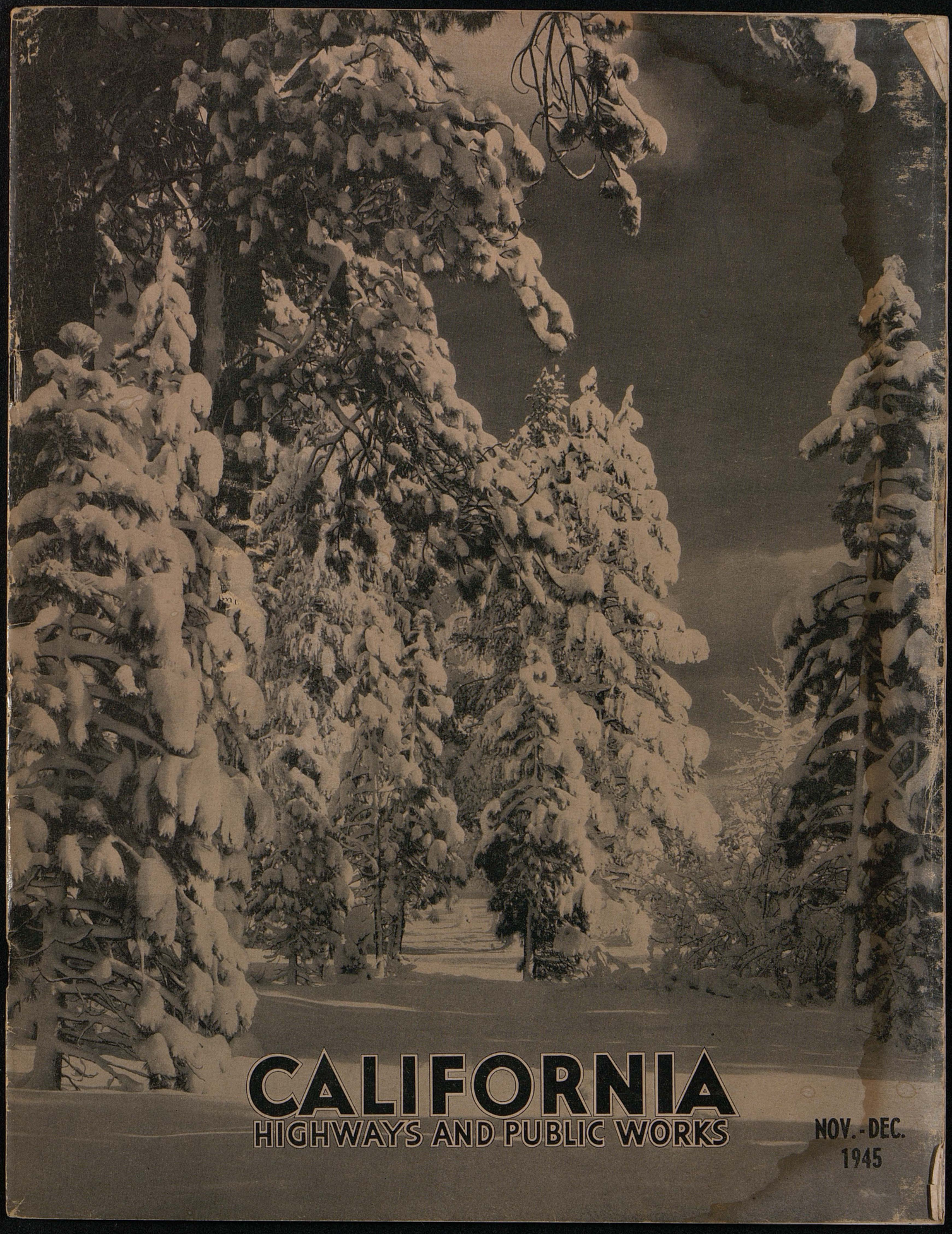

CALIFORNIA

HIGHWAYS AND PUBLIC WORKS

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CALIFORNIA HIGHWAYS AND PUBLIC WORKS

Official Journal of the Division of Highways, Department of Public Works, State of California [PRINTED IN U.S.A.]

C. H. PURCELL, Director | GEORGE T. McCOY, State Highway Engineer | K. C. ADAMS, Editor

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CALIFORNIA STATE HIGHWAY SYSTEM ITS NEEDS, PROBLEMS, AND OUTLOOK

By C. H. PURCELL, Director of Public Works and Chairman California Highway Commission

The following address was delivered by C. H. Purcell, Director of Public Works and Chairman of the California Highway Commission, at the annual meeting of the California State Chamber of Commerce in Los Angeles on November 29th.

THE needs and problems of the California State Highway System and the outlook for its development are subjects of more than considerable magnitude. They are of such size that any discussion of the details would be most impractical in a brief address. It is my purpose today, to ask you merely to stand off with me at a little distance and look at the system and the problems of its administration with some degree of perspective—to appraise the subject of highway transportation and the relation of State roads to that subject as a whole.

Transportation is a fundamental thing. It is so basic to the whole scheme of living that the progress of civilization may be measured by it. Of all transportation media, road transport has always been and continues to be the primary means of movement and intercommunication. Development of the motor vehicle and its mass production have made it a universal means for locomotion. The wartime restrictions placed upon motor travel demonstrated, with results near to catastrophe, that the economy of this Nation is completely dependent upon this universal method of transportation and that any drastic curtailment of it would mean certain breakdown of that economy.

Further, it seems self-evident that expansion of motor transportation to the maximum extent of its usefulness is dependent upon the expansion of physical facilities which it requires for unfettered movement.

GOOD HIGHWAYS VITAL

Whatever is of importance to highway transport in general, applies with added force to California. To an unusual degree, California is indebted to roads for her already phenomenal development. Her highways made possible the development—the development did not bring the highways. This State with its great distances, its extremes in topography, climate and resources could not have evolved into the great commonwealth of today without its road systems.

In California the term "road transport facilities" is nearly synonymous with "State highway facilities" since, although the mileage of the State Highway System comprises but one-eighth of all rural roads in the State it carries three-fourths of highway travel outside of cities.

During the year 1941, prior to wartime restrictions on transportation, traffic on the 14,000 miles of the State Highway System totaled nearly 13,000,000,000 vehicle-miles. This was nearly one-half of *all* motor travel for that year in California, both inside and out of cities.

TRAFFIC INCREASES

Traffic counts taken on the State Highway System during October, 1945, show an increase of 51 per cent over October a year ago and, what is more significant, the 1945 count shows an increase of approximately 10 per cent over the October, 1941, count. This latter comparison for a period only one month after the end of gasoline rationing, is a pointed indication of the difference which may be expected between prewar and postwar traffic.

Analyses of current traffic data for the State Highway System show that 22 per cent of the vehicles traveling up and down and across California are freight vehicles. During the 10 years immediately prior to the war, passenger car registration in this State increased by 41 per cent but in the same time the number of trucks gained 122 per cent and trailers went up 279 per cent. There is little doubt but that during postwar years the ratio of freight to passenger vehicles will continue to increase, although probably not at the high rate of the 10 years prior to the war.

What of the State highway facilities which are available for this increasing traffic?

SYSTEM DEFICIENT BEFORE WAR

Before the war the State Highway System was deficient to the point where the Division of Highways in its report of 1941 on "Highway Needs" estimated that a sum of $450,000,000 would be required to bring the system to satisfactory standards of the period.

This estimate was based upon construction activities of the Highway Department before National and State recognition of the broad responsibility of the higher levels of government for highway transport within cities and for freeway construction in congested urban areas. Proper consideration of this factor, together with the deterioration resulting from the cessation of construction and reconstruction under wartime restrictions which limited State highway activity to maintenance and repair has increased this estimate for correction of critical deficiencies to $695,000,000.

CRITICAL DEFICIENCIES

These critical deficiencies fall into five general categories.

1. **Critical bridges.**
2. **Structural weakness of road base or pavement.**
3. **Inadequate traffic capacity.**
4. **Specific points of hazard or obstruction.**
5. **Required freeways.**

There are many things which may act to restrict or to prevent the use of a highway, but none is more obvious or positive in effect than an inadequate bridge. There are many such bridges on the State Highway System and they are distributed throughout the State. The Division of Highways considers a bridge critical when, because of weakness or deterioration its replacement will be required within an eight or 10-year period. Roughly such structures fall into three classifications:

POSTED BRIDGES

First, are those posted bridges which are both too weak in original design to carry legal loads and at the same time are now in poor physical condition. These are of primary concern.

Second, are bridges which at present are sufficiently strong to carry legal loads, but in which deterioration has progressed to such degree that the structure must either be posted or replaced in the near future.

The third class is made of those bridges which, while in fair physical condition at the present time are so weak or restricted in design that replacement will be required within a few years.

WEAK ROADBEDS

Roadbeds which are structurally inadequate for the type of traffic they are called upon to carry are doubly critical. Such weakness tends to restrict or altogether preclude travel at normal speed and of legal load. When this occurs the highway has failed in its fundamental purpose and, at the same time, in the endeavor to keep traffic restrictions to a minimum excessive maintenance expenditures can not be avoided.

Like critical bridges, sections of critically weak roadbed or pavement with their attendant high maintenance costs are to be found throughout the system.

Traffic on the State Highway System is now more than that system can carry and as previously stated there are still further increases to come. It is fully realized by the California Highway Commission, the Division of Highways and myself that we have not kept pace with traffic increase and have been steadily falling behind in the matter of providing the additional lanes which the increased volume requires. This is a matter of grave concern to State highway officials for, if the State's development is to go forward unhindered, transportation facilities must be provided *in advance* to accommodate the increasing traffic which the very existence of adequate roads helps to create.

HIGHWAY CAPACITY

In estimating capacity-deficiencies of the system, the need of additional lanes included those present two- and three-lane highways which carry a minimum of 5,000 cars per day or frequent peaks of 600 or more per hour. As would be expected, such sections of the State Highway System are closely related to the more heavily populated areas.

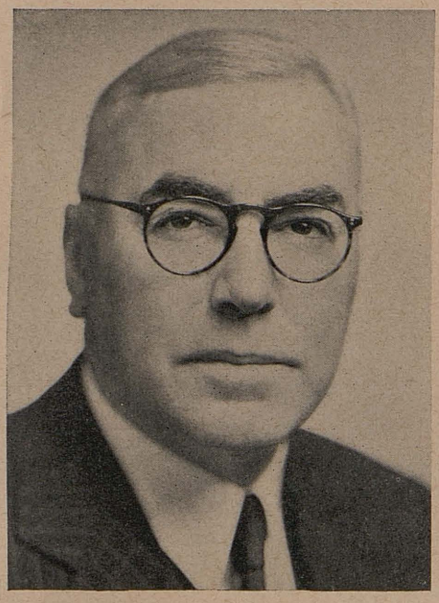
At points where traffic analysis shows an abnormal rate of accident recurrence, or where obstructions such as slides, flood damage, or roadway subsidence, continue at such frequent intervals as to seriously delay or hinder traffic, elimination of the deficiencies are planned through correction in the roadway design and structure.

The urban traffic problem, particularly in the larger centers of population, presents a combination of critical deficiencies that result from inadequate traffic capacity, traffic hazards, and specific obstructions in such quantity and with such frequency that to deal with the immense volume of motor traffic in these areas requires more than simple correction of the physical highway facilities. In such locations, an integrated system of freeways designed to serve the entire area is basic in the solution of the transportation problem.

$695,000,000 REQUIRED

It is for the correction of these critical deficiencies that the $695,000,000 will be required.

With the exception of the addition in 1937 of the 3-cent tax on diesel oil used as motor vehicle fuel, the base of State revenue for road purposes has remained unchanged for nearly 20 years. With exhaustion of funds from the three State highway bond issues, the original two-cent gas tax was passed in 1923, one cent being given to the counties and one cent to the State Highway Department for reconstruction of highways built under the bond



C. H. PURCELL

acts. In 1927 a third cent was added to the gas tax for the purpose of providing funds for new construction on the State Highway System.

At this time the State Highway System was just about one-half its present extent: 6,565 miles in 1928. By 1932 the system had been increased to 7,347 miles and the revenue from the State's two-cent share of the gas tax was providing $2,370 per mile.

MILEAGE ADDED IN 1933

In 1933 the State Legislature added 6,600 miles to the system, nearly doubling the mileage. There was then available only $1,260 per mile from the gas tax revenue. In the same year the Legislature earmarked the net revenue from one-fourth cent of the gas tax for use on State routes through cities, this again reduced the amount available per mile on the rest of the system to $1,020. In 1935 a second one-fourth cent was given to the cities for improvement to streets of major importance other than State routes, this resulted in a further reduction to the point where the revenue from the gas tax provided only $910 per mile of State highway. Thus, in a short period of three years, the amount of State revenue available from the gasoline tax dropped from $2,370 to $910 per mile of State highway—a reduction of almost 62 per cent.

MOTOR VEHICLE REGISTRATION

During this period motor vehicle registration in California increased from 2,080,000 in 1932 to 2,657,000 in 1937, a rise of approximately 28 per cent. But the increase in number of vehicles was only part of the change, for it was during these years that changes in design and speed of cars, in size and load of trucks and trailers were most drastic. These changes in volume and types of traffic demanded corresponding changes in highway design and construction standards.

During the twenties, advances in automotive design necessitated the discarding of eight-foot lanes and four-inch pavements in favor of ten-foot lanes and pavement thickness was increased to six inches. In turn, as traffic density, speed, and the number of truck loads increased, the old standard lane of 10 feet was widened to 11 feet for two-lane pavements and a combination of 12 and 11 feet for multiple-lane routes. Similar changes to seven and nine inches were made in pavement thickness in order to accommodate the heavier trucking loads. Standards now proposed by the Federal government for major highways to be included in the Interregional Highway System provide for a minimum lane width of 12 feet.

