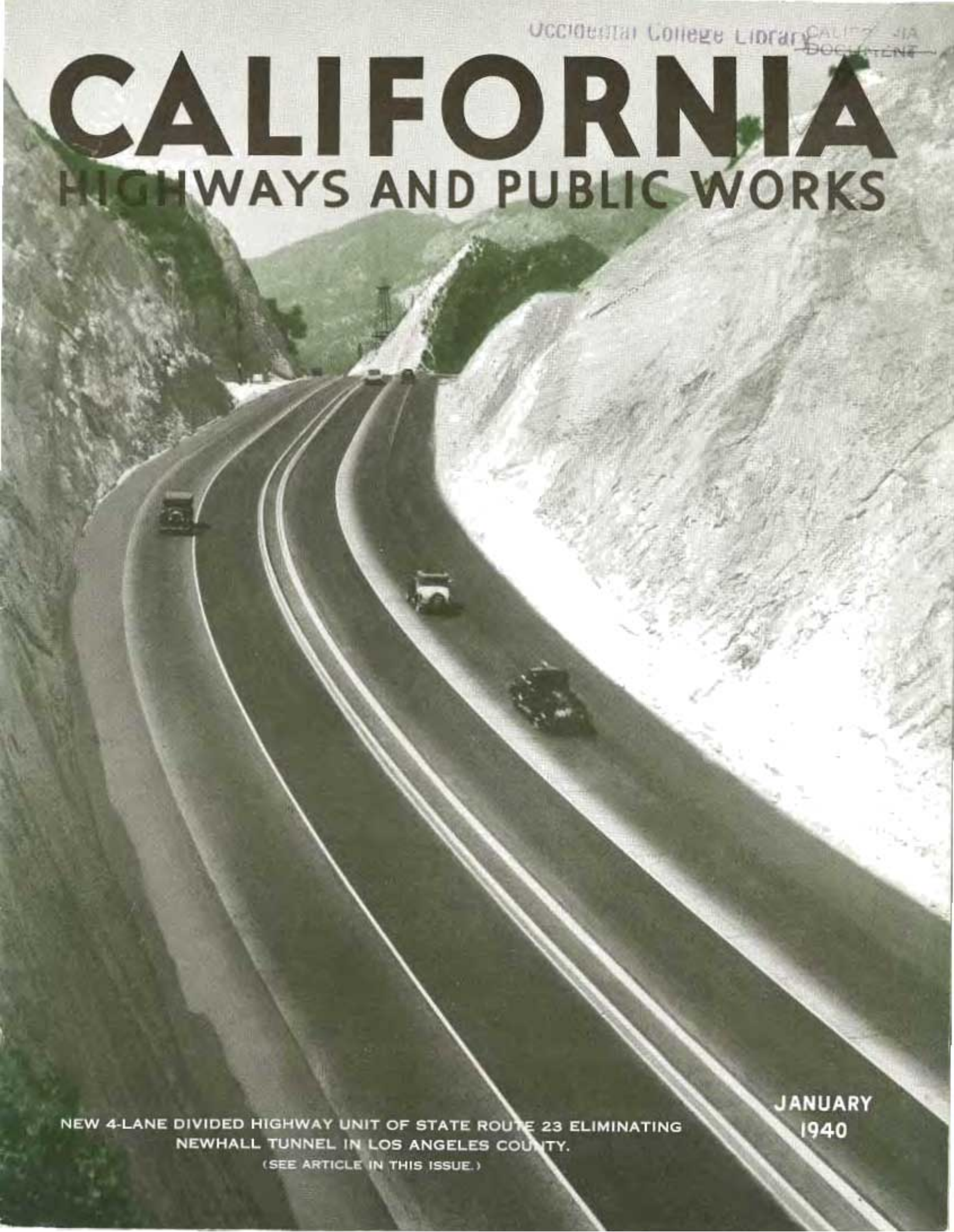
CALIFORNIA
HIGHWAYS AND PUBLIC WORKS



NEW 4-LANE DIVIDED HIGHWAY UNIT OF STATE ROUTE 23 ELIMINATING NEWHALL TUNNEL IN LOS ANGELES COUNTY.
(SEE ARTICLE IN THIS ISSUE.)

JANUARY
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

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

Vol. 18 JANUARY, 1940 No. 1

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Federal-State Groups Act to Unfreeze $50,000,000 in Central Valley Project Bonds

LEGISLATION which would enable the Water Project Authority of California to cooperate with the Federal government in the complete development of the Central Valley Project has been presented to Governor Culbert L. Olson and the United States Bureau of Reclamation for their consideration.

The legislation proposed is an amendment to the Central Valley Project Act which would permit the Water Project Authority to issue up to $50,000,000 of revenue bonds authorized in the act, to be used in performing the purposes and objects of the act approved or requested by Secretary of the Interior Harold L. Ickes. The bonds would be a lien on revenues from the project only and not general obligation bonds of the State.

Federal, State and local representatives joined forces in working out the legislation at a two-day conference held in Sacramento December 21st and 22d. Representing the Federal Government were Walker R. Young, supervising engineer of the Central Valley Project, and R. J. Coffey, attorney for the U. S. Bureau of Reclamation. Public Works Director Frank W. Clark, State Engineer Edward Hyatt and members of their staffs represented the State. Local groups were represented by Governor Olson's Central Valley Project Committee and the Central Valley Project Association.

The meeting was called at the request of Commissioner of Reclamation John C. Page, who urged that the State take the necessary steps to provide public outlet facilities for the project not contemplated by the Bureau of Reclamation. While the bureau is building the major features of the Central Valley Project, it has made no provision for distribution of water and power to local agencies.

Providing this market for the sale of water and power to be developed is of vital importance to the success of the project, for the income derived from these sales will have to repay the Federal Government for its cost.

Secretary of the Interior Ickes also stressed the need for State action in providing these markets. He wrote:

> "I believe that California can render to the United States a valuable service by undertaking a program which would provide public power outlets for the energy to be generated at the Shasta Dam of the Central Valley Project. The value of the service could be increased by early and vigorous prosecution of such a program as is contemplated."

In presiding at the conference Director Clark, as chairman of the Water Project Authority, made it clear that the State is ready to take such action as desired by the Federal Government, and approved by groups genuinely and constructively interested in the development of the Central Valley Project in all its phases.

> "The Federal Government has indicated that legislation should be enacted immediately," Director Clark said. "The representatives of the Federal Government have indicated that now is the time to prepare such legislation if the Secretary's wishes are carried out. The State is anxious to fulfill these wishes and place itself in a position to cooperate with the Federal Government."

Mr. Coffey, as attorney for the Bureau of Reclamation, amplified the position of the Federal Government by stating:

> "The Water Project Authority should be in a position to go ahead where the government leaves off. We think you have all the necessary legal power to do what should be done. You need only funds for the Authority to go ahead. I can not say how you should do it. One

Ickes Stresses Need for Legislation

Excerpts from a letter by Secretary of the Interior Harold L. Ickes to Governor Culbert L. Olson read as follows:

"Commissioner Page, of the Bureau of Reclamation, which is building the project, and I, understand the need for such assistance as can be given by the State, in the encouragement of and assistance in organization of both irrigation and power districts. Adequate provisions in State law permitting issuance of revenue bonds to finance the construction of distribution systems afford a convenient and desirable machinery.

"There is no doubt in my mind that the public interest will be served best if publicly controlled outlets for the salable commodities provided by the project are brought into existence. I realize that so far as the power is concerned the supply from Shasta Dam must be supplemented by adequate stand-by capacity if its maximum benefits are to be obtained. * * * *

In my opinion, therefore, the proposal by the State to empower the Water Project Authority to provide these supplemental facilities and to aid in the organization of the public power outlets should be commended and deserves the support of the people of California. Because of the underlying Federal law, such legislation can not unfavorably affect the prospective water users of the project, but on the other hand the provision, as proposed, of a competitive power market should mean actually more favorable rates on the water."

way would be to provide revenue bonds."

Starting with this as a basis the conferees worked out the following premise on which the legislation should be designed:

1. That no change in the original intent of the Central Valley Project Act was necessary.

2. That despite Federal financing of the major features of the project the responsibility for providing outlet facilities still rests with the State and local agencies.

3. That means should be devised whereby the Water Project Authority could assist local agencies and cooperate with the Federal Government in financing these outlets.

4. That the best possible method presently available of securing these distribution facilities would be through the issuance of revenue bonds.

It was determined by the conferees that the simplest method of issuing revenue bonds to carry on this work would be to unfreeze a portion of the $170,000,000 bond issue authorized in the Central Valley Project Act which was approved by a vote of the people in 1933. This act provides for the construction of distribution facilities as well as the major features of the project.

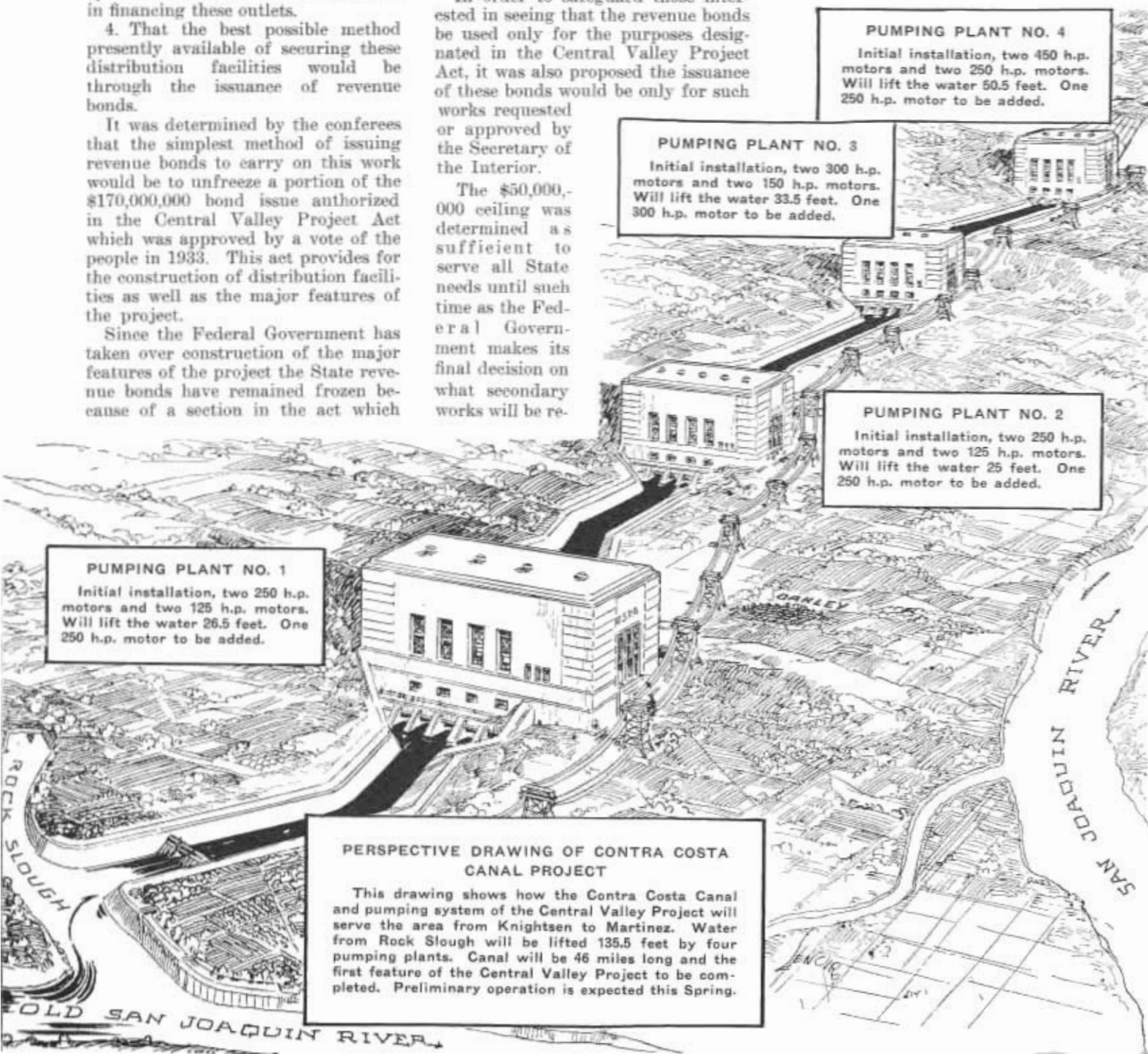
Since the Federal Government has taken over construction of the major features of the project the State revenue bonds have remained frozen because of a section in the act which provided that the total issue was to be reduced by the amount of the Federal Government's "contribution." Until the amount of that "contribution" is determined bonds provided by the act remain frozen.

The method adopted to overcome this difficulty was the framing of a new section to the act which would release a portion of these bonds. The amendment drawn calls for a ceiling of $50,000,000 in revenue bonds that can be issued under the new section, leaving frozen in the original act $120,000,000 in revenue bonds as a safeguard against the failure of the Federal Government to complete the major features of the project.

In order to safeguard those interested in seeing that the revenue bonds be used only for the purposes designated in the Central Valley Project Act, it was also proposed the issuance of these bonds would be only for such works requested or approved by the Secretary of the Interior.

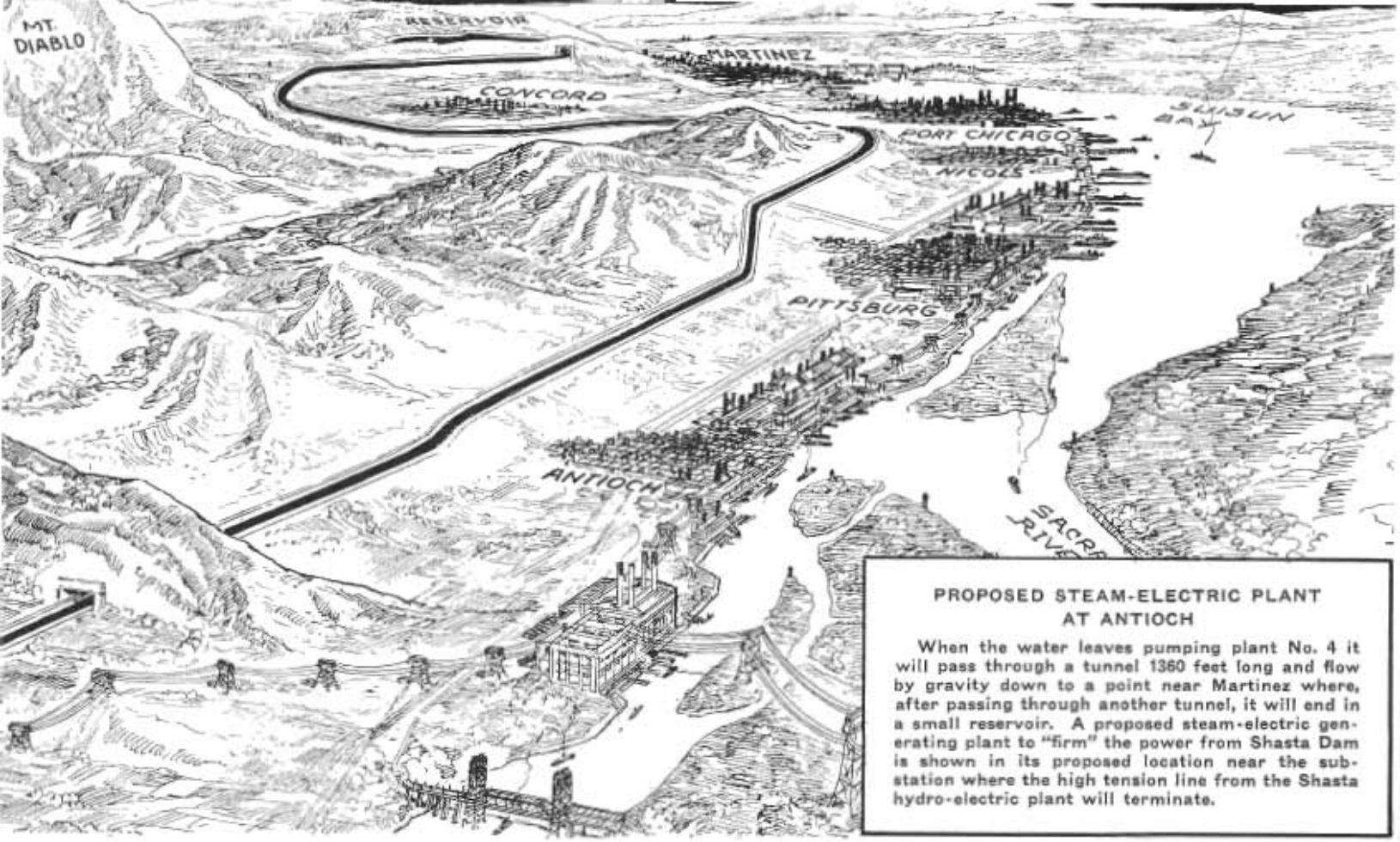
The $50,000,000 ceiling was determined as sufficient to serve all State needs until such time as the Federal Government makes its final decision on what secondary works will be required of the State. If pending Federal legislation authorizing the government to finance construction of lateral canals is not approved, approximately half the $50,000,000 will be available for this purpose. It will also provide funds for the construction of secondary electric distribution lines and a standby steam electric generating plant at or near load center of the Northern California power market.

