads the act of 5 May 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; the remainder, $9,500,000, was available for forest highways. 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 the period of availability was later extended through the fiscal year 1934 by act approved 3 March 1933.

In the main, the Bureau of Public Roads supervises the construction of forest highways, for which the combined sums authorized and appropriated for the fiscal year 1933 were $14,500,000 as above noted. Forest-development road work generally is administered by the Forest Service. While this definition of the work of the two bureaus is approximately correct, the exact line of separation is drawn between what are termed major and minor projects. Projects of the major class which, under the rules and regulations, are administered by the Bureau of Public Roads, include all projects on the forest-highway system, except those which do not require the technical services of a highway-engineering organization and those having an estimated average cost of less than $2,000 per mile, and in addition, those forest-development road projects of estimated average cost in excess of $5,000 per mile and those requiring the technical services of a highway-engineering organization.

In accordance with requirements of the governing rules and regulations a system of forest highways has been designated by concurrent action of the several State highway departments, the Forest Service, and the bureau, approved by the Secretary of Agriculture. The highways constituting this system have been classified as follows:

Class 1. Forest roads forming sections of the Federal-aid highway system, either wholly within or, when so designated by the Forester and the

Chief of the Bureau of Public Roads, partly without and adjacent to the national forests.

Class 2. Forest roads, not of class 1, which are parts of approved State highway systems, when so designated by the Forester and the Chief of the Bureau of Public Roads.

Class 3. All other forest roads, of primary importance to counties or communities.

The roads which, according to these definitions, had been classified as forest highways, had an aggregate length on 30 June 1933 of 16,458.3 miles. The mileage of completed forest-highway roads, by States, is given in Table 4.

Table 4.—MILEAGE OF COMPLETED FOREST-HIGHWAY PROJECTS, BY STATES

State	Mileage of forest-highway projects completed	
	During 1933	Total to 30 June 1933
Western:		
Alaska	3.7	246.6
Arizona	52.8	514.3
California	55.8	595.2
Colorado	29.7	445.9
Idaho	36.2	626.9
Montana	16.5	472.7
Nevada	1.1	143.7
New Mexico	32.6	266.5
Oregon	47.6	855.6
South Dakota	4.1	51.9
Utah	2.2	356.5
Washington	19.5	259.5
Wyoming	5.1	330.7
Total	313.5	5,166.0
Eastern:		
Alabama	.....	5.1
Arkansas	18.4	93.4
Florida	3.2	72.3
Georgia	.....	21.4
Michigan	4.9	21.1
Minnesota	16.1	85.0
New Hampshire	.....	8.1
North Carolina	.....	43.3
Pennsylvania	.....	1.8
South Carolina	.....	15.6
Tennessee	.....	37.4
Virginia	3.3	19.3
West Virginia	.....	3.5
Total	45.9	427.4
Grand total	359.4	5,593.4

During the past year 359.4 miles of the forest-highway system were improved, bringing the total mileage improved to date with Federal funds to 5,593.4. Of the mileage improved during the year, 313.5 miles were in the western States and Alaska, and the remaining 45.9 miles were in the forests of five eastern States. Of the total mileage improved to date, 5,166.0 miles are in the West and 427.4 in the East.

On 30 June 1933, work was in progress under the supervision of the Bureau of Public Roads on 1,067.4 miles of road at a total estimated cost of $11,282,213.78. Work estimated to cost $1,933,827 had been planned but not yet started; and there was a balance of authorized funds not yet obligated to definite projects amounting to $1,722,113.70.

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. During the fiscal year 1933, 174 miles of road were constructed, making a total of 674 miles thus far improved. The mileage constructed during the fiscal year and to date in the several parks is shown in Table 5.