FREIGHT LOADS

While most of you undoubtedly have been aware in a general way of the increase in the size of freight loads traveling the highways, it is wondered how close your estimates are to the facts. Between 1936 and 1944 average weights of empty trucks and trailer combinations increased 34.7 per cent; the average of loaded trucks and combinations rose from 14,000 pounds to 23,500 pounds, an increase of 70.3 per cent; and the average maximum

(Continued on page 35)

Water Problems of California In Hands of Experts Named by Warren

As this issue of California Highways and Public Works goes to press, preparations are being completed for the state-wide water conference called by Governor Earl Warren for December 6th and 7th in Sacramento.

The purpose of the meeting, in the words of the Governor, is "to explore all phases of water development and use." It is hoped the conference will provide an overall picture of the State's water problems which will be invaluable in seeking the necessary solutions.

The Federal Government, State agencies dealing with water and power problems, California counties and cities, irrigation and reclamation districts, electric power companies and various groups and organizations interested in water and power and flood control will be represented by speakers who will address the conference over which Governor Warren, flanked by his new State Water Resources Board, will preside.

Among the prominent officials scheduled to speak are: Harry W. Bashore, United States Commissioner of Reclamation; Leland Olds, chairman of the Federal Power Commission; Brigadier General Philip G. Bruton, Division Engineer, Corps of U. S. Engineers; Brigadier General J. H. Stratton, Chief, Civil Works Division, U. S. Army Engineers; Richard L. Boke, Regional Director, U. S. Bureau of Reclamation, and Edward Hyatt, State Engineer.

The program for the opening session follows:

Opening Address: Earl Warren, Governor. Edward Hyatt, State Engineer. Subject: "State Water Plan."

Brigadier General Philip G. Bruton, Division Engineer, Pacific Division, Corps of Engineers, U. S. Army. Subject: "Plans of Corps of Engineers for War Department in California."

Richard L. Boke, Director, Region II, United States Bureau of Reclamation, Department of Interior. Subject: "Low Cost Water for California Farms."

S. B. Show, Regional Forester, Region V, Forest Service, U. S. Department of Agriculture. Subject: "Upstream Flood Control Program of the United States Department of Agriculture."

Luncheon will be at Elks Club, at which an address by Brigadier General J. H. Stratton, Chief, Civil Works Division, Office of Chief of Engineers, U. S. Army, on the subject: "War Department's Policies on Flood Control in Sacramento-San Joaquin Valley of California," will be the feature.

Governor Warren will be chairman of conference section meetings on the afternoon of December 6th. He announced section chairmen as follows:

Section 1. North Coast — Chairman, George G. Hoberg, President, Redwood Empire Association, Middletown, Lake County.

Section 2. Sacramento Valley — Chairman, Otto Rohwer, Attorney at Law, Sacramento.

Section 3. San Francisco Bay—Chairman, Ralph Bollman, President, Board of Directors, Contra Costa County Water District, Concord.

Section 4. San Joaquin Valley—Chairman, Harry Barnes, Chief Engineer, Madera Irrigation District, Madera.

Section 5. Mountain Counties — Chairman, Edward J. Reagan, District Attorney, Weaverville.

Section 6. Central Coast — Chairman, Charles L. Pioda, Chairman, Flood Control and Water Conservation Committee, Salinas.

Section 7. South Coast—Chairman, Fred A. Rhodes, City Manager, City of San Diego, San Diego.

Section 8. Colorado River—Chairman, Evan T. Hewes, President, Board of Directors, Imperial Irrigation District, El Centro.

A dinner will be held in the Empire Room of the Senator Hotel on the night of December 6th at which Mr. Olds of the Federal Power Commission will talk on the subject: "Policy of Federal Power Commission on Water Resources."

The program for Friday morning, December 7th follows:

W. A. Smith, President, Supervisors Association of California. Subject: "A County Official Views the Flood Control Problem in California."

Harrison Robinson, President, California State Chamber of Commerce. Subject: "Water Policies of California State Chamber of Commerce."

George Sehlmeyer, Master of State Grange and President of Central Valleys Project Conference. Subject: "Water Resources and Power Development in California."

C. J. Haggerty, Secretary, California State Federation of Labor.

Milton L. Kidd, President, Irrigation Districts Association of California, and California Water Council.

S. B. Morris, Chief Engineer and General Manager, Department of Water and Power, City of Los Angeles. Subject: "Water and Power Problems of California Municipalities."

Arthur T. Evans, Past President, Associated Sportsmen of California. Subject: "Fish, Wild Life, and Recreation."

Neil Cunningham, President, Shoreline Planning Association of California. Subject: "California Beaches."

Luncheon, Empire Room, Senator Hotel 12:15 p.m. Address by the Honorable Harry W. Bashore, Commissioner, U. S. Bureau of Reclamation, Department of Interior. Subject: "California's Stake in National Reclamation."

For Friday afternoon and evening the program will be:

Henry J. Kaiser. Subject: "Industry and the West."

Ray Wiser, President, California Farm Bureau Federation. Subject: "California Agriculture and its Water Problem."

Speakers: To be announced. Subject: "Policies of Electric Power Companies Relative to Water Development in California."

Senator Bradford S. Crittenden. California Joint Legislative Interim Committee on Water Problems.

Open discussion. Five minute talks with privilege of filing for the record papers not to exceed 2,500 words.

Reports of chairmen of geographical sections.

Friday evening, 7:30 p.m., Governor Warren, presiding.

Forum on Administrative Aspects of the Central Valley Project.

Speakers to be called upon, followed by full discussions from the floor.

Adjournment of Conference

GOVERNOR MEETS WITH BOARD

Governor Warren met with his new Water Resources Board in his office in Sacramento on November 1st. After being welcomed by the Governor and hearing brief talks by Director of Public Works C. H. Purcell, State Engineer Edward Hyatt who, by law, is executive secretary of the board, and Senator Bradford S. Crittenden of Stockton, author of the act creating the agency, the board organized and elected Royal Miller of Sacramento its chairman.

Mr. Purcell and Mr. Hyatt promised the fullest cooperation, Mr. Purcell saying that the Department of Public

Governor Warren meets with his new State Water Resources Board. Left to right, front row: C. A. Griffith, Azusa; State Senator Bradford S. Crittenden, Stockton, Chairman of Legislative Interim Committee on Water Problems; Governor Warren, and Philip D. Swing, San Diego. Back row: Howard F. Cozzens, Salinas; Royal Miller, Sacramento, Chairman; B. A. Etcheverry, Berkeley; Lester Ready, San Francisco; Roy Meikle, Turlock; State Engineer Edward Hyatt, Executive Secretary of the Board

Works had engineering data on water problems extending back more than three decades which his department would make available to the board.

Members of the board determined by lot the length of their terms which will expire as follows:

Former Congressman Philip D. Swing, San Diego, January 15, 1946; Professor B. A. Etcheverry, University of California, Berkeley, and Lester Ready, San Francisco, 1947; Roy Meikle, Turlock, and Howard F. Cozzens, Salinas, 1948; C. A. Griffith, Azusa, and Miller, Sacramento, 1949. (Thereafter all board terms will be for four years.)

In addressing the board members, Governor Warren said:

PERPLEXING PROBLEMS

"With the inauguration of this State Water Resources Board California has taken another long step forward in accepting State responsibility for the solution of its perplexing water problems.

"In the past numerous boards and commissions have been authorized by the Legislature to deal with specialized water problems on a temporary basis. This is the first time in the history of California that a permanent board has been created, by Legislative enactment, to consider all the beneficial uses of the State's water resources, including irrigation, generation of electric power, municipal and industrial consumption of water and power, repulsion of salt water, preservation and development of wild life resources and recreational facilities.

"The problems which you face as you assume your tasks as members of this newly created board are not, when taken singly, new to our State. In fact, it is probably a conservative statement to say that this State has more water law on its statute books than any other State in the Country. California in the past century has been a testing ground for procedure, both in the legal field and in the construction of works for the control and beneficial use of water. We have witnessed at first hand the gradual evolution of the control and use of our water resources. First, there was the small individual, privately financed, project which disregarded all other considerations save immediate local need. Today we are devoting ourselves to integrated State planning in the face of rapidly increasing demands upon steadily diminishing supplies of water.

FOR FUTURE GENERATIONS

"No matter how prudent we are in California, a time is inevitably approaching when all possible water supplies will be put to use. We know now the growth and prosperity of our State will be limited by the extent to which water can be controlled and used.

"It is the solemn duty of our generation to plan wisely for the greatest possible use for all purposes of every drop of water. Upon such planning will depend the happiness and welfare of millions of people, not only of this generation but of future generations.

"It was recognition of the need for better management of our water resources which caused the planning of the great Central Valley Project, the planning of Boulder Dam, and of

(Continued on page 23)

HIGHWAYS OF CALIFORNIA

By J. D. GALLAGHER, Associate Highway Engineer

This is the third in a series of articles on Highways of California by Mr. Gallagher.—Ed.

A CUSTOM-BUILT HIGHWAY

BACK in 1927, under a grant of $6,000,000 from the Rockefeller Foundation the California Institute of Technology was commissioned to erect an astronomical observatory equipped with the best in instruments and apparatus. The astronomy department of the institute knew what they wanted and began plans for a reflecting telescope equipped with a 200-inch mirror, just twice the size of that on Mt. Wilson, which for many years had been the largest in the world.

On the basis of extensive investigation the institute selected as the location of its "super-observatory" Palomar Mountain in northern San Diego County, some 47 miles easterly of Oceanside and 75 miles northeast of the City of San Diego. The site chosen for the erection of the obseratory and other necessary buildings was a plateau at elevation 5,568 near the summit of the mountain. This spot was considered as being most favorable because of the prevalence of clear nights throughout the year, a minimum of turbulence in the upper air, and it was a sufficient distance from interfering glow from lights of urban areas.

SAN DIEGO TAKES INITIATIVE

A condition of the selection of the Palomar Mountain location was that San Diego County provide a road to the observatory site. In turn, one of the first stipulations for construction of the road was that it be adequate for the transportation of material required for the several buildings, heavy machinery and the large mirror.

The San Diego County Road Department took the initiative in meeting the requirements for a suitable road to the observatory site. Provision of the desired road facilitates, however, was consummated by cooperation between the county, the State Division of Highways, and the Public Roads Administration of the Federal Government.

As the old road up the mountain was little more than a primitive trail the county found it necessary to make surveys along a new line over a distance of some 12 miles from its connection with State Highway 195 at Cuca Mesa about 5.3 miles easterly of the settlement of Rincon. Highway 195 is a lateral route in the State System which extends easterly from Oceanside to Morettis near Lake Henshaw.

CUCA GRADE PROJECT

On this State route, the Division of Highways in 1937 reconstructed the 2.8 miles of the Cuca Grade leading up to the mesa from the west, at a contract cost of $40,000. County forces then constructed about nine miles from the State highway across the mesa and up the mountain to Iron Springs Creek and the State, using $306,400 in Federal feeder road funds, completed in 1937 a contract for construction of the last 3.3 miles from Iron Springs Creek to the observatory site.

In addition to the construction of the road up Palomar Mountain and the reconstruction of the State highway approach from the west, the Public Roads Administration reconstructed with $186,000 of Federal land funds over five miles through the La Jolla Indian Reservation to the east and the Pala Indian Reservation west of Rincon. With funds from the same source the Division of Highways surfaced the 3.9 miles through the La Jolla Reservation under a $15,000 contract. The State also reconstructed with prison labor about eight miles of the State highway along the San Luis Rey River between the La Jolla Reservation and Morettis.

FEDERAL AID GIVEN

On the Valley Center Road county forces reconstructed bridges and the old Rincon Grade and oiled the surface between Escondido and Rincon. With $44,500 of Federal aid feeder and county road funds the Division of Highways supervised and let a contract for construction of a steel girder bridge across the San Luis Rey River on this county road about two miles south of Rincon.

During the periods of design of the telescope and its mechanism and of the road construction outlined above, the staff of Cal-Tech conferred with county and State highway engineers to assure that transportation of the large and heavy members of the telescope and observatory buildings could be accomplished without difficulty.

The weight of the moving parts of the telescope totaled 425 tons. For convenience in manufacture and assembly, this was of necessity divided into various pieces. Further division was necessary to meet the limitations of transportation facilities.