It was the concensus of opinion of those attending the conferenee the proposed legislation will meet the sectional objections offered to the Pierovich Bill, defeated at the last session of the legislature. The Pierovich Bill



PERSPECTIVE DRAWING OF CONTRA COSTA CANAL PROJECT

This drawing shows how the Contra Costa Canal and pumping system of the Central Valley Project will serve the area from Knightsen to Martinez. Water from Rock Slough will be lifted 135.5 feet by four pumping plants. Canal will be 46 miles long and the first feature of the Central Valley Project to be completed. Preliminary operation is expected this Spring.



PROPOSED STEAM-ELECTRIC PLANT AT ANTIOCH

When the water leaves pumping plant No. 4 it will pass through a tunnel 1360 feet long and flow by gravity down to a point near Martinez where, after passing through another tunnel, it will end in a small reservoir. A proposed steam-electric generating plant to "firm" the power from Shasta Dam is shown in its proposed location near the substation where the high tension line from the Shasta hydro-electric plant will terminate.

would have unfrozen the entire $170,000,00 bond issue for use by the State in developing markets for the water and power from the project.

The amendment complies with the request of the Federal Government that the State carry on the work of organizing districts for the consumption of the water and power.

Unfreezing a portion of the revenue bonds voted in the original act rather than authorizing a new issue, does not add to the cost of the project.

Enough bonds are left frozen in the Central Valley Project Act to protect the State against any future needs in completing the project.

Only objection the measure does not meet is that raised by the private power company which is seeking the privilege of marketing all of the power generated at Shasta Dam. The company has opposed any effort on the part of the State to furnish power to public agencies without the company acting as the marketing agent.

At present there are a number of public agencies operating or organized which have indicated their desire to buy the power directly from the State and not after a private profit has been collected by a private utility. Under the terms of the Federal Reclamation Act and the Central Valley Project Act these public agencies must be given preference in the sale of power developed by the project.

Public Works Director Clark declared he believes passage of the proposed legislation will materially aid California in obtaining further appropriations for the project in Congress. He pointed out that some congressmen already are raising objections to further appropriations for reclamation projects on which provision has not been made for repayment of the money.

"By showing these congressmen that California has placed herself in a position to assist the Federal Government in providing a market for the water and power from the Central Valley Project, we can overcome these objections," Clark said.

In his budget message to Congress President Roosevelt recommended an appropriation of $16,000,000 to carry on construction work on the Central Valley Project for the next fiscal year. The Bureau of Reclamation asked that $22,000,000 be appropriated.

To date $44,600,000 has been appropriated by the congress, but contracts committing the government to an expenditure of $73,000,000 already have been awarded. If the $16,000,000 recommended in the President's budget is not increased it will leave the Reclamation Bureau $12,400,000 short of its present obligations.

The Water Project Authority, through the State Division of Water Resources, already has done considerable work in providing a market for the water and power from the Central Valley Project. Many irrigation districts have been organized and others are in the process of organization which will use the water developed.

Presently a survey is under way in the area which could be served by a steam electric generating plant to be built at load center near Antioch. It has been definitely determined that such a plant will be necessary to firm the power generated at Shasta Dam in order to operate the system in an economical manner. Construction of the plant was authorized in the original executive order issued by President Roosevelt on September 10, 1935, as an alternative feature of the project suitable for immediate construction. However, funds to build the plant were not made available.

Contra Costa Canal Pumping Plants Near Completion

The Contra Costa Canal, extending from Knightsen to Martinez, will be the first portion of the project completed. The first 20 miles of the canal are virtually completed and bids now are under consideration for the construction of head works at Rock Slough. Four pumping plants which will lift the water to the high-line canal are reported two-thirds complete.

Heafey-Moore Company and Frederickson and Watson Construction Company of Oakland have started work on an additional nine-mile section of the canal extending from the end of the present work east of Pittsburg to a point two miles northeast of Concord. Only about 17 miles of the 46-mile canal remain on which contracts have yet to be let. However, bids have been called for construction of an additional 8½-mile section which will carry the work on to a point near Walnut Creek.

Arrangements are pending between the Bureau of Reclamation and the Contra Costa County Water District for preliminary use of the completed part of the canal on an interim basis beginning next April. It is planned to serve a number of industries and municipalities with such water as is available.

Regular supply for the canal will come from Shasta Reservoir when that key unit of the project is completed probably in 1944. During the interim, the supply will be of a supplemental nature. When completed the canal will carry 350 second feet of water, which is estimated sufficient to supply all future industrial, agricultural and domestic uses in the district served.

That there will be a heavy expansion of industrial and domestic use of water when the present deficiency is overcome was predicted by George W. Dowrie, Stanford University economist, who made a survey of the district in 1936 for the Water Project Authority. He estimated the increase in water consumption for the area in the next 30 years would be 166⅔ per cent.

While no recent study has been made by the Water Authority on future power needs in the same area, an expansion comparable to the water consumption might be anticipated with low cost electricity. The area will be within short radius of the termination of the high tension line carrying the energy generated at Shasta Dam to Antioch and thus easily served.

Including the pumping plants for the Contra Costa Canal and the San Joaquin pumping system, which eventually will be served by Shasta Dam energy, there is an available market of more than 500,000,000 kilowatt hours of electricity annually.

Early construction of the planned steam electric generating plant at load center near Antioch will assist in taking care of a portion of this load until Shasta Dam energy is made available and at the same time create a market for Shasta Dam energy.

Bids Opened for Madera Canal Unit

An important step towards the delivery of a supplemental supply of San Joaquin River water to the thirsty lands of Madera County was recently taken when the United States Bureau of Reclamation opened 10 bids for the first construction on the Madera Canal, a feature of the Central Valley Project.

The Utah Construction Company of San Francisco and Ogden submitted the lowest offer of $397,963 for building the first 8½ miles of the canal from Friant to a point just beyond the crossing of State Highway 41 in the foothills east of Madera.

Walker R. Young, supervising engineer of the Central Valley Project, said the upper reaches of the Madera Canal will be 10 feet wide at the bottom and 36 feet wide at the top of the concrete lining which will be 3½ inches thick. With a capacity of 1000 second-feet, it will carry water about 9 feet deep. The first 600 feet of the canal, diverting from Friant Dam, will be built under the general contract for Friant Dam.

The 8½-mile section just bid upon will include three siphons, three highway bridges, seven farm bridges, three overchutes, two culverts, and a wasteway. The construction job will include 580,000 cubic yards of excavation, 22,000 cubic yards of concrete placement, installing 1,770,000 pounds of reinforcement bars and erecting 57,500 pounds of bridge steel. The contractor will be allowed 500 calendar days.

The Madera Canal ultimately will extend a total distance of 40 miles from Friant Dam to Ash Slough, which is a channel of the Chowchilla River in northern Madera County.

Improving Madera Approach Road to Friant Dam

The first fifteen miles of the twenty mile Madera approach road to the Friant Dam is the portion of State Highway Route 126 between Madera and the Fresno-Yosemite Highway.

The Division of Highways, in cooperation with the WPA and SRA, are now reconstructing approximately nine unimproved miles of this route. The completion of this work in the summer of 1940 will place the State highway section of the approach in shape to handle Friant Dam transportation. It is understood that Madera County has completed arrangements for the improvement of the remaining five miles of county road connection to the dam site.

The highway improvement is estimated to cost on a WPA basis about $240,000. The State Division of Highways is supervising this day labor operation and contributing about $38,000. The State Relief Administration is participating to the extent of approximately $18,000 while the WPA cost will be about $184,000.

The Division of Highways and SRA contributions are being used for the purchase of materials and rental of equipment. Because of these additional funds, it will be possible to operate the project on a more efficient equipment basis instead of the usual relief hand labor methods. Thus the project will not only provide an improved access to the Friant Dam, but will also help the serious relief problem of the San Joaquin Valley. This dual objective was made possible by the fact that state highway funds had been provided under a coincidental budgetary item for a smaller project.

Friant Office Building

The Midstate Construction Company of Fresno has submitted the lowest offer of $19,319 for building a one-story office structure at Friant for use by the Bureau of Reclamation. The building will be 45 by 102 feet, air cooled and heated. With excavation proceeding at Friant Dam and work soon to start on the Madera Canal, Construction Engineer R. B. Williams' staff at the Government camp has increased to 87, necessitating the additional office building.

Public Works Program Totals Over $50,000,000 for Next 18 Months

By FRANK W. CLARK, Director of Public Works

GOVERNOR CULBERT L. OLSON'S public building program will make the year 1940 an exceptionally busy one for the Department of Public Works.

Its five Divisions—Highways, Water Resources, Architecture, Contracts and Rights of Way, and San Francisco-Oakland Bay Bridge—constituting the largest agency in State government, will spend more than $50,000,000 of State and Federal funds during the eighteen months' period that began January 1.

The larger portion of this sum will be expended during 1940.

With the beginning of the new year, there will be bridge and highway construction in the amount of approximately $27,083,000 to be placed under way during the remaining 18 months of this biennium.

CONSTRUCTION FUND

This work will include construction financed from funds as follows:

Regular Federal Aid Feeder Funds and State Funds for Current Biennium	$24,366,000
Federal Grade Crossing Funds for Current Biennium	1,772,400
Remaining Funds From Last Biennium	944,600

It is quite safe to assume that during the calendar year of 1940 about two-thirds of this work will be let to contract and placed under way.

In addition, on January 1, there remained some $9,123,500 for highway maintenance activities during the next 18 months. Approximately two-thirds of this amount will be spent during 1940.

RIGHTS OF WAY

For rights of way and engineering there was on hand at the first of the year for expenditure during the remainder of the biennial period about $3,936,400.

The sum of $500,000 has been set aside for maintenance of the San Francisco-Oakland Bay Bridge during 1940.

The Division of Architecture's program for construction, improvement and equipment for the first 18 months of this biennium amounts to approximately $12,000,000.

Of this amount $3,061,643 represents work now under way and which will continue to be in the construction field during part of 1940.

FRANK W. CLARK

New work to be started in the field during the year will amount to $9,235,400.

WATER RESOURCES PROGRAM

The 1940 program of the Division of Water Resources covers every phase of California's complex water problems from snow surveys and stream gaging through conservation, flood protection, and distribution, on down to ground water surveys. It includes the administration of all water rights, supervision of dams, flood control and reclamation work, irrigation and drainage supervision, water resources investigations, the Central Valley Project and cooperative work with the Federal government.

As a result of the passage and signing by Governor Olson of Senate Bill 950, the Sacramento Valley will have for the first time an adequate flood control maintenance program. The Division will spend $1,020,000 in State and Federal funds, $695,000 of which will be for permanent bank protection at 47 places along the Sacramento River and the remainder for levee work and clearing flood channels of vegetation. An additional $55,000 will be spent on extension of the Russian River Jetty.

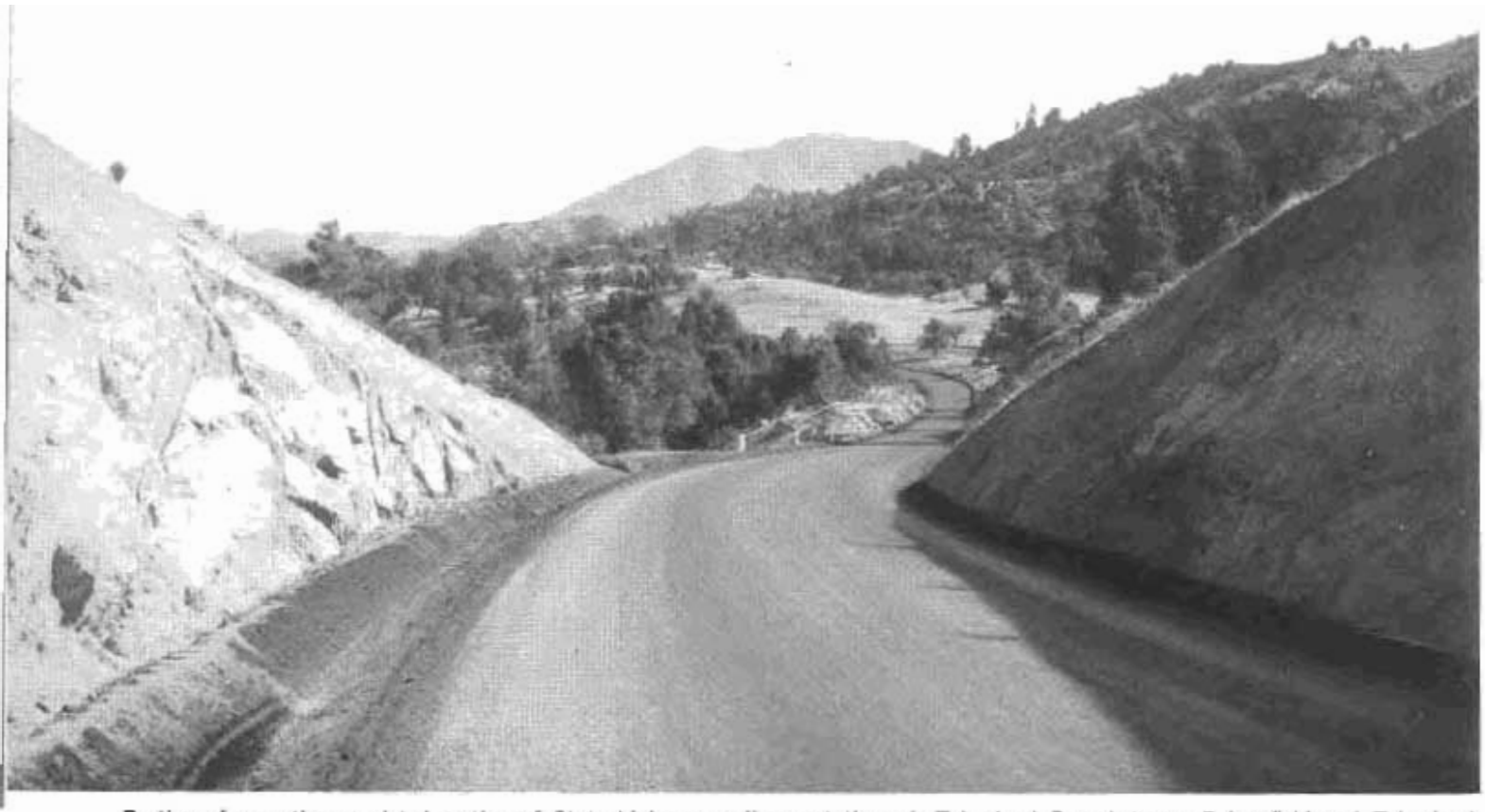
In connection with the Central Valley Project, on which the Federal government has awarded contracts amounting to approximately $75,000,000 to date, the division will continue engineering, legal, economic and financial studies relative to the disposal and utilization of the water and power to be developed. About half of the $100,000 provided for these studies will be spent in 1940.

DAMS AND FLOOD CONTROL

During the year the Division will inspect each of the 618 dams under its jurisdiction, supervise repairs and alterations made on these dams and supervise all new construction and enlargement of dams undertaken during the year.

Repair of damage caused by the floods of 1937-38 in 51 counties, for which $5,000,000 in emergency funds was voted by the legislature, will be completed in 1940. Between 175 and 200 contracts have been let and reconstruction still is under way on about 40 of them.

(Continued on page 13)



Portion of recently completed section of State highway realignment through Tehachapi Pass between Bakersfield and Tehachapi.

Tehachapi Pass Unit Opened

By JESSE W. COLE, Resident Engineer

A RECENTLY completed stretch of highway 4.6 miles in length on State Highway 58 as a part of the reconstruction of the important Tehachapi Pass route between Bakersfield and Tehachapi has resulted in a great aid to motorists. The section just completed extends from Bear Mountain Ranch to one mile north of Keene.

This short stretch of new highway has eliminated many steep grades and sharp radius curves. A twenty-eight foot minimum width of traveled way replaces the sixteen foot width along the old route.

The new work has been built to modern standards for the volume and type of traffic using this highway through the canyon. On the old route there were curves with radii as short as 50 feet, while on the work just completed the minimum radius is 1000 feet. The grade line has been flattened from a maximum of 7.5 per cent on the old road to a maximum of 6 per cent on the new. The minimum horizontal sight distance has been increased from 50 feet to 400 feet and vertical sight distances lengthened from 100 feet to 600 feet.