Table 5.—MILEAGE OF NATIONAL-PARK ROADS IMPROVED UNDER THE SUPERVISION OF THE BUREAU OF PUBLIC ROADS

National park or monument	Mileage completed under supervision of the bureau	
	During fiscal year 1933	Total to 30 June 1933
Acadia	0.3	3.9
Bryce Canyon	14.4	14.4
Colonial National Monument	....	10.0
Crater Lake	14.8	38.1
Devils Tower National Monument	....	.3
General Grant	2.4	6.4
Glacier	10.4	47.3
Grand Canyon	35.9	129.7
Hawaii	9.0	20.2
Lassen Volcanic	....	30.4
Mesa Verde	2.2	20.4
Mount Rainier	4.5	54.8
Petrified Forest National Monument	0.4	16.7
Rocky Mountain	28.1	36.8
Scotts Bluff National Monument	.6	.6
Sequoia	4.1	32.8
Shenandoah	40.1	40.1
Wind Cave	1.4	6.7
Yellowstone	3.4	92.9
Yosemite	1.8	56.4
Zion	.6	15.5
Total	174.4	674.4

The most important project constructed for the National Park Service under supervision of this bureau is the Wawona Tunnel in Yosemite National Park. This tunnel on the Wawona road connecting Yosemite Valley with the Mariposa Grove at Big Trees is 0.8 mile in length. It was completed during the past year. The great length of the tunnel made it necessary to provide lighting and ventilation.

An outstanding project of interest to the eastern States which was completed during the year is the Skyline Drive along the ridge of the Blue Ridge Mountains in the proposed Shenandoah National Park in Virginia. The completed road is 40 miles in length and for 35 miles it runs along or near the crest of the Blue Ridge Mountains through a section that has been visited in the past only by mountain hikers. Near the beginning of the project at Panorama the road leads through Mary's Rock Tunnel, 600 feet in length. There is then presented a panorama of the foothills of the Blue Ridge Mountains and plains of Virginia extending as far as the eye can see. The entire completed section is a route of continuous scenic beauty. This section comprises about one-third of the total improvement contemplated which will extend from Front Royal at the northern end of the park to near Waynesboro at the southern end.

The Fall River Highway in the Rocky Mountain National Park, Colorado, 28 miles in length, was built at a cost of $900,000. The road is located east of the Continental Divide on the main east-and-west road traversing the park. The entire project is located at a very high elevation. Some of the highest and most rugged peaks of the Rocky Mountains may be seen along this route.

Other park projects constructed during the past year include a parking area on the Cadillac

Mountain Road in Acadia National Park, the Rim Road in Bryce Canyon National Park and a section of the Scotts Bluff Road in Scotts Bluff National Monument.

Two large bridges were constructed in Petrified Forest National Monument. These bridges are known as the Rio Puerco and Dry Creek Bridges and are located on the main north-and-south highway which was completed during the fiscal year 1932.

Improvement of State Highways.—The State systems consist of 358,210 miles of road of State-wide importance selected out of the total 3,000,000 miles in the United States. The more important routes have been selected to make up the Federal-aid system and from this system, in turn, the U. S. highways have been selected. In 1932 the construction of State highways continued at a rate somewhat below that for other recent years but the decline was not so marked as for construction industries in general. Nearly 30,000 miles of road were surfaced, bringing the surfaced roads of State systems to 266,000 miles.

At the end of 1932 only 109,735 miles of the State systems had been improved with high-type surfaces such as bituminous macadam, bituminous concrete, Portland cement concrete and block types. Low-type surfaces such as waterbound macadam, gravel and sand-clay comprise 156,325 miles, and 92,150 miles were unsurfaced.

A recent survey shows that the State systems now have 4,300 miles of road of more than two lanes. These wide roads are in the more populous States and most of them are on the Federal-aid system. The States having more than 200 miles of such road are California, Illinois, Massachusetts, Michigan, New Jersey, New York, Ohio, and Wisconsin.

The above figures show that 73 per cent of the State highways are now initially surfaced but this is far from representing the progress of the work necessary to produce a complete and adequate system. A large portion of the 156,325 miles of low-type surfaces by reason of increased volume of traffic now requires a higher type of surface. Many of the surfaces require widening to make them safe for two lines of traffic. Changes in the character and speed of highway traffic make necessary some relocation to remove dangerous curves and grades, lengthen culverts and bridges and other similar work. In 1932, 6,210 miles of the surfacing placed involved a new surface of different type from the old surface on which it was placed and, in general, consisted of higher types to meet the needs of increased traffic.