HEAVY MATERIAL TRANSPORTED

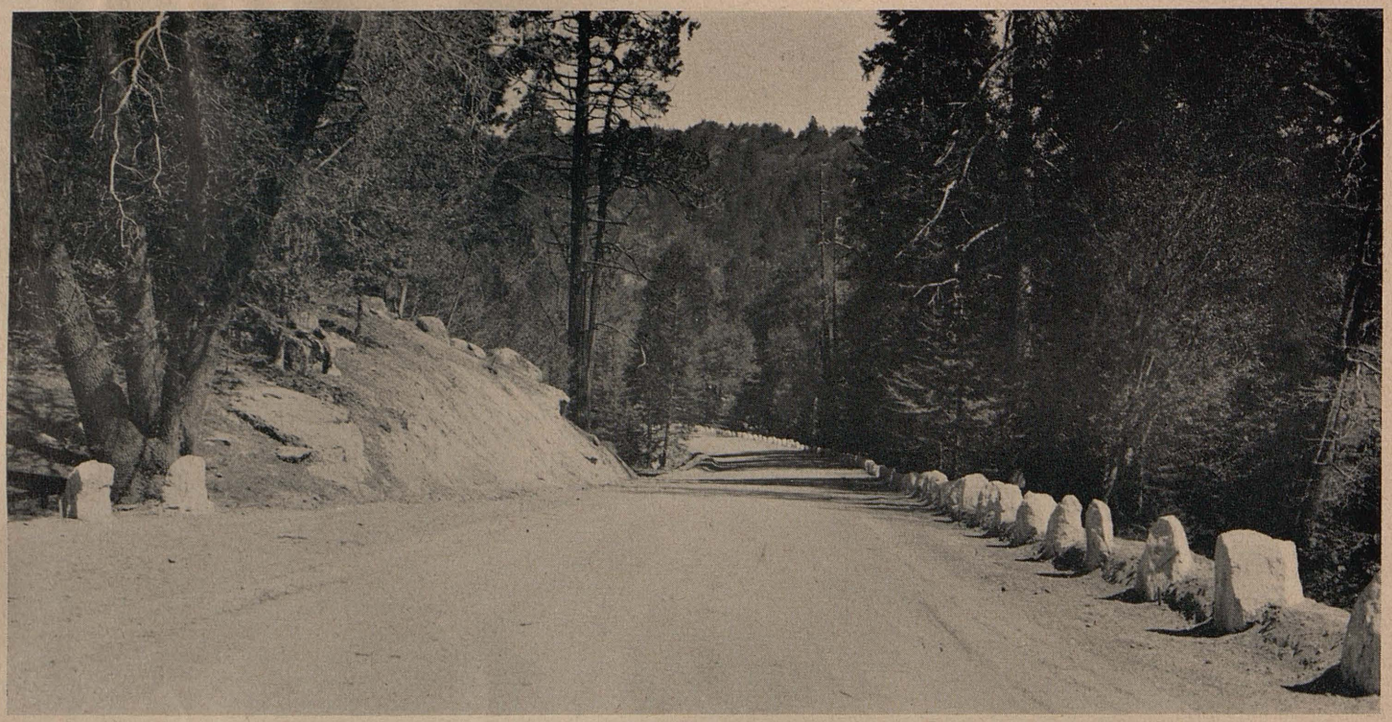
In 1937 material for the 135-foot diameter dome of the main observatory began to arrive by steamer in San Diego and was transported over the partially completed road to the site. In October, 1938, the metal parts of the telescope arrived at the port. The heaviest of these weighed 54 tons and in size the largest was 24 feet in diameter and 14 feet in height.

On a specially built four-axle low-bed trailer, with two large trucks pulling and a third pushing, the heaviest parts were carried over a carefully selected route to the road up the mountain. The route selected included eight bridges on State highways and two on county roads, all sufficiently modern in design and width to support the unusually heavy loads.

The 12 miles up the mountain naturally presented the steepest grades, but this section had no large bridges. It required about two days for transport of each load over the 75 miles from the ship's side to the observatory. At the time, it was estimated that these loads were the heaviest ever discharged at port of San Diego and the heaviest ever taken over highways in the vicinity.

HUGE MIRROR CONCEALED

The 200-inch mirror was cast in the east and delivered to Cal-Tech in Pasadena for the tedious and exacting job of grinding and polishing. Before this could be completed, however, the war was on and the Pacific Coast threatened with a very real possibility of attack. To prevent the possible loss of this, the world's largest astronomical mirror, it has been stored safely underground for the past four years



This is one of many attractive sections of Mt. Palomar Highway in San Diego County

and just recently has been taken out and the work of grinding and polishing is again in progress. When this is completed, transportation to the top of Palomar will be a relatively simple matter.

The 12 miles of county road from the State highway at Cuca Mesa to the observatory has very aptly been named "The Highway to the Stars." When the scientists of Cal-Tech begin their work of astronomical investigation, many motorists who are normally engrossed in such mundane interests as earning money for the rent may find relaxation and recreation in driving through the heavily timbered sections along this mountain highway up to the clear plateau of the observatory site where they may obtain a glimpse of far away celestial bodies on their courses through the infinite.

THE RIDGE ROUTE ALTERNATIVE

Probably nowhere in the State has the hand of the locating engineer been so ruthless in slashing through on modern alignment, as on the relocation of the Ridge Route, U. S. Highway 99, between Los Angeles and Bakersfield. Probably nowhere in the State is there a better example of the evolution of modern highways since the advent of the motor car.

Prior to 1933, the motorist traveling from Castaic northerly to the floor of the San Joaquin Valley labored and fretted through 48 miles of narrow, tortuous mountain grades culminating in the hairpin turn of the infamous "Deadman's Curve" in Grapevine Canyon. Today he travels only 38 miles between the same points, speedily and safely, unhindered by sharp curvature and unhampered by slow-climbing trucks.

The record of this development as shown by comparison of data on the old and the new routes indicates most clearly the great degree of improvement.

	Old Route	New Route
Length, miles	48.36	37.56
Width, lanes	2	3
Maximum grade, per cent	6	6
Minimum radius curve, feet	70	1,000
Total curvature, degrees	39,441	3,070
Curvature equivalent in circles	109½	8½
Highest elevation, feet	4,234	3,550
Adverse fall, feet	2,220	1,040

With such improvement possible, the questions naturally arise; Why wasn't the latter location chosen in the first place? Why wasn't the earlier road built to better standards? A trite answer might be: Why weren't 1914 cars built like those of today? But the reason is much more complex.

REASON FOR ORIGINAL ROUTE

Even as far back as 1914 when the original Ridge Route was constructed, the engineers knew that a better road could be built. The degree of perfection of any highway in such mountainous terrain, however, is dependent upon an economical balance between costs, money available, and justifiable expenditure.

Many factors require consideration, such as; relative distances, grades, traffic volumes, speeds and types of traffic. For traffic of that day, when there were less than 126,000 cars in the entire State and 35 miles per hour was "wide open," such an investment, as the present road would have entailed, was not justified. Indeed, it would have noticeably depleted money available for improvement elsewhere in the State, at a time when the main objective was to "get out of the mud." So the much more difficult location, later selected for the alternate, was avoided and the original route was built along the ridge to standards typical of mountain highways of that time, following the contours in order to save grading costs.

OLD HIGHWAY OUTMODED

The old highway served for many years. As traffic increased the sharpest curves were widened and day-

lighted, but by 1929 the volume had reached such proportions that further improvement of the old route would have been uneconomical. Reconnaissance surveys and economic studies revealed that a complete new three-lane highway would pay for itself in savings to motorists within 2½ years; finances, however, did not permit immediate construction of the entire project.

Work on the first unit was begun early in 1930. By late 1933 the 27-mile Ridge Route Alternate between Castaic and Gorman was open to traffic and by 1936 the last unit of the Grapevine relocation was completed.

Some of the new route's features are: eight major bridges, four across Piru Creek alone; several miles of channel changes; 5,000,000 cubic yards of excavation; and costs totaling more than 5½ million dollars—are answers why such a road could not have been considered in 1914.

HEAVY EXCAVATION

While the total of 5,000,000 cubic yards of excavation is an indication of the overall size of the grading contracts, a better idea of the enormity of some of the earth moving problems encountered may be had from the fact that, within a center line distance of only 400 feet in Piru Gorge, excavation required the removal of 230,000 cubic yards of material. Literally, that was moving a mountain.

Traffic increased prodigiously with the breaking of the old barrier, both in passenger cars and long-haul trucking. From 2,500 cars and trucks daily in 1933, the volume rose to 4,800 in 1936 and to almost 6,000 by 1941.

Most of the new road was fully adequate for this volume and more, but the Grapevine was not. Its nearly six miles of continuous 5½ per cent grade, with an abnormal uphill speed differential between fast traffic and heavy trucks (20 per cent of the total), and frequent runaway trucks made the Grapevine again one of the most hazardous sections of highway in the State.

WIDENED TO FOUR LANES

To remedy the condition, this section was widened in 1942 and 1943 to four lanes, divided for nearly four of its six miles by a heavy steel barrier rail, and with 3,000 feet of heavy concrete curb on the downhill shoulder to act as a snub for runaway trucks—

Striking view of U. S. 99 as it winds through Piru Gorge south of Gorman

this protection may be rough on tire sidewalls, but it is effective.

At the same time a badly saturated hillside, the scene of many slides which threatened to carry the roadway into Grapevine Canyon was corrected in an unusual manner. A buttress consisting of 180,000 cubic yards of fill was placed on the bottom of the canyon to act as a counterweight in balancing earth pressures exerted by the unstable hillside, and numerous perforated pipes were driven as much as 170 feet into the hill above the highway as drains for ground waters.

DEATH VALLEY

Of all natural attractions within the boundaries of California, the world famous Death Valley in southeastern Inyo County is undoubtedly the most unique. The first recorded story of this ominous wasteland of awesome beauty came from Lewis Manly, who early in 1850 led the remnants of the "Jayhawker" emigrant train over the west side escarpment formed by the towering Panamint Range. The survivors of that ill-fated party of Kansas paused on the summit of the range to look back on the land of their trial, suffering and death only long enough to bestow upon that desert sink the fitting name of "Death Valley."

By Presidential Proclamation in 1933 some 2,500 square miles of desert mountains and valley were set aside as the Death Valley National Monument. Included within the monument boundaries are the 400 square miles of Death Valley proper, a flat, dry, seabed hemmed in by the 6,000-foot Amargosa Range on the east and on

Upper—State Sign Route 90 in Death Valley, looking towards Furnace Creek. Lower—Bad Water, lowest point in United States, 276 feet below sea level. Salt deposits in foreground

the west by the precipitous Panamint Range, where elevations such as the 11,045 feet of Telescope Peak tower above their base as do no other peaks in the United States.

LOWEST POINT IN U. S.

Nearly the whole floor of the valley lies below sea level, with the 276 elevation at Bad Water marking the lowest point in the United States. The sea level contour encloses an area more than 70 miles along and from one to six miles wide.

The winter temperature in Death Valley is ideal. The summer climate is something else. Accurate meterological data in Death Valley has been accumulated only in recent years. A temperature of 134 degrees in the shade has been recorded at Furnace Creek Ranch, it should be noted, however, that, that was the limit of the thermometer. Geological Survey documents indicate that a temperature of 150 degrees has been observed around the stone beds at the mouths of several canyons and out on the salt beds it is estimated the temperature will go 10 degrees higher. The average annual temperature of 75 degrees indicate a most delightful climate, was it not that the range included in computing this average runs from 15 degrees to 134 degrees.

PROSPECTORS SEEK WEALTH

Following the '49 "Jayhawker" emigrants, prospectors were lured into the ranges surrounding the valley by stories of gold, silver, and lead deposits, the wealth of which would stagger the imagination. These fabled deposits are still missing and still sought. The prospecting, however, did lead to other mineral wealth, such as the discovery of borax, which resulted in the construction of wagon roads, railroad, and the gradual development of the area to its present status. In this connection, the "Twenty-Mule Team" trade mark probably has given Death Valley more widespread publicity than any other single factor.

Because of the highly mineralized nature of the valley, its formations are fantastic and colorful in the extreme, providing most interesting and entertaining scenes.

Prior to its incorporation into the Federal System of National Parks and Monuments, there were several so-called roads throughout the valley. These roads usually followed the bottoms of washes as the most convenient and were quite regularly obliterated by summer cloud bursts.

DESERT HIGHWAYS

At about the time the Death Valley National Monument was created, the 1933 Session of the California State Legislature added to the State Highway System some 6,600 miles of roads. Included in these additions were two highways serving as the main entrances to the valley. One of these extended along the east side of the valley from Baker in San Bernardino County through Death Valley Junction; the other, provided a westerly approach from Lone Pine through Darwin.

Improvement of the entrance via Baker and Death Valley Junction involved only typical desert construction, and aside from usual desert drainage problems presented no serious difficulties. The road in from Lone Pine was quite another matter.

From a connection with U. S. 395 about two miles south of Lone Pine, the old road traveled southeasterly through Keeler on the dry Owens Lake bed, to Darwin. This road had long served the mining properties in this section.

In 1926, H. N. Eichbaum, a pioneer resident of the Death Valley country, secured from Inyo County a franchise to build and operate a toll road from Darwin to Death Valley. He built his road along an old trail following down Darwin Wash, in the Argus Mountains, across Panamint Sink, over the Panamint Range by way of Towne's Pass and thence down to Stove Pipe Wells in Death Valley.

OLD TOLL ROAD

For the privilege of driving the 31 miles of this narrow dusty road, 20 miles of which was crooked and precipitous with grades of from 15 to 20 per cent, the traveler paid a toll of $2 per car and 50 cents per person.

As soon as the Legislature had incorporated in the State Highway System a westerly route into the valley, the Division of Highways began negotiations for acquiring the Eichbaum franchise, which, by way of interest, extended into perpetuity. On December 20, 1934, the deed vesting title in the State was filed and tolls abolished.

In the meantime, reconnaissance by State highway engineers developed a line connecting with the old route some distance north of Darwin and following northeasterly along the ridges, in lieu of washes, down the side of Rainbow Canyon to a connection with the old toll road at the floor of Panamint Sink where Darwin Canyon debauches into the sink. The routing, while it involved difficult rock construction, eliminated the tortuous descent of the Zinc Hill Grade in Darwin Wash. In former days the road down Zinc Hill was subject to annual obliteration by cloud bursts.

CURVES ELIMINATED

The distance on the old road from the point of connection north of Darwin to that at the foot of Zinc Hill Grade was 19.9 miles and included 245 curves. On the present highway the distance is 17.5 miles with only 72 curves. The total difference in curvature between the 245 and the 72 curves was more than 8,950 degrees or nearly 25 complete circles; the curves on the old road were also much sharper than those on the revised alignment, the minimum radius on the old route being only 30 feet while on the new the minimum radius is 200 feet.

Easterly from the mouth of Darwin Wash, improvement to the route was considerably less difficult. Across the Panamint Sink the going was straight and through Towne's Pass the old alignment was satisfactory. The remainder of this western entrance into the monument to its connection with the Park Road System lies across the flat valley floor and is an excellent highway.

Through regular improvement and maintenance on these two State highway entrances into Death Valley, motorists have been provided with the means of easy access to this awe-inspiring portion of California.

THE YUMA SAND HILLS

Crossing the southeasterly corner of Imperial Valley and lying to the west of the Yuma Indian Reservation is a ribbon of continually shifting sand dunes usually referred to as the Sand Hills, or to be a little more specific the Yuma Sand Hills. The northeasterly end of these Sand Hills is located near Niland and the southwesterly end is south of the border in Mexico.