SAVINGS TO MOTORISTS

Construction operations on the 4.6 miles involved nearly 500,000 cubic yards of roadway excavation. In construction of the surface about 655 tons of liquid asphalt was mixed with the roadbed material over a total area of 79,500 square yards. In providing adequate drainage facilities some 4760 linear feet of various sizes of corrugated metal pipe were used.

Because of the higher standard for both grades and alignment, trucks are now able to reduce their traveling time between Bakersfield and Tehachapi by as much as from 20 to 40 minutes. While the stretch of highway recently completed is short, it will give some idea as to the tremendous saving to motorists, particularly to those operating heavy trucks, that will be accomplished when the entire stretch of U. S. 466, between Bear Mountain and Tehachapi, is completed.

Traffic over this route is continuously increasing, especially by out-of-State cars and heavy trucks. A large cement plant east of Tehachapi hauls by truck a great portion of its product to various points in the metropolitan area of Los Angeles over this route as well as throughout the San Joaquin Valley.

GREATLY INCREASED TRAFFIC

During the past five years the week day traffic has increased 148 per cent. During the wild flower season this highway carries a daily flow of traffic reaching nearly 4,000 vehicles.

The construction of another section, 4.3 miles in length, between the easterly end of the work recently finished and a point opposite Marcel is now in progress.

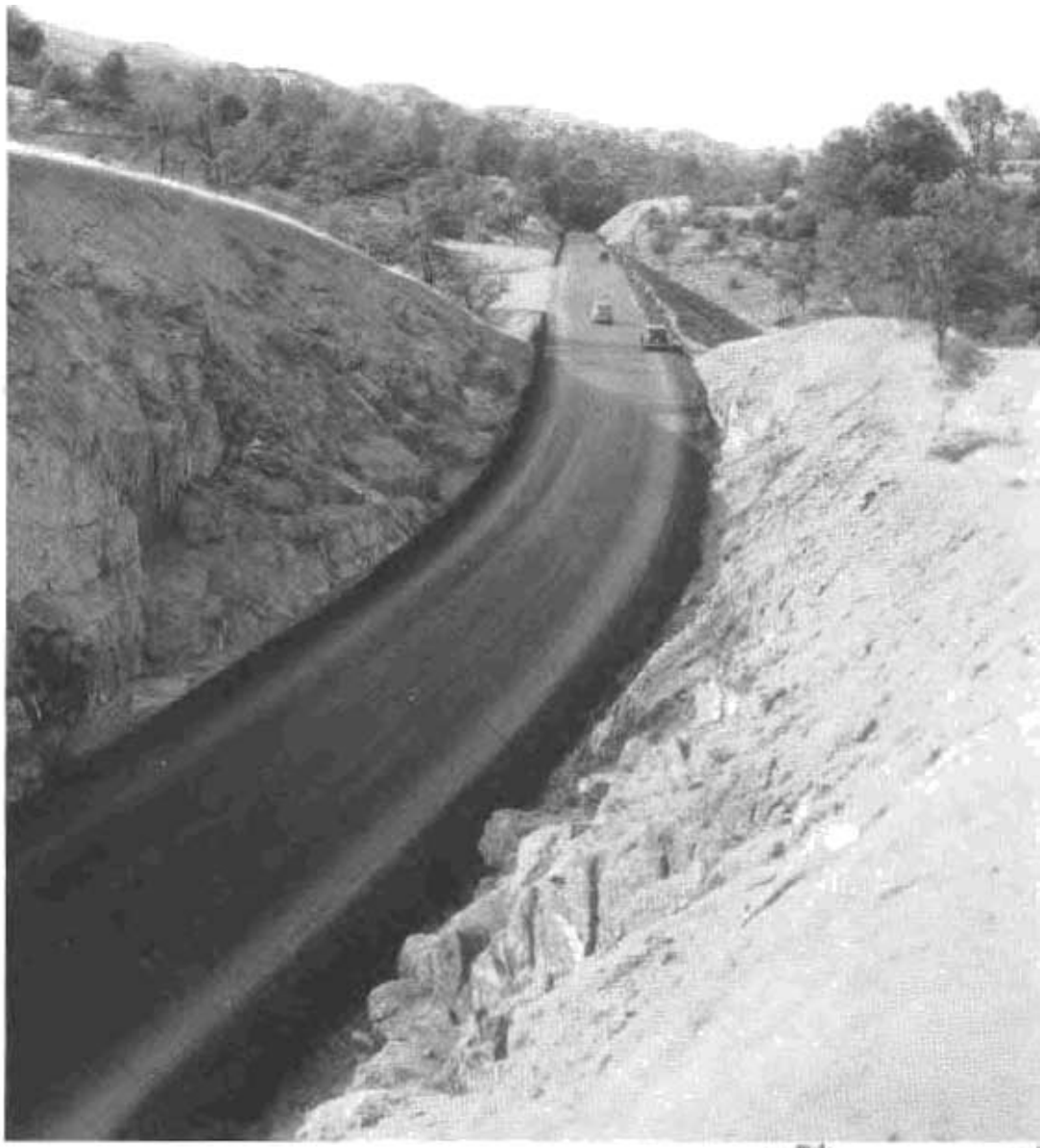
This new location, however, provides for construction along the northerly side of the Southern Pacific Railroad. The new alignment across the railroad from the existing road together with the fact that the new road is kept at a much lower elevation, will greatly improve conditions from the standpoint of snow removal.

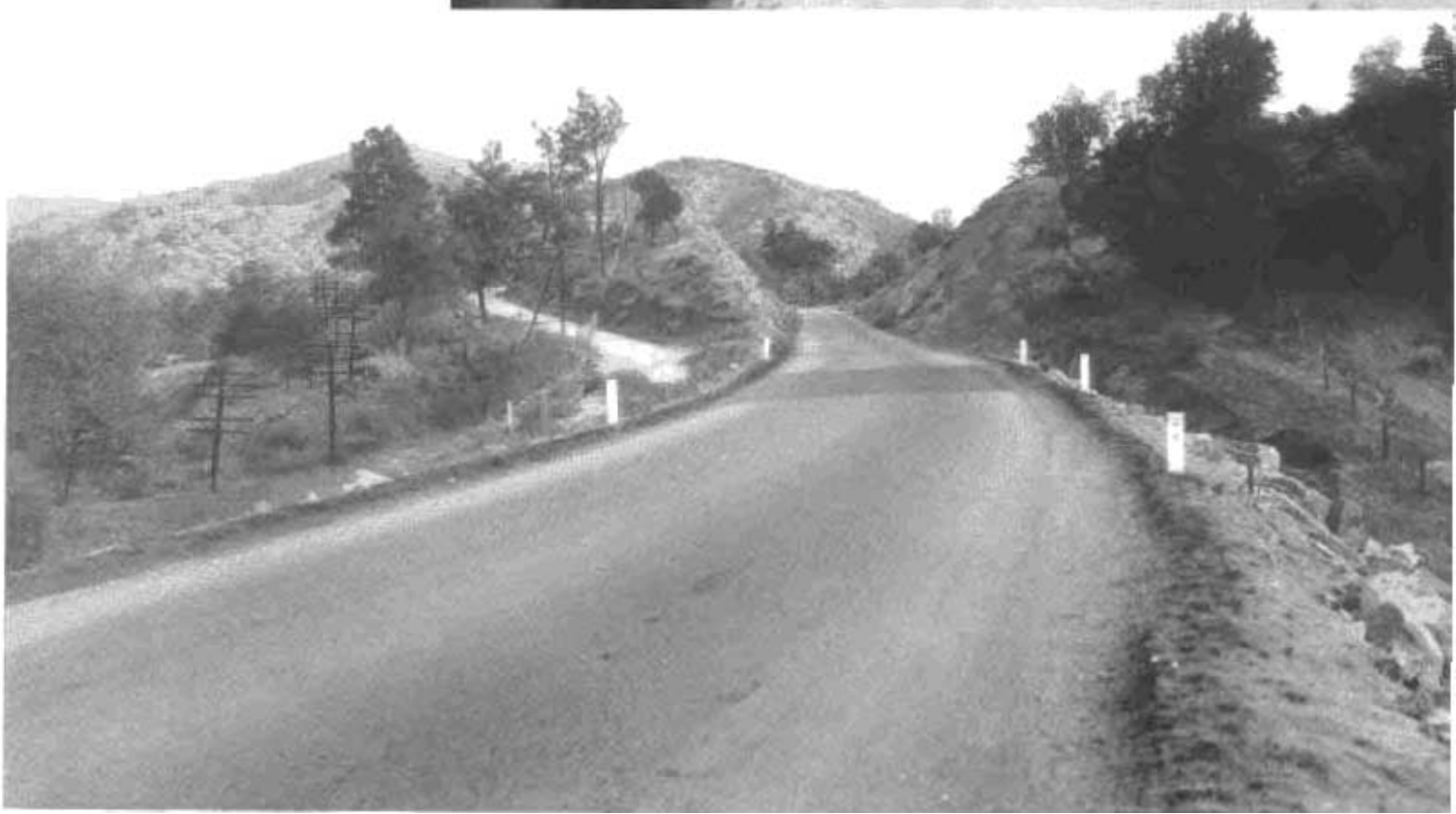
Along the present highway the road has a north exposure and reaches elevations three or four hundred feet higher than the new location. Much difficulty is had during the winter snows.

When other transcontinental routes farther to the north are closed, the new Tehachapi Pass Road will remain open to all-year traffic.

The original road through the pass was a wagon trail built during the mining excitement caused by the discovery in 1870 of silver in the Panamint Valley just west of Death Valley. Los Angeles was doing a thriving business by wagon trains with the prosperous Panamint camp area and the railroad was pushed south through the San Joaquin Valley as far as Bakersfield to participate in that business.

The nearest feasible route for the wagons to the new rail terminus was through Tehachapi Pass branching off at Mojave from the Panamint route to Los Angeles.





Views of improved sections of Tehachapi Pass widened from 16 to 28 foot width of traveled way eliminating many steep grades and sharp radius curves.

Administrative Problems of State Highway Maintenance

By T. H. DENNIS, Maintenance Engineer

Following is the first installment of an address delivered by Mr. Dennis at the recent meeting of the State-Wide Highway Committees of the California State Chamber of Commerce at the Palace Hotel in San Francisco.

MAINTENANCE of the State Highway System more closely touches the life of the State than almost any other phase of public work. The system extends into every major community.

Members of the maintenance organization are in daily contact with traffic needs, and with local problems and emergencies. The work involves a great amount of detail, and requires careful planning. It can be best understood through presentation of such detail. Before entering into a discussion of the subject, it is desirable to outline the extent and use of the highway system so that the problem may be better visualized.

There are 13,657 miles of traversable road in the system. This includes 1035 miles of through city streets. This mileage is all maintained by State forces, with the exception of 687 miles of city streets located mainly in the larger cities.

The field force engaged in maintenance work consists of some 2557 men, including superintendents, timekeepers, bridge and ferry tenders. The territory assigned varies with the extent of work. On the average, each superintendent is in charge of about 240 miles of road, and a foreman and crew is assigned 40-mile sections. Excluding supervision, this is equivalent to an average of one man to each 5½ miles of road maintained.

For administrative purposes, the system has been divided into some 1300 sections. These sections have been designated arbitrarily on a geographical basis, but in general it may be said that each section represents an individual problem of maintenance. The type and standard of improvement; the age, soil and climate; and the volume and composition of traffic are all factors which must be considered.

There are approximately 6,825,000,000 vehicle miles generated annually on the rural State Highway System. The average daily density of traffic is 1485 vehicles per mile of road. About 15 per cent of the annual vehicle mileage is generated by commercial vehicles. It is to be noted that the term "rural State highway" is merely a reference to the location of the road rather than the traffic. The traffic itself is predominantly of urban rather than rural origin.

Traffic of urban origin on the rural State Highway System is very large near the great centers of population,

The mileage by type of surface and the traffic range and average traffic on the rural State Highway System is shown in Table 1.

TABLE 1

Miles of Rural Road by Surface Types, Number of Lanes, and Traffic

TYPE OF SURFACE	MILES BY NUMBER OF LANES				TRAFFIC	
	Two	Three	Four	Total	Range in traffic vehicles per day	Average daily
Bridges (all types)	76.169	3.643	8.640	88.452	100 to 20,000	2,327
Dual or Divided (miscellaneous types)	40.269	43.370	47.111	130.750*	2,500 to 20,000	6,414
Brick	0.550			0.550		871
Portland Cement Concrete	1,574.901	170.473	107.465	1,852.839	500 to 20,000	3,369
Oiled Concrete	285.562	.348	0.267	286.177	250 to 7,500	1,925
Asphaltic Concrete	1,099.727	138.793	65.641	1,304.161	500 to 20,000	3,266
Bituminous Macadam	968.829	11.990	18.718	999.537	250 to 7,500	1,541
Plant Mix	1,317.383	14.587	11.191	1,343.166	100 to 5,000	1,329
Road Mix	1,883.958	1.170	1.923	1,887.051	Up to 5,000	671
Oiled Gravel	1,593.291		0.357	1,593.648	Up to 2,500	681
Oiled Earth	2,641.889	1.550	0.392	2,643.831	Up to 2,500	333
Gravel	29.557			29.557	100 to 250	
Earth	460.300		1.474	461.774	Up to 250	131
Total	11,972.385	385.924*	263.179*	12,621.488		1,485
Miles of city streets mantained by State forces				348.078		
				12,969.566		
Miles of city streets maintained by city forces				687.326		
Total mileage in system as maintained				13,656.892		

* The 130 miles of dual or multiple lane roads is equivalent to nearly 200 miles of two lane road from a maintenance point of view. The 649 miles of three and four lane pavement is equivalent to some 1,100 miles of two lane surface.

Winter Failure of Light Surface North of Quincy, Feather River Route, from Storm and Traffic Conditions.

constituting over 80 per cent of the vehicles. The rural State highways are frequently considered as connecting links between cities, but in many cases it is equally appropriate to consider them as extensions of city streets.

Only in the more isolated sections do the urban-owned vehicles drop below 60 per cent of all vehicles, and in all cases urban vehicles are over 40 per cent of the total, even in such counties as Trinity, Plumas and Alpine, which have no incorporated municipalities.

CONDITION OF FACILITIES

The condition of highway facilities is changing constantly. Considerable sums are being expended for major improvements and for a certain amount of reconstruction. In any one year only a small percentage of the system is so improved.

It has been estimated that twenty-five years will be required to complete desirable improvement work on the system at the present rate of progress. In the meantime, the present facilities must be kept in condition to carry traffic or restrictions placed on normal operation. A portion of the bridges, for example, were not designed originally to carry loads which are legal under present laws. Others have deteriorated to an unsafe condition. The same is true of certain sections of road.

The condition of the bridges is indicated by Table 2.

TABLE 2

Condition of Bridges

Number posted for restricted loading as of Dec. 1, 1939	369
Number considered inadequate because of narrow roadway (less than 20 feet)	682
Number considered inadequate because of restricted overhead clearance	29

There is an overlapping as to width, vertical clearance and condition, but taking the structures as a whole, it appears that approximately 27 per cent are inadequate for one reason or another. There is frequent damage to structures because of accidents resulting from deficiencies in clearance. The main expense, of course, is on the 11.7 per cent which are obsolete due to age or inadequate design.

A review of the road surfaces by types indicates deficiencies as to thickness, width and type of surface for the traffic served. The extent of these deficiencies is indicated in Table 3.

Deficiency as to type, width, or thickness of road surface for the vol-

TABLE 3

Deficiencies in Road Surface

Type of Surface	Miles Deficient	Daily Traffic	Type of Deficiency	Desirable Standard for Volume of Traffic
Portland Cement Concrete	900	1,000 to 10,000	Less than 6 inches thick	6 inches x 9 inches 22 feet wide
Oiled Gravel	332	1,000 to 5,000	Too low type	P.M.G. or high type pav't
Oiled Earth	505	500 to 2,500	Too low type	P.M.G. or R.M.G.
Earth	220	100 or more	Too low type	Oiled earth
All Types	6,549		Less than 20 feet wide	20 feet to 22 feet width

ume of traffic results in greater maintenance expense. For each year that such deficient facility continues in service, more careful attention must be given, with a corresponding increase in expenditures. This is particularly true in the case of deficiency in width. Where the width is less than 20 feet, shoulders require more than ordinary attention to insure essential pavement support and traffic protection. As indicated in Table 3, this problem is acute on 6549 miles or 51.8 per cent of the rural State Highway System serving 27.8 per cent of the traffic.

