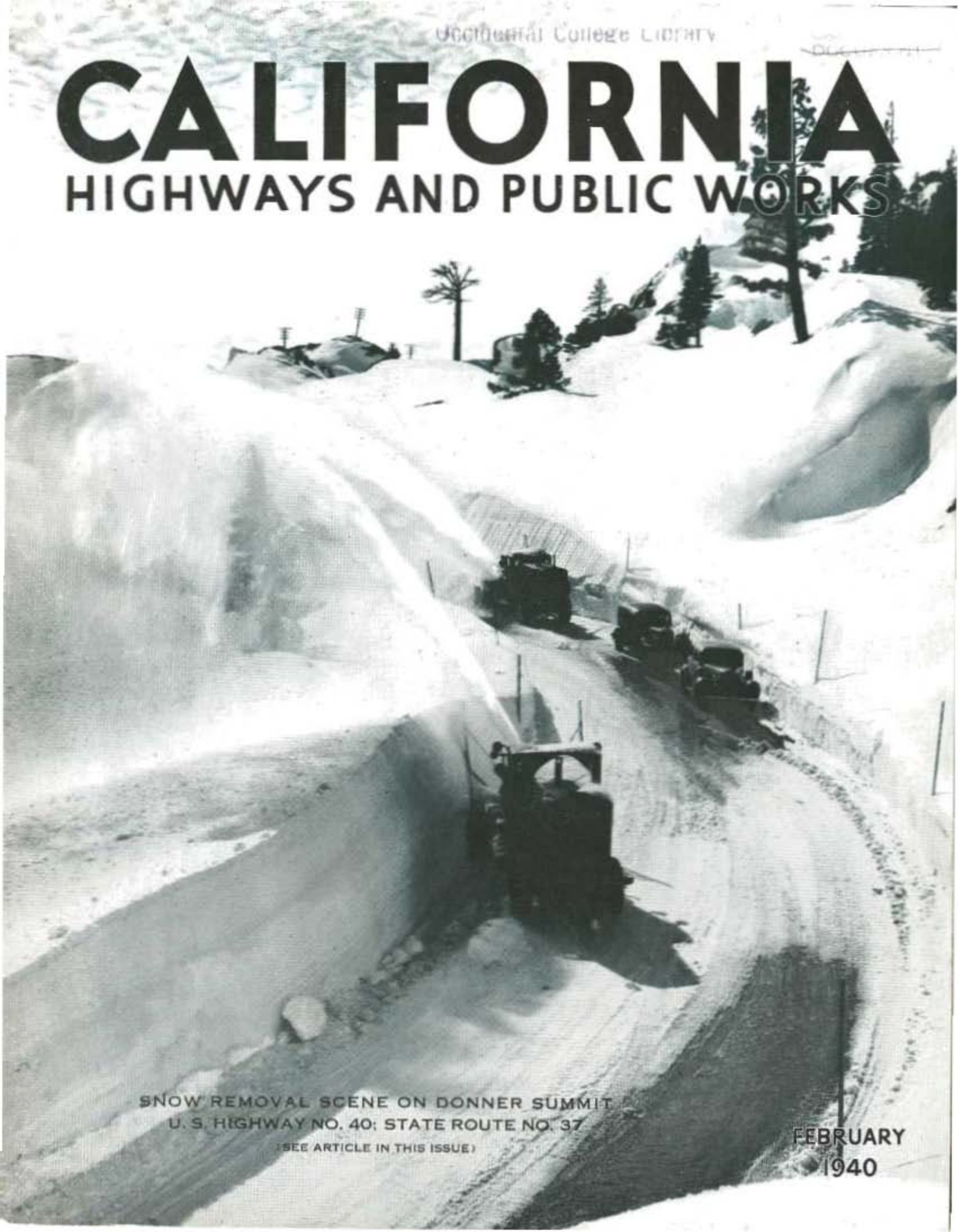
CALIFORNIA
HIGHWAYS AND PUBLIC WORKS



SNOW REMOVAL SCENE ON DONNER SUMMIT
U. S. HIGHWAY NO. 40; STATE ROUTE NO. 37
(SEE ARTICLE IN THIS ISSUE)

FEBRUARY
1940

CALIFORNIA HIGHWAYS AND PUBLIC WORKS

Official Journal of the Division of Highways of the Department of Public Works, State of California

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Published for information of the members of the department and the citizens of California

Editors of newspapers and others are privileged to use matter contained herein. Cuts will be gladly loaned upon request

Address communications to California Highways and Public Works, P. O. Box 1499, Sacramento, California

Vol. 18 FEBRUARY, 1940 No. 2

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Governor Olson Asks Solons to Unfreeze $50,000,000 Central Valley Project Bonds

IMPORTANT developments affecting the Central Valley Project moved in swift succession during the last month. In Washington, D. C., President Franklin D. Roosevelt made a supplemental recommendation to the Congress asking an additional $6,000,000 for construction work on the Central Valley Project during the present fiscal year. The President previously had recommended to Congress an appropriation of $16,000,000 to carry on the work this year. The figure was $6,000,000 less than the $22,000,000 which engineers of the United States Bureau of Reclamation had determined was the minimum amount on which the construction could be carried out without interruption or delay and brings the President's recommendations up to the engineers' estimates.

In California, Governor Culbert L. Olson, in compliance with requests from the Federal Government and numerous local groups, included in the agenda for the special session of the Legislature an amendment to the Central Valley Project Act which would unfreeze up to $50,000,000 of the revenue bonds authorized by the act.

Enactment of the legislation would place the Water Project Authority in a position to provide supplementary works necessary to make the project operative and thus effectively assume the responsibility which the Federal Government repeatedly has pointed out is the duty of the State.

Specifically, the proposed amendment is designed to accomplish the following:

1. To authorize the Water Project Authority to issue up to $50,000,000 of the $170,000,000 bond authorization of section 18 of the act, notwithstanding any restriction or limitation contained in section 18.

2. To limit the authorization to purposes and objects of the act as may be requested or approved by the Secretary of the Interior.

3. To provide adequately for successive and independent bond issues.

Complete Text of The Central Valley Project Bond Bill

An act to add section 18a to the Central Valley Project Act of 1933, relating to the issueance of revenue bonds by the Water Project Authority of the State of California.

The people of the State of California do enact as follows:

Section 1. Section 18a is hereby added to the Central Valley Project Act of 1933 to read as follows:

Sec. 18a. In order to carry out and perform such of the purposes and objects of this act as may be requested or approved by the Secretary of the Interior of the United States, the Authority, notwithstanding any restriction or limitation contained in section 18, is authorized and empowered to issue a portion of said bonds authorized by said section 18, in a total sum of fifty million dollars, or so much thereof as may be necessary therefor. Notwithstanding any provision of this act inconsistent herewith, successive issues of bonds within the limits of the authorization contained in this section shall have preference with respect to the redemption thereof and the payment of interest thereon and the lien thereof upon revenues as the Authority in its discretion shall determine.

In his message to the Legislature concerning the amendment, Governor Olson declared:

"I have considered carefully whether legislation could be further delayed until the next regular session without injury to the public interest and without ignoring the requests received from the Federal administration. I am convinced that can not be done and that the need for this legislation is so urgent that it would be a dereliction of duty on my part if I failed to include it in the subjects submitted for your consideration.

"The Federal Government will surely complete this project if California will do the things needed to be done and give the people its full benefit in the delivery to them, at the lowest possible cost, of the water and power from this project. That objective can only be obtained through public distribution.

"The proposed amendment in simple language would free up to $50,000,000 of the $170,000,000 of revenue bonds authorized in the present act, to be used by the State in carrying out the purposes and objectives of the act itself. It would place the State in a position to contract with the Federal Government for distribution of the electric power developed by the project, instead of leaving the Federal Government and the people to be served at the mercy of a private power distribution monopoly which would be its only purchaser.

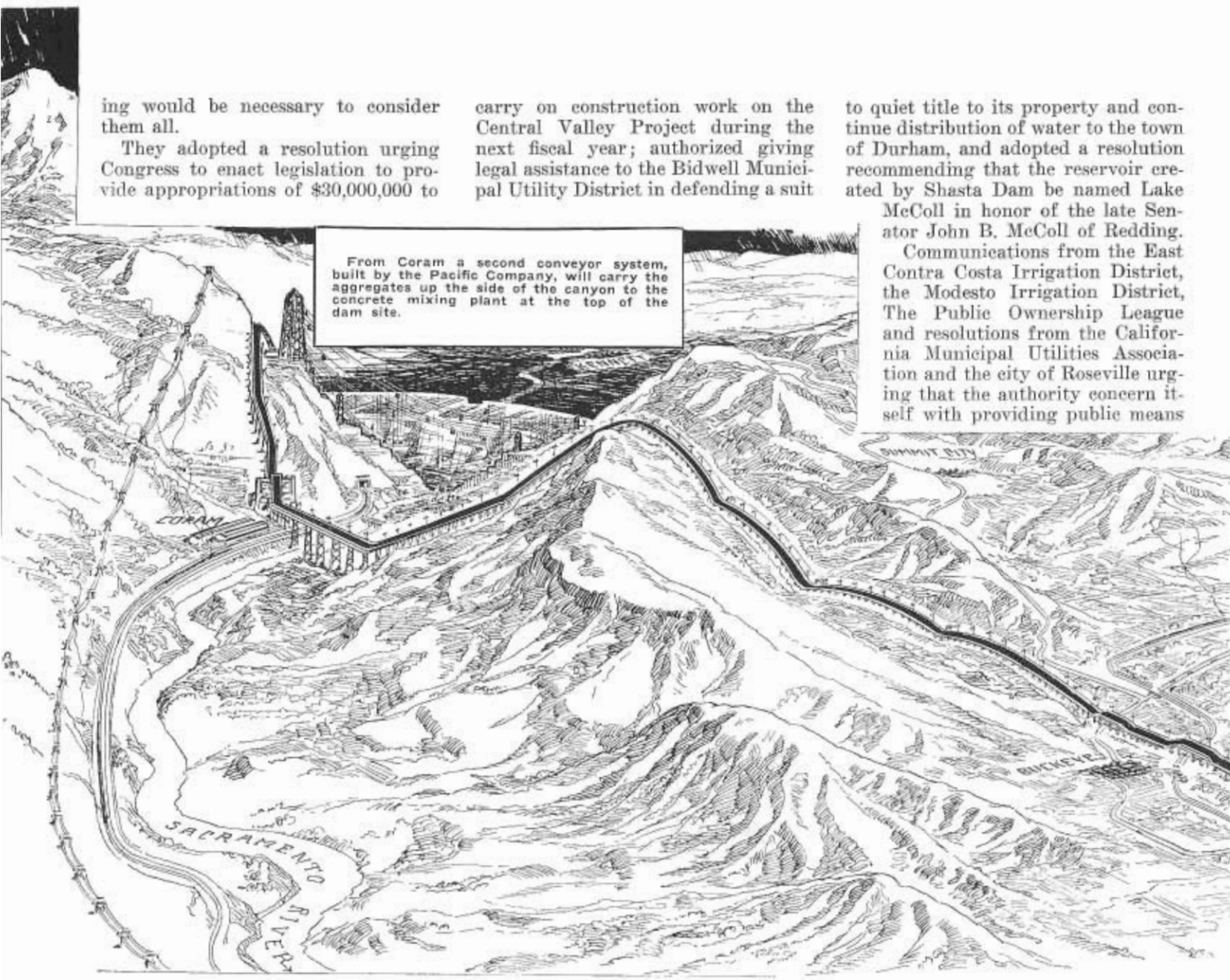
"Federal Government officials are well aware of the need for haste in having this legislation enacted. They know the inevitable delays which follow if the distribution and marketing features of a project are left untouched until the project is completed. The Federal Government and the people suffered loss from delays in providing for public distribution of power upon the completion of the Bonneville project in the State of Washington. Such a condition in California should be prevented by your action at this session."

During January, the Water Project Authority held three important meetings. At the first of these, held on January 16, the authority members found there were so many important matters on the agenda a second meet-

ing would be necessary to consider them all.

They adopted a resolution urging Congress to enact legislation to provide appropriations of $30,000,000 to carry on construction work on the Central Valley Project during the next fiscal year; authorized giving legal assistance to the Bidwell Municipal Utility District in defending a suit to quiet title to its property and continue distribution of water to the town of Durham, and adopted a resolution recommending that the reservoir created by Shasta Dam be named Lake McColl in honor of the late Senator John B. McColl of Redding.

Communications from the East Contra Costa Irrigation District, the Modesto Irrigation District, The Public Ownership League and resolutions from the California Municipal Utilities Association and the city of Roseville urging that the authority concern itself with providing public means



From Coram a second conveyor system, built by the Pacific Company, will carry the aggregates up the side of the canyon to the concrete mixing plant at the top of the dam site.

Shasta Dam Aggregate Conveyor Belt, Longest in the World, Will Carry 22,000 Tons Daily 9.6 Miles Over Hills and Valleys

WITHIN a few weeks California will have another "first" to add to her already imposing galaxy of super-colossals. The newcomer will be the longest conveyor belt system in the world. It is being built to transport aggregates from gravel deposits at Redding to Shasta Dam.

Work on the conveyor system is being rushed to completion and it is anticipated it will be in operation early in March in ample time for the beginning of concrete pouring at the dam. The conveyor will be 9.6 miles long, cutting across the hills and valleys in an almost straight line from Redding to Coram. Another conveyor system, more than a mile long will be used to carry aggregates from pits at Coram up the steep sides of the canyon to base of head tower where concrete for dam will be mixed.

The Columbia Construction Company, which has the contract for preparation of the aggregates, has completed its washing and grading plant at the gravel deposits just east of Redding. A subcontract for furnishing 16,000 trough and return belt idlers, or rollers, was awarded by Columbia to the Chain Belt Company of Milwaukee, Wisconsin. About 18 miles of steel tubing, 11 miles of steel shafting, 10½ miles of angle iron, 50,500 malleable castings and 83,000 anti-friction roller bearings are required for the idlers.

A second subcontract for the manufacture of more than 20 miles of 36-inch, six-ply belting was awarded to the Goodyear Tire and Rubber Company of Akron, Ohio. Almost 1,000,000 pounds of rubber and more than 1,000 bales of cotton are required.