Increased traffic has not only required further improvement of highways built some years ago but it also has increased the importance of many local roads to the point where they must be taken into State systems. From 1927 to 1932 there was an increase of nearly 65,000 miles in the extent of our State systems. At the present time there is a general need for study and classification of our highways so that all routes of general interest will be placed in State systems and supported by State highway revenues.

The total employment on construction and maintenance of State highways was 229,000 men in January of 1932 and rose to a peak of 374,000 men in September, with a subsequent decline to 290,000 in December. It is estimated that for every man directly employed in highway construction at least two others are indirectly employed in supplying materials, transportation, etc.

Continuation of State road work in 1931 without the marked decline shown in other industries was due in part to the steadiness of the income for these highways and in part to the accelerating effect of the Federal emergency highway appropriation of $120,000,000 on 21 July 1932.

The total State highway income during 1932 amounted to $898,318,000 composed of $632,200,000 from State revenue sources, $161,468,000 contributions from Federal and local sources and $104,650,000 from the sale of bonds and notes. Of the $632,200,000 derived from State sources, $49,977,000 was derived from direct property taxes and from appropriations and miscellaneous sources based principally on property taxation and $582,223,000 or 92 per cent, was derived from taxation of motor vehicles or gasoline and bridge tolls.

The expenditure for State highway purposes during 1932 was $816,765,000. This expenditure was composed of $551,446,000 for construction and right of way, $169,479,000 for maintenance, $22,132,000 for equipment and machinery, $69,292,000 interest on bonds and notes and $4,416,000 for miscellaneous expenses.

Inter-American Highway.—All field operations in connection with the reconnaissance survey of the proposed inter-American highway from Panama to the United States were completed before 1 July 1933. The reconnaissance operations included ground surveys through the republics of Panama, Costa Rica, Nicaragua, Honduras, and Guatemala, in which the American engineers and representatives from the local governments covered approximately 900 miles afoot or on horseback. Aerial photographic surveys of the region along the route were also made by the United States Army Air Corps operating from its Panama base at France Field.

A report of this important project is now being compiled. It will contain complete engineering details and in addition will outline the general and economic characteristics of the countries to be traversed by the proposed highway. From an engineering standpoint, the construction of an all-weather road 3,200 miles long, from Panama City, Republic of Panama, to Nuevo Laredo, Mexico, is entirely practicable; more than 1,200 miles of the total route, in fact, are already passable to motor vehicles in all seasons, and 1,000 miles more are passable in the dry season. Construction work is being actively pushed on a number of local stretches of road, particularly in Panama and Mexico.

Transportation, Economic and Statistical Investigations.—A number of investigations were conducted in connection with the traffic on roads. A study of the highway system of Michigan disclosed the fact that 50 per cent of the traffic is on city streets, 5 per cent on township roads, 12 per cent on county roads, and 33 per cent on the State highway system. Of the traffic on city streets, 69 per cent was local to the city and 31 per cent from or to points beyond the city limits. A regional-area traffic survey was made of Washington, D. C., and its environs, and possible relocations and extensions of important highways to accommodate the traffic were pro-

jected. Extensive traffic surveys were made of 11 representative counties in Indiana and the highway system of the whole of New Jersey. Research in the traffic capacity of highways and intersection studies disclosed valuable information. The best color combination for traffic signs was found to be a yellow background with black lettering. Uniformity of motor vehicle regulations in the various States and studies of taxation in Wisconsin, Michigan, and Illinois were among the other research projects.

Production Cost Studies.—Studies of the previous year that showed some 90 per cent of the taxpayers' road dollar eventually was paid to workers as wages and salaries were expanded to show the extent to which normal industries profit from highway work. Trends of costs of highways were studied and index figures prepared. A monthly record of persons employed on State and Federal highway work was made and studies of wage rates and hours of employment were carried on. Technical studies of rolled concrete pavements were conducted. Concrete from central mixing plants was studied as to mixing time and aggregates. Investigations of methods of building low-cost highways by plant-mix and road-mix methods showed gratifying results. Grading studies to determine the application of machines to such work were made in an effort to meet the changing conditions existing for that class of highway work. An investigation was made to provide a system of accounts and records that will meet the most exacting requirements as to speed and economy of operation and yet give the highest accuracy.