LIFE OF SURFACE

A matter of concern is the increasing tendency, due to a lack of funds, to substitute a lower standard of surface than that which the traffic requires. In addition to items in Table 3, for instance, there are 1975 miles of plant or road mix carrying a daily traffic of from 500 to 10,000 vehicles a day. Two hundred and five miles of this surface type is now carrying a volume of traffic which is almost twice that of the average density for the entire system.

While it is impossible at this time to estimate the span of life of this surface, it is entirely reasonable to assume that its economic life will not exceed ten years. Since the average age of this type of surface is now approximately five years, it follows that unless replacement is commenced during the next five years, its maintenance will increase.

In a progress report to the Highway Research Board which was received early this year, H. K. Bishop, Chief of the Division of Construction of the Public Roads Administration, who acted as chairman of the subcommittee on Maintenance Costs, furnishes data on the cost differential between adequate and inadequate surfaces; and also between surfaces of adequate and inadequate width.

COST OF SURFACE

In the Pacific States group, it was observed that the cost of maintaining surface only was $126 for high type pavements and $219 for intermediate type pavements, carrying from 751 to 4000 vehicles daily. It is to be noted that the high type pavement, despite its lesser annual maintenance cost, was given a higher condition rating than the intermediate type surface. These figures were for surfaces 20 feet wide. A similar, though less pronounced, differential exists in the case of surfaces less than 20 feet in width.

Failure of Red Bluff-Susanville Route Due to Inadequate Base.

Again, taking the same traffic group and considering high type pavements, the cost of maintaining traveled way was $169 for 18-foot surface and $126 for 20-foot surface, and moreover the lesser expenditure produced a higher condition rating.

MAINTENANCE COSTS

The report concludes that "Surface maintenance costs are lowest for the high-type pavements—durability being built into the surface; increase for intermediate types, and are the highest for low-type surfaces." And, "Surface maintenance costs are generally lower on 20-foot widths of surface than on 18-foot widths. The 20-foot widths have less pavement edge failures and water seepage under surface through rutty shoulders."

The committee also states "Surface maintenance costs increase with increase in traffic on specific types of pavement. Weight of traffic further increases cost, but more data are desirable to determine extent."

The foregoing comments serve to present the size of the maintenance problem and some of the specific conditions with which the maintenance organization is faced.

We come now to the question of standards of maintenance. In California, it has been the policy to provide funds to insure an adequate but not an unusually high standard of maintenance. In this regard, it is interesting to note a comparison of maintenance costs in California with those in other parts of the United States.

The H. K. Bishop report previously mentioned covered maintenance costs over a three-year period on 1233 sections representative of the principal type surfaces in use, covering 18,716 miles of highway in 47 states. The sections selected were of standard construction and adequate for the traffic served.

Early this year a report was issued showing a compilation of these data. This report shows that the average annual maintenance cost in the four groups of Eastern States, which compare in traffic volume with the Pacific States group, was $537 per mile. The average annual cost for the Pacific States group was $436 per mile.

The sections in California included some 361 miles scattered throughout the State, which were representative of surface type, climatic and average traffic conditions. The average cost for these sections was $460 per year per mile.

A comparison of maintenance cost items between the selected standard sections and the rural entire State Highway System is shown in Table 4.

The routine maintenance of $413 per mile includes provision for operation of movable span bridges, highway lighting, operating expense and lighting of two tunnels, operation of two ferries, and similar work not

directly connected with upkeep. The net amount estimated for routine work is $400 per mile.

TABLE 4

Comparison of Average Maintenance Cost per Mile

Item	For selected sections	For entire State Highway System on basis of present budget
Routine Maintenance	$223	$413
Replacements	70	135
Improved Service	132	83
Major Slides and Repair of Storm Damage	35	80
Total	$460	$711

The main difference between the cost on selected sections and statewide average is reflected in the Routine Maintenance. This condition is to be expected, since the sections for which costs were reported are of fairly recent construction, and with surface and other facilities designed for the existing traffic. The cost of this Routine Maintenance should approximate the minimum for the particular traffic volumes. The cost of "Improved Service" as shown in the following table is higher than the State Average. This, also would be expected. A review of the several classes of work which entered into this charge as shown in Table 5 is interesting.

TABLE 5

Detail of Improved Service Charges

Item	Cost per Mile
Upkeep of guard rail	$7.00
Cutting and control of roadside vegetation	34.90
Care of plantings	30.77
Care and installation of highway markers	6.65
Traffic Striping	25.46
Snow removal	18.13
Miscellaneous items	9.09
	$132.00

When viewed in detail, it is apparent that no single item is excessive if a good appearance and proper service is to be assured. The item for snow removal is low, as only about 50 miles out of the 361 miles of the selected sections are in territory where snow removal is required each season, and the fall is comparatively light.

The cost of major slide removal and repair of storm damage likewise is lower on the selected sections than the State average, as they are located in areas where such damage seldom occurs.

The Bishop cost report referred to above also included a condition rating for the model sections. The Pacific States group, including California, was given a condition rating of 93 per cent. This compared with a rating which ranged from 88 to 94 per cent for other sections of the country. Taking this into account along with the favorable cost comparison, it appears that maintenance work in California is on a reasonable par with other sections of the United States.

This is the first installment of Mr. Dennis' address. The second installment will appear next month.—Editor.

2,191,683 Autos Delivered

In the first ten months of 1939, 2,624,738 motor vehicles were delivered to consumers, an increase of 46 per cent over the same period in 1938. Of this number, 2,191,683 were passenger cars, representing a gain of 48.8 per cent; and 433,055 were commercial vehicles, representing a gain of 35 per cent.

"My girl friend has a wonderful new job now, doing settlement work."

"Settlement work?"

"Yes, her lawyer sues, and she gets the settlement."

Typical Slip-out During Heavy Storm on Topango Canyon Route Near Santa Monica in Los Angeles County.

Modern Psychiatric Clinic Unit to be Added to U. C. Medical School

By P. T. POAGE, Assistant State Architect

THE popular conception of mental disorder or disease is generally accompanied by a feeling of horror and hopelessness. Up to comparatively a few years ago, persons so afflicted were isolated in "asylums," usually for the remainder of their lives, where a low standard of living, general neglect, and often mistreatment were designed to increase rather than lessen the effects of the mental disorder.

As medical science progressed and the public became more conscious of its responsibility to those suffering both physically and mentally, there gradually evolved first the hospital in which proper care and safe custody were the prime factors, followed by further steps to the present time in which special attention is being given to research for determining causes, and to treatment for effecting cure and rehabilitation to society.

In dealing with this phase of the problem, California has long been at the front, both in the work done in its public institutions and in that performed by psychiatrists in private practice. Under the leadership of Dr. Aaron J. Rosanoff, Director of Institutions, it is now preparing to take the lead in this field with the construction of a new specialized Psychiatric Clinic to be constructed by the Division of Architecture for the Department of Institutions in San Francisco.

$500,000 APPROPRIATION

Dr. Rosanoff has given a lifetime to the study of this problem and is a nationally recognized leader in the field and the author of numerous books widely read wherever psychiatry is considered. His familiarity with the results to be obtained by proper application of existing knowledge and his enthusiasm for research and the development of a greater understanding of the functions of the human mind were effective in convincing Governor Olson and the Legislature of the urgent need for a proper plant in which to carry on this work. As a result, there is now available an appropriation of $500,000 for this purpose.

In the furtherance of this project, in July, 1939, Dr. Rosanoff, W. B. Reynolds of the University of California, and P. T. Poage, Assistant State Architect, visited approximately twenty of the important centers of psychiatric research and treatment in eastern cities, including Madison, Wisconsin; Chicago, Toronto, Boston, New York, Baltimore, Philadelphia and Pittsburg. Detailed inspections were made of the physical plants and consultations held with the directors and other staff members of these specialized hospitals and clinics.

COOPERATING WITH MEDICAL SCHOOL

The site for the new unit is on the property of the University of California Hospital and Medical School facing Parnassus Avenue. Careful attention is given to coordination with the future development of the Medical School whose interests in the teaching and study of psychiatry are tied closely to those of the Department of Institutions. This strategic location is of mutual advantage to the university and to the Department of Institutions in giving to the latter the full advantage of ready access to the specialized staff, laboratories, and other facilities of the Medical School; and offering to the university the best of facilities for study and research in advanced psychiatry.

As this is written, late in December, 1939, the preliminary plan has been agreed upon and working drawings and specifications will proceed as rapidly as the details can be developed to meet the approval of the consultants in the various branches of the work to be housed.

The basic architectural character is drawn from the designs of the University architect for the proposed main unit of the Medical School which will be the dominating mass of the entire hospital and medical group when constructed, and of which the Phychiatric Clinic will, in effect, be one wing. The accompanying perspective sketch shows in tentative form the general mass of the design in its present stage of development.

TWO GARDEN AREAS

The plan form is that of an unsymmetrical "T." Two garden areas occupy the space on either side of the stem of the "T," one giving special interest as an entrance feature exposed to the view of the main street, and the other a secluded area protected from the public view to provide outdoor recreation area for patients under treatment and observation.

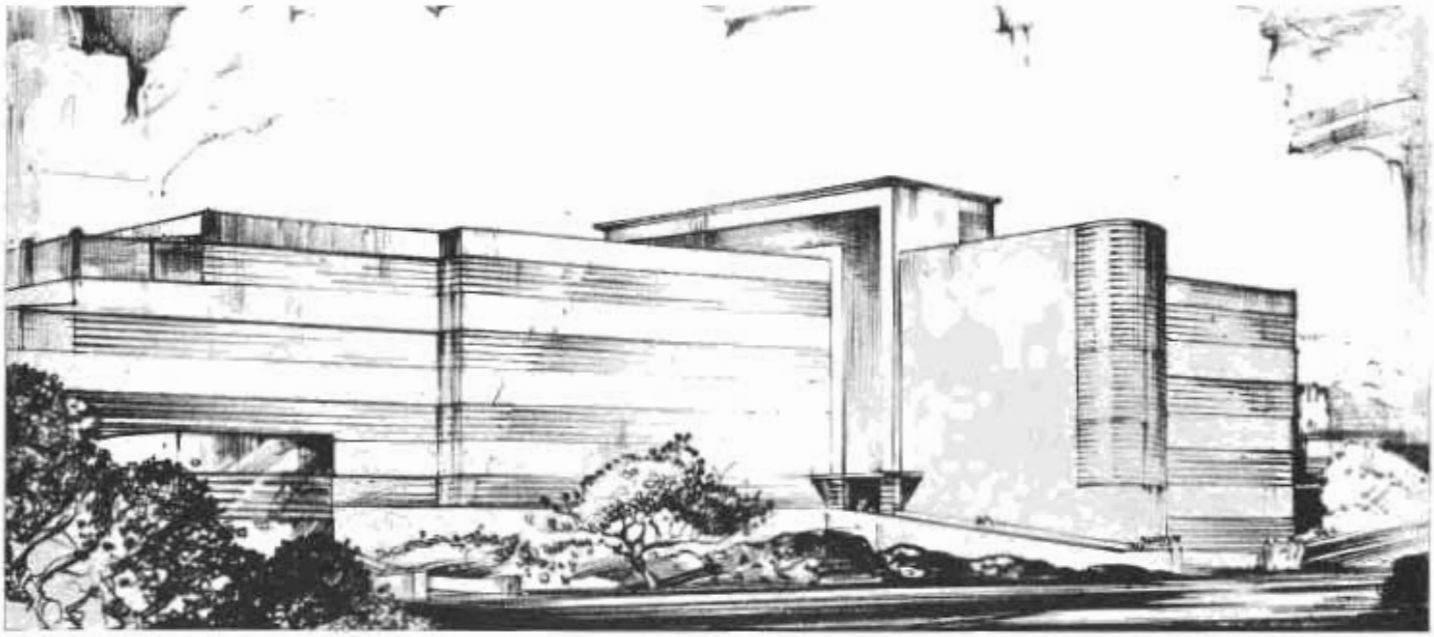
The main mass of the structure will be four stories high. Additional area for necessary service units and storage will occupy a partial basement. The elevator pent house, living quarters for resident physicians and other minor elements will be housed in a central fifth floor unit.

The first floor will be given primarily to the out-patient department, administrative offices, receiving unit, laboratories, and lecture room.

HOUSES 100 PATIENTS

The principal areas on the second, third, and fourth floors are devoted to housing approximately 100 patients divided equally between the sexes. Distinct separation of sexes is provided, except in the neuro-surgical and the children's wards.

On the extreme front wing of these three upper floors are specialized units including: (1) Facilities for insulin shock therapy, a treatment giving excellent promise in the cure of cases not too far advanced; (2) a complete neuro-surgical unit with operating room, X-ray, and related accessories to care for all surgery of the brain and the nervous system; (3) occupational therapy rooms devoted to craft work designed to oc-



Sketch of proposed psychiatric clinic to be built at the University of California Hospital and Medical School in San Francisco.

cupy the mind, develop coordination of faculties, and otherwise improve the general mental condition.

The new clinic is intentionally limited in size, being considered not as a basic treatment unit, but as a center from which will be directed an increasingly broader program of practical applied psychiatry to be carried out by the various institutions already in existence.

STUDY OF MATERIALS

A careful study has been made of types of material best adapted to the special service required in this type of hospital. Construction will be of reinforced concrete in so far as the principal structural frame is concerned and other materials will in general be fire resistive to provide the fullest protection to the patients.

Acoustic materials will be used extensively to minimize noise disturbances. Adequate natural light and ventilation will be available generally through the generous window area characteristic of the modern architectural treatment.

The Division of Architecture is happy to have a small part in bringing this important service to humanity.

"Since I've stopped going around with college boys, I'm three pounds lighter."

"Do you mean you're worrying and losing weight?"

"No, I've given back all the fraternity pins I've been wearing."

Public Works Program for 1940

(Continued from page 5)

The Division will continue the supervision of irrigation districts and lend assistance to the District Securities Commission in refinancing and refunding old bond issues. Seventy-three districts with a total of $89,500,000 in outstanding bonds come under this jurisdiction.

In the water rights section applications for permits to appropriate water for the year 1940 will approximate 350. It is estimated that 225 of these will be approved, that rights will be confirmed by issuance of licenses in 110 cases. Approximately 275 inspections and field investigations of water rights will be made.

WATER ADJUDICATION

The Division will complete the adjudication of water in five districts including the large Middle Fork of the Feather River district and the North Fork of the Pit River district; and in the smaller districts of Ash Creek in Big Valley, South Cow Creek and the Raymond Basin Area Reference. Two new water master districts will be created in addition to the 14 now in existence.

Cooperative work with the Federal government on which the State and Federal government share the expenses equally will include stream gaging, at a cost of $50,000; topographical surveys, $10,000; irrigation investigations, $10,000; and other cooperative work with the War and Agriculture Departments on statewide flood control investigations.

On small surveys the Division will spend $7,500 and supervise the work of several cooperative agencies both public and private which will spend an additional $30,000.

Under miscellaneous projects the Division will dredge Mission Bay at San Diego at a cost of $30,000; prepare plans for a water supply for the State institutions in Napa Valley and continue the South Coastal Basin surveys.

Six Trucks Move 150-Ton Gun

One of the heaviest loads ever hauled over a road on this continent was moved to Fort Cronkite, California, recently when a 16-inch gunbarrel weighing 150 tons was transported with four trucks pulling and two trucks pushing.

The six trucks, generating 900 horsepower, moved the hauling unit, with forty wheels under it, at a rate of one and one-half to two miles per hour.