Most of the framework for the conveyor is of wood construction. One canyon crossing requires 90-foot steel

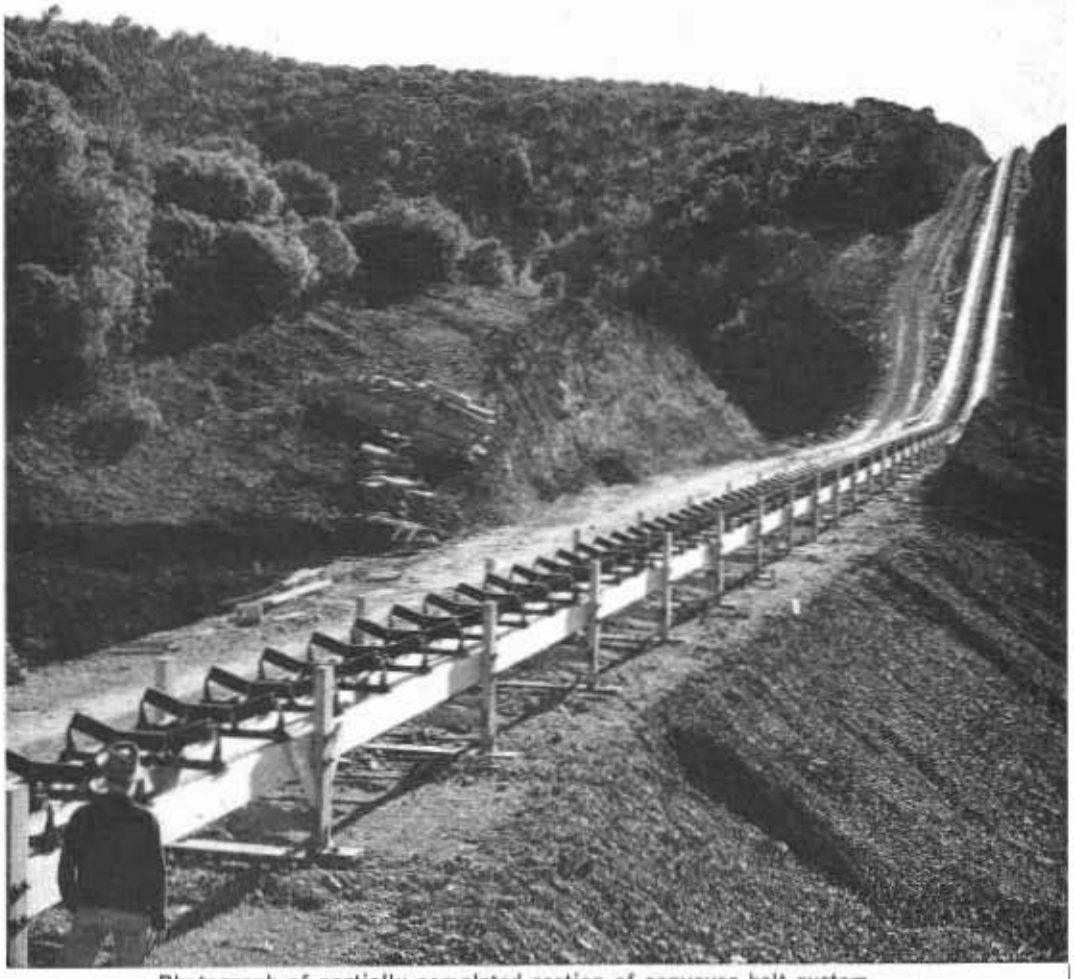
(Continued on page 4)

of power distribution were received and filed without action.

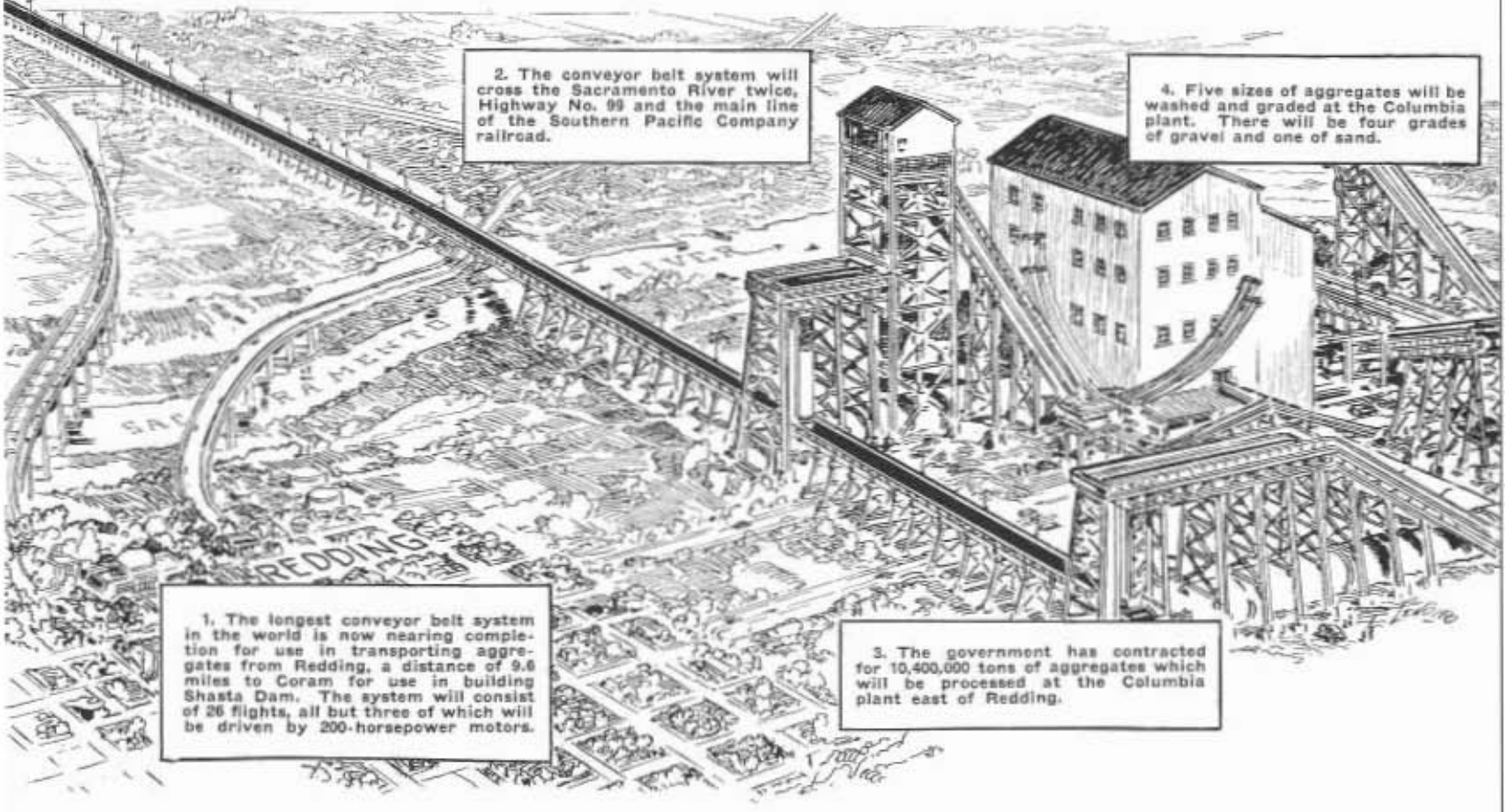
Stephen W. Downey, attorney for the Sacramento Municipal Utility District, presented a written statement asking the authority to make the district a firm offer on energy from the Central Valley Project.

In addition representatives from a number of valley irrigation districts and other agencies made verbal requests that the authority take steps to provide them with power from the project. Among those appearing were W. F. Wooley on behalf of the West Stanislaus Irrigation District and five other west side districts in the lower San Joaquin Valley; George K. Anderson of the Byron Bethany Irrigation District; Felix Swan of Reclamation District 2068; F. R. Reyner of the Banta Carbona Irrigation District; L. L. Miller of the Central San Joaquin Municipal Utility District and John Henning representing the city of Lodi.

Clarence Breuner and Roland Curran of Sacramento, and Thomas M. Carlson of Richmond, members of the Central Valley Project Association, spoke in opposition to the enactment of any State legislation at the special



Photograph of partially completed section of conveyor belt system.



session which would permit the authority to assist the Federal Government in making the project operative.

In view of the importance of the proposed legislation, the authority set it for a special hearing on January 22. Opposition to the legislation received wide publicity, with the result that approximately 200 farmers, representing all sections of the Central Valley, came to the hearing. The board room in the Public Works Building was much too small to accommodate them and the meeting was transferred to the Assembly Chamber in the Capitol.

State Grange Master George Sehlmeyer, representing 25,000 farmers in the State, told the authority his organization would fight any effort on the part of the authority to make the Central Valley Project a "water conservation plan that does not include the development and distribution of power."

"Power must take the majority of the load," he declared, "and we must have public outlets for that power in order to get competitive bidding and build the revenue from power up to the point where it will carry its share of the load. The California State Grange and these farmers are requesting that public outlets for power be made available."

In the all-day hearing, farmer after farmer took the floor to stress the need for early action on the part of the authority to provide the means for public distribution of the power from the Central Valley Project. Irrigation district representatives from the lower San Joaquin Valley declared that the only reason the project was approved in that part of the State was on the promise of cheap power through public distribution.

Farmers from the Sacramento Valley, from which surplus water is being transferred to the San Joaquin Valley, asked in exchange that power be served to them from the project by the State.

Again members of the Central Valley Project Association, Clarence Breuner of Sacramento, Thomas M. Carlson of Richmond, Harry Barnes of Madera and James Fauver of Exeter reiterated the opposition of their association as presented at the previous meeting.

At the end of the day-long session, the farmers stayed on to organize a new committee dedicated to furthering the interests of the Central Valley Project. The organization adopted the name of the Citizens' Central Valley Committee and unanimously went on record urging Governor Olson to include the proposed legislation in the agenda for the special session of the Legislature.

Two days later the Water Project Authority met again and after hearing statements from members, Attorney General Earl Warren and State Treasurer Charles G. Johnson, opposing introduction of the legislation at the special session, voted two-to-two on the proposition. Chairman Frank W. Clark and State Director of Finance John R. Richards voted aye and Attorney General Warren and Treasurer Johnson voted no. The fifth member of the authority, State Controller Harry B. Riley, was absent.

The authority approved the work program being carried on by the Division of Water Resources in its behalf and authorized the preparation of a test case to secure a decision by the Supreme Court of California that a public district, corporation or municipality owning and operating or contemplating owning and operating an electric power distribution system may compel a privately owned public utility serving the same territory to furnish electric energy to such publicly owned system.

Belt to Tote 22,000 Tons Daily

(Continued from page 2)

bents. The belt line will cross the Sacramento River twice, pass over U. S. Highway 99, the main line of the Southern Pacific, five county roads and four creeks.

The conveyor system will consist of 26 flights. Each flight will be operated by a 200-horsepower motor except the last three. These are located on a 25 per cent down grade on the east slope of the Sacramento River Canyon and will be equipped with motor generators which can utilize the potential energy of the loaded belt to generate power to help pull the aggregates up the other side of the hill. The entire system will be illuminated by sodium vapor lamps.

The estimated maximum daily aggregate requirement at Shasta Dam is to be 16,000 tons of gravel and 6,000 tons of sand. The capacity of the belt system is to be 1,100 tons an hour at a speed of 550 feet per minute.

F. R. Sachse Made Assistant Director of Public Works

FRANZ R. SACHSE

GOVERNOR Culbert L. Olson on February 6 announced the appointment of Franz R. Sachse of Los Angeles as Assistant Director of the Department of Public Works.

Mr. Sachse, who has been engaged in the practice of law in Southern California since 1933, will take over the duties of chief assistant to Director of Public Works Frank W. Clark. Educated in the public schools of California, Mr. Sachse is a graduate of Stanford University.

As a member of the executive board of the Municipal League of Los Angeles and of the executive body of the Los Angeles Chapter of the National Lawyers' Guild, Mr. Sachse has been prominent in civic affairs in Southern California.

The new assistant director is the son of Richard Sachse, Director of the Department of Natural Resources. He will make his home in Sacramento with his wife and four year old daughter.

"The Department of Public Works is fortunate in securing the services of Mr. Sachse," Director Clark said. "He will be of great help to me and to the department and a credit to Governor Olson's administration."

Auger blower rotary plows at work during night on Donner Summit highway (U. S. 40) clearing and keeping it open for traffic.

Costs of Snow Removal in Relation to Traffic

By T. H. DENNIS, Maintenance Engineer

EACH winter, approximately 3400 miles of State highways which traverse the high mountain areas are cleared of snow so that normal communication and travel will be possible. The magnitude of this task is apparent from the size of the annual bill, which has varied from $390,000 during a mild winter, to as much as $575,000 during a severe winter—the average cost for the last three years being $482,000 per season.

Expenditures for snow removal add up to such a substantial amount, and there is such an increasing demand for this winter service, that a question is suggested as to whether the benefits resulting from this work justify the expense. A definite answer to this question is hardly possible. It would be exceedingly difficult even to list all the various kinds of benefits which derive from open highways. However, an analysis of snow removal costs on the State highway system has produced some interesting data, which is at least pertinent to the subject.

The State highway routes included in the present snow removal program may be classified into two groups, according to the predominating type of traffic which uses the road. One group includes the main line or through routes, and the second group comprises those routes which carry purely recreational traffic.

DIFFERENCE IN COSTS

In investigating snow removal expenditures, it has been found that, while there is a wide divergence in costs between various individual roads, the average unit cost incurred on the purely recreational routes has been considerably in excess of the average cost incurred on the through routes. This is due primarily to the highly intermittent character of recreational traffic. Daily winter traffic on the main highways, even through snow country, conforms more or less closely to a fixed pattern, and is fairly constant. Winter recreational and snow sport travel, however, is very sensitive to conditions which effect winter sports, particularly the weather, and is spasmodic.

AVERAGE TRAFFIC FLOW

This type of traffic usually reaches peak flow on week ends and holidays, with a comparatively small travel, often practically nothing, throughout

Scene on U. S. 40 in snow sports area of Nevada County near Soda Springs.

the balance of the week. In spite of the popularity of certain winter sports areas, average daily traffic on recreational roads during the winter months is low, and consequently unit costs per vehicle mile for snow removal on those routes are high.

High snow removal costs on a route in relation to traffic volume do not, of course, necessarily indicate that the expenditures are unwarranted. In general, the cost of clearing snow should have some relation to the volume of travel on the road. There are, however, other factors of an economic and social nature which may tend to justify an all-year highway service, which would not be warranted on the basis of highway travel only.

This analysis of the cost of snow removal on the State highway system is based on average costs incurred during the last three years, and upon the classification of State highway routes according to the purpose served by the snow clearing operations—that is, whether traffic is through or purely recreational.

In the first group of roads there are 2838 miles of State highway, which are normally cleared of snow to maintain travel between county seats or centers of population, or to serve important or through traffic. The average cost of clearing these routes has been $368,454 per season. By applying the seasonal percentages ascertained from monthly recount stations to the traffic volumes obtained in the regular counts, it is estimated that approximately 90,727,000 vehicle miles are generated on this road mileage during the months of January, February and March. Thus on the through routes and connections, the average unit cost for snow removal has been $4.06 for 1000 vehicle miles of snow territory travel.

Costs on certain routes have been considerably in excess of this average. For example, it is estimated that 6,606,000 vehicle miles are generated on the Donner Summit highway during the winter quarter (a portion of this is recreational), and the cost of clearing snow on this route has amounted to $12.52 per 1000 vehicle miles. Traffic on the Red Bluff-Susanville highway is estimated at 2,520,000 vehicle miles for the winter quarter, and snow removal on this route has cost $13.94 per 1000 vehicle miles.

In the second group of roads, there are 555 miles of State highways which are cleared of snow each win-

ter solely for recreational purposes. None of these routes connect centers of population or serve through traffic, the primary purpose of the snow removal operations being recreational.

The average cost of clearing these roads has been $113,626 per season. On the basis of the regular snow counts where available, or where no snow counts have been taken, by the application of monthly percentages to the total annual traffic, a close approximation has been made of the vehicle miles generated on these 555 miles of highway during the winter quarter. It is estimated that this travel amounts to approximately 10,306,000 vehicle miles during January, February and March, and the average unit cost per snow removal on the purely recreational roads has been $11.02 per 1000 vehicle miles of snow territory traffic.