Since the earliest days of occupation in Southern California, travel across the Imperial Desert has followed a trail through these Sand Hills. The route has always been popular as a link in the most southerly transcontinental route. At intervals throughout the year, strong winds from the northwest blow across the dunes resulting in a constant movement of the Sand Hills to the southeast.

One peculiarity of the Sand Hills country is that in the middle of the dunes is a small level "Open Valley" about one-half mile wide and 1¼ miles long which is free from sand drifts. This valley apparently has remained in the same place for many, many years, for as late as 1924 there were in place in the valley several old telegraph poles which were reportedly placed there in 1857 by General John C. Fremont as a part of a pole line across the desert.

PLANK ROAD LAID DOWN

Information is quite vague relative to any improvement of the Sand Hill's section of the desert road in the early days when San Diego County extended to the Arizona line or even after the formation of Imperial County in 1907.

In 1916 the California Highway Commission in building the State highway between Yuma and El Centro constructed about 6.5 miles across the ever-moving Sand Hills. From the old "county well" on the westerly edge of the hills a wooden plank road, eight feet wide, was laid on the shifting sands to the westerly end of Open Valley. Through the 1¼ miles of Open Valley a 10-foot roadway was oiled and from the easterly end of the valley to Ramanda at the east edge of the Sand Hills another three miles of plank road was laid on the sand.

This unusual eight-foot plank highway, with its passing turnouts spaced at convenient intervals, or inconvenient to the motorist who had to back-up, served desert travelers for many years. The chief maintenance operation along the plank road consisted of scraping the drifts to the lee side with a team and fresno.

MODERN DESERT ROAD BUILT

In 1924 a new and improved plank highway was laid on two 1,000-foot sections to replace splintered and weathered portions of the old road. The new design consisted of heavy redwood timbers separated by blocks and fastened together with long bolts. This type was considered better than the old flat plank sections held together along the edges with longitudinal boards and wire.

During the years which the two sections of plank highways were serving desert traffic, the State Highway Department was learning quite a bit about desert road construction. In 1926, in order to provide facilities through the Sand Hills which were comparable with other desert highways, 6.5 miles of asphalt concrete pavement were placed on a new grade line as replacement of the old plank road.

The method adopted consisted of constructing a 30-foot graded roadbed to a height which corresponded to the tops of surrounding dunes. The fill was constructed of the only material available: the blowsand of the dunes. While no unusually hard winds were experienced during the contract, the movement of the sand was so continual that it was necessary to take the cross-sections for determination of contract pay-quantities immediately behind the draglines placing the embankment. In fact, a review of this contract revealed three unusual items: "First Blow Off," "Blow On" and "Second Blow Off."

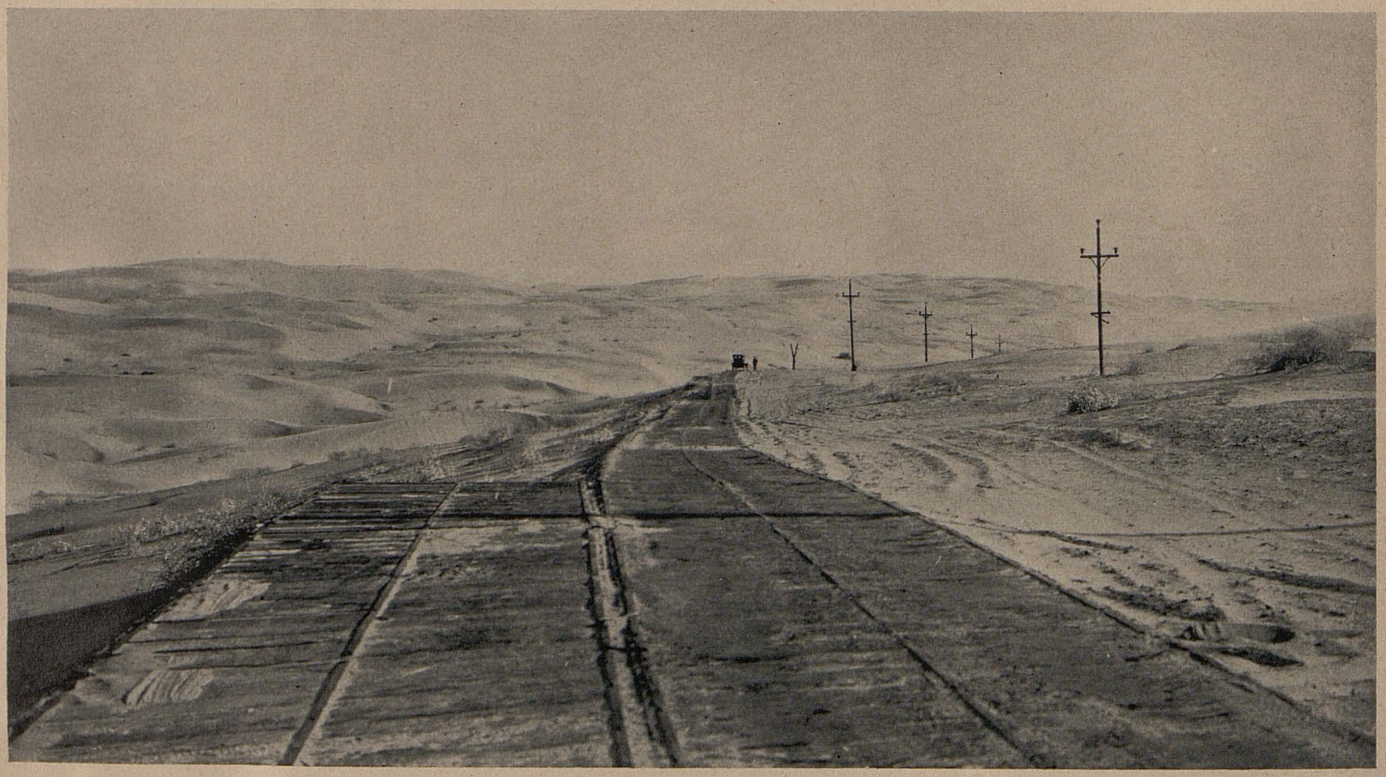
HARD ON ENGINEERS

"First Blow Off" was material which was placed in the allowable embankment, but which, because it was "Gone with the wind," had to be replaced once.

"Second Blow Off" was material in the allowable embankment which had to be replaced twice, and

"Blow On" was material which was blown onto the embankment after con-

This corduroy road carried vehicular traffic across the Yuma sand dunes west of Open Valley in Imperial County for many years following its construction in 1915-16. Note plank turn-out for traffic on left



And this is a view of a section of the modern highway which replaced the old plank road. Slopes in right foreground are constructed to prevent sand drifting over the traveled way

struction and which had to be removed by the contractor before the embankment slopes were oiled.

How the resident engineer and his assistants kept their quantity records for this "put and take" game with blowing sand and at the same time kept their sanity is difficult to imagine.

As rapidly as possible, subgrade was shaped behind the draglines, header boards lined up and the base course of the 20-foot asphalt concrete placed. This required laying planks on the subgrade for travel of the trucks carrying the hot asphalt concrete. As the planks were removed steel plates were laid to support the trucks while dumping.

No difficulty was encountered in laying the surface course, except that the continual deposit of drifting sand required a small crew with hand brooms steadily sweeping up the base immediately in front of placing the top course.

While these construction operations must have left the boys on the verge of nervous collapse, it was a good pavement and undoubtedly the most stable thing in the Sand Hills—it and General Fremont's telegraph poles.

To be Continued.

Maintenance Men Given Red Cross First Aid Course

THE first group of highway maintenance men to be awarded Red Cross first aid instructors' certificates under the new revised techniques finished training November 17th at Redding, California. This is a part of the California State Division of Highway's state-wide program to have all maintenance men ready to give proper first aid care in case of highway accidents.

A new Red Cross first aid textbook, based upon wartime advances in medical science was used in the 30-hour course which gave special emphasis to the type of accidents highway men are most likely to encounter.

Aiming to increase highway safety, the course was given by Red Cross first aid experts at Sacramento, November 26th, at Fresno, December 3d; and at Los Angeles, December 10th. The program was arranged through the cooperation of Ralph E. Carlson, Pacific Area Director of Red Cross First Aid, Water Safety and Accident Prevention; G. T. McCoy, State Highway Engineer; and T. H. Dennis, Maintenance Engineer, Division of Highways.

The men trained in these sessions will in turn train maintenance personnel in the 11 State highway districts. Men who received their instructors certificates at Redding were John A. Copitzky, Assistant Highway Mechanic Foreman of Redding; Laures H. Fretts, Assistant Highway Engineer of Redding; Tollie G. Hinton, Equipment Operator of Cummings; and Frank L. Meyer, assistant to District Maintenance Engineer of Eureka.

A middle aged woman stopped a man on the street and demanded:

"Why aren't you in the army?"

The man, well past the draft age, replied:

"For the same reason you aren't in the Follies."

Bridge Maintenance Practice On California Highway System

By R. A. WAGNER, Associate Bridge Engineer

THERE are 4,636 bridges on the California State Highway System omitting culverts. Of this number 3,142 are built of steel and concrete, 1,394 of timber or steel with timber approaches and 100 are steel bridges with timber deck systems. The estimated value of these bridges exclusive of State-owned toll bridges is $125,000,000.

The protection of this investment and the maintenance of the bridges in such condition that they will best serve the traveling public is a duty of the Bridge Department of the Division of Highways. Within the Bridge Department, maintenance work is handled directly by the Maintenance and Research Section. Methods of repair and maintenance as developed and field tested by this section over a number of years have included several practices that are worthy of note and should be of interest to the engineers and construction men engaged in this work throughout the Country.

There will be no attempt made to enumerate all maintenance problems encountered, but the more important features of the work, with illustrations, will be covered in a series of articles, of which this is the seventh. It deals with Maintenance Problems on Timber Trusses.

THERE are 57 timber truss bridges and nine combination timber and steel truss bridges on the State Highway System, most of which were built many years ago while under County jurisdiction. Maintenance of these county-built structures was assumed by the State when the Highway System was expanded in 1933. Their upkeep and repair has raised many formidable and perplexing problems under present day heavy duty traffic. Many of these bridges were constructed, with untreated timber, at a time when loads were far lighter than they are at the present and, in addition, they are now nearing the end of their service lives.

These untreated timber structures, even when properly maintained, show considerable deterioration with time. Analyses to determine actual stresses under heavy vehicle traffic disclose certain typical and common points of weakness. These weaknesses are generally corrected by strengthening or repairs, but if this work is found to be too extensive or impractical, the bridge is posted for a restricted loading under provisions set up in the Vehicle Code.

Another item of extensive maintenance on timber truss bridges is the repair made necessary by damage resulting from collisions. Such damage may result from collision between two passing vehicles, one or both vehicles being thrown into vital truss members, or more commonly, it results from over-hanging portions of load or body. Damage quite frequently results from excessive height as well as excessive width of load or vehicle.

The conditions described in the previous paragraph give rise to a natural segregation of the maintenance problems on timber truss bridges into three general classes, as follows:

Class 1: Normal maintenance work due to replacement of members resulting from decay or action of wood-destroying insects.

Class 2: Strengthening of any members of the truss bridge in order to increase the live load capacity of the structure. This is done when the needs of traffic are sufficient to warrant strengthening rather than restricting the loading by posting.

Class 3: Replacement of, or repairs to, members damaged due to accidental collision by vehicles.

EXAMPLES OF CLASS 1— NORMAL MAINTENANCE

The principal cause of deterioration to timber truss members is the development of core rot. When untreated timber is used in the construction of bridge trusses, it will usually check, due to progressive seasoning. These checks often occur in the top surfaces of the members and when water enters such checks it can not readily drain out. This develops a condition which is ideal for growth of decay fungus and results in core rot in the bridge timbers. The same conditions also occur due to seepage of water through the joints generally found in composite timber members. Typical of such members is the lower chord of a timber truss which is built up of two or more timbers having staggered splices.

Usually there are no outward manifestations of core rot in a timber truss member and exploratory borings with a hand auger or an electric drill are necessary to discover and locate the extent of such decay. The Bridge Department has special equipment with which to make such borings. This equipment consists of a low speed electric drill, powered by a gasoline engine driven electric generator unit mounted in a station wagon. A sufficient length of extension cord is supplied in order to permit access with the drill to all points on a bridge. Also supplied are a ladder, ropes, and other small tools necessary for this type of investigation work.

CORE ROT TREATMENT

Exploratory holes, using a $\frac{3}{8}$-inch diameter drill, are bored into the timber truss members at vulnerable locations as determined by the judgment of the field engineer, these holes later being plugged by $\frac{3}{8}$-inch wooden dowels which have been dipped in asphalt mastic.

Core rot is located by a lessening of the resistance of the wood to the action of the drill as well as by examination of the drillings. When such rot is only minor in extent, repairs are not necessary, but the structure is then scheduled for a re-examination at an earlier date than would normally be set. If the core rot in a member has progressed to a point where the remaining cross-sectional area of sound wood is insufficient to safely sustain the total loads, then this member is replaced.

Timber bottom chords of truss bridges are more susceptible to decay than are top chords because they are usually not as well ventilated as are top chords and, in addition to collecting water in the joints, they also collect

along their tops dirt and debris which is thrown from the roadway by traffic. This debris retains the moisture and it is this moisture retention which is the big factor in hastening decay.

DECAYED TIMBER TRUSSES

In replacing decayed timber truss members, the usual underpinning procedure is used, a sufficient amount of camber being jacked into the truss to relieve the stress and free the member. The new timber is cut to exact length, erected and bolted into place, and the underpinning then removed.