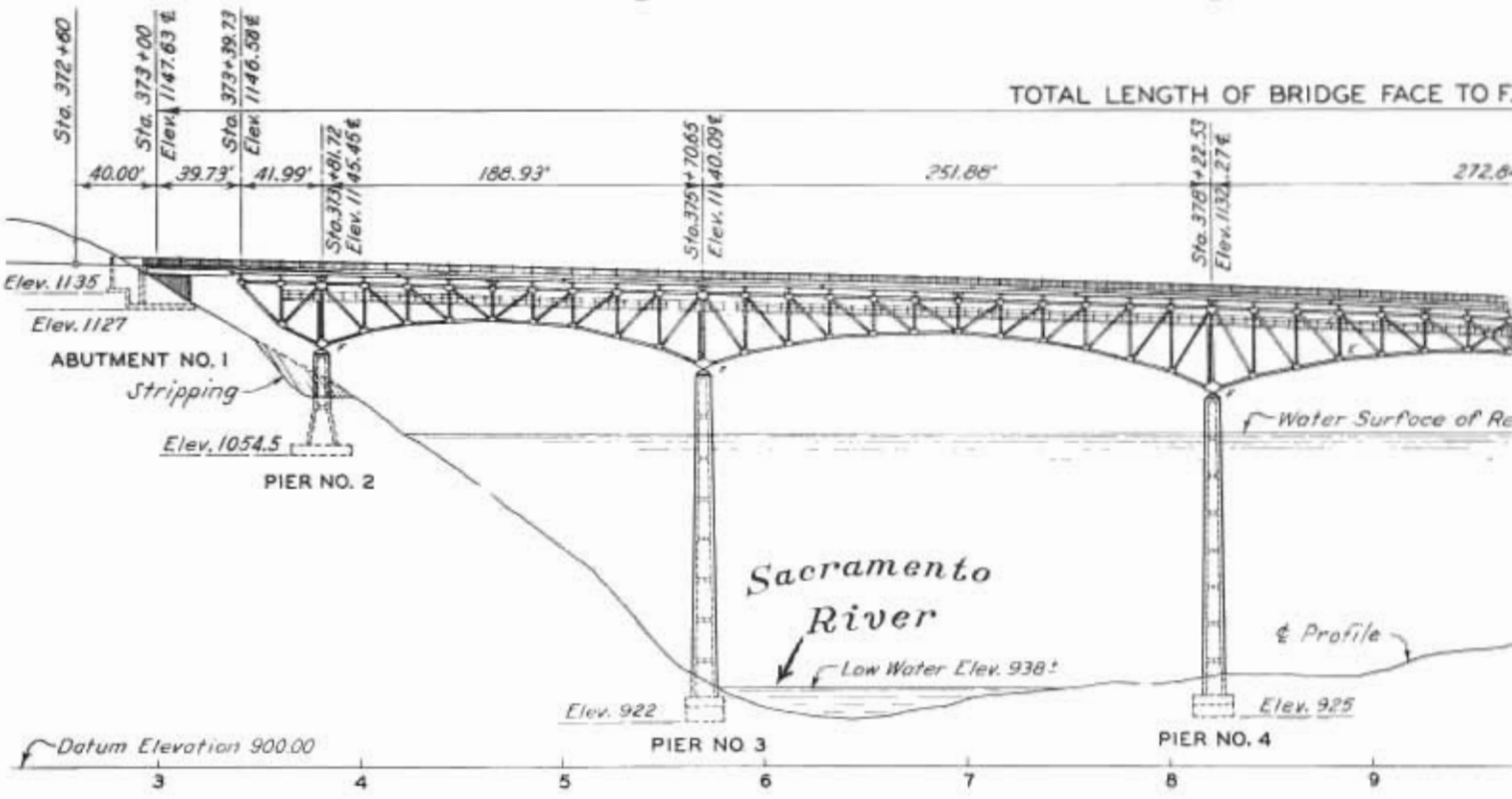
The incident demonstrates once more that highways are vital in national defense.

"Who is that terribly homely man sitting over there?"

"That's my brother."

"Pardon me. I hadn't noticed the resemblance."

Steel Truss Bridge at Antler Will Carry Four-lane



By GLENN L. ENKE, A

A FOUR-LANE highway relocation project across the proposed Shasta Reservoir is the 1330-foot steel and concrete bridge now under construction over the Sacramento River near Antler, about 14 miles above Shasta Dam. At that point, the reservoir will be 150 feet deep, and the water surface will be more than 100 feet above the present stream in the Sacramento River Canyon.

As the new highway approaches the south end of the bridge location on a long 6 per cent descending grade, at a sharp angle to the structure, it was necessary from a safety standpoint to locate the entire bridge on a 5000 foot radius curve with an 850 foot curved approach highway. Smooth transitions between the various radii will provide safe and comfortable automobile travel at all times.

The bridge is laid out with five major spans; two of 189 feet, two of 252 feet, and one central span of 273 feet. Forty-two foot cantilever spans at each end support short beam spans that serve to distribute and minimize the effect of structure deflection or of settlement of the approach fills.

TWO SIDEWALKS PROVIDED

A 50-foot roadway is provided, with two narrow sidewalks and steel railing. Two lines of steel deck trusses 31 feet apart support floorbeams at each 21-foot panel point, nine lines of steel stringers, and a reinforced concrete roadway slab 7¼ inches thick.

The main piers are eight feet wide at the top, 40 feet long, and of varying heights, the tallest being 172 feet above its rock foundation.

PIERS OPEN TO WATER

Piers are of cellular construction, using 18 inch walls and interior ribs throughout. Varying amounts of reinforcing steel in these walls provide for the differences in stress at the proper points. All piers are founded upon rock. Foundation explorations were made at all pier locations to determine satisfactory depths of footings.

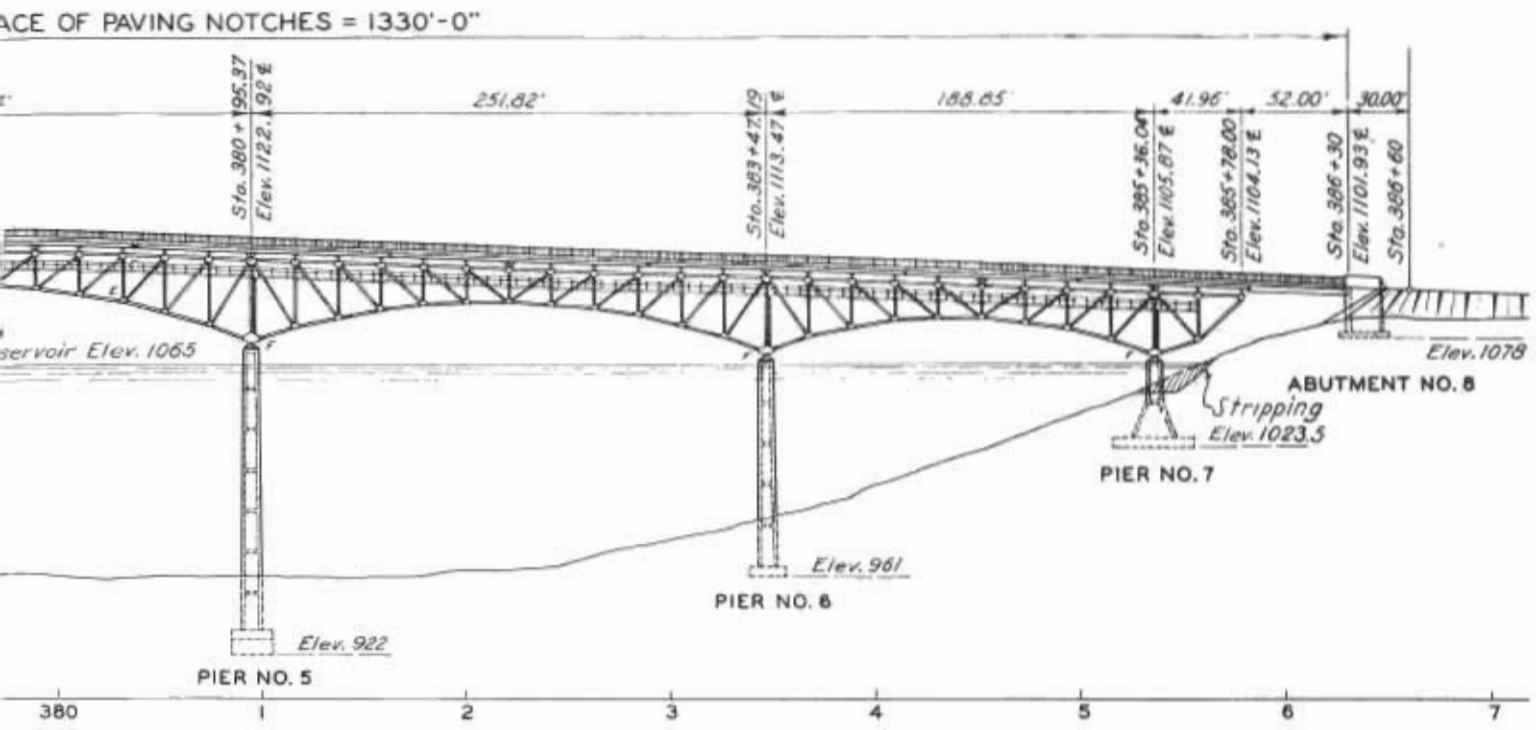
Three of the piers extend down below river level, and will require concrete foundations poured under water. Construction joints are provided in the pier shafts at 20-foot intervals; a horizontal distribution girder, or "floor," being located at these points. Piers are battered ⅛ inch to 12 inches for appearance.

As the ultimate water level in the Shasta Reservoir will practically submerge the main piers, openings are provided at various points in the pier walls and floors to permit the free passage of water. This procedure not only eliminates hydrostatic pressure on the pier walls but adds considerable "mass" or "inertia due to weight of fluid" to resist earthquake forces, discussed later.

Next to structural safety, a fundamental requirement, smooth deck surfaces and good railing appearance are probably the two most important factors to the motorist. Considerable care was taken, therefore, to insure good results in the completed structure, as follows:

(1) A railing and gutter profile was established for each side of the

State Highway Relocation Across Shasta Reservoir



Associate Bridge Engineer

bridge, using long 1400-foot vertical curves to give a smooth change of superelevation over the structure to fit approach alignment.

(2) Truss deflections due to full dead load were carefully computed, and elevations determined for each truss panel point to fit an "unloaded" profile. This "unloaded" profile is the final profile, plus the anticipated deflection under dead load.

(3) The fabricating shop will sub-punch, or sub-drill, all main truss connections, then completely assemble each truss in a horizontal position in the shop, placing each top chord panel point in its correct relative position to fit the "unloaded" profile.

(4) All truss joints are then reamed to full size, and all members match-marked for erection.

(5) Trusses may then be erected at the bridge site in any desired order as correct position is secured simply by jacking the trusses into shape until all truss connections are fair. No field drilling of these connections will be allowed.

(6) The concrete deck will then be poured in any order to suit the contractor's working schedule. This is an important feature, as pouring a deck slab uniformly from one end of a structure to the other is much less costly than requiring short individual pours over various parts of the bridge, as has heretofore been necessary in trusses of this type.

DECK IS "CUT LOOSE"

To prevent participation of the concrete deck slab in resisting stress set up in the trusses by the weight of the slab, as it would surely do if rigidly attached, the deck has been literally "cut loose" by introducing small expansion joints in the stringers approximately 100 feet apart. This is of no consequence to actual strength of truss members, but has a pronounced effect upon deflection of the trusses. As accurate truss-deflections can be determined only if the slab is prevented from taking direct stress, this procedure is essential to secure a smooth deck.

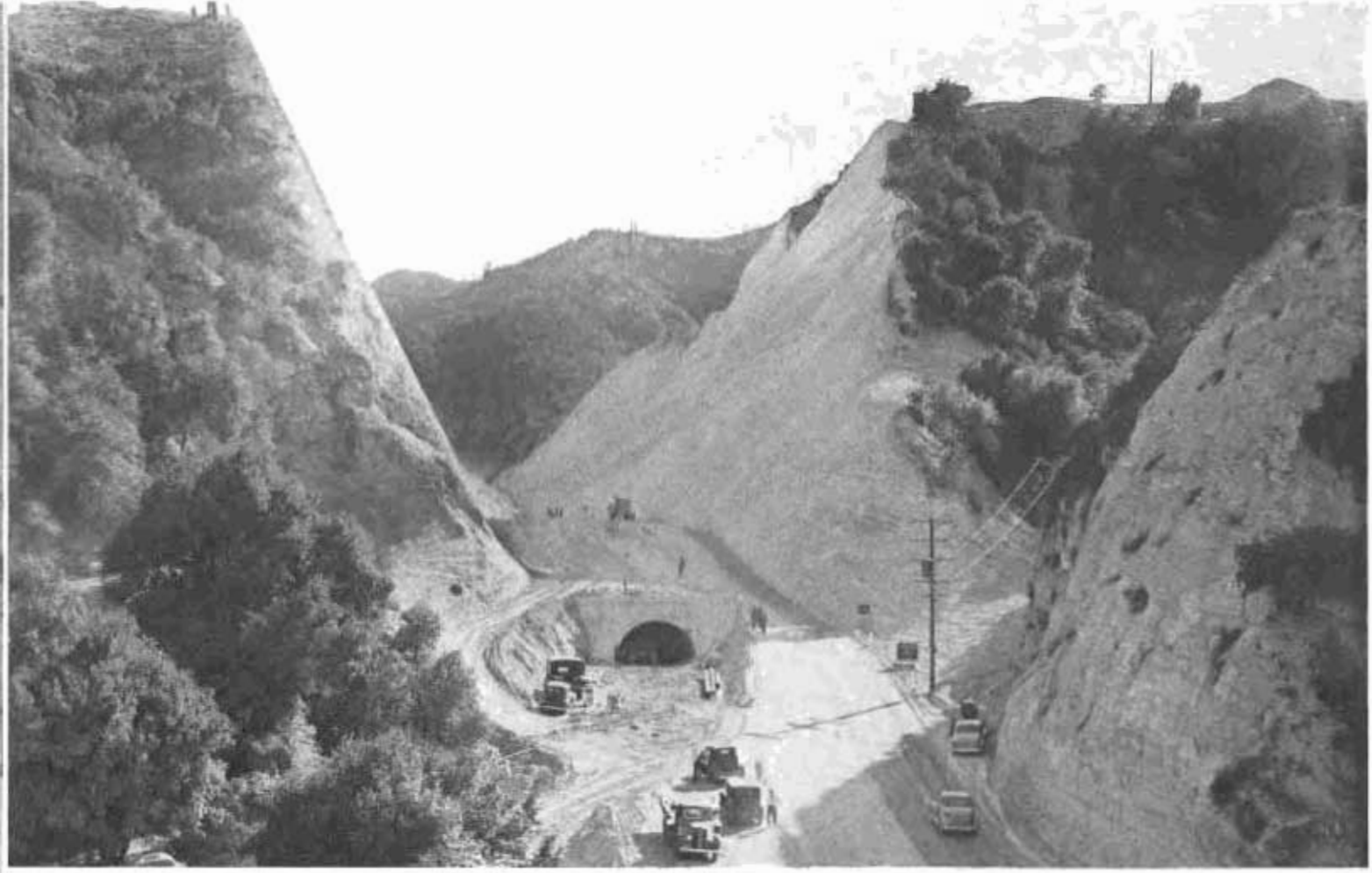
It is most important in constructing a concrete deck to anticipate accurately the deformation of the various members involved, as correcting a rough or wavy deck after construction is a difficult and costly process.

To eliminate deflection stresses from the piers, temporary expansion rollers will be used at the tops of all piers. Upon completion of the deck slab and upon a suitable day of average temperature, the truss shoes will be grouted into permanent position.

ROTATING TYPE JOINTS

Piers are arranged so that the four main piers on either side of the central span are supported longitudinally by anchor piers of comparatively low height located high up on the canyon walls. The main trusses are pin connected to the tops of all piers. A suspended span in the central 273-foot span, with provision for expansion at one end, establishes a symmetrical truss layout, continuous over three supports on each side of this span. Trusses are then fully "indeterminate" only over the center support of the group, the "degree of

(Continued on page 25)



Santa Susana Mountain ridge in process of being cut through to transform Newhall Tunnel into an open cut highway.

Newhall Tunnel Replaced by Cut

By JOHN D. GALLAGHER, Assistant Highway Engineer

ACROSS the northerly end of the San Fernando Valley, some thirty miles north of the center of Los Angeles, extends the rugged, brush covered range of the Santa Susana Mountains which has long presented a troublesome barrier to road builders.

In the earlier days of development of this portion of the State, energetic pioneers hewed a narrow vertical cut through a low point in the hills. This cut, known as "Fremont Pass," served travelers to the north of Los Angeles until 1910, at which time Los Angeles County constructed a tunnel through the hills just southerly of the town of Newhall. This arch tunnel, only 17 feet-five inches wide, was used by the rapidly increasing traffic from the metropolitan Los Angeles area to the San Joaquin Valley, Mojave and the Owens Valley for the next twenty years.

In 1928-29 the California Division of Highways constructed a three-lane highway through Weldon Canyon, west of the tunnel, for traffic to the San Joaquin and Sacramento valleys. Thus, the tunnel which had become a serious bottleneck was relieved of a large portion of traffic. During the past ten years, however, traffic to Antelope Valley, Owens Valley and the northwestern portions of the colorful Mojave Desert increased to an average of 4000 cars a day, with Sunday traffic during the wildflower season reaching 20,000 cars in nine hours. Under this congestion Newhall Tunnel again became an intolerable bottleneck.

On May 5, 1938, a contract was awarded by the State for reconstruction of this portion of the route as a unit in the program for a new alignment of the highway between the San Fernando Valley and Mojave along the so-called Mint Canyon Short Cut.