Here again unit costs on certain routes have considerably exceeded the group average. For example, costs on the Wrightwood-Big Pines Camp road have been $19.18 per 1000 vehicle miles, on the Big Bear Lake road, $12.35 per 1000 vehicle miles, and on Route 83, Burney to Lassen Park, $35.79 per 1000 vehicle miles.

GAS TAX COMPARISONS

How do these units costs for moving snow compare with the gasoline tax revenue earned by these routes during the winter months? It has been found that the average gasoline consumption per automobile is about 13½ miles per gallon, and 1000 vehicle miles, therefore, represents the purchase of 74 gallons of gas. The tax paid on this amount of gasoline, at 3 cents per gallon, is $2.22 per 1000 vehicle miles. The Division of Highways' portion of this revenue is 1½ cents per gallon or $1.11 per 1000 vehicle miles, and this earned revenue compares with an average snow removal cost of $4.06 per 1000 vehicle miles on the through routes, and $11.02 per 1000 vehicle miles on the recreational routes.

Obviously, traffic through snow territory by no means pays its way, but on the contrary a generous contribution from the average motorist is required to keep the through routes open and an exceedingly liberal subsidy is required to keep the recreational routes open.

It is to be noted that the unit costs for snow removal, stated above, have been calculated on the basis of the traffic generated only on the road

Groups of skiers arriving on Donner Summit for day's sport.

Truck equipment slicing down high snow bank on Donner Summit Highway

mileage actually cleared of snow. There is, of course, a considerable volume of travel on highways leading to the snow routes which is induced by the fact that these snow routes are kept open. This tributary traffic may be regarded as contributing to some extent to the revenue earned by the snow routes, as undoubtedly some of this travel is over and above what would otherwise occur. There is, however, no way of estimating the extent of such traffic or earnings.

The volume of traffic which traverses those routes on which heavy snow removal costs are incurred appears, also, to be very small in relation to the funds allocated to keep the roads open. It is estimated that there were generated in 1938 on the rural State highway system an average of 19,000,000 vehicle miles per day, and that a total of 1,453,500,000 vehicle miles occurred during the months of January, February and March.

During these three winter months, 90,727,000 vehicle miles, or 6 per cent of the total State traffic, occurred on the through routes on which snow removal operations were carried on. In the same three months, 10,306,640 vehicle miles, or 0.7 per cent of the total State traffic, occurred on the routes which were cleared of snow for winter sport and recreational purposes.

In an average year over 5 per cent of all funds budgeted for State highway maintenance purposes is expended for clearing snow on roads which carry only 1.4 per cent of the total annual highway traffic, and 1.3 per cent of all maintenance funds are expended for clearing snow on the purely recreational routes, which carry only 0.15 per cent of the total annual traffic. It would seem that the snow sport enthusiasts are being well provided for, in so far as service on State highways is concerned.

There is one conclusion which can be drawn from these figures which is not controversial—clearing snow from highways is expensive. The following tabulations list the State highways now cleared, their classification as recreational or through routes, and the average expenditures for snow removal on each road for the past three winters:

AVERAGE SNOW REMOVAL COST ON ALL STATE HIGHWAYS EXCLUDING RECREATIONAL ROUTES

Route	Road	Road Miles	Average Cost Snow Removal
1	Crescent City-Grants Pass	43.6	$1,833.67
20	Blue Lake-Redding	141.7	5,575.81
84–46	Willow Creek-Yreka	155.1	1,764.69
35	Alton-Red Bluff	102.2	2,766.48
1	Willits-Cummings	43.4	645.45
89	Middletown-Lakeport	19.6	746.80
3	Redding-Ashland	124.9	21,550.77
72	Weed-Klamath Falls	62.2	6,243.09
28	Redding-Alturas-Stateline	174.5	19,872.07
29	Red Bluff-Susanville-Reno	184.1	35,117.34
21	Feather River Highway	116.0	12,741.82
73	Susanville-Oregon Line	141.1	8,042.80
82	Etna-Montague	34.2	2,373.81
83	Mt. Shasta City-Hat Creek-Chester-Keddie-Sierra Co. line	123.1	19,342.72
35	Peanut-Douglas City	28.5	1,747.20
47	Deer Creek Road	55.7	1,083.97
37–38	Donner Summit	89.6	82,705.96
11	Placerville-Echo Summit	47.9	7,047.26
38–39	Lake Tahoe Roads	56.4	19,375.71
83	Truckee-Sierraville	39.3	3,999.28
25	Colfax-Grass Valley-Downieville-Sattley	87.8	12,949.66
17	Auburn-Nevada City	25.5	342.82
57	Bakersfield, Isabella-Freeman	64.4	$981.88
4	Ridge Route	33.8	4,702.05
58	Tehachapi Route	49.7	1,297.98
41	Kings River Canyon	11.6	4,362.57
59	Gorman-Lancaster	16.2	94.59
138	Ventura-Maricopa	33.0	190.34
61	Carlton Flats Road	8.4	584.18
62	San Gabriel Canyon	14.3	508.17
59	Palmdale-Cajon	30.3	691.88
31	Cajon Pass	30.0	860.93
26	San Gorgonio Pass	14.6	59.33
31	Barstow-Las Vegas	14.0	515.26
64	Hemet-Keen Camp-Indio	30.0	1,099.24
23	Los Angeles-Reno	187.4	63,000.03
96	Bridgeport-Sweetwater	13.8	274.83
76	Bishop-Tonopah	41.6	888.59
63	Big Pine-Goldfield	18.0	927.55
40	Tioga Pass	14.6	1,396.33
13	Sonora Pass	59.5	745.31
40	Benton Station-Benton	8.7	315.61
76	Camp Sabrina Road	17.6	2,912.51
34	Carson Pass	57.1	2,765.71
23	Luther Pass-Woodfords-Markleeville	31.7	3,427.06
24	Ebbetts Pass	65.3	2,294.26
40	Big Oak Flat Road	21.2	510.20
12	San Diego-El Centro	24.0	1,596.91
78	Descanso-Julian-Santa Ysabel	25.0	3,138.12
198	Julian-Kane Springs	6.0	444.14
	Totals	2,838.2	$368,454.74

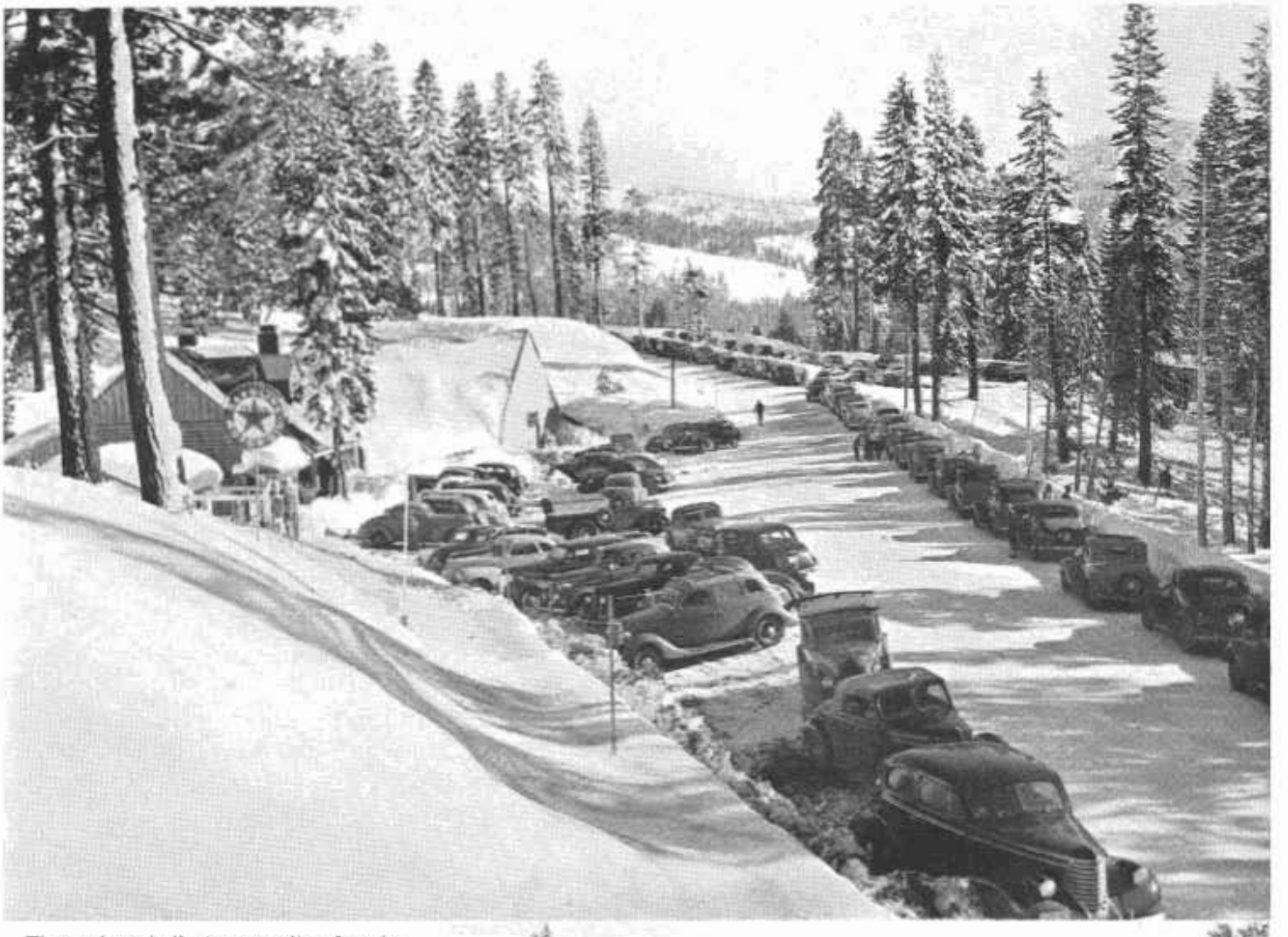
AVERAGE SNOW REMOVAL COST ON STATE HIGHWAYS FOR RECREATIONAL PURPOSES

Route	Road	Road Miles	Average Cost Snow Removal
20	Redding to Lassen Park	35.9	$1,600.24
83	Burney to Lassen Park	21.2	1,365.85
15	Nevada City-Emigrant Gap	27.1	18,092.62
11	Placerville-Kyburz	30.3	5,264.25
125	Coarsegold-Yosemite	19.3	3,976.05
76	Toll House-Huntington Lake	35.1	7,356.80
41	Dunlap-General Grant Park	20.4	4,144.14
129	Badger-General Grant Park	15.0	553.09
127	Camp Nelson Road	29.1	232.87
142	Glennville-Isabella	43.5	1,676.25
61	Wrightwood-Big Pines Camp	8.7	4,505.99
43	Big Bear Lake Road	71.4	32,573.20
59–189	Lake Arrowhead Road	39.8	6,270.06
188	Camp Seeley Road	11.8	1,127.58
190	Camp Angelus Road	20.3	3,853.02
111	June Lake Road	15.6	3,426.14
112	Mammoth Lake Road	8.3	3,583.26
34	Pine Grove-Antelope Springs	15.5	1,035.07
24	Murphy's-Camp Connell	19.0	5,401.78
13	Pooleys-Strawberry	22.3	6,001.41
40	Groveland-Cliff House	14.6	754.91
18	Mariposa-Yosemite	30.8	831.65
	Totals	555.0	$113,626.23

Another phase of this snow problem concerns the State's investment in plant and equipment. When the Division of Highways undertakes to keep a highway open through snow country, it assumes a heavy responsibility, and it is imperative that proper and adequate equipment be available to insure, at all times, the safety of traffic using the route.

As of November 30, 1939, the inventory value of all snow plows operating on the State highway system amounted to $492,488 and the value of trucks engaged in snow removal work amounted to $582,919. In addition, numerous light vehicles and miscellaneous equipment amounting to between $150,000 and $200,000 are used, the total investment in equipment used for snow removal being over $1,200,000.

The investment in maintenance stations and plant facilities chargeable to snow operations is difficult to seg-



These views indicate necessity of parking regulations on snow roads as enacted by the last Legislature. The upper picture shows the highway kept open in a controlled area and below a traffic jam in an area without control.

regate, but the figure is substantial. In connection with snow fighting, it is also very important that continuous communications be maintained between areas subject to heavy snowfall and the lower elevations. There have been instances where failure of the regular channels of communication and lack of information as to conditions along the routes have resulted in serious delays.

To supplement other means of communication, radio facilities are now being installed in all districts where deep snow or severe storm conditions are likely to create a hazard, and continuous communication will be possible with the various field offices and even with the rotary snow plows at work on the roads. The investment in this radio equipment will be approximately $60,000.

Highway Improvements in 1939 Exceeded Those of Previous Year

THE CALENDAR year of 1939 included the last six months of the biennial budgetary period ending June 30, 1939, and the first six months of the current biennial period which began on July 1, 1939, and ends June 30, 1941. Since the final months of a biennium are devoted ordinarily to getting under way the few remaining projects budgeted for that period and various unavoidable contingencies normally tend to retard progress at the start of a two-year program, the year 1939 might well have been expected to show a relative reduction in highway progress in comparison with 1938.

The records of the Division of Highways indicate, that while a reduction in the total estimate cost of contract work initiated in 1939 did occur, and that the number of construction and maintenance contracts awarded was 213 as compared with 216 in 1938, from the standpoint of mileage, improvements undertaken in 1939 were actually in excess of those in either 1937 or 1938.

This circumstance reflects in concrete fashion the success which has attended the efforts of those charged with the administration of the department to so arrange its activities that highway development in California may progress in uniform fashion to the end that the most efficient and economical use may be made of available funds and facilities.

During 1939, construction work was started on projects providing for a total of 1228 miles of highway to be graded, surfaced, paved or oiled and for construction of 110 bridges and grade separations.

The following tabulation shows various types of improvement initiated during the year together with the mileage involved:

Type of Improvement	Miles
Pavement	34
Plant-mixed surfacing	130
Road-mixed surfacing	103
Oiled Gravel	93
Armor coat and retread	123
Penetration oil and seal coat	343
Untreated gravel	12
Graded roadbed	3
Dust oil roadbed	314
Shoulder construction	73
Bridges and grade separation	(110)
Total	1,228

The degree to which the year's work was distributed throughout the entire State may be gauged from the fact that one or more contracts were awarded for projects in each of 55 of the State's 58 counties.

The wide range and diversity of character of highway projects undertaken in 1939 is indicated in the following brief descriptions of a few of the larger and more important improvements.

On the Pacific Highway, U. S. 99, north of Redding, work was started on two major projects comprising a portion of the relocation of 15 miles of this highway required to clear the flooded area which will result from the building of the Shasta Dam unit of the Central Valley Project now under construction.

One of these contracts provides for the construction of a four-mile section of the relocated highway in the vicinity of the Pit River beginning at a point about 12 miles north of Redding. The other involves the construction of a bridge on the new highway alignment over the Sacramento River at Antler. This bridge will be 1330 feet long with a roadway fifty feet wide and will cross the river channel at an elevation 210 feet above the river bed.

The relocation of the entire 15 miles of this highway is being performed in cooperation with the U. S. Bureau of Reclamation.

GRADE SEPARATIONS

In cooperation with the Federal Government and the various railroads, contracts were awarded during 1939 for grade separation structures in or near Los Angeles, Turlock, Berkeley, Palm Springs Station, Pomona and Palo Alto. At Firebaugh in Fresno County a grade crossing is being eliminated by rerouting the State highway through the city.