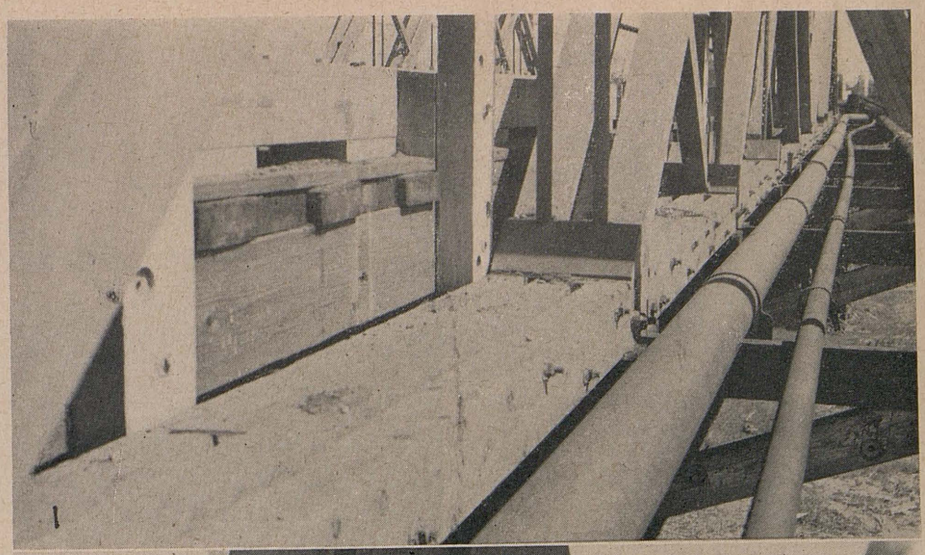
The bridge across Rio Hondo on Anaheim-Telegraph Road, State Route 166, in Los Angeles County, consists of eight 60-foot pony Howe truss spans and decay in the bottom chords of the trusses had become so general that it was necessary to underpin the bridge in order to keep it in a condition safe for traffic. **Photograph 1** shows the old lower chord, while **Photograph 1a** illustrates the damage resulting from decay which developed at the timber contact surfaces, a condition which has been pointed out in a previous article.

The spacer blocks, placed between the three lower chord members at the mid-point of the panels, set up conditions favoring decay with the result that the three chord members were almost completely destroyed at this point. Similar conditions also developed at the panel points. The partially decayed timber lower chords were replaced with new all welded, structural steel lower chords. **Photograph 1b** shows the chords after alterations were completed.

TRUSSES UNDERPINNED

After the trusses were underpinned, the new steel lower chords were placed under traffic by restricting vehicles to one-half roadway width. A heavy timber traveler frame with projecting cantilever beams was used in the remaining traffic lane to support the truss and web members during the time the lower chord was being removed and replaced. In order to relieve the stresses in the members, a truss was jacked into camber, the top chord was then tied to the timber cantilever beams of the traveler and the web members and joint castings were then removed along with the partially decayed timber lower chords.

New structural steel lower chords which had been shop fabricated for half length of the span were then placed, but the shear plates which held the castings were not placed until after the entire lower chord was erected and spliced. These plates were welded across the top of both channels to receive existing truss joint castings, while spreader plates were welded to the top and bottom of channels at mid-panel, in order to retain their spacing.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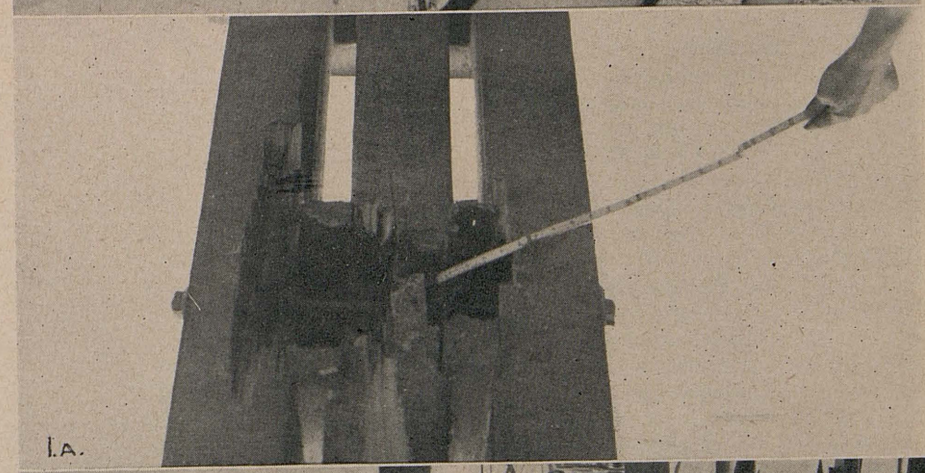
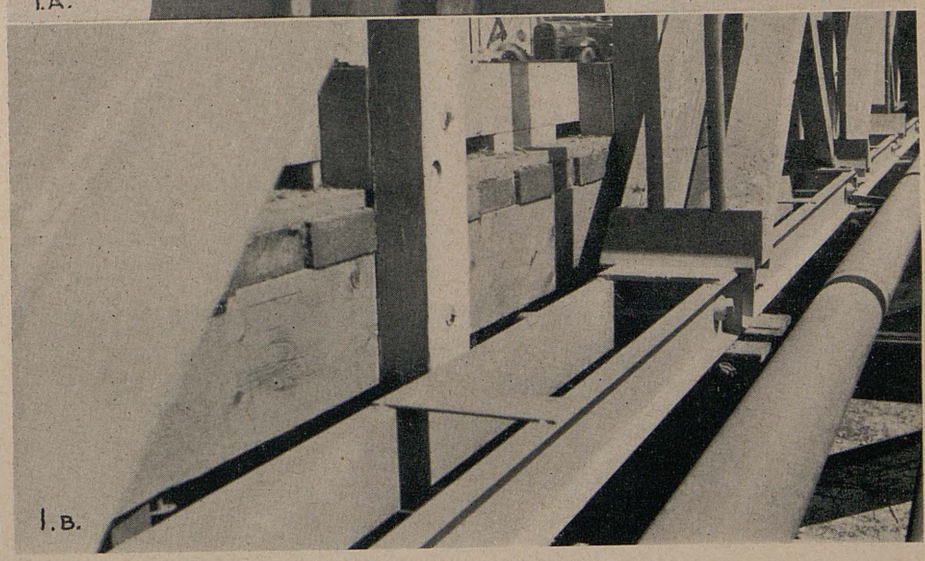

1.A.


1.B.

The new bottom chords were spliced at mid-span, using all welded construction with two splice plates per channel.

VICENTE CREEK BRIDGE

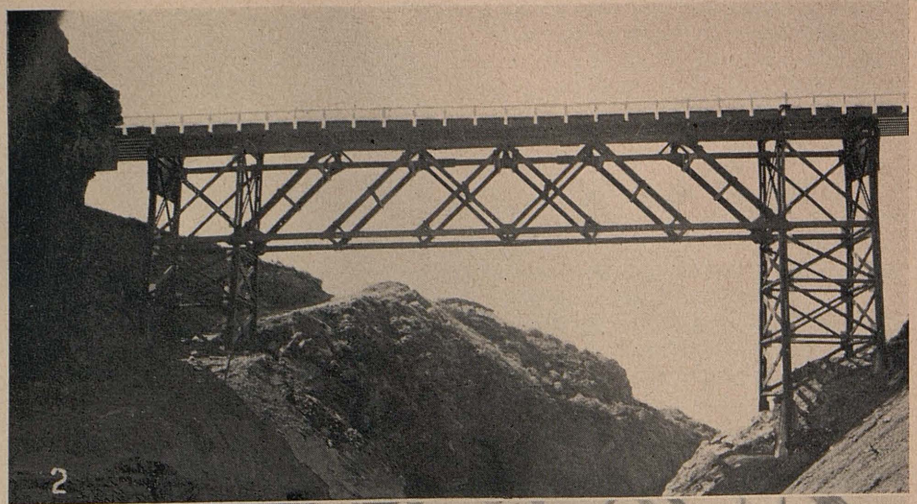
Upon completion of this operation, the shear plates were welded into posi-

tion necessary to give proper camber to the truss; the lower chord castings were reset and the truss reassembled and tightened. The traveler was then skidded along the deck and the remaining trusses were completed by similar operations.

The bridge across Vicente Creek on the Monterey Coast Road, State Route 56, developed core rot in the lower chord splices, causing partial failure at some of these locations. This bridge is composed of a 126-foot timber deck truss with several timber trestle approach spans. As a result of the partial failure noted above, the joints opened up as much as $\frac{3}{8}$ inch to $\frac{1}{2}$ inch, the truss developed a bad sag and the bridge was immediately closed to traffic.

The lower chord of this bridge is about 132 feet above the stream bed and complete underpinning of the span at all panel points was not considered practicable due to high cost of falsework. The canyon has relatively steep sides and the channel under the truss supports is about 42 feet higher than it is at the flow line of the creek. **Photograph 2,** Vicente Creek, as originally built, and **Photograph 2a** show how reinforced concrete footings were constructed on the channel side of each truss tower to support inclined bents.

These bents support the second and third panel points from each end of the truss and, being removed from the channel area, they offer no objectionable restriction to the waterway opening under the bridge. The two central panels of the truss, with minor alterations, continue to act as a span for the central portion.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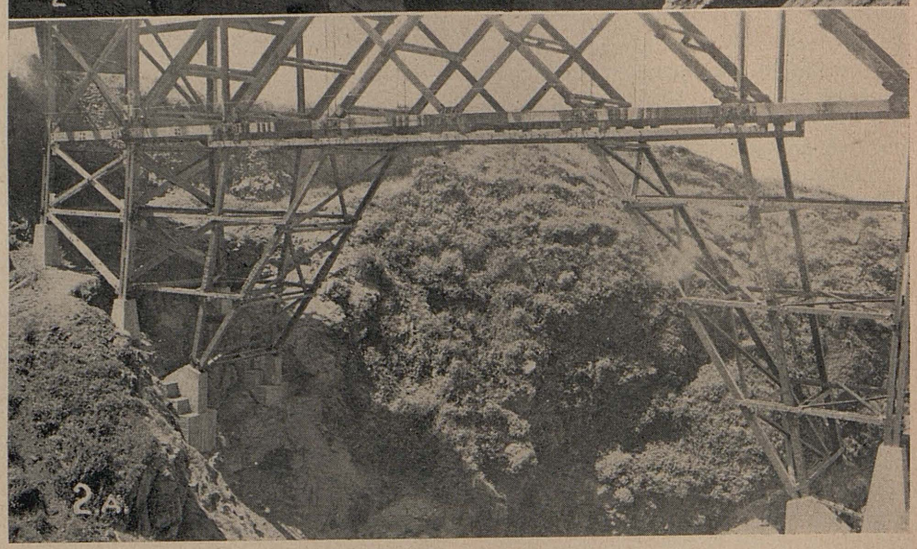
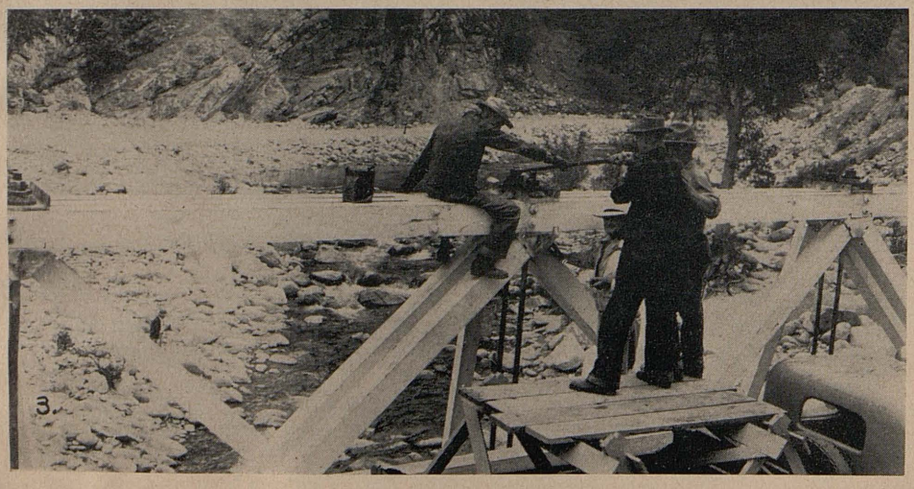

2A.

TRUSS TIGHTENING

Tightening timber Howe trusses is a normal maintenance item which is necessary in order to maintain sufficient camber in the spans and to insure proper truss action of all the members. This tightening work is particularly necessary during the early life of a timber truss bridge since it is during this time that most of the shrinkage occurs, and shrinkage is a direct cause of much of this type of trouble. Tightening continues to be necessary at periodic intervals because of progressive shrinkage and compression occurring in the wood. **Photograph 3** shows a State Maintenance crew in the process of tightening one of the Howe trusses in the bridge across the West Fork of the San Gabriel River on State Route 62 in San Gabriel Canyon.


3.

EXAMPLES OF CLASS 2—STRENGTHENING

Strengthening of old and weak timber truss bridges is made necessary in order to improve their live load capacities and to bring the general design features into better balance. Completion of tress analysis locates the weaknesses in such structures and if the needs of traffic are such as to make it inadvisable to post the bridge for a restricted loading, then strengthening is considered.