The contract included construction of 3.73 miles of State highway, between Foothill Boulevard and Placerita Canyon on the Mint Canyon Cut-off, where a connection was made with another unit of the general improvement. From the Foothill Boulevard junction, which is about a mile south of the old tunnel, to a point almost a mile north of the tunnel, the project followed the old road. The contract called for a divided highway, with two 12-foot center lanes of plant-mixed surfacing and two outside lanes of portland cement concrete, each 11 feet wide, with 7-foot shoulders. The central dividing strip is four feet

Modern 4-lane section of Newhall Tunnel highway has a raised central dividing strip covered with plant-mixed surfacing.

Narrow Newhall Tunnel bottleneck on State Highway 23 as it appeared before excavating of cut slopes as indicated by dotted lines.

wide with concrete curbs and covered with a plant-mixed surfacing.

At the point one mile north of the old tunnel location, the new highway leaves the road to Newhall and bears to the right on new alignment as part of the Mint Canyon Cut-off. This section was constructed with a three-lane plant-mixed surface 33 feet wide and 8-foot shoulders.

The major interest of the contract centered around the replacement of the tunnel with an open cut and this phase of the contract was graphically presented in the final report on the work submitted by Mr. S. V. Cortelyou, district engineer, at Los Angeles.

The tunnel was 435 feet long, concrete lined, with a grade line 200 feet below the top of the hill and entirely within the prism of the proposed cut. Investigation had shown the hill to be composed of cemented conglomerate and sandstone, indicating that no serious difficulty would be encountered in excavation. As traffic was carried through the tunnel during construction, protection from falling material at the tunnel portals was provided by a thirty-foot timber extension of the tunnel on I-beam posts and caps. The extension above the tunnel portal also provided a suitable area for the operation of power shovels and trucks and was used first at the north portal, then moved to the south portal to serve the same purpose. Ramps were constructed from the existing road to the area above the tunnel.

The greater portion of the material in the cut was loosened with rooters and bulldozed from the top of the cut to the working area above the tunnel portal where it was loaded by two 2½-yard shovels into a fleet of sixteen 10-yard dump trucks. The cut was designed for one-half to one slopes.

DRILLING AND BLASTING OPERATIONS

No blasting was done in the removal of the upper 120 feet of the cut. When excavation had reached a point about 60 feet above the tunnel roof drilling and blasting operations were begun. Holes were drilled with a wagon drill rig to depths of 35 to 40 feet and the material loosened with charges of approximately 1000 pounds of black powder to each hole. In order to minimize loosening material in back of the designed slopes firing was limited to four holes at a time.

Operations advanced until excavation had been completed to an elevation about 10 feet above the tunnel roof (about 30 feet above the roadbed grade) when a slide occurred on the easterly slope which entirely blocked the south portal of the tunnel. The slide moved along one of several slip planes which dipped toward the roadbed at angles of from 20 to 35 degrees.

Slope design on the easterly side was then changed to 1 to 1 and approximately 42,000 yards of material from the top 65 feet of the cut placed in adjacent canyons by the use of bulldozers and carryall scrapers. From this point the material remaining back to the 1 to 1 slope was brought into the cut by blasting and bulldozing where it was loaded into trucks with power shovels and hauled to widen fills.

RECURRENCE OF SLIDES

The 1 to 1 slopes did not, however, prove to be sufficiently stable and another slide came in on the easterly side near the north end of the cut. On this portion the slopes were flattened further to 1½ to 1. Just after this work was completed a triangular wedge of about 500 cubic yards slid out in back of the 1½ to 1 slope, indicating that eventually all the material above the slip plane might slide into the cut. Removal of all this material would have involved a greater yardage than funds provided for the work would permit.

At the same time other slides occurred at the southerly end of the cut and in high cuts immediately south of the tunnel cut. In all cases it was noted that the material had broken out in triangular sections, bounded on the southerly side by nearly vertical planes more or less parallel to the direction of dip and that movement of the sliding mass was along the direction of dip, which formed an oblique angle with the roadway gutter line. The slip planes intersected the gutter line at various points throughout a distance of about 800 feet.

To determine the limits of material required to be removed in order to stabilize the cut slopes, planes with a ¾ to 1 slope were passed through the intersections of the slip planes and the gutter line and on a line approximately 10 degrees back of the direction of slip. All material north of these slope planes, down to the surface of the slip plane was removed. By this method the material remaining south of the slope planes and below the slip planes was supported at the toe, and the total amount of material removed was much less than if a uniform slope of sufficient flatness to stable had been adopted.

611,000 YARDS REMOVED

The result of this procedure in removing unstable material is a series of saw-toothed peaks or ridges with valleys intersecting the gutter line.

The westerly slope of the tunnel cut has remained stable on the ½ to 1 slope to which it was originally designed and constructed.

The preliminary estimate of roadway excavation for the area in which the heavy slides occurred was 295,000 cubic yards on the basis of the designed ½ to 1 slopes. The slide yardage removed amounted to 316,000 cubic yards making a total of 611,000 cubic yards of material removed in the construction of the tunnel cut.

On the remaining portions of the roadway little difficulty in excavation was encountered, although some of the cuts reached 100 feet in height and required considerable drilling and blasting to bring material down to the roadway where it could be loaded into trucks with power shovels.

The preliminary estimate of excavation quantities for the entire 3.7 miles of the project was 520,000 cubic yards and the final quantities showed that approximately 857,000 cubic yards were removed, an excess of 337,000 cubic yards, nearly all of which came from the tunnel cut.

PAVED DRAINAGE DITCH

Other features of the contract such as the plant-mixed surfacing, portland cement concrete pavement and shoulder treatment followed more or less standard practice. The construction of a paved drainage ditch along one portion of the project, followed, however, experimental lines. The ditch was built on a curved section and paved with asphalt concrete reinforced with wire mesh.

The length of the ditch was about 300 feet and has a top width of 39 feet with a flow line 6 feet below the top. The section is curved, with a radius of 35 feet. The grade of the ditch was finished by hand trimming using a circular templet and compaction of the subgrade accomplished with an eight-ton tandem roller. The asphalt concrete was spread and raked by hand and compacted by the tandem roller.

After one inch of the surfacing was in place the wire mesh reinforcement

(Continued on page 24)

New Cut in Bay Bridge Toll Rates Goes into Effect

AN OUTSTANDING demonstration of the benefits that can be obtained for the people through public ownership was given on January 1, 1940, when in conformity with Governor Culbert L. Olson's determination to reduce tolls on the San Francisco-Oakland Bay Bridge as rapidly as revenues of the great span permit, another reduction was made in the automobile, truck, trailer and commutation rates.

The California Toll Bridge Authority by unanimous vote on December 12, 1939, authorized the decrease in rates.

Action of the Authority was in line with Governor Olson's policy of giving to the people under public ownership the greatest possible benefits accruing to them under such ownership, and constituted the second reduction in Bay Bridge tolls made under the present State administration.

"CONSPICUOUSLY SUCCESSFUL"

"Public ownership and State operation of the San Francisco-Oakland Bay Bridge are proving conspicuously successful," Governor Olson declared in announcing the new toll decrease. "That is why we are able to make further reductions at this time in charges for the use of the Bay Bridge. We shall put lower tolls in effect in the future just as soon as the income of the bridge warrants."

The Authority by its action cut the toll for pleasure automobiles from 40 cents to 35 cents per vehicle with no charge for extra passengers.

The superseded rate had been 40 cents for an automobile (including the driver and up to four passengers) but with extra passengers paying 5 cents each.

Rates for automobile commuters were reduced from $14 to $12.25 and from $11.60 to $10.25, respectively, which approximates 25 cents per one-way ticket.

For automobile trailers the toll was cut from 50 cents to 35 cents.

Provided the bus lines operating over the bridge apply to the Railroad Commission for new tariff rates which will give to their passengers the benefit of the reduction in bus tolls, the rate for buses will be fixed at a flat toll of $1 with no extra charge for passengers. Buses now pay 75 cents per vehicle and 5 cents for each passenger carried.

The Authority empowered its secretary, Director of Public Works Frank W. Clark, to put the new bus tolls into effect when the bus lines obtain approval of new tariff rates in which will be reflected the saving to their passengers.

An important new regulation affecting trucks was approved. Formerly trucks paid 50 cents per vehicle and 2 cents for each 100 pounds of load carried. The new toll is based on the gross weight of the truck and load and is intended principally to speed up the weighing of trucks at the toll station.

GRATIFYING TO AUTHORITY

In submitting the matter of further toll reductions at the recent meeting of the Authority, Governor Olson said:

"When the tolls were reduced from 50 cents to 40 cents, we announced that as soon as conditions would allow, in keeping with the underwriting contract for the bond issue, there would be a further reduction. I understand from the Director of Public Works and counsel for the Authority that conditions have now obtained under which there can and may be further reductions. Therefore, I would like to take that matter up at this time.

"It is gratifying to the Authority to make these reductions which are largely beneficial to the motoring public. The motorist, commuter and patrons of bus lines will all benefit materially under the new tolls. In the case of the bus operators, they will have to submit new tariff rates to the Railroad Commission and if these rates give to bus passengers the full benefit of the elimination of toll charges for each passenger, then Director of Public Works Clark is authorized to put the revised tolls into effect.

THOUSANDS WILL BENEFIT

"Thousands of Californians in the interior of the State who use bus lines in traveling to San Francisco will be the beneficiaries."

The new method of weighing trucks on a gross weight and load basis will facilitate truck transportation across the bridge by saving a great deal of time at the toll stations.

Following are the new and old rates on the bay bridge:

CLASS	VEHICLES	NEW RATE	OLD RATE
1	Automobiles, ambulances, taxis, commercial or light delivery automobiles	$0.35	$0.40
2	Trailers drawn by automobiles	.35	.50
3	Trucks or truck trailers, including any load:		
	Gross weight up to 20,000 lbs., per ton, at	.175	.60 for truck
	Additional gross weight from 20,000 lbs. to 40,000 lbs., per ton, at	.15	
	Additional gross weight over 40,000 lbs., per ton, at	.125	.40 per ton for net load
	Minimum charge	.50	
4	Local Key System buses, per passenger carried	.025	No change
*5	Other buses	1.00	Bus .75 Passengers .05
6	Motorcycles	.15	.20
7	Tricars	.25	.30
8	Vehicles requiring special permit, per ton		
	Gross weight	.20	.40
	Minimum charge	1.00	1.00
9	Vehicles not otherwise specified, per ton		
	Gross weight	.175	.40
	Minimum charge	.50	.90
	The following monthly commutation rates are prescribed:		
10	Commutation—For passenger automobiles only. Book to contain from 50 to 54 one-way trip tickets (depending on length of calendar month) good for the calendar month	$12.25	$14.00
	In addition the book will contain twenty (20) provisional tickets, each good for a one-way trip upon presentation and payment of twenty-five cents (25c) providing all regular tickets have been used. Additional provisional tickets for the same calendar month will be issued upon surrender of the complete empty cover—front and back—of a $12.25 commutation book of the same month.		
11	Commutation—For passenger automobiles only. Book to contain 40 one-way trip tickets, good for the calendar month	$10.25	$11.60
	In addition, the book will contain ten (10) provisional tickets, each good for a one-way trip upon presentation and payment of twenty-five cents (25c) providing all regular tickets have been used. Provisional tickets, in excess of the above will not be issued to purchasers of this book.		

*Subject to future action of California Railroad Commission.

Scene showing bags being filled at concrete mixing machine and carried by crews for placement on Cache Creek embankment.

Concrete Riprap Bank Protection

By C. F. CHILD, District Construction Engineer

SOME of the highest water in the memory of the oldest citizens was experienced in the Sacramento Valley in December, 1937, and considerable damage was done to many sections of roads, most of which have been repaired or restored.

Shortly after the storm our central office caused a complete state-wide survey to be made of the adequacy of different types of slope protection and of the suitability for different conditions. Guided by the report of this survey sacked concrete riprap was selected as slope protection for the sections of Route 50 between Rumsey in Yolo County and the junction of Route 15 en route to Clear Lake in Lake County via Cache Creek and Bear Creek.

Sections of the road along these creeks had been entirely washed away, showing a tremendous action of the water in carrying away portions of the road containing boulders of from five to eight feet in diameter and leaving a hillside where once was a road.

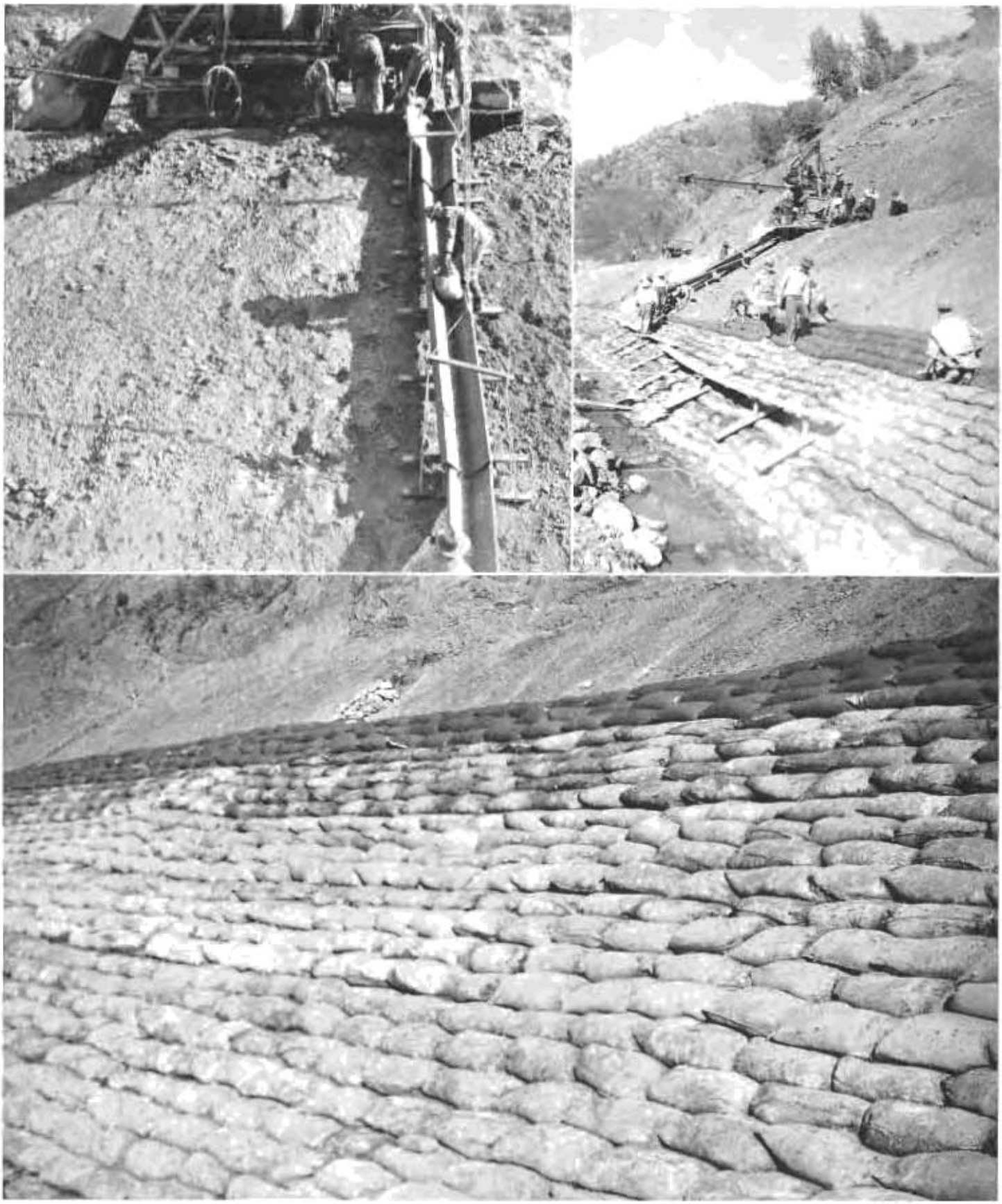
PLACED IN THREE LOCATIONS

Sections of rock riprap had been placed protecting the slopes. Some sections were overtopped and partially carried off by the current, resulting in the loss of considerable roadway. The road was partially restored for one-way traffic by the maintenance forces until such time as funds were available for more permanent construction.

In September, 1939, a contract was let involving approximately 94,000 sacks of concrete riprap along with 2100 cubic yards of rock riprap and other items of construction, being the largest amount of sacked concrete placed in District III, totaling 2645 lineal feet in three locations. The average height was approximately 22 feet.

A suitable foundation of bedrock or large boulders was found from four

(Continued on page 28)



At top, filled bags of mixed concrete being delivered by chute to crews at bottom of riprap job. Below—Close-up of a portion of the 94,000 bags of concrete riprap required on the Cache Creek job.

University Avenue Grade Separation in Berkeley Formally Dedicated

MADE the occasion for a gala city-wide celebration, dedication of the newly completed University Avenue grade separation at Berkeley attracted a large crowd of citizens on Saturday, January 6, at which State, county, city and Federal officials made brief addresses.