In Santa Clara County work began in the closing days of the year on the last link in the construction of the highway between Santa Cruz and Los Gatos. The construction of this final two-mile section between Oaks Road and Los Gatos will complete a program first begun in 1933 looking toward the complete replacement of the totally inadequate original road with a through route of modern grade, alignment and width.

DIVIDED HIGHWAYS

To meet the urgent requirements of increased traffic volume on the State Highway System for modern divided highways several projects of this type were started in 1939.

One contract for the reconstruction of an additional stretch of the Coast Highway between Oxnard and Santa Monica provides for an increase of 3.7 miles in the portion of this route constructed with a central dividing strip.

Through the suburban area east of San Diego between La Mesa and El Cajon construction was begun during the year on a four-mile section of divided highway on U. S. Route 80.

Extending northerly for 1.7 miles from the City of Merced on U. S. 99 work is in progress on a contract for divided 4-lane construction. On this project the present two-lane pavement will be preserved intact throughout the major part of the project. To provide a 4-lane traveled way a separate two-lane road is being built on a slightly higher grade east of the present roadway.

ARROYO SECO PARKWAY

Five separate contracts were awarded during the year in continuance of the program for construction of the Arroyo Seco Parkway. When complete this development is designed to afford a high speed freeway for the great volume of traffic between Los Angeles and Pasadena.

Other important work undertaken during the year includes the pavement of a six-mile stretch of the Pacific Highway, U. S. 99-W, from Red Bluff southerly; grading and surfacing of 3.4 additional miles of the Mint Canyon Short Cut on the new align-

Director Clark Signs His Name On 71,000 Bonds

SIGNING his name at the rate of 15,000 times on each day he devoted himself to the task, Director of Public Works Frank W. Clark during the last three weeks has been engaged on five separate days in attaching his signature to $71,000,000 worth of San Francisco-Oakland Bay Bridge bonds.

Using a multiple signing device, Mr. Clark has been able to sign twenty bonds at a time. He was completing his monumental job when this issue of California Highways and Public Works went to press.

The work of signing the bonds should be completed by February 15 in order that they may be distributed to bond holders prior to March 1.

The bonds will replace temporary ones issued last summer when a group of bond houses purchased from the Reconstruction Finance Corporation the entire San Francisco-Oakland Bay Bridge bond issue.

This issue has been resold by the bond houses and the new bonds will be delivered to the purchasers by the San Francisco Bank, fiscal agent of the California Toll Bridge Authority after Mr. Clark and the bank have signed them.

The Reconstruction Finance Corporation originally financed the building of the bay span, holding as collateral bonds of the State of California, and then disposed of the issue to bond houses which sold them to the public.

The bonds pay 4 per cent interest.

FRANK W. CLARK, Director of Public Works

At duplicating machine signing his name 15,000 times a day on Bay Bridge Bonds

ment of State Route 23 in Los Angeles County; reconstruction of 7 miles of the Redwood Highway in Mendocino County between Hopland and Ukiah; improvement of 7.3 miles of the Coast Route in Monterey County along the Salinas River between Bradley and the San Luis Obispo County line; grading and surfacing 9 miles of the Redding-Alturas Lateral between Adin and Canby in Modoc County; and the relocation of 6 miles of the Sacramento-Placerville Road U. S. 50 between Folsom and Clarksville.

Low Tolls Boost Bay Span Traffic

A TOTAL of 849,910 vehicles crossed the San Francisco-Oakland Bay Bridge in January, 1940, Director of Public Works Frank W. Clark reported to Governor Culbert L. Olson.

This was 13.9 per cent in excess of the figure for January a year ago.

If the traffic to Treasure Island is excluded, the resulting net bridge traffic over the previous January shows an increase of 21.7 per cent. Some of this is attributable to a natural healthy growth, but the majority of it has resulted from the two substantial toll reductions effected during the last year. The present toll is 29.2 per cent less than it was 12 months ago.

The 35-cent toll on autos created an unprecedented demand for nickels and dimes. The coin wrapping machine at the toll plaza handled 1,008,000 coins during the month.

The elimination of the charge for extra passengers in automobiles and the substitution of a truck toll based on gross weight, in lieu of the former combination toll for truck and net weight, have both proved a big boon in handling traffic at the toll plaza. This has particularly facilitated the speed of handling trucks.

January totals and comparative figures were:

	Jan. 1940	Jan. 1939	Dec. 1939	Total Since Opening
Passenger Autos and Auto Trailers	772,440	667,648	776,625	28,444,728
Motorcycles and Tricars	2,471	2,774	2,824	132,173
Buses	16,469	13,105	16,596	457,421
Trucks and Truck Trailers	41,798	43,651	42,816	1,360,847
Others	16,732	18,917	15,552	479,362
Total Vehicles	849,910	746,095	854,413	30,874,531

Before and after channelization of East 18th Street and Lakeshore Avenue, Oakland, along south shore of Lake Merritt.

Channelizing Traffic In Oakland

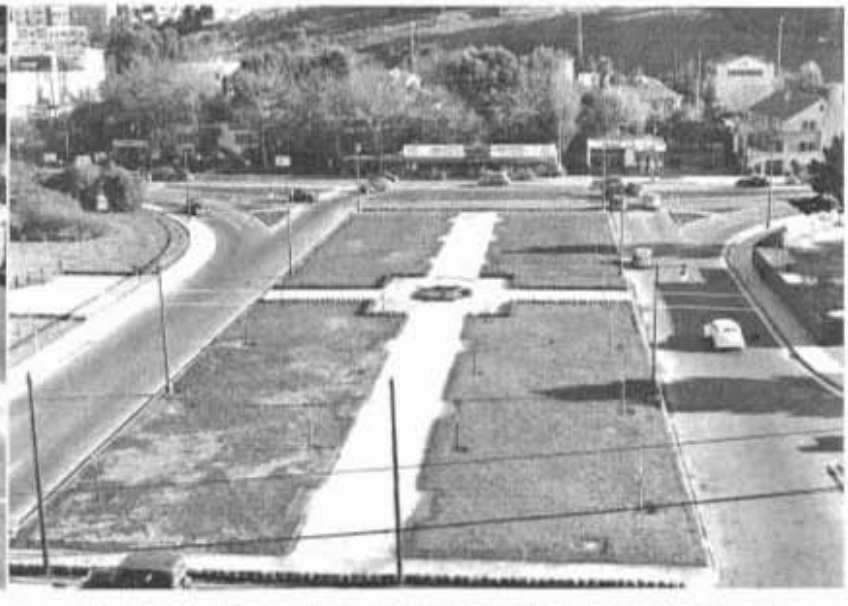
By GEORGE MATTIS, Engineer, City Cooperative Projects District IV

THE many recurring accidents, both to vehicular and pedestrian traffic, at street and highway intersections have led to an intensive study by highway and municipal engineers everywhere in an effort to determine adequate measures to reduce accidents at these danger zones.

The Division of Highways has created a Department of Safety which is now actively working on the problems of safety for highway traffic throughout the State. The larger cities have also inaugurated Safety Departments which are now actively attempting to solve the traffic problems created by the ever-increasing traffic on their streets.

In the City of Oakland, this problem has been assigned to a Traffic Committee composed of certain city officials and representatives of important civic organizations. Frank C. Myers has been designated as Acting Traffic Engineer and, in cooperation with John G. Marr, City Planning Engineer, has designed and the city has constructed, 12 channelization projects under the supervision of City Engineer Walter N. Frickstad.

These improvements were constructed as a cooperative project with the State ½ cent gas tax allocation to cities for streets of major importance and with WPA funds and personnel. No attempt was made to segregate the costs for each project as in most cases the work was a part of a larger



El Embarcadero between Grand Avenue and Lakeshore Avenue, a wide, high traffic count street transformed into 2 lanes separated by a small park.

Grand Avenue and Harrison Street intersection, first marked with painted line and then channelized as shown at right.

project of street widening and resurfacing.

The 12 channelization projects already completed are located at the following street intersections:

1. Broadway and Patton Street.
2. Grand Avenue and Harrison Street.
3. Broadway and Landvale Road.
4. 55th Avenue and Camden Street.
5. Camden Street and Seminary Avenue.
6. Excelsior Avenue and Athol Avenue.
7. Van Buren Avenue and Perry Street.
8. Santa Clara Avenue and Grand Avenue.
9. 14th Avenue and East 12th Street.
10. 98th Avenue and San Leandro Street.
11. East 18th Street and Lakeshore Avenue.
12. El Embarcadero, between Grand Avenue and Lakeshore Avenue.

To those familiar with Oakland's street system, it will be noted that eight of these projects are on State highway routes and four on major streets only. Strangely enough, the larger projects are not on State highway routes.

The two largest and most comprehensive projects are designated as No. 11, East 18th Street and Lakeshore Avenue, and No. 12, El Embarcadero, between Grand Avenue and Lakeshore Avenue. Project No. 9, 14th Avenue and East 12th Street, which is on State Highway Route 105, might be considered of major importance because of its size and cost, but as now constructed, is only considered a temporary development to provide relief until a more comprehensive project can be financed.

In determining the projects for channelization, the committee emphasized particularly the problems of traffic control and movement, special emphasis being placed upon the factors causing accidents, the time of greatest accident frequency, type of accident, physical conditions of the street system, and the effect channelization would have upon future development.

The size, shape, and general design of the channelization is determined by the topography of the intersection, giving full consideration to the direction the traffic desires to go. In all cases, a design is prepared by the Acting Traffic Engineer and approved by the City Engineer and City Planning Engineer before being submitted to the committee as a whole. When the design is finally approved, the channelization is constructed as designed.

In one case, the intersection at Broadway and Patton Street, the design was painted upon the pavement with white water paint and traffic was directed to follow the lanes as out-

(Continued on page 18)

Broadway and Patton Street intersection as it looked before and after traffic was plainly directed by channelization.

Administrative Problems of State Highway Maintenance

By T. H. DENNIS, Maintenance Engineer

This is the second installment of an address delivered by Mr. Dennis at the recent meeting of the State-wide Highway Committee of the California State Chamber of Commerce at the Palace Hotel in San Francisco.

MAINTENANCE expenditures have increased since 1934, but with the sole exception of 1938, when extraordinary storm damage occurred, such expenditures have been at a lesser rate than the growth of traffic, which has increased approximately 33 per cent, measured on the basis of fuel used. Maintenance expenditures have increased 24.2 per cent in the same period.

Tables 6 and 7 have been prepared to show the variation in expenditures from July 1933 to June 1939—a six-year period. Table 6 shows the proportion, expressed in percentage, of funds expended by years for each class of work. Table 7 shows the variation from year to year of the amount required by class of work.

The effect of the storms of 1938 is particularly noticeable on traveled way, shoulders and roadsides. Some of the shoulder repair was deferred and carried out in 1939. The general increase from year to year is attributable to several factors—to the increase in traffic for one thing; to the necessity for handling ever-growing traffic on pavements that are too narrow to permit the most economical maintenance; and to the necessity of maintaining types of surface that are below the design required for the number of vehicles using the roads. In this connection, there is cause for concern not alone with the number of vehicles using the roads, but with their weights. Recent studies indicate that many roads are carrying heavier weights than was generally supposed.

SLIDE REMOVAL COSTS

There are incidental items of expense which appear of minor importance, but absorb an appreciable amount each year. A case in point is the cost of flagmen. During work on the travelled way on heavy traffic routes, it is now necessary to provide flagmen as a regular part of the operations in order to protect the workmen.

The largest single item in roadside charges is the cost of slide removal. This item reflects the severity of storm conditions, one year with another. It is influenced, also, by standards of construction.

In response to traffic demands, such standards have been raised from year to year. This is exemplified in the expenditures for grading. In the years 1913 to 1923, only 37.8 per cent of construction cost was for grading. From 1934 to 1938, this item required 56.2 per cent of the funds expended. This increase in depth of cut and height of fill naturally has been reflected in a definite increase in cost of maintenance.

STABILIZATION RUNS HIGH

It is not economical to trim cut banks and slopes to their ultimate position at the time of construction. It is the accepted practice to trim them to reasonably safe limits and to take care of slides and subsidence through maintenance operations. It is not uncommon to spend $50,000 or more for stabilization on a piece of new construction ten miles or less in length during this period of weathering. As an example, at Point Mugu on Route 60 a single slide of a half million yards occurred. Recurring slides are likewise encountered along the Redwood Highway, the San Simeon Highway, the San Marcos Pass,

TABLE 6

Variation in Maintenance Expenditure from Year to Year by Class of Work 1934 to 1939

Symbol	Expenditures Expressed in Percentage by Class of Work						Total Expenditures July, 1933, to June, 1939	
	1934	1935	1936	1937	1938	1939	Percentage 1934-39	Amount
Traveled Way	48.74	43.18	45.32	37.30	36.11	37.47	40.86	$20,668,295.77
Shoulders	4.36	4.76	4.69	4.29	4.75	7.79	5.13	2,597,094.31
Road Sides	28.59	31.43	32.03	35.07	39.49	30.61	33.29	16,842,131.15
Structures	5.61	6.27	3.92	5.67	6.37	7.48	5.93	3,000,370.36
Safety Devices	5.24	5.05	5.51	5.53	4.86	6.74	5.48	2,771,175.69
Trees	1.69	1.65	2.10	2.26	1.88	2.55	2.03	1,026,635.51
Drifts	2.26	4.44	3.27	7.37	4.56	4.92	4.54	2,295,426.68
Miscellaneous	2.80	2.51	2.45	1.91	1.35	2.44	2.18	1,103,949.49
Engineering	0.71	0.71	0.71	0.60	0.63		0.56	281,854.34
Totals	100.00	100.00	100.00	100.00	100.00	100.00	100.00	$50,586,933.30

Washout north of Ojai on the Ventura-Maricopa Highway in Ventura County during the storm of 1938.

the Angeles Crest, the San Gabriel Canyon, the Rim of the World and the Sharp's Park road south of San Francisco.

In addition to increased slide removal it is pertinent to mention here other increases inherent in the construction not commonly taken into account by the layman in considering maintenance expenditures. A typical example is the new route through Altamont Pass. This is a divided four-lane section, 56 feet wide, with heavy cuts and fills, as compared to the two-lane width of old road. The cost of maintaining this new section for the year just past was $958 per mile.

Another type of improvement that represents a direct increase in maintenance cost is the divided roadway, where the old road is retained in service to carry traffic in one direction. Typical examples are the sections north of Modesto, south of Merced and south of Bakersfield, all on U. S. 99. The cost of upkeep on the old sections of road is nearly as great as before and, in addition, there is the new section with shoulders on each side, the extra width of right of way and all facilities for a complete two-lane road.

Roadside charges also include cost of weed and vegetation control. The expense of this work has increased from about $70,000 in 1934 to $136,000 in 1939. Weed control, under the law, is subject to recommendations by county horticultural commissions and is mandatory when so initiated.