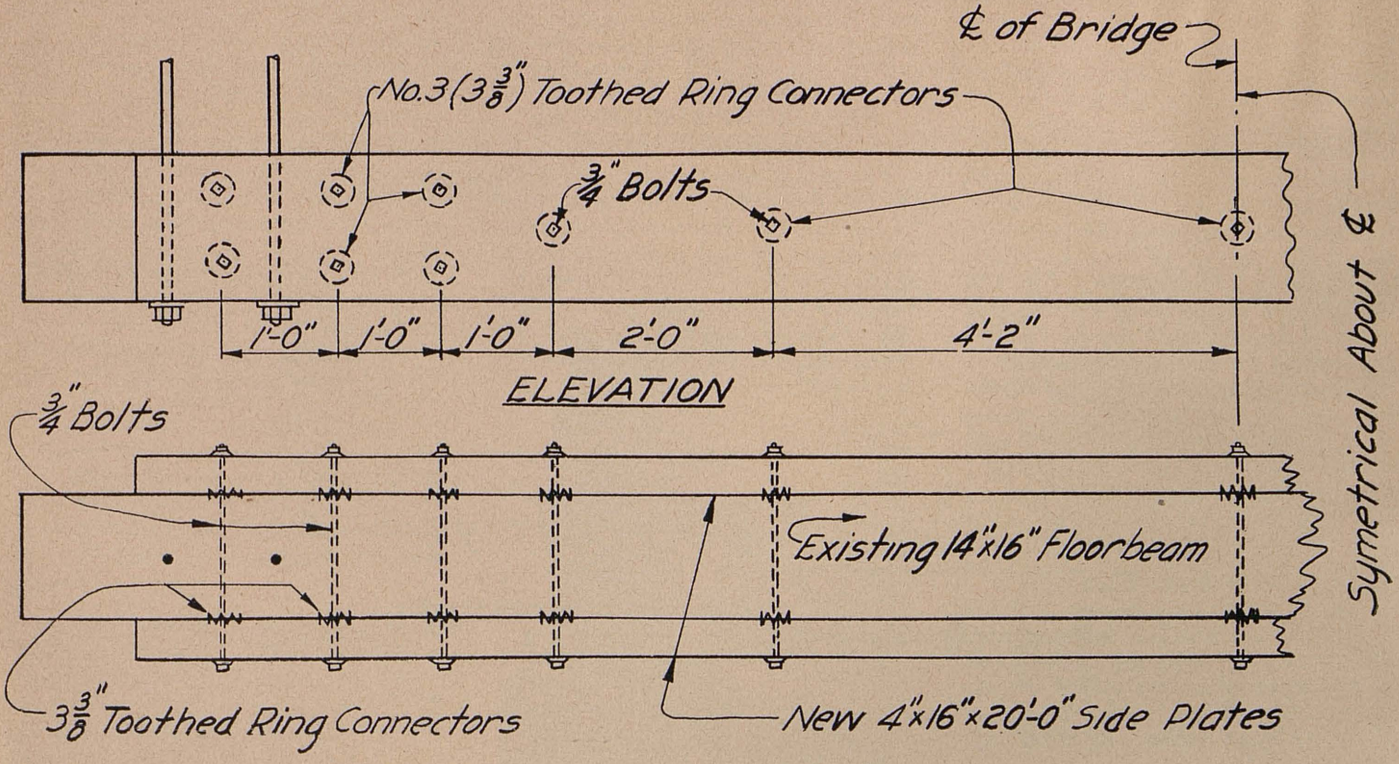


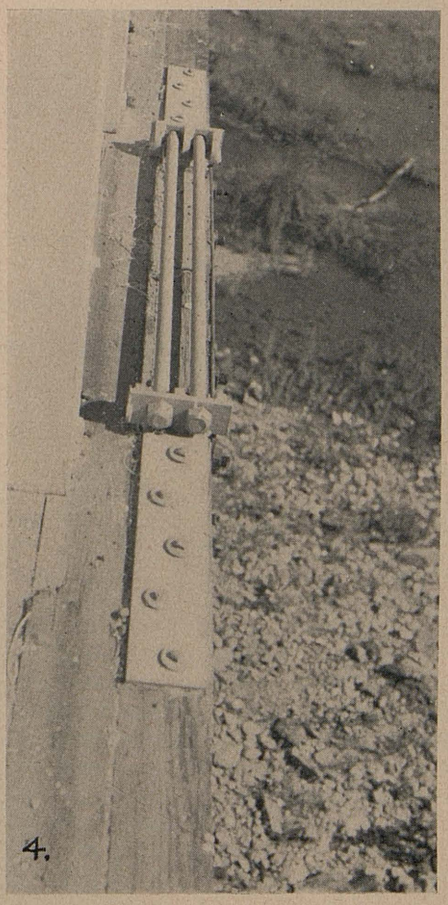
PLATE I

Floorbeams on old timber truss bridges are frequently found to be weak when analyzed under the heavy axle concentrations of present day loads. **Plate I** shows a method used in strengthening such floorbeams on the bridge across Big River on the Mendocino Coast Highway, State Route 56. As noted in this strengthening scheme, timber side plates were bolted to the existing floorbeams and toothed ring connectors were used to develop the shear between the side plates and the existing floorbeam.

RUSSIAN RIVER BRIDGE

The bridge across the Russian River on State Route 70, east of Ukiah, partially failed in the lower chord splices of the 125-foot truss spans. These lower chords are made of three 6-inch-by-12-inch timbers with splices staggered so that only one of the three timbers is joined at any one point. The original splices, which were of the tabled joint type with steel side plates, slipped due to partial failure of the connection. This put the spliced timber out of action and overstressed the other two timbers of the chord member.

In making repairs, it was necessary to provide a detail which would be adjustable and, when tightened, would take one-third of the total stress in the bottom chord of the particular panel in which it was introduced, thus equalizing the stress in the three timbers comprising the lower chord member. This was accomplished by using steel splice plates in conjunction with Teco claw plates and the necessary bolts, angles and adjustable rod features shown in **Plate II.** After the complete detail was assembled, the four rods were tightened sufficiently to cause the stick to take its due portion of the total load in the chord. The advantage of this method of doing the work is that it can be done under traffic without underpinning of the truss. **Photograph 4** shows the splice after completion of such a repair.


4.

DULZURA CREEK BRIDGE

The bridge across Dulzura Creek on State Route 200, between San Diego and Campo consists of two 54-foot pony Howe truss spans. Stress analysis showed the safe load capacity of the bridge to be 14 tons per vehicle, 16 tons per 2-axle truck and 1-axle trailer, and 19 tons per other semi-trailer unit, as governed by the hip verticals (U1-L1). These members consisted of two 1¾-inch round rods, not upset, but by replacing them with

rods of larger size and by doing some other minor repair work, the above-mentioned load restriction could be removed. This was done and a bridge having full legal load capacity was provided at relatively small cost.

Some time after the above repair had been completed, it was found necessary to completely underpin the trusses of this bridge because of weakness which developed due to progressive decay in the timbers. This underpinning will support the structure for its remaining service life or until about 1946 or 1947, at which time it is tentatively planned to replace it with a new one on revised local alignment. This method of converting a truss into a trestle and thus carrying a structure along for a few years is a cheap and effective one. It may be used in special cases where the profile and other stream characteristics will permit placing and holding supplemental bents and where the deck and other necessary supporting members are still in such fair shape as to permit their continued use under such circumstances.

EXAMPLES OF CLASS 3—REPAIRS OF ACCIDENTAL COLLISION DAMAGE

The bridge across the West Fork of the San Gabriel River on State Route 62, in the San Gabriel Canyon consists of two 60-foot pony Howe truss spans. In July, 1940, a passenger vehicle struck the south end post of the upstream truss of the southerly span, breaking the endpost and causing this truss to fail.

This type of accident and resulting failure are typical and occur quite frequently in structures of this type. When the truss dropped to the stream bed, the timber lower chord broke at the north end panel, was damaged at the south end panel, a floorbeam was also damaged and a casting cracked. The downstream truss of this span was warped and twisted due to failure and movement of the upstream truss, but no members of the downstream truss were broken. By jacking and supporting on timber cribbing and falsework, the failed truss was raised to proper position, the broken endpost and the damaged casting and floorbeam timber were replaced in kind and the broken lower chord was cut off at the center of both end panels and spliced. **Photograph 5** shows the splice at the north end panel.

The existing lower chords were made up of three pieces of timber. The splice consisted of a total of six scabs, each seven feet in length, one at the top and bottom of each of the three timbers of the chord. A total of forty-eight 4-inch toothed ring connectors between the splice scabs and the parent chord were used with a total of twenty-four $\frac{3}{4}$-inch bolts in order to develop the splice.

(Continued on page 33)

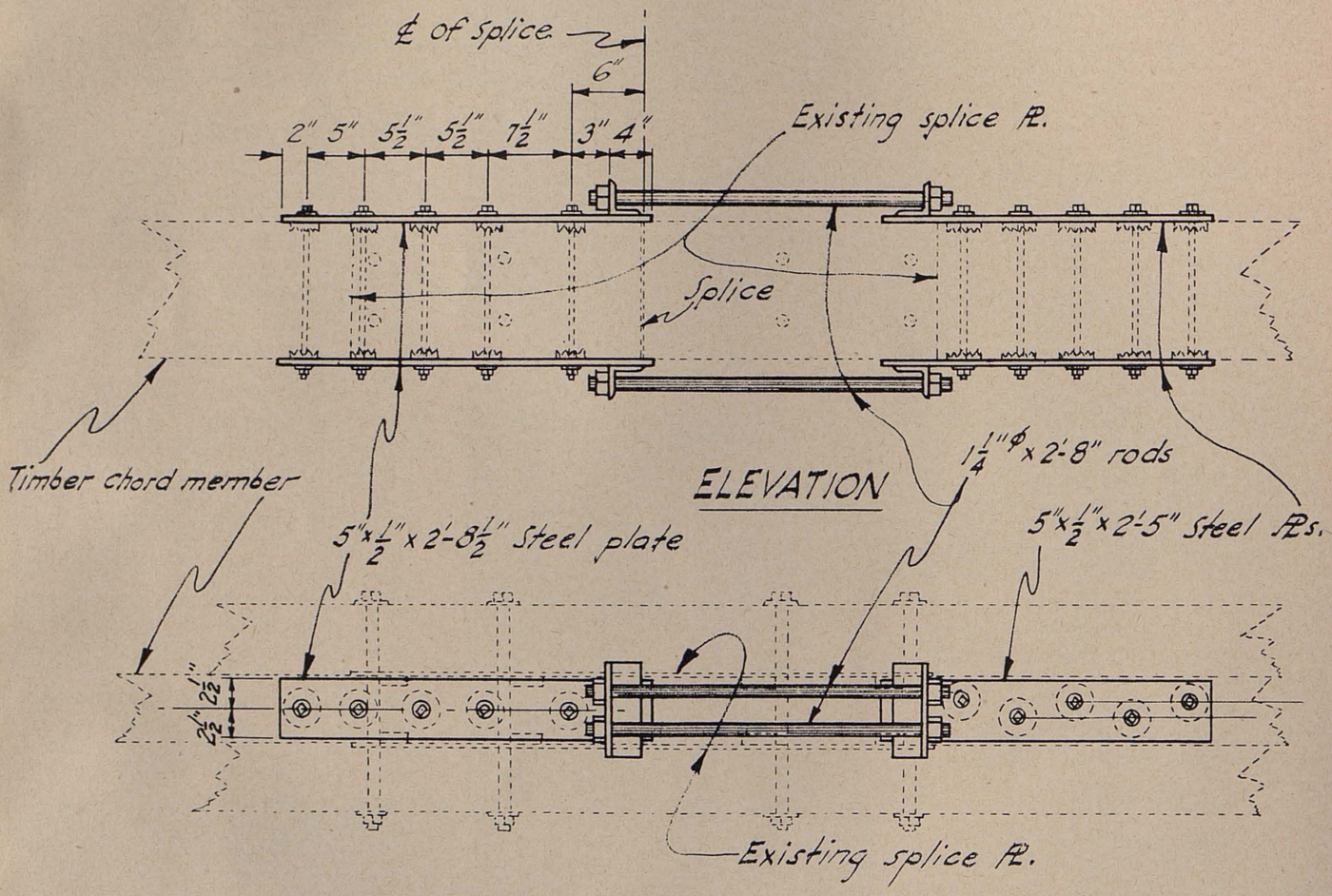


PLATE II

California Enters New Highway Era

By HARRISON R. BAKER, State Highway Commissioner

DUE to the foresight of Governor Earl Warren and the Legislature in making available to the Division of Highways an appropriation of $12,000,000 for acquisition of rights of way and the preparation of plans and surveys for postwar State highway projects, the California Highway Commission, with the war's end, was in a position on September 24th, last, to launch its $115,000,000 postwar road building program.

On that date, the commission allocated approximately $48,000,000 for engineering, construction and rights of way to designated highway projects on which bids shall be called for prior to July 1, 1946.

As of November 30th, projects aggregating $14,000,000 have been authorized to be advertised for bids.

During the war, the commission and the Division of Highways strove to keep the State Highway System functioning as efficiently as possible as a vital link in our war effort.

With the coming of peace, it is the duty of these two agencies to carry out a definite postwar highway construction program in order to correct damage caused by excessive wear and tear occasioned by abnormal wartime traffic loads; to provide a large scale public works program against the time when the postwar labor readjustment problem becomes acute, and to raise the standards of the California Highway System to a point commensurate with the needs of the greatly increased population of the State and the increasingly complex demands of growing traffic requirements—with particular attention to the necessary solution of traffic problems in congested metropolitan areas.

The Division of Highways has estimated that it will require $695,000,000 over a 10-year period to correct critical deficiencies in the State Highway System and to build the nucleus of a needed freeway system in our metropolitan districts. Anticipated revenues for this 10-year period are only about $240,000,000, wherefore some additional highway financing must be provided to defray the cost of this necessary highway construction.

HARRISON R. BAKER

It is estimated freeways needed to solve metropolitan traffic problems will require an expenditure of $285,000,000.

In the past, California has been generous with highway funds and will continue to be. Since the first State Highway Bond Issue in 1909, when the people voted $18,000,000, to June 30, 1945, a total of $829,369,837 has been spent on our highways. Every California citizen is a stockholder in this great enterprise.

From early pioneer days, when the Forty-niners crossed the Sierras, the Mormons trekked across mountain trails and the Mojave Desert to settle in San Bernardino and the Jayhawkers fought starvation and thirst in Death Valley, the development of California has gone hand in hand with the development of our highway system.

California has grown up in the motor age. Our economy, predominately agricultural before the war and transformed in four years by industrial progress equivalent to 50 years of normal growth, is dependent upon the proper functioning of our highway facilities.