In the absence of Governor Culbert L. Olson, who was in Los Angeles on State business, Larry Barrett, chairman of the California Highway Commission, dedicated the $330,000 project to public service, following a program of music and speech-making.

Many years before the building of the San Francisco-Oakland Bay Bridge and the East Shore Highway, the need for a grade separation at the intersection of University Avenue and the main line tracks of the Southern Pacific was recognized. Back in the early twenties, when ferries first began to carry motor traffic between the Berkeley pier and San Francisco, relief for traffic delays at this crossing became apparent. With the great impetus given to traffic by construction of the Bay Bridge and the East Shore Highway, this need became a pressing necessity.

City Manager Hollis Thompson, and other Berkeley officials, importuned the California Highway Commission to include the construction of a grade separation at this site in the Division of Highways' Federal financed program for elimination of grade crossing hazards on feeder roads off the State highway system. The data submitted by the Berkeley authorities reflected the thoroughness of their preliminary studies and convinced State highway officials of the necessity of the improvement.

As University Avenue is not located on the State highway system, the only method by which construction of the structure could be financed by the State was by including it in a Federal grade crossing elimination program. Funds for these programs are apportioned by the Public Roads Administration of the United States Government from appropriations made by Congress for Federal Aid to States for highway work. State highway departments are permitted to use a portion of these grade crossing funds for projects located on feeder roads which are off the State highway system.

It was as this type of project that the University Avenue grade separation was included by the California Highway Commission in the program financed from funds provided by the Federal Government for the two-year period between July 1, 1937, and June 30, 1939.

Comparative preliminary engineering studies and estimates by State highway bridge engineers determined an overhead structure as more suitable and economical to the site than an underpass type. On the basis of these studies, the final design for the modern structure which was turned over to the City of Berkeley was completed.

4-LANE DIVIDED ROADWAY

The overhead itself is of most modern design. The fifteen reinforced concrete slab spans and three steel girder spans total 922 feet. The central steel girder span over the railroad tracks is 118 feet, 6 inches in length, and the two adjoining steel girders are each 85 feet, 6 inches. These three steel spans are carried on reinforced concrete piers which rest on pile foundations. The fifteen concrete slab spans vary in length from 33 feet to 48 feet and are supported by concrete bents.

The roadway across the structure is designed for safety. Four traffic lanes, each 12½ feet wide, are divided by a four-foot curbed median strip and provide ample facilities for both east- and west-bound traffic.

The cost of the overhead, its approaches, and the street work alongside and beneath the structure will amount to approximately $330,000. These funds were provided entirely from Federal apportionments to California for grade crossing elimination.

The only major direct cost to the City of Berkeley has been provision of additional right of way on each side of University Avenue. This was necessary to provide adequate width for satisfactory street construction for local traffic not using the overhead.

FUTURE GRADE SEPARATION

While this overhead is now complete, grade lines at the intersection of University Avenue and the East Shore Highway have been laid so as to conform with plans for an intended grade separation to be built in the future at that junction.

In the meantime, funds have been provided for the installation of semi-traffic-actuated signal lights at the East Shore intersection. This signal system is so designed that cars on University Avenue, approaching the East Shore Highway and wishing to make a left turn or cross the thoroughfare, will automatically turn traffic lights to "stop" against the East Shore Highway traffic for a sufficient time interval to permit the car to safely enter the traffic stream on the highway.

The "robot" controlling these lights is so constructed that a maximum time limit is established for stopping traffic on the highway and, should a more or less continuous line of cars on University Avenue approach the East Shore Highway, the signal system willl operate alternately with conventional red and green lights to control the traffic in both directions as at any other intersection.

While the basic engineering features entering the design of the present overhead follow conventional principals and practice, the treatment of the structural members has been such as to give a modernistic, streamlined appearance.

TRIBUTE TO DEMOCRACY

In his dedicatory address, Chairman Barrett said in part:

"We may well be thankful to live in a land of true democracy where a structure such as this stands as a

(Continued on page 28)

At top, University Avenue overhead structure in Berkeley dedicated January 6. Center, left, Group, C. H. Sweetser, Public Roads Administration, Mayor Frank Gaines, "Miss West Berkeley" (Rene Verbeck), Chairman Larry Barrett, State Highway Commission, District Engineer Jno. H. Skeggs. At right, view of four-lane divided roadway. At bottom, crossing of main railroad tracks.

Highway Bids and Awards for the Month of December, 1939

INYO COUNTY—Between Big Pine Airport and Big Pine, about 1.6 miles to be graded and surfaced with road-mix surfacing. District IX, Route 23, Section C. Isbell Construction Co., Reno, Nev., $27,659; Valley Construction Co., San Jose, $28,459; A. S. Vinnell Co., Alhambra, $29,552; Anderson & France, Visalia, $30,858; G. W. Ellis, No. Hollywood, $30,918; Oilfields Trucking Co., Bakersfield, $32,085; Triangle Rock & Gravel Co., San Bernardino, $33,652. Contract awarded to Basich Bros., Torrance, $25,492.

LASSEN COUNTY — Between Milford and Bird Flat, about 10.5 miles to be graded and penetration oil treatment and seal coat applied. District II, Route 29, Section D. Fredrickson Bros., Emeryville, $69,890; Isbell Construction Co., Reno, Nevada, $71,949; Claude C. Wood, Lodi, $73,249; Poulos & McEwen, Sacramento, $74,148; Fredrickson & Westbrook, Sacramento, $77,330; Harms Bros., Sacramento, $77,805; Louis Biasotti & Son, Stockton, $79,360; Lee J. Immel, Berkeley, $79,486; Heafey-Moore Co. and Fredrickson & Watson Construction Co., Oakland, $79,907; Dodge Construction, Inc., Fallon, Nevada, $80,839; M. J. B. Construction Co., Stockton, $81,287; Utah Construction Co., San Francisco, $81,802; McNutt Bros., Eugene, Oregon, $87,422; A. Teichert & Son, Inc., Sacramento, $88,818; Hemstreet & Bell, Marysville, $95,874. Contract awarded to Parish Bros., Hollywood, $66,383.90.

LOS ANGELES COUNTY—A reinforced concrete slab bridge across each branch of Compton Creek to be constructed, and approaches graded and surfaced with plant-mixed surfacing. District VII, Route 175, Section A. Oscar Oberg, Los Angeles, $5,854; R. M. Price, Huntington Park, $6,085; Carl Hallin, Los Angeles, $6,216; W. E. Robertson, Los Angeles, $6,286; Fred Fredenburg, San Francisco, $6,399; W. J. Disteli, Los Angeles, $6,612; A. S. Vinnell Co., Alhambra, $6,624; T. P. Schultz, Compton, $7,327; C. R. Butterfield & Kennedy Co., San Pedro, $7,990; Sordal & Bishop, Long Beach, $8,638. Contract awarded to Mojave Corp., Los Nietos, $5,553.50.

LOS ANGELES COUNTY — Between Main Street and Central Avenue, about 1.5 miles to be graded and paved with Portland cement concrete and asphalt concrete. District VII, Route 175, Section A. J. E. Haddock, Ltd., Pasadena, $103,796; Basich Bros., Torrance, $106,735; Radich & Brown, Burbank, $110,203; Griffith Co., Los Angeles, $111,240; Sander Pearson, Santa Monica, $111,496; Spicer & Thompson, Los Angeles, $111,742; Claude-Fisher Co., Ltd., Los Angeles, $114,263; Matich Bros., Elsinore, $116,863; Dimmitt & Taylor, Los Angeles, $119,282; R. M. Price, Huntington Park, $122,406; Sully-Miller Contracting Co., Long Beach, $125,526. Contract awarded to Oswald Bros., Los Angeles, $97,097.40.

NEVADA COUNTY—Between 1½ miles south and 1½ miles north of Rattlesnake Creek, about 3 miles to be graded and surfaced with plant-mixed surfacing on crusher run base. District III, Route 17, Sections A, B. Claude C. Wood and Frank B. Marks & Sons, Lodi, $111,861; Parish Bros., Hollywood, $112,098; Fredrickson Bros., Emeryville, $113,393; Harold Smith, St. Helena, $114,592; Harms Bros. & N. M. Ball Sons, Berkeley, $114,641; The Utah Construction Co., San Francisco, $118,911; J. R. Reeves, Sacramento, $120,780; Piazza & Huntley, San Jose, $126,384; A. Teichert & Son, Inc., Sacramento, $127,578; Louis Biasotti & Son, Stockton, $130,949; Isbell Construction Co., Reno, Nevada, $150,338; McNutt Bros., Eugene, Oregon, $151,180. Contract awarded to Hemstreet & Bell, Marysville, $105,727.90.

RIVERSIDE COUNTY — At Salton Creek, about 33 miles south of Indio, a reinforced concrete bridge to be constructed and approaches, about 0.64 mile in length, to be graded and road-mix surface treatment applied. District XI, Route 187, Section A. G. W. Ellis, North Holywood, $39,682; B. G. Carroll, San Diego, $40,877; Martin & Schmidt Contractors, Long Beach, $41,186; A. S. Vinnell Co., Alhambra, $41,506; R. M. Price, Huntington Park, $41,866; J. E. Haddock, Ltd., Pasadena, $43,155; J. S. Metzger & Son, Los Angeles, $43,333; T. P. Schultz, Compton, $46,620; V. R. Dennis Construction Co., San Diego, $48,750; Gibbons & Reed Co., Burbank, $50,936; Contracting Engineers Co., Los Angeles, $61,767. Contract awarded to Valley Construction Co., San Jose, $38,181.

SACRAMENTO AND EL DORADO COUNTIES—Between 3¾ miles east of Folsom and 2¼ miles east of Clarksville, about 5.8 miles to be graded and surfaced with plant-mixed surfacing on crusher run base. District III, Route 11, Sections A, A. Parish Bros., Hollywood, $248,062; Utah Construction Co., San Francisco, $249,991; Macco Construction Co., Clearwater, $255,227; Eaton & Smith, San Francisco, $262,962; Daley Corp., San Diego, $262,518; Harms Bros. & N. M. Ball Sons, Berkeley, $276,170; Jones & King, Hayward, $277,496; Louis Biasotti & Son and Piazza & Huntley, San Jose, $288,233; Heafey-Moore Co. Fredrickson & Watson Construction Co., Oakland, $288,264; Granfield, Farrar & Carlin, San Francisco, $298,307; A. Teichert & Son, Inc., Sacramento, $368,312. Contract awarded to Hemstreet & Bell, Marysville, $230,837.75.

SAN DIEGO COUNTY—A reinforced concrete box girder bridge on Washington Street at Sixth Avenue in the City of San Diego to be constructed. District XI, Washington St. Extension. Daley Corp., San Diego, $133,814; Chas. J. Dorfman, Los Angeles, $136,377; B. G. Carroll & H. L. Foster, San Diego, $142,740; Byerts & Dunn, Los Angeles, $143,330; J. S. Metzger & Son, Los Angeles, $149,142; B. O. Larsen, San Diego, $152,864; Carlo Bongiovanni, Los Angeles, $153,456; J. E. Haddock, Ltd., Pasadena, $156,264; Sordal & Bishop, Long Beach, $166,381. Contract awarded to Contracting Engineers Co., Los Angeles, $132,422.50.

SANTA BARBARA COUNTY—Between one-half mile east of El Capitan Creek and Orella, about 2.3 miles to be graded and surfaced with plant-mixed surfacing. District V, Route 2, Sections G, F. J. E. Haddock, Ltd., Pasadena, $181,085; A. Teichert & Son, Inc., $187,136; Denni Investment Corp., Wilmington, $190,135; Basich Bros., Torrance, $194,832; Daley Corp., San Diego, $197,686; Hemstreet & Bell, Marysville, $204,327; N. M. Ball Sons, Berkeley, $207,479; Claude-Fisher Co., Ltd., Los Angeles, $210,244; United Concrete Pipe Corp., Los Angeles, $214,059; Radich & Brown, Burbank, $216,091. Contract awarded to R. E. Hazard & Sons and Clarence Crow, San Diego, $178,076.90.

SANTA CLARA COUNTY — Between Oaks Road and Los Gatos about 1.8 miles to be graded and surfaced with plant-mixed surfacing on crusher run base. District IV, Route 5, Sections C, B, Los Gatos. Granfield, Farrar & Carlin, San Francisco, $170,467; Macco Construction Co., Clearwater, $186,777; Piombo Bros. & Co., San Francisco, $219,598. Contract awarded to Heafey-Moore Co., Fredricksen & Watson Construction Co., Oakland, $160,969.10.

SHASTA COUNTY—A steel deck truss bridge with concrete deck on concrete piers and abutments to be constructed across Sacramento River about 30 miles north of Redding. District II, Route 3, Section C. Barret & Hilp, San Francisco, $676,920; Heafey-Moore Co.-Fredrickson & Watson Construction Co., Oakland, $677,109; Engineers, Limited, San Francisco, $680,650; A. Soda & Son, Oakland, $690,932; Bates & Rogers Construction Corp., Oakland, $703,178; C. W. Caletti & Co., San Rafael, $757,180. Contract awarded to United Concrete Pipe Corp., Los Angeles, $673,046.

Newhall Tunnel Replaced by Cut

(Continued from page 18)

was laid and the remaining pavement material placed and rolled. The finished thickness of the pavement was three inches. Aggregate for the surfacing provided 100 per cent passing a 1 inch screen, 65 per cent passing a No. 3 sieve and 4 per cent passing the 200 mesh. Six per cent of Grade "D" asphalt was the binder.

DITCH CONSTRUCTION EXPERIMENTAL

While the California Division of Highways has constructed many miles of various types of paved drainage ditches, the use of wire mesh reinforcement with asphalt concrete is an experiment and the service which this ditch renders during the storms of the next few winters will be watched with interest.

Supervision of the design and construction of the project was under S. V. Cortelyou, District Engineer and E. L. Seitz was Resident Engineer in direct charge of the work. The contractor was Griffith Company of Los Angeles. The entire project cost $475,700 of which approximately $191,000 was for roadway excavation.

The highway is an example of that large class of highways which are not main inter-city arterials but which are called upon to carry relatively large volumes of traffic with high peaks of density. The construction standards are typical of present California practice on these important thoroughfares.

Highway Relocation Across Shasta Reservoir

(Continued from page 15)

indeterminancy'' diminishing toward the two outer supports of the group, becoming fully ''determinate'' at these supports and beyond.

In order to support the main piers in a longitudinal direction, the trusses are attached to the pier tops by a rotating type of joint that will transmit horizontal shear, but no bending moment. The elimination of a moment connection is important as a rigid type of connection would practically double the temperature stresses in trusses and piers set up by horizontal deflection of the piers.

Transversely, the four high piers must provide their own stability. No temperature stresses exist in this direction, but wind and earthquake forces are quite severe. Analysis of the effect of ''wave action'' of the reservoir water due to earthquake forces was made. This ''wave action'' effect refers to the oscillating motion set up by an earthquake, and should not be confused with surface ''waves'' due to wind or tide. Extensive research and model experimentation has been done in this field by the U. S. Reclamation Bureau at Denver, Colorado. The Department is indebted to the Reclamation Bureau for the use of these studies.

TRUSSES BEND AROUND CURVE

Trusses are bent horizontally at two points between each pier rather than at the piers, to fit the horizontal curve of the bridge. A number of advantages result from this:

1. The eccentricity, or overhang, of deck stringers relative to the trusses is but one-fourth that produced by bending the trusses only at the piers. This eliminated additional steel in the floor-beams located between bend lines.
2. Bending moment in the truss is very low at the bend line due to the continuous truss layout. These bend lines occur at approximately the quarter points in the span where the dead load moments are practically zero.

Truss joint stresses are correspondingly low, and the torque resulting from these stresses is greatly reduced. While it is true that the torsional stresses set up at the bend lines must be transferred along the trusses to the piers, stresses are so low as to require no additional metal in the main trusses to resist them. The writer knows of no previous use of this arrangement in American or European bridge construction.

NEW ALLOY USED

A newly developed alloy steel will be used in the trusses, with 50 per cent greater tensile strength and five times as rust resisting as ordinary structural steel. Its excellent corrosive resistance permitted minimum sections of ¼" thickness, while the additional strength available resulted in large savings in weight of metal.

The truss member design represents a considerable departure from previous construction. All members consist of a 14-inch beam section, supplemented when necessary on the compression members with 15-inch or 18-inch channel sections shop welded to the beam flanges. No stay plates or lacing bars, formerly considered indispensable to truss members, are used. This not only reduces shop fabrication, but eliminates excess metal not directly participating in stress resistance.

As truss members are perfectly smooth and accessible for painting, maintenance costs will be materially reduced.