Expenditures for bridges, while relatively not a large amount, are increasing from year to year. The number of weak or otherwise inade-

TABLE 7

Variation in Maintenance Expenditures by Years for Each Class of Work July, 1933, to June, 1939, Expressed in Percentage

Symbol	Percentage by Years						Total 1934-39	
	1934	1935	1936	1937	1938	1939	Per cent	Amount
Traveled Way	16.44	16.43	17.82	14.92	18.69	15.70	100	$20,668,295.77
Shoulders	1172	14.42	14.67	13.65	19.56	25.98	100	2,597,094.31
Road Sides	11.84	14.67	15.46	17.21	25.08	15.74	100	16,842,131.15
Structures	13.05	16.42	10.62	15.60	22.71	21.60	100	3,000,370.36
Safety Devices	13.20	14.34	16.16	16.47	18.76	21.07	100	2,771,175.69
Trees	11.47	12.60	16.66	18.17	19.56	21.54	100	1,026,635.51
Drifts	6.88	15.21	11.57	26.53	21.24	18.57	100	2,295,426.68
Miscellaneous	17.70	17.85	18.01	14.25	13.06	19.13	100	1,103,949.49
Engineering	17.48	19.88	20.46	18.00	24.18		100	281,854.34
Totals	13.79	15.54	16.07	16.33	21.15	17.12	100	$50,586,933.30

TABLE 8

High Maintenance Cost Roads During Year, June 1938-1939

Location	Miles	Type of surface		Cost per mile	Remarks on cost per mile
PLUMAS-21-A Butte Co. line to Howells	16.219	Oil gravel	TW	$194.68	Routine maintenance
			RS	559.18	$457 of this was slide removal and restoration work
			SD	72.67	Signs and traffic stripe
			T	13.22	
			D	42.17	Snow removal and sanding icy pavement
			M	44.92	A portion of this was pro rata charge due to radio [station installation
			Total	$926.84	
SAN MATEO-68-A So. San Francisco to San Francisco	3.496	P. C. C.	TW	$380.15	Pavement 40'-60' wide
			SH	156.81	Including retreatment of raveled shoulders
			RS	1,080.72	$854 of this item was due to slides
			SD	1,605.46	Mainly upkeep and operation of lighting system
				196.88	Traffic stripe renewal
				36.90	Install signs
			T	464.99	Trees and shrubbery upkeep
			M	9.89	
			Total	$3,931.98	
HUMBOLDT-1-B Garberville to Miranda	11.217	Oil gravel	TW	$784.13	This included retreatment of portions
			SH	6.39	
			RS	4,244.19	This included $3,515.71 storm restoration
			S	21.38	
			SD	87.12	$40 of this was for traffic stripe
			T	5.37	
			D	1.74	
			M	1.07	
			Total	$5,151.39	
SACRAMENTO-11-D Bridge over Sacramento River N. of Isleton	0.120	Bridge	S	$8,129.58	Operation of movable span
				1,914.08	Repairs and protection work
				1,378.97	Replace and modernize operating equipment
				11,965.26	Sand blast and painting (this work is required at [intervals of not less than 10 years)
			SD	17.35	
			M	514.87	
			TW	1.70	
			Total	$23,921.81	This is total and not per mile cost
PLACER-37-C Placer Co. line to West end of Donner Lake	3.025	Rd. mix gravel	TW	$1,409.25	Routine upkeep (on Donner Grade)
			RS	53.14	
			S	6.25	
			SD	123.19	This includes traffic striping and work on stock trail
			D	3,283.90	Snow removal [to divert stock travel
			M	333.98	Includes ventilating facilities and boiler in truck [shelter
			Total	$5,209.71	
SAN BERNARDINO-43-C Running Springs Park to Big Bear Dam	13.262	Rd. mix gravel	TW	$1,225.02	Includes $790 per mile for replacement, road mix and [seal coat of portions
			SH	8.75	
			RS	595.90	Includes slides, trimming, removal native trees, etc.
			S	183.76	
			SD	94.41	Includes $44.89, cost of traffic striping
			T	4.62	
			D	676.65	Includes snow removal and sanding icy pavement
			M	23.93	
			Total	$2,813.04	
RIVERSIDE-64-Q Jct. Rte. 87 west of Indian Wells to Jct. Rte. 26	10.130	Rd. mix gravel	TW	$93.82	
			SH	53.74	Includes retreatment of 6' oil shoulder
			RS	185.28	
			S	596.44	Includes $560 for repair and protection work at Deep
			SD	59.94	Mostly for traffic stripe [Creek
			T	12.55	
			M	2.45	
			Total	$1,004.22	
SAN DIEGO-2-B Encinitas to Oceanside	9.222	Asph. concrete	TW	$574.51	(This includes a section of divided roadway)—In- [cludes $526.96 for seal coat application
			SH	366.47	Includes $230.21 for remixing and sealing shoulders
			RS	65.18	
			S	89.12	
			SD	266.85	Includes $150.50 for traffic stripe and renewal and [$69.81 for metal guard rail
			T	302.37	This includes upkeep on trees between the divided
			D	6.83	Account of drifting sand [roadways and two
			M	10.29	[rows of shrubbery
			Total	$1,681.62	

Symbols—TW—Traveled Way. SH—Shoulders. RS—Roadside. S—Structures. SD—Safety Devices. T—Trees. D—Drifts. M—Misc.

quate structures can not be reduced materially by replacement in any one year. It is essential therefore, that whatever funds are required to keep the bridges in safe condition be made available as soon as a need develops. The trend in this regard is shown in Table 7, with 44.3 per cent of the six-year expenditure applied in the last two years.

The steady increase in expenditures for safety devices is shown in Table 7, with a variation of from 13.2 per cent in 1934 to 21.07 per cent in 1939. This item includes cost of placing traffic stripes, as well as operating illuminated signs, traffic signals and highway lighting. If present demands are an indication, the amount required will continue to increase each year.

Slide on Ridge Route, Los Angeles County, in 1938 storm.

Large slide on Coast Route, north of Santa Monica, Los Angeles County.

There are some 850 miles of road on which trees have been planted by the State. In addition, there are many plantings at subways and entrances to towns.

The marked increase in the cost of "tree" maintenance is primarily due to improvement work undertaken at the insistance of the Federal Government. One per cent of Federal funds must be applied to roadside beautification under existing regulations.

As the annual cost of upkeep is frequently equal to the original cost on certain types of planting, maintenance expenditures have increased unduly. If the investment is to be preserved, there is little prospect that this item can be reduced.

The cost of snow removal and sanding icy pavement is a major item in the "Drift" classification. The cost of this work varies from year to year with the severity of the particular season. It is essential, if the work is to be successful, that a complete organization be ready and equipped to start work at any time after the first heavy snowfall. There is little indication in advance as to the severity of a season. The expense of preparation is the same, therefore, every year, and the expense of stand-by service is considerable, even in a mild season.

In reviewing the record of expenditures for the year ended June 30, 1939, it is found that the average cost per mile for maintenance in thirty-seven counties of the State with San Francisco city and county excluded, was less than the average rate of $700 per mile. In the other twenty coun-

Flood damage on Redding-Alturas Highway, Shasta County in 1937 storm.

ties, the average cost exceeded that amount. As an indication of the amounts and reason for such heavy expense, there is listed in Table 8 a few sections showing the occasion for the work, as well as per mile cost for the various classes of work.

In summarizing the discussion by class of expenditures, it is to be noted that the upkeep expense for the most essential features—the traveled way, shoulders and structures—represents nearly 52 per cent of total maintenance cost. The roadside item, which, insofar as slide removal and restoration is concerned, is equally essential, represents 33 per cent of expenditures. The cost for safety devices, trees and drifts is 12 per cent of the total.

Expenditures may also be analyzed from an entirely different point of view. Expenditures for salaries and wages for the year ended June 30, 1939, were 44.53 per cent of the total on the rural State highways.

The balance of the expenditure was made up as follows:

Materials and Supplies	21.44%
Service and Expense	6.12%
Equipment Rental	17.39%

All the charges for these things were directly applicable to specific sections of the highway. In addition, 10.52 per cent of the total expense was of a general nature and not susceptible to direct allocation to the foregoing items.

Total expenditures for direct labor amounted to $3,837,719.46. It is estimated that during the current year, this amount may be increased by approximately $375,000 due to increases in salaries. This is a matter over which the Division exercises only nominal control, since the statutes provide, when an employee's efficiency rating amounts to 80 per cent, for an automatic increase in salary up to a set maximum. Since, from February 1932 to April 1937, no increases in salaries were given within any grades, and since appointments were made at the minimum salaries, it follows that a large percentage of the employees are eligible for increases in salary. Had salaries been increased in the normal manner during that period, the change of trend that will develop in labor cost would have been less marked.

It may be noted in passing that the above distribution of expenditures in California is in line with those general throughout the United States. The report to the Highway Research Board already referred to states: "Maintenance expenditures are made in reasonably fixed proportions: Direct labor 43 to 52 per cent of total expenditures; materials 17 to 28 per cent; equipment 20 to 31 per cent; and overhead 5 to 11 per cent."

The third installment of Mr. Dennis' address will appear in the March issue of California Highways and Public Works.—Editor.

Channelizing Traffic in Oakland

(Continued from page 13)

lined. A study was made of the manner in which the traffic used the traffic lanes. From this study, a few minor modifications were made in the design before it was constructed.

SPEED OF VEHICLES CONTROLLED

Some cities have outlined the design on the pavement with timber bulkheads, tie curbs, and sand bags painted white as an experiment in channelizing an intersection. These methods are effective but often create a hazard because of their temporary nature, with the added necessity of proper illumination at night.

Two reasons are paramount in the causes of accidents; namely, speed and disregard of the rules of the road; i.e., traffic laws.

By channelizing traffic into well-defined lanes, it becomes imperative for traffic to slow down to enter the traffic lanes, so speed is controlled. Since all traffic in a channelized intersection must use the same lane or parallel lane when going in one direction, the whims of the "roadhog" are in a measure controlled.

INTERESTING STATISTICS

The Safety and Traffic Engineering Department of the American Automobile Association has given a great amount of thought and study to the safety of traffic and many interesting facts have been disclosed. It was found that in a 7-year trend of traffic fatalities, in 30 cities, nonpedestrian deaths had been reduced 30 per cent while pedestrian fatalities had increased 40 per cent. It was also found that two out of three pedestrians killed were over 40 years of age, less than 1/10 are children under 15 years, and only $\frac{1}{3}$ are between 15 and 40 years of age.

In another investigation, it was found that unfamiliarity with problems of motor vehicle operation plays an important part in pedestrian fatalities. Connecticut studied 1,031 deaths to pedestrians over 15 and found that 95 per cent had never been licensed to drive. Who, of the drivers of motor vehicles, has not been startled at night by a pedestrian appearing suddenly in view, walking leisurely? These pedestrians apparently do not realize that unless they are in direct line of the beams of light, the driver of the car is invariably unaware of his presence on the roadway.

These investigations disclosed that 75 per cent of the pedestrian fatalities occurred after sunset. An elderly pedestrian walking at the rate of about 2 miles per hour will require half a minute to cross an intersection having a roadway width of 90 feet between sidewalks. An automobile traveling at the rate of 25 miles per hour will traverse 1,100 feet in the same length of time. The lack of appreciation of the time and speed of the automobile and often the lack of the driver's consideration of the pedestrian's problems have led to many accidents.

By channelizing vehicular traffic, the width of roadway has in all cases been reduced to a one-way street. This permits the installation of safety zones for pedestrian traffic. In all cases, accidents to both vehicular and pedestrian traffic have been greatly reduced by channelization.

A collision diagram submitted by the City of Oakland on two of the intersections fully substantiated this statement. At East 18th Street and Lakeshore Avenue in 1937, before channelization, there were 10 accidents with a daily vehicular traffic through the intersection of approximately 14,000 vehicles. In 1938, the channelization was made. During all of 1939, there was only one accident in the new channelized intersection. This accident was due to a deliberate violation of right-of-way rules on the part of one of the drivers. While no traffic count has been made since the intersection was channelized, it is known that vehicular traffic has increased considerably.

(Continued on page 27)

New highway in Santa Ana Canyon graded for ultimate 4-lane divided highway section with surfacing for two lanes completed. Oil-mix berms on right prevent slope erosion.

Relocation in Santa Ana Canyon

By A. EVERETT SMITH, Assistant Highway Engineer

THE "Mountains to the Sea" route provides the residents of Riverside and San Bernardino counties their most accessible route to the coast where many go to enjoy the recreations of the beach areas. This same route also provides the populous harbor and beach areas of Los Angeles and Orange counties their most direct road to the various resorts located in the mountains of Riverside and San Bernardino counties.

This route is State Sign Route No. 18 which passes through the cities of Riverside, Corona and Santa Ana and through the Santa Ana Canyon, entering the canyon proper west of Corona. The highway at this location is known as the "Santa Ana Canyon Highway."

Construction on new alignment of that portion of the highway extending westerly from Corona to the Riverside-Orange County line on the south side of the canyon was completed December 8, 1939. The realignment was made necessary by the construction of the Prado Dam across the Santa Ana River for flood control in Orange County.

The dam, now being constructed for the impounding of flood waters, has caused the dehabiliment of the area within the confines of the ultimate high water contour line and involved the removal of many buildings and facilities. A portion of the Santa Fe Railway and the Santa Ana Canyon Highway were under the ultimate high water elevation. This necessarily involved the relocation of the railway and the highway facilities.

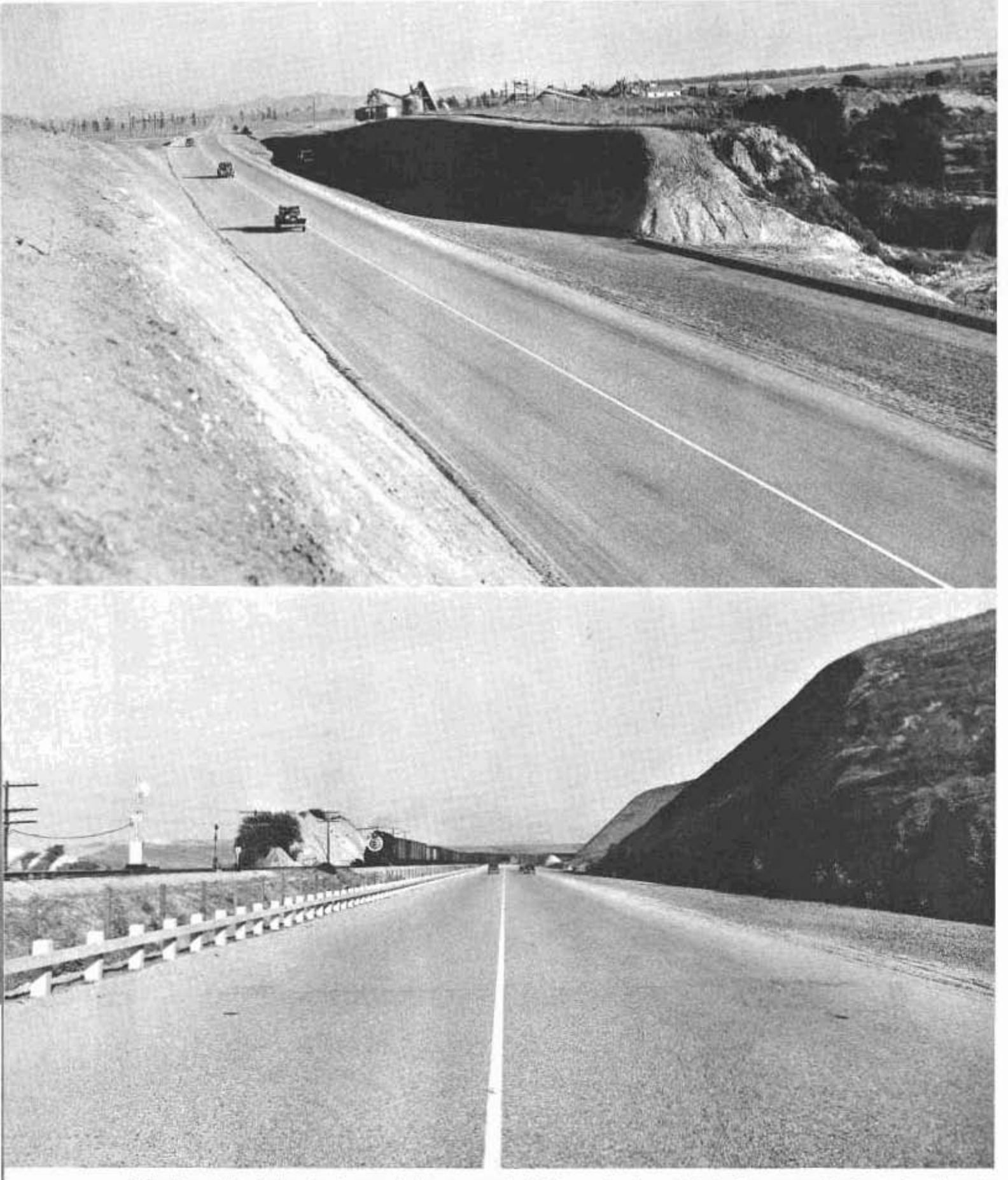
Reconstruction of this portion of highway had been under consideration for some time, but could not be undertaken until the location of the dam was determined.