Physical Research.—Studies were made of the impact reactions of motor vehicles and an extensive program outlined to investigate the effect on road surfaces of suddenly applied forces. Many loadings and other observations were made to assist in a better understanding of the structural action of concrete pavement slabs with a view to improving the design methods. Concrete aggregates were studied in tests of full-size specimens giving conclusions as to the effect of vibration, delayed finishing and durability. Examinations were made of several types of arch bridges and studies of the sliding of expansion bearings were conducted. A single-wheel trailer to determine the roughness of pavements was developed. Research in the field of bituminous materials and low-cost roads was continued in field studies and in the laboratory. Progress has been made toward the development of simple tests to determine subgrade characteristics, a field in which comparatively little research previously had been undertaken.

ROBERTSON, Field Marshall Sir William, British army officer: b. Welbourne, Lincolnshire, 29 Jan. 1860; d. London, 12 Feb. 1933. Sir William was the only man who ever rose from trooper to the highest rank in the British army. Enlisting in 1877, for 11 years he served in the ranks before being commissioned. Eight years service in India followed and in 1896 he was sent to Camberley College. From 1900 until the outbreak of the World War he served in various posts in England, being commandant of the Staff College, 1910–13. On the outbreak of the World War he was sent to France as quartermaster-general, but was made chief of the General Staff in the field in 1914 and chief of the Imperial General Staff in London in 1915. Convinced that concentration on the western front was the only way to beat Germany, Sir William soon came into conflict with the British War Cabinet and in 1918 was relieved of his high command. Subsequent events proved the accuracy of his contentions. In 1919–20 he was commander-in-chief of the British Army on the Rhine. Knighted in 1919, a year later he was promoted to Field Marshal. He published 'From Private to Field Marshal' (1921).

ROCKEFELLER FOUNDATION The. An institution chartered in 1913 "to promote the well-being of mankind throughout the world." Its plan of work provides for co-operation toward the advancement of knowledge in the fields of public health, the medical sciences, the natural sciences, the social sciences and the humanities. For work in these fields the foundation during the year 1933 expended approximately $15,000,000.

In addition to the new grants made during 1933, enumerated below, the foundation continued to make payments towards many projects initiated in 1932 or earlier years, where support or assistance over a period of years was specified in the original appropriations.

Public Health.—In the field of public health, assistance was given for research on yellow fever, malaria, hookworm disease, tuberculosis, undulant fever, yaws and diphtheria; for yellow fever surveys and control campaigns; for demonstrations of malaria and hookworm disease control and of local health work; for the organization or maintenance of essential services of State and national health departments; toward the advancement of the work of the Health Organization of the League of Nations; and for the development of schools and institutes of hygiene and public health. The following institutions were included among those receiving the larger grants: the Institute of Hygiene and Public Health, Rome; the Institute of Hygiene and the Health Center, Bucharest; the London School of Hygiene and Tropical Medicine; the State Institute and School of Hygiene, Warsaw; the Institute of Public Health, Tokyo; and the School of Public Health, Zagreb, Yugoslavia. Fellowships in public health and public health nursing were provided, and opportunities were given for the training of health workers in connection with health demonstrations and through travel.

A considerable amount of research work was done by members of the field staff of The Rockefeller Foundation's International Health Division. Some 35 articles covering the results of this work appeared in the medical press during the year.

The Medical Sciences.—Appropriations for the advancement of medical science included grants to the following institutions or organizations for maintenance, for the development of specific departments, for endowment, or for special research projects: to the China Medical Board, Inc., for maintenance of the Peiping Union Medical College; to the University of Utrecht, for a building for the Institute of Comparative Physiology; to the Johns Hopkins University Medical School, for research in the Department of Psychiatry over a four-year period; to the Harvard Medical School and the Massachusetts