ECONOMICAL ''T'' SECTIONS

Bracing members are made from structural tee sections obtained by splitting wide flange beam sections at the rolling mill when hot. These sections became available fairly recently and have proven very economical, reducing weight and eliminating shop fabrication.

Truss-shoes are built-up assemblies of rolled steel plate, shop-welded together to form a rigid unit. Welded frames constructed in this manner are far superior to steel castings in every respect. Alloy steel is used, resulting in a strength and ductility equal to that secured in the main truss. The largest truss shoe is approximately 5 feet square, 2½ feet high, and supports a load of more than 2,000,000 pounds.

Temperature variations of 20 to 120 degrees Fahrenheit produce a

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Bay Bridge Traffic Passes 30 Million Mark Since Opening November 1936

TRAFFIC on the San Francisco-Oakland Bay Bridge since its opening November 12, 1936, passed the thirty million mark by 24,621 on the last day of December, 1939. The total vehicles for the year 1939 reached a new high record of 10,963,432.

For the month of December the total traffic was 854,413 vehicles, compared with 822,494 for the preceding month and 783,846 for December a year ago. This was a very gratifying increase although it would undoubtedly have been better had the harbor not been closed during the entire month. The increase in traffic over December a year ago was 8.3 per cent. Revenues, however, were 13.8 per cent less than a year ago. This is accounted for by the toll reduction that was made last July.

Christmas week was especially heavy in traffic and Christmas day alone accounted for 43,929 vehicles.

December totals and comparative figures were:

	Dec. 1939	*Dec. 1938*	*Nov. 1939*	*Total 1939*	*Total Since Opening*
Passenger autos and auto trailers	776,926	709,906	743,127	9,964,917	27,672,589
Motorcycles and tricars	2,824	2,879	3,184	42,803	129,702
Buses	16,596	13,616	16,329	125,903	373,537
Trucks and truck-trailers	42,826	41,871	44,220	559,160	1,319,059
Others	15,241	15,574	15,634	271,042	529,734
Total vehicles	854,413	783,846	822,494	10,963,432	30,024,621
Extra passengers	265,599	247,439	267,327	2,506,884	8,256,519
Freight, tons	49,748	57,500	53,386	715,455	1,626,585

Old Indian Trail Over Mountain Springs Grade Being Modernized

By E. E. SORENSON, District Construction Engineer

THE old Mountain Springs Grade connecting San Diego and Imperial counties, which supplanted ancient Indian trails, is in turn to be replaced by a standard highway over the In-ko-pah Mountain Range.

The first unit of construction in what is planned to be a complete modernization and realignment of the Mountain Springs Road, which is Route 12 from Boulder Park to Coyote Wells, has been completed and accepted by Director of Public Works Frank W. Clark.

The contract recently finished involved the complete realignment of 2.55 miles of extremely difficult mountain construction up the face of the In-ko-pah Range, which lies in the edge of the San Andreas Fault. The maximum grade was reduced in excess of 1.1 per cent; 950 degrees of curvature was eliminated, and the minimum radius decreased from 126 feet to 600 feet.

The average passenger car, which negotiated the old grade at 20 miles per hour, can now travel the new route at the legal speed limit.

SIGHT DISTANCE IMPROVED

Sight distance, which hampered travel on the old route, has been increased to eliminate all interference. Major construction items involved in the work included approximately 270,000 yards of rock excavation, which required 150 tons of dynamite, 11 million gallons of water, 900,000 station yards of overhaul, 18,000 yards of imported borrow, and 500 tons of liquid asphalt.

Records extending for many years into the past, indicate that the Mountain Springs route between the Imperial Valley and the coast has proved a difficult, but, nevertheless, the only feasible one for the primitive Indians, as well as the motorists of today.

The Yuma tribes from the Colorado Valley traveled this way to their fishing grounds on the coast. The In-ko-pah Indians, from which the mountain range derives its local name, while not extremely war-like, nevertheless made numerous changes in the route of travel necessary.

The easiest and best trails followed Carriso Creek through Carriso Gorge to what is now known as Jacumba Hot Springs. That this range of mountains was for many years a serious obstacle is borne out by the histories of the various expeditions which avoided it.

In 1774 De Anza, after skirting the Sand Hills of Imperial Valley, marched through lower Carriso Valley, then continued on to the northwest, in preference to forcing his way over the mountains to the cooler coast route.

In 1846 and 1847 the expedition from Fort Leavenworth to San Diego, commanded by Lt. W. H. Emory, U. S. Topographical Engineer, was forced to avoid these same mountains and detour from Carriso via Warners Valley to San Diego.

The historical battle of San Pasqual might have been avoided if, in 1846, General Stephen W. Kearney had found the Mountain Springs route less formidable and had not marched via San Felipe, Warners and Santa Ysabel to his defeat.

In 1857 the Butterfield Stage Company was awarded a contract to carry transcontinental mail. It found its objective by way of San Diego to be difficult, although affording a much cooler and more desirable route, and therefore blazed the now historic Butterfield Trail, which passes through Carriso and then avoids the mountains by heading northwest.

Beginning about 1890, the attractions of the Laguna Mountain, Jacumba Springs, and Boulevard Valleys to the settlers moving into the lower California Valley, made necessary the development of routes via Mountain Springs. These routes changed in location rapidly, from trails up Carriso Gorge to a stage route through Devil's Canyon, and then to one more nearly conforming to the present road. These roads were built on excessive grades, with no surfacing, and subject to damage by sudden mountain storms.

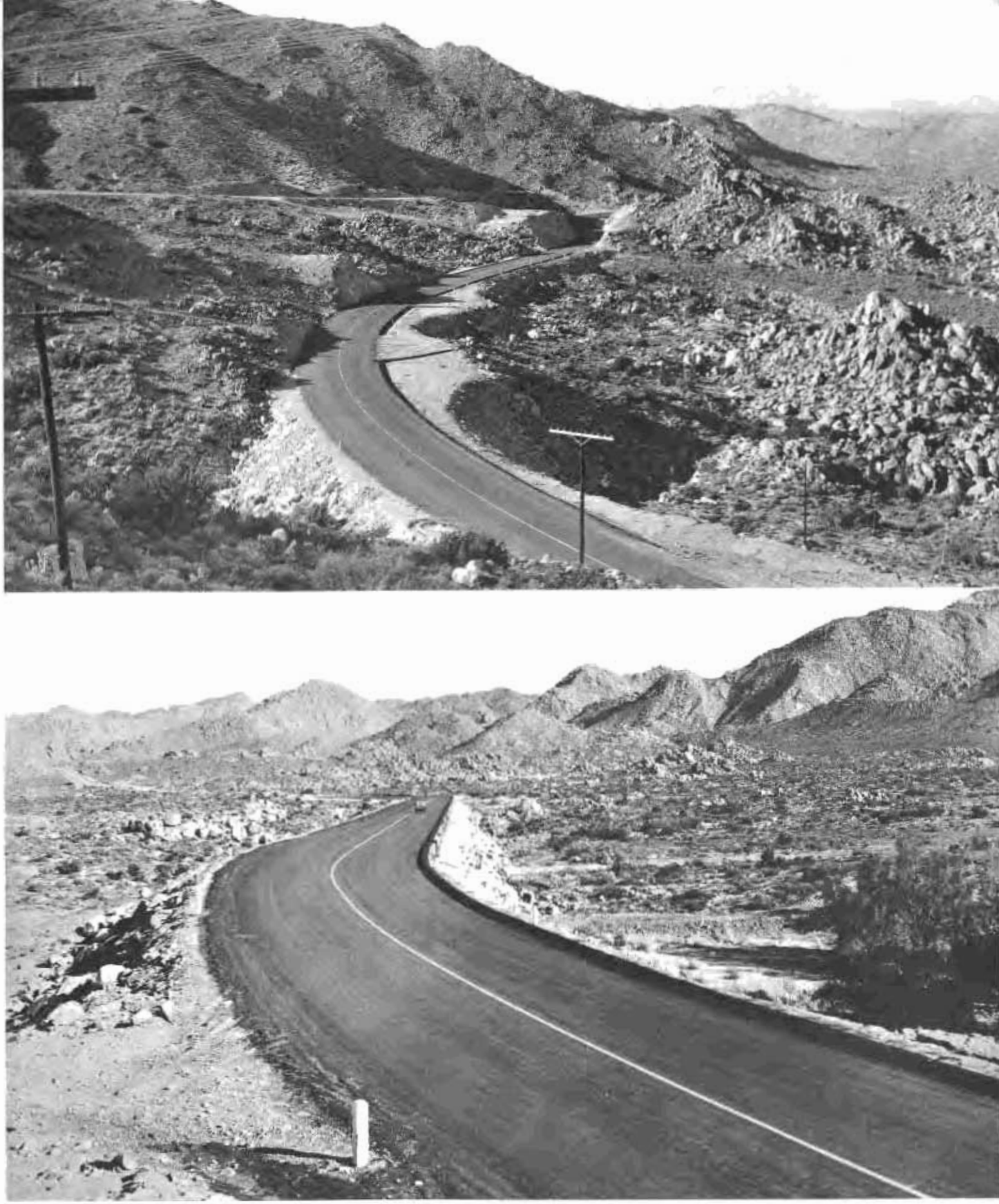
Highway consciousness was first noted in San Diego County about 1908, when the construction of 450 miles of highway was started, using the proceeds of a bond issue. Records indicate that, about this same time, interest was awakened in the construction of a highway from Mountain Springs to Coyote Wells, through what was then commonly known as San Diego Canyon. The move was fostered by F. W. Jackson, who personally raised $50,000 by popular subscription.

The road at this time climbed through an elevation of 2330 feet, had grades in excess of 22 per cent, and included nine miles of sand. With the $50,000 the road was shortened to approximately 12 miles, the maximum grade reduced to 7 per cent, and all but one mile of sand eliminated. The need for this road was strongly felt by San Diego business men, who were determined to obtain a share of the valley business, which in 1912 amounted to $10,000,000, and was being diverted mostly to northern cities.

The advent of the motor car and truck and its phenomenal increase in numbers and use made several changes necessary between 1912 and the current time, and the present highway is the result of several projects covering grading, paving and drainage, each one a decided improvement over that replaced.

Considerable credit is due to the A. S. Vinnell Company, contractors on the Mountain Springs grade job, for their efficient handling of modern highway equipment, which resulted in the successful completion of the job.

Work was done under the supervision of E. E. Wallace, District Engineer, who was represented in the field by R. C. Payne, Resident Engineer, and F. D. Pearce, Assistant.



New realigned Mountain Springs Grade highway ascending the rocky slopes of the In-ko-pah Mountain Range in San Diego County.

Concrete Riprap Bank Protection

(Continued from page 20)

to six feet below the stream bed, and after preparation of the embankment slopes to 1½:1 and 1¼:1, a single layer of sacked riprap was placed thereon. Cut-off walls at 50-foot intervals were placed in these embankment slopes to confine the damage to small sections in case of failure.

Damaged portions of existing rock riprap approximately two feet thick were replaced in kind to well above the extreme high water mark and portions were grouted with concrete.

No doubt the behavior of the two types of riprap will be followed by some engineers with interest, as the velocities are high in both streams at times, and the work will be forced to withstand a severe test in the future.

There still remains considerable work to be done on this route and constant maintenance is necessary because of the steep hill slopes and poor stability of soils.

The road is subject to large slides coming into the roadway after each rain in the form of earth and water at about the consistency of a heavy syrup, making it difficult to keep culverts open, and the road clear.

The 1939 season was exceptionally dry and the run-off of the streams very light. The Contractor experienced very little difficulty from water in the construction of footings.

Work was completed December, 1939. J. W. Corvin was Resident Engineer.

Grade Separation Open

(Continued from page 22)

monument to the cooperative initiative of governmental groups and private industry.

"Here is a beautiful, modern highway structure, built, not at the command of some dictator, but built because you of Berkeley needed and desired it. You convinced the State of your need, and the State requested approval of the enterprise by the Public Roads Administration for construction to be financed with Federal funds appropriated by Congress for that purpose.

"That is the public cooperation of a democracy.

"The overhead was designed by consultation among State highway engineers, your own city engineering staff and engineering officials of the Southern Pacific Railroad, and built under a State contract by Heafey-Moore Co. and Fredrickson and Watson Construction Co., who are private contractors.

"That is cooperation of public bodies and private industry.

"In all this procedure, mutual agreement was the basis of all negotiations.

"That is democratic initiative.

"And here stands a utilitarian public facility as a thing of beauty in satin-smooth concrete and sturdy steel for the free use of the citizens of Berkeley and the guests within their gates."

In Memoriam
Everett N. Bryan

Everett N. Bryan, died at his home in College Tract, Sacramento, December 17, 1939, at the age of 55. Surviving are his widow, Mrs. Gladyes Huber Trumbo Bryan; a son, Everett Elgin Bryan, both of Sacramento; a sister, Myrtle, and five brothers, Ross, Claude, Ellis, Jasper and Homer Bryan. He was a native of Montezuma, Iowa, educated in the public schools of California, graduating from the University of California with the class of 1907, of which he was secretary.

For two years after his graduation he was employed by the Western Pacific Railroad Company. From 1909 to 1921 he was actively engaged with irrigation construction and operation and for four years was chief engineer of the Waterford Irrigation District. In 1921 he took a position with the State Division of Water Rights. The Water Commission Act had been enacted some years before, but due to the shortage of engineers during the World War period the work of the Division had not become standardized.

Mr. Bryan immediately took a leading part in perfecting the procedure now in effect supervising the initiation and perfection of water rights. He became one of the best known engineering authorities in California on water rights and was eminent in this particular line.

At the time of his death he was supervising hydraulic engineer of the Division of Water Resources.

Mr. Bryan was a member of the American Society of Civil Engineers, was active in the formation of Sacramento section of the society, served on many of its committees, took an active interest in its affairs and was fifth president of the local section. He took a keen interest in all civic affairs. In 1928 he was a member of the Sacramento Water Commission for the investigation of a water supply for Sacramento.

When the law for registration of civil engineers was first proposed, Mr. Bryan took a leading part in drafting the proposed act and received Certificate of Registration No. 4 under the act, the members of the first Board of Registration having been assigned the first three numbers. As engineering was his profession, so was it his avocation. He was always keenly interested in every thing affecting his work and wrote many papers for leading engineering periodicals on various phases of engineering.

Mr. Bryan was a member of Sacramento Lodge No. 40, F. & A. M., and the Sutter Club. He had a gift of personal charm and affability, was a faithful public servant and loyal friend.

Highway Relocation Across Shasta Reservoir

(Continued from page 25)

total movement of nine inches at the one expansion joint in the truss system. A sliding "finger" type of joint is used in the deck slab, featured by a locking device that anchors it rigidly to the deck to prevent noise and vibration due to passing vehicles. The joint is self-cleaning, in that rubbish and dirt can not collect in the openings, but are pushed off by movement of the bridge.

An inspection walkway is provided under the roadway slab, with ladders leading down to each pier. Interiors of the piers are accessible for inspection.

Telephone and telegraph cables are carried across the bridge under the roadway deck.

The structure should be completed in July, 1941. Mr. Charles R. Poppe is Resident Engineer for the State on this project. The structure was designed by the Bridge Department under the direction of F. W. Panhorst, Bridge Engineer, L. C. Hollister, Design Engineer, and the writer.

The United Concrete Pipe Corporation of Los Angeles is the contractor having been awarded the contract by Director of Public Works Frank W. Clark on their bid of $672,046, the lowest of seven bids received.

State of California

CULBERT L. OLSON, Governor

Department of Public Works

Headquarters: Public Works Building, Twelfth and N Streets, Sacramento

FRANK W. CLARK, Director of Public Works

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80911 1-40 20,500

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

California Highways and Public Works
Division of Highways
P. O. Box 1499
Sacramento, California
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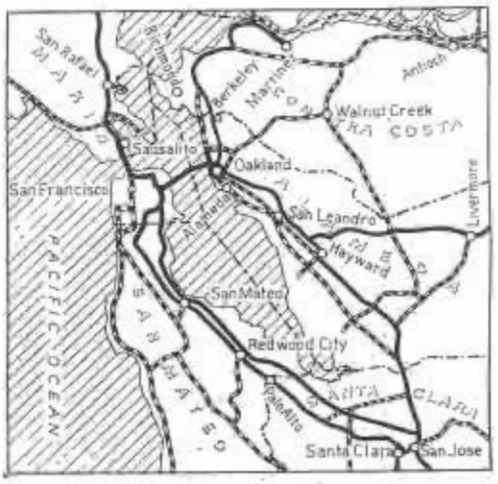
MAP
SHOWING
STATE HIGHWAY SYSTEM

LEGEND
Primary Roads
Secondary Roads
Proposed Roads



SAN FRANCISCO AND VICINITY

LOS ANGELES AND VICINITY

See Detail Map

See Detail Map