When the dam location was definitely fixed by the U. S. Engineers, a survey was made and plans drafted for the new highway. The new highway location extends in an almost direct line from Corona to an intersection with the existing highway at the Orange County line, whereas the old road angled from Corona northwesterly to Prado and continued down along the south side of the Santa Ana River.

It was through this section along the river that considerable damage was experienced during the flood of March, 1938. The new location is a distinct advantage over the old road. It is high above the river, it reduces the length by about one mile and eliminates many sharp and dangerous curves. It is south of the old road and skirts the mountains rising from the river channel.

For building this new highway link, a contract was first awarded by the Orange County Flood Control District to Person & Hollingsworth and Wilbur C. Cole for the construction of approximately 1.5 miles op-

(Continued on page 28)



Relocation of the Santa Ana Canyon Highway necessitated by construction of Prado Dam across the Santa Ana River for flood control in Orange County between Corona and the Orange County line, takes the highway and Santa Fe Railroad, both of which were flooded in 1938, high above the river. In addition the more direct route shortens the distance about a mile and eliminates many sharp and dangerous curves.

Construction Progress and Pavement Records for 1939

Publication of the following annual report by the Construction Department of the Division of Highways, giving details of pavement construction during the past year, is eagerly awaited both by contractors and State engineers connected with the various projects, who evince a keen competitive interest in the records of average daily concrete yardage, strength per square inch, per cent variation in cement control, asphalt tonnage, etc., and roughness index per mile.

By EARL WITHYCOMBE, Assistant Construction Engineer

PRESENT policy dictates that intensive investigational work be conducted on all projects during the planning stage to note and study the subsurface conditions that might affect the stability of the roadway. The character of the soil, the presence of underground water and any weakness in the geological structure are carefully investigated. Expenditures for such work range from $75 per mile to as high as $1,000 per mile on heavy highway construction. The greater part of this expenditure is invested in borings taken with drill rigs constructed especially for this purpose, and with the information furnished by these borings, a fairly accurate record can be obtained of the efficiency with which nature has laid down the foundation upon which the roadway is to be constructed.

The actual cash value of the returns paid by such investigational work is a very intangible figure, but the fact that it does pay dividends can not be denied. In work constructed in recent years, the frequency of major slides, slipouts, and settlements, with their annoying interruption to traffic, has been materially reduced. That overdesign sometimes results from the effort to avoid any chance of failure where indications given by the investigations are unfavorable, can not be denied, and special effort is necessary to guard against excesses; however, the added factor of safety in such instances is often a very desirable quality.

The greater part of the investigational work is carried on by the various districts with their own laboratory forces, but when large diameter borings become necessary, the Headquarters Laboratory is called into conference, and they furnish the equipment and personnel required to conduct such work.

For the newly constructed roadway blankets are provided wherever possible with the most suitable local material selected for the purpose, and in some instances, blanketing material has been imported from a considerable distance. This strengthening of the immediate foundation for the road surface has resulted in a more or less revolutionary revision of ideas of the requirements for a satisfactory pavement surface. Such bases have eliminated the necessity of the so-called high-type pavement in a great many cases, permitting the use of intermediate types, or have made it possible to materially reduce the pavement thickness. As a consequence, construction costs have been materially decreased and more miles of improved highway have been constructed with the funds available. A concrete example of this tendency is indicated in the comparison of mileages constructed during the past two years. The combined mileage of the permanent or high-types constructed in 1939 is but 17 per cent of that constructed in 1938.

The life of the intermediate types is not expected to be comparable with that of the higher-type pavement, but their service life will be such that they will pay for themselves in returned income, and when permanent pavement becomes necessary, they will provide an ideal base upon which to construct same. By such procedure weakness that may exist in the pavement foundation will be disclosed and will be corrected before the permanent pavement is placed.

PORTLAND CEMENT CONCRETE

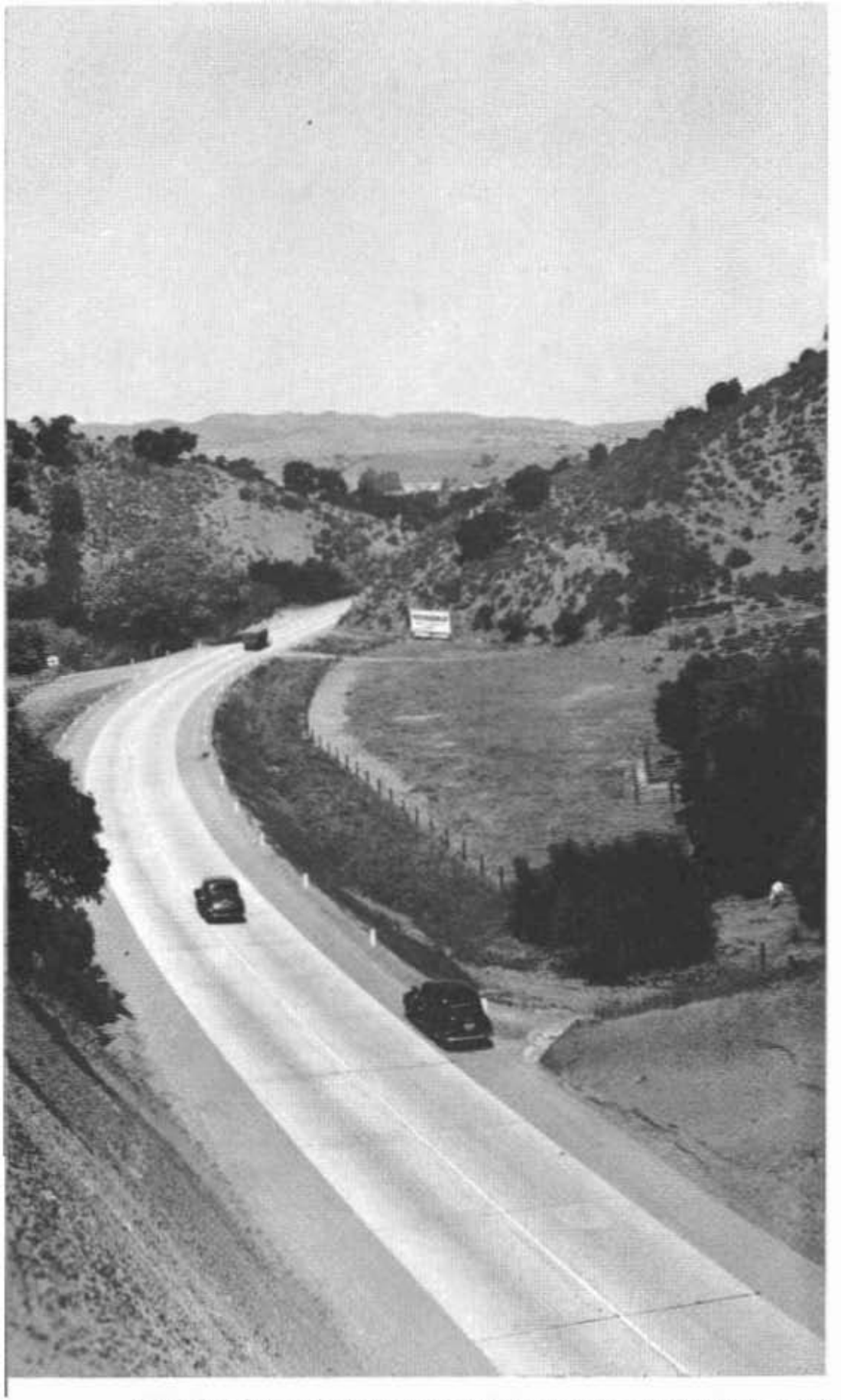
Construction Methods

Surface smoothness has been materially improved by the use of the Johnson drag finisher, a development made by one of the assistant engineers in the Construction Department, who has been connected with this type of work for a long period of time. The drag finisher type of manipulation was made optional in competition with standard methods and has met with such enthusiastic reception by contractors that it was used exclusively during the past season. This method has spread to adjoining states, and results have been very gratifying.

Another device developed by a construction employee, known as the Wilczek volumeter, was used to advantage on some of this season's projects to measure the pay quantity of concrete pavement. This device is a volume integrator of the subgrade section and provides a speedy and more accurate means of measurement of pay quantity than former methods. This device has been given recognition by engineering publications.

Approximately 60 per cent of the 1939 concrete pavement was Class "A" concrete with six sacks of cement per cubic yard, the remainder consisting of Class "B" with five sacks of cement per cubic yard.

Automatic scales were used to proportion the aggregates on all major projects, and these scales have been developed to the extent that little difficulty is experienced in their operation. Very little cement was proportioned in with the aggregate and in



Twenty-two foot portland cement concrete pavement between Gaviota Pass and Santa Ynez River on State Highway Route 2 in Santa Barbara County. The record for cement control was made on this contract, the average variation being only 0.28 per cent. The average variation on State contracts during the year 1939 was 0.58 per cent.

nearly every project, cement was delivered to the grade in cloth bags and dumped by hand into the mixer skip.

With the adoption of the Johnson drag finisher, the operation of placing concrete has been greatly simplified. The equipment now consists of one mechanical tamper and finisher, providing it is a modern machine; otherwise, two are required, with one Johnson drag finisher and one cut float. Very little remains to be done with the cut float behind the drag finisher, but it does help to give a more granular surface texture and removes any slight irregularities that may remain after the drag finisher has finished.

Construction Records

The maximum *average daily output* for portland cement concrete pavement per 8-hour day was on Contract 07XC20, Road VII-L.A-79-A, at San Martinez Chiquito Canyon, Matich Brothers, Contractor, 450.0 cubic yards being placed per day. F. A. Read was the resident engineer, with H. J. Johnson as street assistant. The average daily output for the State was 381 cubic yards during the year 1939, as compared to 408 cubic yards in 1938.

The *average compressive strength* at 28 days for Class "A" concrete pavement was 5170 pounds per square inch in 1939, compared to 4760 pounds in 1938; while for Class "B" concrete pavement, an average strength of 3740 pounds was obtained in 1939, as against 3890 pounds in 1938.

During 1939, the highest average compressive strength for Class "A" concrete pavement was 5694 pounds, also being on Contract 07XC20, Road VII-L.A-79-A, referred to above. The strongest Class "B" concrete pavement averaged 3815 pounds, on Contract 08XC3, Road VIII-SBd-26-E, Santa Ana River Bridge approaches, Basich Bros., Contractors; G. E. Malkson, resident engineer; and H. Bridgeman, assistant.

The record for *cement control* was made on Contract 05VC2-65VC13, Road V-S.B-2-D, Gaviota Pass to Santa Ynez River, the average variation being but 0.28 per cent. Sparks & Mundo were the contractors; J. C. Adams, resident engineer; and S. N. Isham, assistant. The average variation for the State during 1939 was 0.58 per cent, as compared to 0.72 per cent in 1938.

Six-lane free-way with 11-foot asphalt concrete, portland cement concrete, and plant-mix pavement strips on Arroyo Seco Parkway between Los Angeles and Pasadena.

The record for *surface smoothness* was made on Contract 04TC7-84TC16, Road IV-Ala-5-D, Castro Valley Junction to San Leandro, with an average roughness per mile of 4.8 inches, Jones & King were the contractors; F. W. Montell, resident engineer; and H. H. Deardorff, assistant. The average smoothness for the State in 1939 was 5.8 inches per mile as compared to 7.8 inches for 1938, a 26 per cent improvement in riding surface.

ASPHALT CONCRETE

Construction Methods

The operation of mixing plants has not changed much in the past few years. Automatic scales for the proportioning of aggregate were used on all major projects during 1939.

The use of higher-penetration asphalts has become standard practice, and a considerable amount was used in the past season's work. There are three penetration ranges permissible, 71 to 85, 86 to 100, and 101 to 120, the grade to be designated by the engineer to suit conditions for the particular project.

Sand gradings for asphalt concrete have been materially revised, permitting a much coarser sand to be used, and the amount of filler dust has been reduced. These changes have produced a mixture that is easier to handle and is less critical to fluctua-

PORTLAND CEMENT CONCRETE PAVEMENT RECORDS FOR 1939

Location	Contractor	Resident Engineer	Street Assistant	Average cu. yds. laid per 8-hour day	Average strength, 28 days, lbs. per sq. inch	Per cent average daily variation in cement	Roughness index, inches per mile
Castro Valley Junction—San Leandro	Jones & King	F. W. Montell	H. H. Deardorff	427.0	3620	0.82	4.8
Gaviota Pass—Santa Ynez River	C. O. Sparks & Mundo Eng'g. Co.	J. C. Adams	S. N. Isham	350.0	4822	.28	5.8
Tunnel Sta.—Placerita Canyon	Griffith Company	E. L. Seitz	J. Fleharty	423.9	5269	.47	5.8
Hough Street—Meridian Ave.	Claude Fisher Co.	R. J. Hatfield	A. W. Carr	433.4	5042	.50	4.9
Sulphur Slide—Riverside County Line	V. R. Dennis Co.	F. B. Cressy	H. D. Johnson	215.0	5527	1.00	8.6
Santiago Blvd.—Santa Ana Canyon Rd.	United Concrete Pipe Corp.	H. B. Lindley	H. D. Johnson	359.0	4510	.71	6.1
At San Martinez Chiquito Canyon	Matich Bros.	F. A. Read	H. D. Johnson	450.0	5694	.72	7.2
Santa Ana River Bridge approaches	Basich Bros.	G. E. Malkson	H. Bridgeman	97.1	3815	1.92	5.4
La Mesa—Grossmont	Griffith Company	L. H. Williams	E. C. Dodson	309.0	3562	.50	8.2
			Averages	381.0	5170(A) 3740(B)	0.58	5.8

tions in the amount of asphalt used. A seal coat has been provided for asphalt concrete using not to exceed one-tenth gallon of emulsified asphalt per square yard of surface and without a cover coat. Where the surface is somewhat closed, the emulsion is diluted before application with equal parts of water. Traffic can be carried over this seal coat without inconvenience. The amount of actual asphalt is just sufficient to coat the bottom of the surface interstices which are inaccessible to the roller and without leaving an appreciable amount on the surface that is in contact with the tires. No raveling of the surface is experienced with work carried on even in the coldest weather, since this seal coat has been adopted, and the surface is apparently sealed off from any infiltration of water. Asphalt surfaces with this seal coat have functioned remarkably well over a period of five years.