California is the first State in the Union in the number of motor vehicle registrations and now ranks third in population, yet is forty-fifth among the 48 States in the average annual cost to the motorist of license fees and fuel taxes per motor vehicle.

In California, with a 3-cent gasoline tax, the average annual cost to the motorist is $25; in New York with a 4-cent gas tax it is $40 and in Florida with a 7-cent gas tax it is $65.

Highway transport in California is entering upon a new era, calling not merely for improvement but for a revolutionary forward step in transportation.

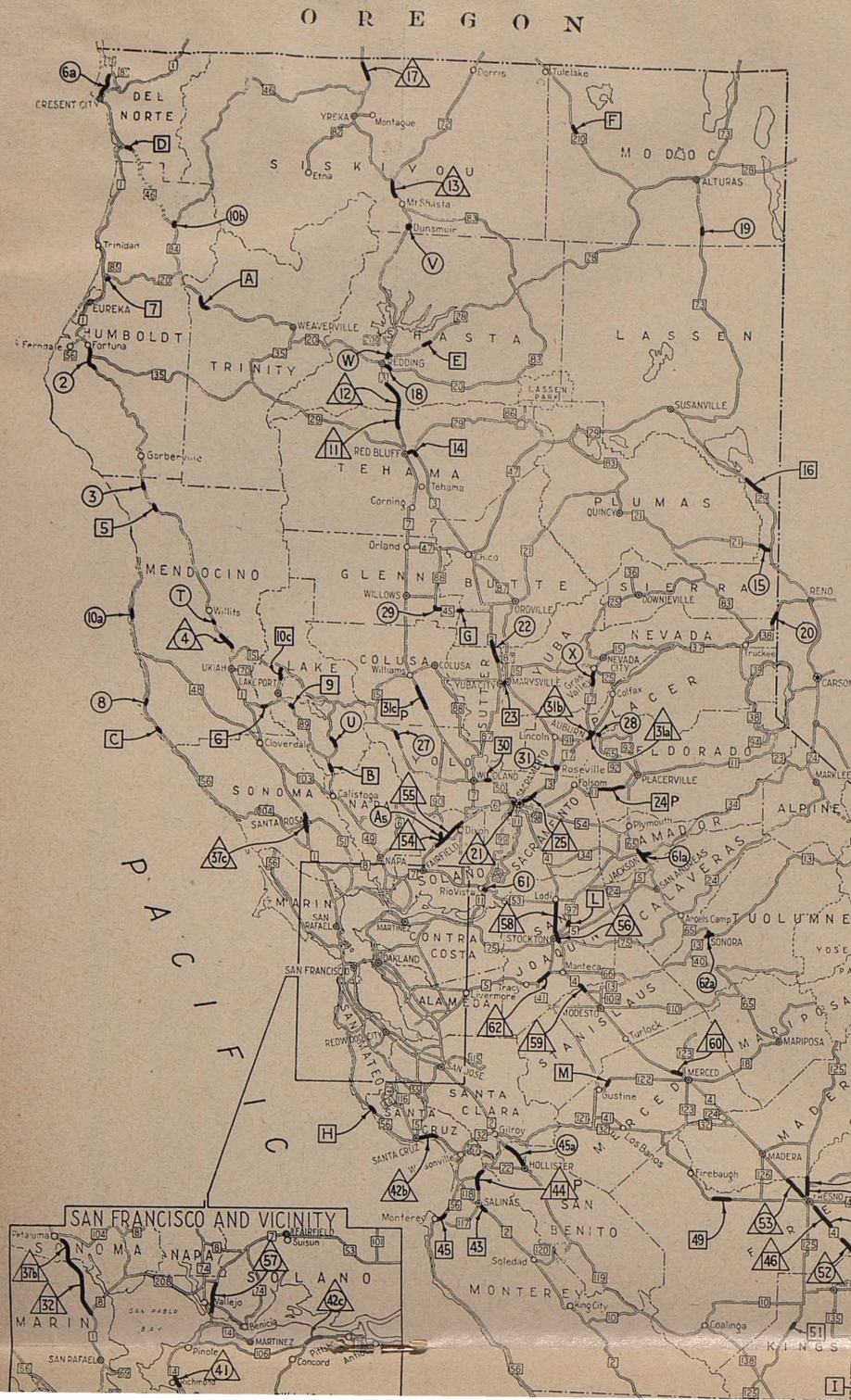
Future highway distances will be measured in time—in minutes, not miles.

Freeways are a new factor in motor transportation. Their growth will have an important influence on the lives of all of us who reside in or have business or social relationships with our metropolitan cities.

That our present State Highway System is outmoded due to financial inability to keep it abreast with the development of the motor vehicle and the demands of modern fast traffic and population increases must be admitted.

California faces a new and a bright future. To assure its full attainment we must make steady progress with our highways. We must keep the gains we have made and build upon this foundation.

Remember the Chinese proverb: "It Is Later Than You Think."



STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS

MAP OF

CALIFORNIA

POST WAR PROJECTS

Statute Miles
0 5 10 20 30 40 50

~ LEGEND ~

22 — PROJECTS PROPOSED FOR ADVERTISING PRIOR TO JULY 1, 1946

27 — PROJECTS PROPOSED FOR ADVERTISING SUBSEQUENT TO JULY 1, 1946

△△ — PROJECTS ON ESTABLISHED FREEWAY

P — DENOTES ONLY A PORTION TO BE ADVERTISED PRIOR TO JULY 1, 1946

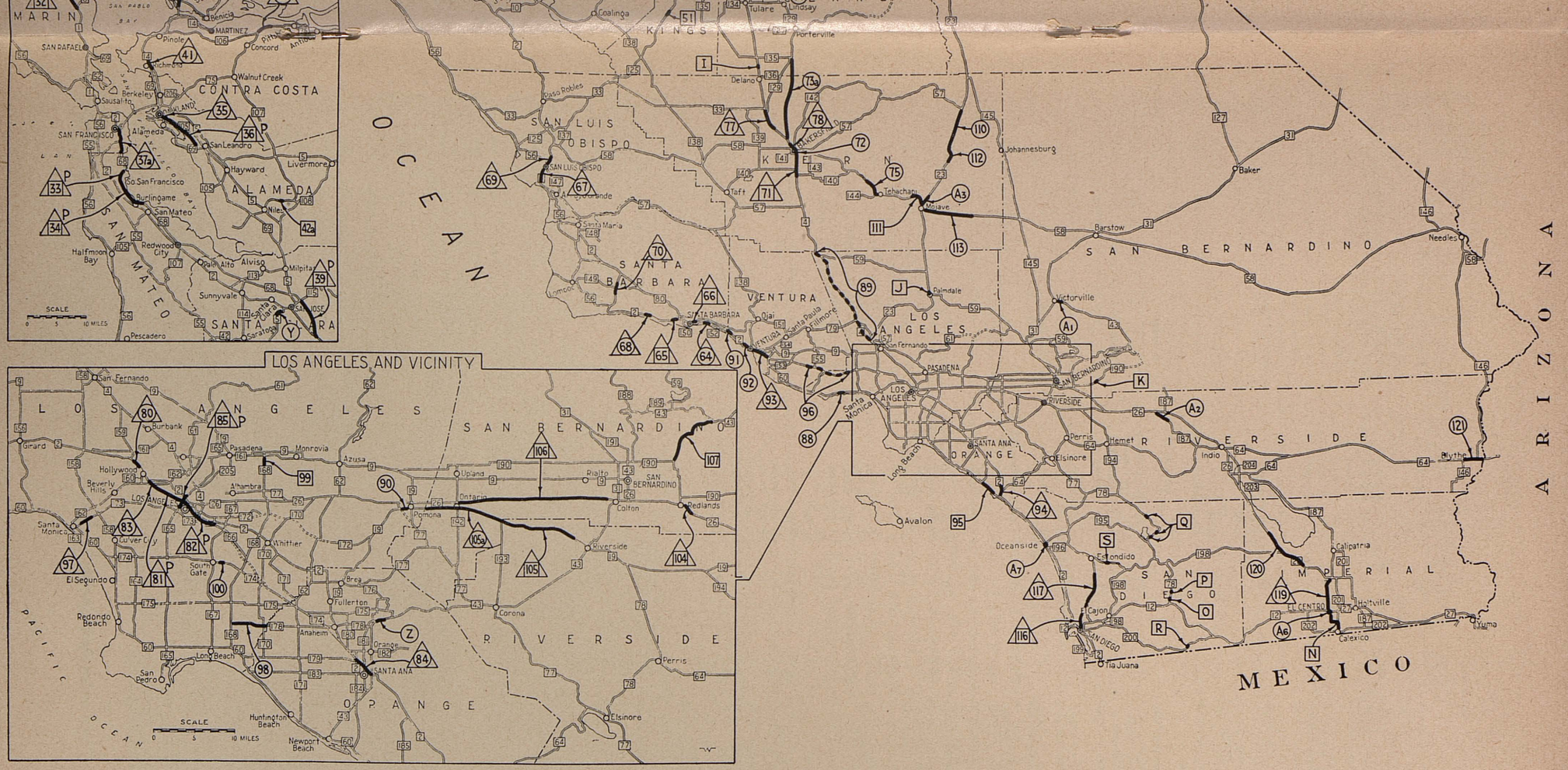
NUMBERS IN SMALL SQUARES ARE STATE ROUTE NUMBERS

October 22, 1945

Following is the key to the map of California Postwar Project. Route numbers in boldface are Legislative State Routes, all others are State Sign Routes or U. S. Routes.

POSTWAR CONSTRUCTION PROGRAM

Project	Rt. No.	County	Description	Approximate Length, Miles
2	US 101	Humboldt	North Scotia Br. to 16th St. in Fortuna; NW. P.R.R. Overhead, Strong Creek Br.; Van Duzen Overflow Br.	8.0
3	US 101	Humboldt	Red Mountain Creek to Piercy (Portions); Sidehill Viaduct	4.6
4	US 101	Humboldt	1.5 Mi. S. of Forsythe Creek Br. to Ridgewood Summit, Forsythe Creek Br.	10.2
5	US 101	Humboldt	Rock Creek Br. and Approaches	0.6
6	SR 16	Mendocino	Dooley Creek Br. and Approaches	0.1
6a	US 101	Humboldt	Route 1 to Smith River	5.6
7	US 299	Humboldt	Mad River Br. and Approaches	0.2
8	29	Mendocino	Alder Creek Br. and Approaches	0.2
9	1	Lake	Kelsey Creek Br. and Approaches	0.6



No.	Route	County	Description	Approximate length, miles
10(a)	1	Mendocino	Mitchell and Hare Creeks, Bridges, and Approaches	2.5
10(b)	96	Humboldt	Klamath River at Weitchpec, Bridge and Approaches	0.6
10(c)	29	Lake	1.2 Mi. North of Rodman Narrows Road to Route 15; Scott and Robinson Creeks, Bridges	2.0
A	US 299	Trinity	New River Bluffs to Cedar Flat	------
B	29	Lake	At St. Helena Creek	0.7
C	1	Mendocino	At Slick Rock Creek	0.9
D	SR 216	Del Norte	At Turwar Creek	0.7
T	US 101	Mendocino	NW.P.R.R. to Underpass	------
U	29	Lake	1.3 to 5.9 Mi. NE. Putah Creek	------
11	US 99	Tehama	6 miles north of Red Bluff to North County Line	7.1
12	US 99	Shasta	South county boundary to Clear Creek; Anderson and Spring Creek Bridges	10.7
13	US 99	Siskiyou	Spring Hill to Weed; S.P.R.R. Overhead	8.0
14	US 99E	Tehama	Cone Lane to Red Bluff; Samson and Sand Slough, Paynes Creek and Salt Creek Overflow Bridges	2.8
17	US 99	Siskiyou	Camp Lowe to Bailey Hill; S.P.R.R. Underpass	7,8

No.	Route	County	Description	Approximate length, miles
15	24	Lassen	West County boundary to Route 29; W.P. R.R. Overhead	4.2
16	US 395	Lassen	Bird Flat to Doyle	7.5
18	44	Shasta	Sacramento River Bridge and approaches and A.C.I.D. Canal Bridge	1.3
19	US 395	Modesto	South Fork of Pit River Bridge	0.1
E	US 299	Shasta	At Seamans Gulch	------
F	139	Modoc	Cornell to Stronghold—Culverts	------
V	US 99	Siskiyou	North approach to Dunsmuir	------
W	US99-299	Shasta	Sulphur Creek to Boulder Creek, Underpass Jct. Rts 3 and 28	------
20	US 40	Nevada, Sierra	½ Mile North of Farad to ¾ Mile South of Nevada State Line	3.0
21	US 40 US 99W	Yolo	Washington Underpass and Approaches	0.5
22	US 99E	Sutter, Butte	Lomo to 0.4 Mile South of Fagan	8.0
23	US 99E	Yuba, Sutter	Feather River Bridge and Approaches	2.5
24	US 50 US 99E	Placer	2½ Miles East of Clarkesville to 1¼ Miles West of El Dorado	8.2
25	US 40	Sacramento	North Sacramento Viaduct to ½ Mile East of Ben Ali	4.1
31	US 99E	Placer	Roseville Underpass and Approaches	0,7