The efficiency of spreading and finishing machines has been materially increased, and machines that are now manufactured in California especially for this purpose are far superior to any on the market.

Rolling and compacting of mixtures follow previous practice. The use of the three-axle roller has reduced the amount of equipment required where large output is produced. The method of cross-rolling to remove irregularities as a final operation is necessary behind any equipment so far used. The Seitz bump-marker, a development by one of the construction personnel, is in general use to rapidly mark surface irregularities on which to concentrate the cross-rolling. This equipment has been in demand throughout the western states.

The average roughness for the 1939 season exceeds that of 1938 by 3.5 inches per mile, largely because of the limited length of each project constructed in 1939, the average length being but 23 per cent of that of the 1938 projects.

Construction Records

The highest *average daily output* of asphalt pavement tonnage was placed on Contract 04TC7-84TC16, Road IV-Ala-5-D, between Castro Valley Junction and San Leandro, where 684 tons were placed by Jones & King, Contractor; F. W. Montell was the resident engineer, with E. E. Watkins, street assistant.

The average daily output for the State was 561.8 tons in 1939, as compared to 660 tons in 1938.

The highest *stability of surface mixtures* was obtained also on Contract 04TC7-84TC16, with an average of 48.2 per cent. The average stability for the State was 32.4 per cent for 1939, compared to 35.4 per cent in 1938.

The *densest surface mixture* was placed on Contract 011VC3, Road XI-Riv-26-Ind,F, between west city limits of Idaho and Route 64, where the average relative specific gravity was 96.0 per cent. R. E. Hazard & Sons were the contractors; R. C. Payne, resident engineer; and M. C. Barron, street assistant. The average for the State in 1939 was 93.8 per cent, compared to 93.5 per cent in 1938.

The record for *surface smoothness* was secured on Contract 04TC7-84TC16, Road IV-Ala-5-D, between Castro Valley Junction and San Leandro, where the average was 9.7 inches per mile. The contractor was Jones & King, with F. W. Montell as resident engineer, and E. E. Watkins, street assistant. The average for the State in 1939 was 18.8 inches per mile, compared to 15.3 miles in 1938.

BITUMINOUS TREATED SURFACES

The road-mix type leads the plant-mix slightly during 1939, about 260 miles of the two types being constructed during the year. A considerable part of this mileage was constructed on roads of major importance.

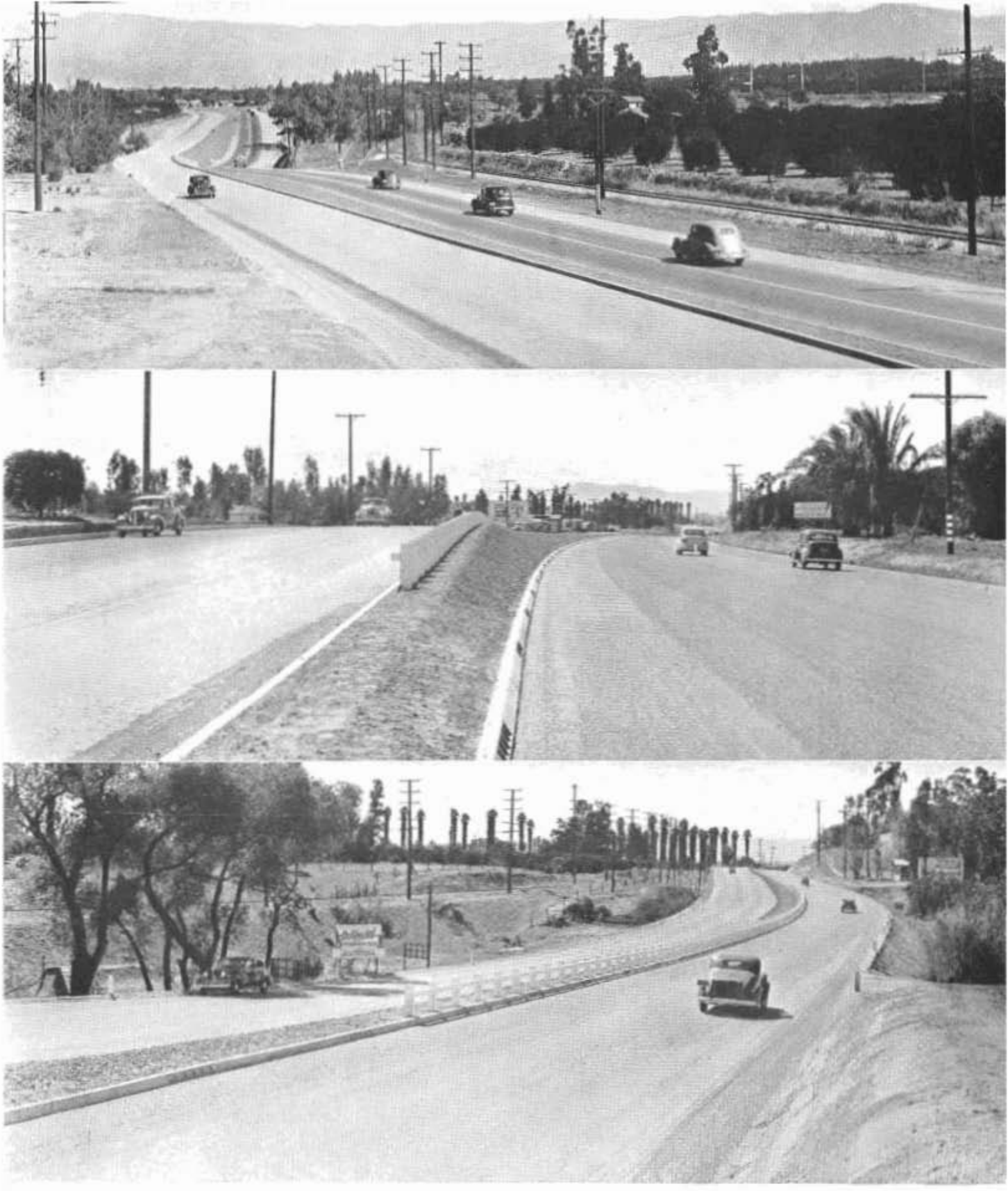
Road-mix construction was largely accomplished by traveling mixers. A method of readily determining the amount of oil necessary with an aggregate by coating the same with a solvent, was experimented with by Resident Engineer C. V. Kane and worked out satisfactorily for the aggregate with which they were using. The Laboratory is now working out a technique to make the method applicable to any aggregate, and it is expected that the equipment will be available for next season's work. By this means, fluctuations in the oil demand may be readily discovered in the field, and the necessary corrections made without delay.

Approximately the same mileage of armor coat was constructed in 1939

(Continued on page 28)

ASPHALT CONCRETE PAVEMENT RECORDS FOR 1939

Location	Contractor	Resident Engineer	Street Assistant	Average tonnage laid per day	Average stability of surface mixture in per cent	Average relative gravity of surface mixture in per cent	Roughometer index, inches per mile
Castro Valley Junction—San Leandro	Jones & King	F. W. Montell	E. E. Watkins	684.0	48.2	93.0	9.7
N. Main St.—Mission Road on Daly and Marengo Sts.	J. E. Haddock	C. P. Montgomery	A. L. Hawkins	523.0	36.0	92.3	17.3
Filmer—Hopper Creek	Macco Construction Co.	W. I. Templeton	W. A. Norman	594.0	22.0	94.5	24.0
Hough Street—Meridian Ave.	Claude Fisher Co.	R. J. Hatfield	A. W. Carr	430.0	36.9	92.0	10.8
Rivera Underpass—Shenandoah Ave.	W. E. Hall Co.	W. D. Eaton	G. H. Lamb	292.0	38.0	93.1	17.5
Lomita Blvd. to Wilmington—San Pedro Rd.	Griffith Company	C. N. Ainley	A. W. Carr	428.3	42.5	90.8	10.6
Glassell Ave., Fairhaven Ave.—S. City limits	Sully-Miller Co.	A. L. Hawkins	G. H. Lamb	449.1	34.0	90.3	19.3
Anaheim—Telegraph Rd. to Rivera	J. E. Haddock	W. D. Eaton	H. D. Johnson	248.0	16.0	95.6	30.6
Ocean Ave., Colorado Ave.—Pico Blvd.	Oswald Bros.	H. J. Fallai	A. W. Carr	551.0	36.0	91.9	41.7
W. City Limits, Indio—Route 64	R. E. Hazard & Sons	R. C. Payne	M. C. Barron	635.0	24.1	96.0	22.7
			Averages	561.8	32.4	93.8	18.8



Divided highway with two 23-foot road-mix surfaced lanes between Colton and Riverside on Route 43 in Riverside and San Bernardino Counties.

BITUMINOUS TREATED SURFACES: RECORDS FOR 1939

Plant Mix

Location	Contractor	Resident Engineer	Roughness Index Inches per mile
4 mi. S. of Fagan—Biggs Rd.	Piazza & Huntley	J. C. Womack	18.9
0.3 mi. N. of Sonoma Co. Line—Squaw Creek	Hanrahan Company	C. M. Butts	28.2
Hirschdale—Nevada State Line	Union Paving Co.	J. W. Corvin	37.1
At Colfax grade separation	Piazza & Huntley	H. O. Ragan	16.1
Colfax Overhead Crossing—0.6 mi. N.	A. Teichert & Son	H. O. Ragan	20.1
Kiesel—Sacramento Weir	J. R. Reeves	W. G. Remington	33.2
1.5 mi.—3.9 mi. southwest of Sebastopol	Embleton-Schumacher	E. Carlstad	23.9
Muir—Willow Pass	Macco Construction Co.	C. F. Price	23.0
Var. points Napa and Sonoma Counties	A. G. Raisch	C. F. Price	64.0
At Napa State Hospital	A. G. Raisch	E. Carlstad	36.2
San Lucas—1.3 mi. southerly	Granite Construction Co.	V. E. Pearson	21.7
1st-2d Crossing Cuyana River, Lompoc—La Salle Rd.	Basich Bros.	J. C. Adams	21.9
Las Cruces—S. Inez River and Orcutt—Guadalupe	Basich Bros.	J. C. Adams	21.7
Kingsburg—Fresno	L. A. Brisco	F. W. Howard	16.3
Tunnel Sta.—Placerita Canyon	Griffith Co.	E. L. Seitz	20.9
Near Galivan	B. G. Carroll	C. L. Gildersleeve	20.3
At Pacific Colony Hospital (Spadra)	Griffith Co.	H. J. Fallai	16.2
Filmer—Hopper Creek	Macco Const. Co.	W. I. Templeton	13.9
1.5 mi. N. of Azusa—San Gabriel River Bridge	Lewis Construction Co.	W. J. Calvin	54.4
At San Martinez Chiquito Canyon	Matich Bros.	F. A. Read	29.3
2 mi. W. of Los Angeles Co. Line	S. Edmundson & Sons	W. E. Melcher	50.3
Lomita Blvd.—Wilmington—San Pedro Rd.	Griffith Company	C. N. Ainley	10.6
Orange Co. Line—Corona	V. R. Dennis Const. Co.	J. M. Hollister	13.3
Devore—Cajon	W. E. Hall Co.	E. A. Bannister	17.1
San Bernardino—Santa Ana River	V. R. Dennis Const. Co.	G. E. Malkson	6.5
Upland—Haven Ave., SBd.—Verdemont	Oswald Bros.	R. A. Bergman	6.6
Briceburg—El Portal	Griffith Co.	A. N. Lund	16.8
0.6 mi. S.—1.0 mi. N. of Vallejo	A. G. Raisch	G. R. Hubbard	20.4
La Mesa—Grossmont	Griffith Co.	L. H. Williams	24.4
Hough Street—Meridian Ave.	Claude Fisher Co.	R. J. Hatfield	23.3
Las Cruces—Atascadero	Basich Bros.	J. C. Adams	21.3
Buckhorn School—1 mi. SE. of Piru	J. E. Haddock	E. L. Seitz	7.4
		Average	26.2

Road Mix

Big Lagoon—1 mi. N. of Orick	Claude C. Wood	C. A. Shervington	28.8
Benbow's—1 mi. N. of Dean Creek	Poulos & McEwen	C. A. Shervington	38.0
5½ mi. E. of Rte. 1, and 1.7 mi.—23 mi. E. of Lucerne (por.)	Lee J. Immel	C. M. Butts	35.8
In Fort Bragg—certain streets	Helwig Construction Co.	A. Wallace	27.4
Madeline—Likely	Poulos & McEwen	C. A. Potter	38.5
2 mi. W. of Rte. 83—Chester	Garcia Construction Company	A. A. Bigelow	29.6
Callahan—Fort Jones	Garcia Construction Company	G. Sundman	37.0
Big Bar—Junction City	Young & Son	G. Sundman	18.4
Shingletown—2.9 mi. easterly	Claude C. Wood	G. Sundman	22.0
At Central Valley, 6.5 mi. N. of Redding	Granfield, Farrar & Carlin	H. B. Milner	17.7
Termo—Northerly boundary	Poulos & McEwen	C. A. Potter	43.5
Inspiration Point—Los Gatos	Heafey-Moore Co. & Frederickson & Watson Co.	A. Walsh	33.3
½ mi. S. of Davenport—Waddell Creek	N. M. Ball Sons	H. A. Simard	11.9
3.5 mi. E. of Bell's Sta.—Mer. Co. Line	Lee J. Immel	H. S. Payson	40.2
Visalia Airport—4 mi. S. of Dinuba	Union Paving Co.	P. B. Stearns	51.8
San Joaquin River—Kelshaw Corner	Ruddy & Corfield	F. W. Howard	39.1
1.2 mi. N. of La Canada—Mt. Wilson Rd.	R. M. Price	W. E. Melcher	35.7
0.1 mi. S. of SBd. Co. Line—Colton	Matich Bros.	G. E. Malkson	12.4
Barstow—1 mile northerly	A. S. Vinnell Co.	R. A. Bergman	25.4
Big Bear Dam—Meadow Lane	R. E. Hazard & Sons	R. A. Bergman	9.5
Sonora Junction—Coleville (por.)	A. S. Vinnell Co.	H. F. Caton	8.2
4 mi. E.—12 mi. E. of Mojave	J. A. Casson	C. M. Rose	15.9
Death Valley National Mon.—Death Valley Junction	Oswald Bros.	J. N. Stanley	53.6
Benton Station—Nevada State Line	J. A. Casson	F. R. Pracht	17.4
9.6 mi.—10.7 mi. SE. of Keeler	Anderson & France	F. R. Pracht	38.1
Boulder Park—Mountain Springs	A. S. Vinnell Co.	R. C. Payne	28.6
Near Thermal	Basich Bros.	C. R. Hagberg	6.3
Through La Jolla Indian Reservation	R. E. Hazard & Sons	R. C. Payne	16.0
		Average	31.9

Armor Coat

½ mi. W. of Snodgrass Slough—Glennvale	Hemstreet & Bell	W. W. Greer	54.2
Davis Wye—Willow Slough, Cache Creek—2.2 mi. N.	E. A. Forde	H. F. Sherwood	62.3
Bryte—Broderick, Lincoln Way—Auburn Blvd.	J. R. Reeves	W. G. Remington	36.3
1 mi. E. of Bell's Sta.—3 mi. W. of Merced Co. Line	Granfield, Farrar & Carlin	H. S. Payson	28.1
Northwood Park—Guerneville	Heafey-Moore Co. & Frederickson & Watson Co.	W. A. Rice	62.3
1.2 mi.—8.2 mi. E. of Mission San Jose	Jones & King	F. W. Montell	85.5
Woodwardia—Hall's Bridge	Eaton & Smith	A. L. Lamb	51.2
		Average	53.3

Highway Bids and Awards Jan., 1940

DEL NORTE COUNTY—Across Smith River about 9¾ miles north of Crescent City, a combination steel girder and reinforced concrete bridge to be constructed and about 0.3 mile of approaches to be graded and a bituminous seal coat applied. District I, Route 71, Section A. Hanrahan Connolly Co., San Francisco, $246,830; John Rocca, San Rafael, $256,222; A. Soda and Son, Oakland, $266,769; C. W. Caletti & Co., San Rafael, $274,978; R. G. Clifford, San Francisco, $279,063; E. E. Smith, Eureka, $279,700; United Concrete Pipe Corp. & Mercer-Fraser Co., Eureka, $291,885. Contract awarded to Joseph Shaw, Oakland, $246,028.

IMPERIAL COUNTY—Construct portland cement concrete bridge and remove existing bridge at Central Main Canal, one and one-half miles west of El Centro. District XI, Route 12, Section C. Thomas Construction Co., Burbank, $10,628; Tavares Construction Co., Los Angeles, $12,500; Chas. W. Pettifer, Long Beach, $20,911; Valley Construction Co., San Jose, $11,818; Walter H. Barber, San Diego, $12,697. Contract awarded to B. G. Carroll and Harry L. Foster, San Diego, $9,965.

MONTEREY COUNTY—Between 2 miles south and 3 miles north of Greenfield, about 5.6 miles to be graded and surfaced with plant-mixed surfacing on crusher run base. District V, Route 2, Sections E,D. Fredrickson Bros., Emeryville, $112,516; Piazza & Huntley, San Jose, $115,983; G. W. Ellis, North Hollywood, $118,844; M. J. B. Construction Co., Stockton, $120,717; A. Teichert & Son, Inc., Sacramento, $121,041; Claude C. Wood, Lodi, $121,785; Hemstreet & Bell, Marysville, $126,659. Contract awarded to Jones and King, Hayward, $107,831.

SAN MATEO COUNTY—Between Lake Lucerne and two miles south of Tunitas about 8.8 miles to be graded and surfaced with plant-mixed surfacing on crusher run base. District IV, Route 56, Sections A,B. A. Teichert & Son, Inc., Sacramento, $287,361; Frederickson & Westbrook, Sacramento, $304,168; Eaton & Smith, San Francisco, $304,748; Heafey-Moore Co.-Fredrickson & Watson Construction Co. & H. Earl Parker, Oakland, $307,192; Granfield, Farrar & Carlin, San Francisco, $308,719; Jones & King and Fredrickson Bros., Hayward, $318,232; Macco Construction Co., Clearwater, $319,704; The Utah Construction Co., San Francisco, $323,726; Chas. L. Harney, San Francisco, $357,929; McNutt Bros., Eugene, Oregon, $381,017. Contract awarded to N. M. Ball Sons, Berkeley, $281,974.

SANTA CLARA COUNTY—About 0.5 mile south of Los Gatos, a steel girder side-hill viaduct having a length of 926 feet 6 inches to be constructed. District IV, Route 5, Section C. Earl W. Heple, San Jose, $94,250; Caputo & Keeble, San Jose, $100,283; A. Soda and Son, Oakland, $105,810; John Rocca, San Rafael, $108,076; M. J. Lyneh, San Francisco, $119,640. Contract awarded to Heafey-Moore Co. and Fredrickson & Watson Construction Co., Oakland, $91,509.

SANTA CLARA COUNTY—On Polhemus Street at San Jose, an underpass under the tracks of the Southern Pacific Co. to be constructed. District IV, Feeder route. Carl N. Swenson Co., San Jose, $134,860; Caputo & Keeble, San Jose, $137,600; Trewhitt-Shields and Fisher, Fresno, $140,083; Barrett & Hilp, San Francisco, $151,428; John Rocca, San Rafael, $152,627. Contract awarded to Earl W. Heple, San Jose, $130,497.

SISKIYOU COUNTY—A reinforced concrete slab and steel girder overhead crossing over the Southern Pacific Co. tracks at Weed consisting of two 62.54-foot and one 98-foot steel girder spans on steel columns with reinforcing concrete footings and abutments. District II, Route 72, Section A. John Rocca, San Rafael, $51,125; M. A. Jenkins, Sacramento, $52,670; D. W. Nicholson, Oakland, $53,892; Albert H. Siemer and John Carcano, San Anselmo, $55,920; Clifford A. Dunn, Klamath Falls, Oregon, $56,248; R. M. Price, Huntington Park, $56,420; Robert McCarthy, San Francisco, $57,610; A. Soda and Son, Oakland, $58,534; Scheumann and Johnson, Eureka, $64,080. Contract awarded to F. Fredenburg, So. San Francisco, $48,865.

SONOMA COUNTY—A reinforced concrete bridge across Tolay Creek about 19 miles southwest of Napa. District IV, Route 8, Section A. Harold Smith, St. Helena, $6,844; Robert McCarthy, San Francisco, $7,888; John Carcano, San Rafael, $8,033; C. C. Gildersleeve, Berkeley, $8,160; A. Soda and Sons, Oakland, $8,256; Utah Construction Co., San Francisco, $8,375; Stanley P. Cooley, Palo Alto, $8,444. Contract awarded to F. Fredenburg, So. San Francisco, $6,242.

TULARE COUNTY—Between Kingsburg and 1.9 miles southerly about 1.7 miles to be graded and surfaced with asphalt concrete and plant-mixed surfacing. District VI, Route 4, Section E. M. J. B. Construction Co., Stockton, $88,205; A. Teichert & Son, Inc., Sacramento, $97,277; Marshall S. Hanrahan, Merced, $98,810; A. Soda and Son, Oakland, $107,482. Contract awarded to Piazza & Huntley, San Jose, $77,614.

TULARE COUNTY—Between Thermal School and Ducor, about 3.1 miles to be graded, penetration oil treatment applied thereto and a reinforced concrete bridge to be constructed. District VI, Route 129, Section A. Claude C. Wood, Lodi, $38,627; Fredrickson Bros., Emeryville, $40,373; A. Teichert & Son, Inc., Sacramento, $41,709; Anderson & France & Knapp, Visalia, $42,844; Rexroth and Rexroth, Bakersfield, $44,222; A. S. Vinnell Co., Alhambra, $45,587; R. E. Hazard & Sons, San Diego, $45,679; Griffith Co., Los Angeles, $46,714; The Utah Construction Co., San Francisco, $48,681; Valley Construction Co., San Jose, $51,581; Basich Bros., Torrance, $53,067; G. W. Ellis, North Hollywood, $53,999; J. W. & E. M. Breedlove, Alhambra, $55,983. Contract awarded to Louis Biasotti & Son, Stockton, $36,712.90.

YOLO COUNTY—Causeway across Yolo By-Pass about 5 miles west of Sacramento, a portion to be redecked. District III, Route 6, Sections A & B. M. J. B. Construction Co., Stockton, $61,138; John Rocca, San Rafael, $66,412; D. W. Nicholson, Oakland, $76,554; A. Teichert & Son, Inc., Sacramento, $76,745; Engineers, Limited, San Francisco, $78,985. Contract awarded to Lee J. Immel, Berkeley, $59,272.

Plaint of Auto Makers

Tax collectors took more money from motorists in special fees and taxes in 1938 than motor vehicle manufacturers received that year for new cars and trucks sold in the United States. Wholesale value of the vehicles, according to the Automobile Manufacturers Association, was $1,400,000,000, whereas special fees and taxes paid by motor vehicle owners exceeded $1,500,000,000.

State highway grading work is in progress over five miles between La Jolla Indian Reservation and Morettis in San Diego County.

Channelizing Traffic in Oakland

(Continued from page 18)

At El Embarcadero during 1938, there were 12 accidents reported, two in which pedestrians were involved. This intersection was channelized during the first 6 months of 1939. During the construction period, 3 accidents occurred. During the last 6 months, 2 accidents occurred, one due to a defective wind shield and one due to following too closely. One accident occurred when a parked car turned into the line of traffic, which is not considered attributable to intersection restrictions. A traffic census of this intersection taken in January, 1937, showed a daily average for a 24-hour period of over 22,000 vehicles through El Embarcadero. In addition, 9,000 vehicles used Grand Avenue, north and south, and 3,000 used Lakeshore Avenue, north and south.

While it is not claimed that channelization is the complete solution of intersection problems, the experiment so far indicates that many of the causes of accidents have been eliminated and that accidents have been reduced.

Some motorists complain of their inability to determine the correct traffic lane to use when approaching a channelized intersection. It is felt, however, that this confusion is more psychological than real because experience has shown that as motorists become familiar with these intersections, no more complaints are received and numbers of accidents are greatly reduced.

HIGHWAYS IMPROVED AS TRAFFIC MOVES

The way the State improves highways today with no inconvenience or delay to traffic is illustrated in a 2.3 miles grading and plant-mix surfacing job being done on U. S. Highway 101 between a point east of El Capitan Creek and Orella in Santa Barbara County.

Sophomore—"Were you ever bothered with athlete's foot?"

Freshman—"Yes, once when the captain of the football team caught me with his girl.—*Hudson Star.*

Relocation in Santa Ana Canyon

(Continued from page 19)

posite the dam site. This portion was graded to a rough grade section including drainage structures, and a roadbed for the Santa Fe Railway tracks. Closely following the completion of this unit, the Division of Highways awarded a contract to V. R. Dennis Construction Company for constructing the highway from Corona to the Orange County line including surfacing the portion constructed under the jurisdiction of the Orange County Flood Control District.

Work on these units was notable for the heavy grading operations. About one mile east of the Orange County line near the head of the Santa Ana Canyon one cut section had a maximum height of over one hundred feet and a length of about one-fourth of a mile. From this huge prism, about ninety thousand cubic yards of gravelly material were selected and processed for surfacing material. The surfacing material was placed on the rough grade to a depth of one foot below profile elevation to provide stability for the plant-mixed surfacing.

As the location of this project was back from the river channel, the new alignment crossed many fingerlike ridges extending from the nearby range of the Santa Ana Mountains. The heavy grading involved in cross cutting these ridges made it necessary, in order to balance quantities, to construct at this time a roadway width adequate for four lanes of divided traffic, rather than to construct for two lanes and later widen for a four-lane section. The westerly one-half mile was constructed to a standard 38-foot section.

For a riding surface, a three-inch thickness of plant-mixed surfacing was placed on the surfacing material. Through the portion graded for an ultimate four-lane, divided highway section the plant-mixed surfacing was placed on the north half of the roadbed in due regard for the future four-lane development.

Bordering each side of the surfacing, shoulders were constructed to a width of seven feet with a road-mix surface treatment.

The section of new highway is built to modern standards with curves so easy they are not a limiting factor in legal speeds.

In addition to the ever increasing volume of pleasure traffic between the mountain resort areas in Riverside and San Bernardino counties, and the beach areas, the volume of freight traffic between the Long Beach and San Pedro harbors and the farms and cities of the interior counties is also constantly increasing.

In the past few years, the Division of Highways reconstructed this route from the Riverside-Orange County line, westerly through the balance of the Santa Ana Canyon. With the completion of this project, the highway through the entire canyon can now be traversed quickly and safely in contrast to the unpleasantness and the ever present danger element of riding over the short steep grades and sharp curves of less than a decade ago.

Another significant development made necessary by the Prado Dam is the necessity for the relocation of the State highway route between Prado and Pomona. This route is one that is likely to become of major importance due to its strategic geographical location.

As some five miles of this route in the vicinity of Prado is under the ultimate highwater line, its relocation is necessary and will involve reconstruction of between five and ten miles of highway to make satisfactory connections outside of the flood water basin.

In Memoriam

George Ernest Watton

With the death of George Watton on January 1, 1940, the San Francisco-Oakland Bay Bridge has lost a loyal and valuable employee, and his fellow workers, both at the Administration Building and Central Office have lost a valued friend.

Mr. Watton graduated in May, 1922, from the University of California with a B. S. Degree in Civil Engineering. He was first employed by private consulting engineers in San Francisco and later by the late George Posey in the construction of the tube underneath the Oakland Estuary that bears his name. After the completion of this project Mr. Watton started to work for the Bridge Department of the State Division of Highways in 1928, as a bridge designer. In September, 1931, he was transferred to the Design Department of the San Francisco-Oakland Bay Bridge where he was employed until his untimely death.

Mr. Watton was a loyal, capable and conscientious worker, interested in helping others in their work, and always willing to give freely of his own time.

He was born May 7, 1899, in Oakland, California. He attended grade and high schools in that city and the University of California in Berkeley, where he graduated with honors from the College of Civil Engineering. He is survived by his widow Adelyn, his parents, Mr. and Mrs. E. M. Watton, and three sisters. To these is extended the deepest sympathy of his co-workers and employees of the Department of Public Works.

Pavement Records for 1939

(Continued from page 24)

as was built in 1938. On the whole, an improvement was made in the riding qualities of this type of road surface.

Construction Records

The record for surface smoothness of plant-mix, 6.5 inches per mile, was made on Contract 08VC6, Road VIII-SBd-26-A, San Bernardino to Santa Ana River. V. R. Dennis Company was the contractor and G. E. Malkson, the resident engineer. The State average for 1939 was 26.0 inches per mile, as compared to 23.5 inches in 1938.

The record for surface smoothness of road-mix type, 6.3 inches per mile, was made on Contract 011XC4, Road XI-Riv-187-F, near Thermal, by Basich Bros., contractor, and C. R. Hagberg, resident engineer. The State average for 1939 was 31.9 inches per mile, compared to 38.7 inches in 1938.

The record surface smoothness for armor coat surface, 28.1 inches per mile, was made on Contract 04WC5, Road IV-SC1-32-C, one mile east of Bell's Station to three miles west of Merced County Line. Granfield, Farrar & Carlin were contractors, with H. S. Payson, resident engineer. This compares to the record for 1938, when 28.4 inches was averaged on one project.

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printed in CALIFORNIA STATE PRINTING OFFICE
SACRAMENTO, 1940 GEORGE H. MOORE, STATE PRINTER

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Division of Highways
P. O. Box 1499
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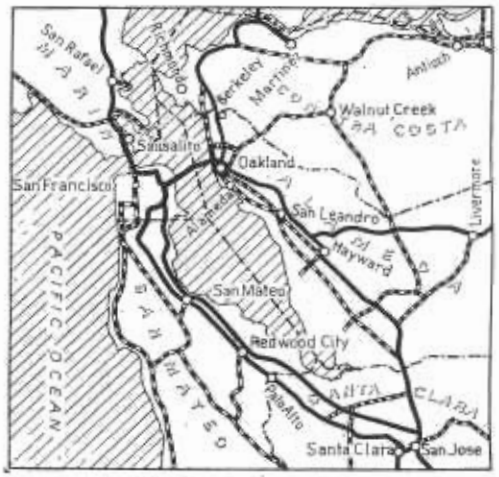

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