No.	Route	County	Description	Approximate length, miles
31(a)	US 40	Placer	0.1 Mile West of Nevada Street in Auburn to 1.0 Mile East of Auburn; East St. Undercrossing, S.P.R.R. Grade Separation, and Walsh St. Separation	2.6
31(b)	49	Placer	Junction New Route 37 in Auburn to U.S. General Hospital; S.P.R.R. Grade Separation	3.5
31(c)	US 99W	Colusa	Arbuckle to 4 mi. South of Williams; Salt Creek, Sand Creek, N. Branch Sand Creek, Rosina Draw and Cortina Creek Bridges	6.4
27	16	Yolo	0.4 Mile North of Rumsey to 0.8 Mile South of Rumsey	1.2
30	16, 24	Yolo	Tule Canal Bridge and Approaches	1.3
28	49	Placer-El Dorado	North Fork American River Bridge and Approaches	0.2
29	SR	Glenn	¼ Mile West of Sacramento River to Butte City; Sacramento River Bridge	0.6
G	SR	Glenn, Butte	At Big Butte Creek	------
X	49	Nevada	1.5 Mi. N. Rattlesnake Creek to Grass Valley	------
32	US 101	Marin	Ignacio to North County Boundary	8.5
33	US 101 Bypass	San Mateo	North City Limits of South San Francisco to 0.3 Mile South of S.P. Underpass	2.0
34	US 101 Bypass	San Mateo	0.3 Mile South of S.P. Underpass to Peninsular Avenue, San Mateo	6.6
39	US 101	Santa Clara	Santa Clara Ave. in San Jose to Ford Road	8.1
41	US 40	Contra Costa	Junction Rts. 69 and 14 to North City Limits of Richmond	1.9
37(a)	US 101 Bypass	San Francisco	In San Francisco, South City Limits to Fifth Street	5.2
37(b)	US 101	Sonoma	South County Boundary to 1 Mi. S. of Petaluma	3.0
37c	US 101	Sonoma	0.3 Mi. S. of Santa Rosa to 1.7 Mi. N. of Santa Rosa	3.7
35	SR 69	Alameda	6th and Oak Streets to Hight Street in Oakland	3.3
36	SR 69	Alameda	South City Limits of Oakland to High Street	2.9
42(a)	SR 107	Alameda	Alameda Creek at Brightside, bridge and approaches	0.7
42(b)	1	Santa Cruz	Aptos to Santa Cruz	6.0
42(c)	24	Contra Costa	Jct. Rts. 76 and 106 in Willow Pass to near Pittsburg	2.3
H	1	Santa Cruz	At Waddell Creek	------
Y	17	Santa Clara	Bascom Ave. to Park Ave.	
43	US 101	Monterey	2 Miles South of Salinas to Salinas	1.9
44	US 101	Monterey	Santa Rita to Pestoni Grade	11.0
45	1	Monterey	Del Monte Junction to Seaside Junction	3.0
45(a)	25, 156	San Benito	Hollister to Santa Clara County Line	9.2
64	US 101	Santa Barbara	Sheffield Drive to San Ysidro Road; Romero, San Ysidro and Oak Creek Bridges	1.3
65	US 101	Santa Barbara	Hollister Wye to Elwood Overhead	9.2
66	US 101	Santa Barbara	Park Place to Rancheria Street	2.3
67	US 101	San Luis Obispo	Miles Station to San Luis Obispo	5.8
68	US 101	Santa Barbara	Las Varas Creek to ½ Mile East of El Capitan Creek	2.9
69	US 101	San Luis Obispo	San Luis Obispo to Cuesta	2.7
70	US 101	Santa Barbara	Santa Ynez River to Jonata Park; Santa Ynez River Bridge	3.9
46	US 99	Fresno	Calwa Overhead to Church Avenue	2.1
47	US 99	Fresno	South City Limits of Fowler to Calwa Overhead	6.3
52	US 99	Fresno	South County Boundary to Selma (See VI-Tul-4-E, Primary South)	4.7
53	US 99	Fresno	Clinton Avenue to San Joaquin River	7.2
48	41	Fresno	Shields Avenue to Fairmount Avenue; Gould Canal Bridge	1.9
49	180	Fresno	San Joaquin River Overflow Bridges	1.4
50	41	Fresno	Fairmount Avenue to Herndon Avenue	2.1
51	41	Kings	5th Standard Parallel to 1.2 miles North	1.5
52	US 99	Tulare	0.3 Miles South of County Line to County Line (See VI-Fre-4-D, Kngb, A, Primary North)	0.4
71	US 99	Kern	10.8 Miles to 1 Mile South of Bakersfield	9.8
72	US 99	Kern	1 Mile South of Bakersfield to North City Limits; Union Ave. Underpass widening	3.2
77	US 99	Kern	Cawelo to Famoso	6.7
78	US 99	Kern	Bakersfield to Snow Road; Minkler Underpass, Oil Junction Overhead, 5 small structures	3.5
73(a)	--	Kern, Tulare	Route 4 to Ducor	23.4
75	US 466	Kern	Keene to Tehachapi; 2 railroad grade separations	10.2
76	SR 132	Tulare	Packwood Creek to Rt. 10	2.3
79	65	Tulare	Yokohl Creek Bridge and Approaches	0.5
I	US 99	Tulare	At White River Sink	
80	US 101	Los Angeles	Barham Overpass to Vineland; Lankershim Grade Separation	1.6
81	US 101	Los Angeles	Aliso Street Bridge to Vermont Avenue	4.1
82	US 101	Los Angeles	Downey Road to Aliso Street Bridge	4.2
83	US 101	Los Angeles	Vermont Avenue to Highland Boulevard	3.4
84	US 101	Orange	First Street in Santa Ana to 0.1 Mile North of Santiago Creek Bridge	2.6
88	US 101 ALT	Los Angeles	Latigo Canyon to Malibu Creek	4.0
89	US 99	Los Angeles	Ridge Route, Tunnel Station to North County Boundary (portions)	6.1
91	US 101	Ventura	At Long Wall North of Ventura	1.2
92	US 101	Ventura	Ventura River to S.P. Overpass	1.0
93	US 101	Ventura	El Rio to Ventura	6.0
94	US 101	Orange	Doheny Park to Trabuco Creek	0.9
95	US 101 ALT	Orange	Laguna Beach to Dana Point; San Juan Creek Bridge	5.3
96	US 101	Los Angeles, Ventura	Calabasas to Newbury Park (portions)	4.7
85	US 6, US 66, US 99, 11	Los Angeles	Harbor Freeway from Adobe Street to Fifth Street	1.2
90	SR 19	Los Angeles	Route 77 to Pomona	0.7
97	26	Los Angeles	Olympic Boulevard, Bundy Drive to Lincoln Boulevard	2.3
98	18	Los Angeles	Lakewood Boulevard to South County Boundary	4.0
99	19	Los Angeles	Huntington Drive to Colorado Street	1.1
100	10	Los Angeles	Los Angeles River Bridge and Approaches	0.6
J	US 6	Los Angeles	Palmdale R.R. Crossing	
Z	18	Orange	Santa Ana Canyon Rd., Peralta to Olive Cutoff	
104	US 70, US 99	San Bernardino	State Street to East City Limits of Redlands	2.8
105	US 60	Riverside	1 Mile East of Mira Loma to 3.0 Miles West of Riverside	5.2
105(a)	US 60	San Bernardino, Riverside	Los Angeles County Line to 1 Mile East of Mira Loma	12.2
106	US 70, US 99	San Bernardino	Ontario to Colton	16.5
107	SR 207	San Bernardino	Route 190 to Route 43 (City Creek Road)	16.4
K	SR 190	San Bernardino	At Mill Creek	
A1	18	San Bernardino	1 Mi. E. Victorville to Victorville	
A2	111	Riverside	Whitewater Pt. to ½ Mi. N. of Palm Springs and Approach to 3 Bridges	
110	US 6	Kern	Ricardo to Freeman Station	16.7
112	US 6	Kern	Cinco to Ricardo	5.3
113	US 466	Kern	Mojave to Muroc Junction	9.9
114	US 395	Mono	Rock Creek to Casa Diablo	18.5
114(a)	US 6, US 395	Inyo	Independence to Division Creek	9.9
111	US 466	Kern	Cameron to Mojave	7.2
A3	US 6	Kern	Mojave to 4.8 Mi. North	
A4	SR 111	Mono	Grant Lake to Rt. 23	
54	US 40	Solano	Ulatis Creek to Midway	6.0
55	US 40	Solano	Midway to 1 Mile North of Dixon	6.1
56	US 99	San Joaquin	Junction Mariposa Road South of Stockton to Calaveras River and Wilson Way to Rt. 4	
57	US 40	Solano	Vallejo Wye to N. of Junction with Rt. 208	5.3
58	US 99	San Joaquin	Calaveras River to Lodi	8.4
59	US 99	Stanislaus, San Joaquin	Salida to 0.5 Mile North of Ripon; Stanislaus River Bridge	4.5
60	US 99	Merced	Black Rascal Canal to Buhach Station	3.8
62	US 50	San Joaquin	Grantline Road to Mossdale; San Joaquin River Bridge	3.7
62(a)	49, 108	Tuolumne	Stockton Street entrance to Sonora, Solinsky St. to Washington St.	0.4
61(a)	88	Amador	In Jackson; 0.5 Mile North of Rt. 65 to Junction Rt. 65. (Portion of project 61(a) in Secondary North)	0.5
61(a)	49, 88	Amador	South of Jackson to East of Jackson (Portion of project 61(a) in Primary North)	1.8
L	88	San Joaquin	At Calaveras River	0.3
M	140	Merced	Mud Slough Bridge-Garzas Creek	0.1
A5	SR 90	Solano	Rt. 7 to ½ mi. N. of Sweeney Creek	12.9
119	US 99	Imperial	El Centro to Brawley	
120	US 99	Imperial	Trifolium Canal to 2 miles north of Sandy Beach	15.2
121	US 60, US 70	Riverside	4 miles west of Blythe to State Line	7.7
116	US 395	San Diego	"A" Street to ½ mile north of San Diego City Limits	6.9
117	US 395	San Diego	Miramar to Lake Hodges	12.2
N	US 99	Imperial	Calexico to El Centro	
O	79	San Diego	At Samagatuma Creek	
P	79	San Diego	At Descanso Creek	
Q	79	San Diego	At Acorn Valley, Matagual Valley and Canada Verde Creek	
R	94	San Diego	At Campo Creek	
S	78	San Diego	At San Dieguito River	
A6	US 80, US 99	Imperial	Jct. Rts. 12 and 26 via Adams Ave. and Fourth St. to Rt. 27	
A7	US 101	San Diego	Wisconsin St. to 8th St.	

Eel River Training Jetties at Shively Bluffs Combat Floods

By L. R. REDDEN, Office Engineer

IN its efforts to adequately maintain those portions of the Redwood Highway bordering the Eel River in Humboldt County, the State has found it necessary during the past two decades to construct numerous protective devices against the erosive action of the river's flood waters. The seriousness of the problem can be well realized when it is understood that high water stages of 40 feet and more above low water flow are not uncommon which, taken in combination with extremely high velocities of flow, result in extremely rapid and destructive erosion.

Several types of protection have been installed depending on the conditions peculiar to the individual location. These have included sacked concrete riprap, heavy rock riprap, pile and cable fence, rock-filled flexible wire mattresses, and, most recently, permeable pile jetties. This last type was constructed last year at Dyerville, at the confluence of the South Fork of the Eel River with the Main Eel. The results obtained there have been so encouraging that a similar installation is now being made at Shively Bluff, about seven miles downstream.

PROGRESSIVE EROSION

A progressive and accelerating erosion condition at Shively Bluff has finally reached the point where some damage to the embankment slopes has been caused by the river during the past two or three years of moderate flood stages. Should a heavy winter and attendant heavy runoff occur there is grave probability that the entire road would be washed out. The permeable jetties being installed at Shively Bluff will serve as a preventative against such an eventuality.

The primary function of a permeable pile jetty is to sufficiently reduce the velocity of flow of a stream in flood stage so that it is below the velocity (1) where erosion or washing away of the natural river bank takes place, and (2) where the river will no longer carry down the stream its bed load of sand and gravel particles but instead will deposit them to form a protective and gradually growing bar above the jetty. Over a period of time the bar becomes large enough to turn the course of the stream away and thus provide protection against erosion of the original river bank.

OPEN JETTY

In order to accomplish a reduction in velocity, as opposed to a complete

View of site of jetty installation just upstream from Shively Bluff. Piles in the two upstream jetties have been driven. Chad Creek enters the river in the right foreground

stoppage of flow, the jetty is purposely constructed very open. It consists essentially of two to three rows of piles on which are strung barbed wire. The rows of piles are 6 feet to 8 feet apart; the piles in each row are 8 feet apart; and the wire is strung horizontally at 6 inches to 12 inches centers. The rows extend into the stream perpendicular to the direction of flow.

The resistance to flow presented by the widely spaced piles and the wire, on which small debris will impale itself, is designed to be open or "pervious" enough to readily permit flow of flood waters, but still offer sufficient obstruction to the current so that it will be reduced to less than that critical velocity at which the force of the water carries along with it considerable quantities of sand and gravel on the bottom or bed of the stream. Thus the stream is induced to deposit this bed load above and below the jetty forming eventually into the characteristic sand and gravel bar so familiar to us all.

One item to guard against is the setting up of eddy currents so large in magnitude as to overcome the moderating effect on the current. Thus, placing the piles too close together, plus the greater likelihood of debris lodging against them, causes the jetty to act like a dam, as a consequence of which disastrous eddy currents are set up, scouring occurs, and the desired result is not obtained.

FOUR JETTIES AT SHIVELY BLUFF

The Shively Bluff installation consists of four jetties which are being installed at a bend in the river. Beginning at the upstream end, the jetties are spaced 255 feet, 300 feet and 355 feet apart; and they extend into the river distances varying from 127 feet to 312 feet, with the outer end conforming to a predetermined curving "line of influence." It is expected, after construction, that eventually the main current at high water stages will conform to this line of influence. To minimize the effects of eddy currents at the outer end of the jetties, wing extensions, set at 30 degrees to the designed line of flow, are being constructed.

Three of the jetties consist of two lines of piles 6 feet apart. The fourth or upstream jetty consists of three lines of piles, the two upstream lines of which are 6 feet apart, and the third line 8 feet downstream from the second. The additional line in the upstream jetty, which receives the first impact of the stream, provides added resistance against the current. Wales and braces bolted near the tops of the piles, and diagonal bracing in the case of the upstream jetty, provide additional strength.

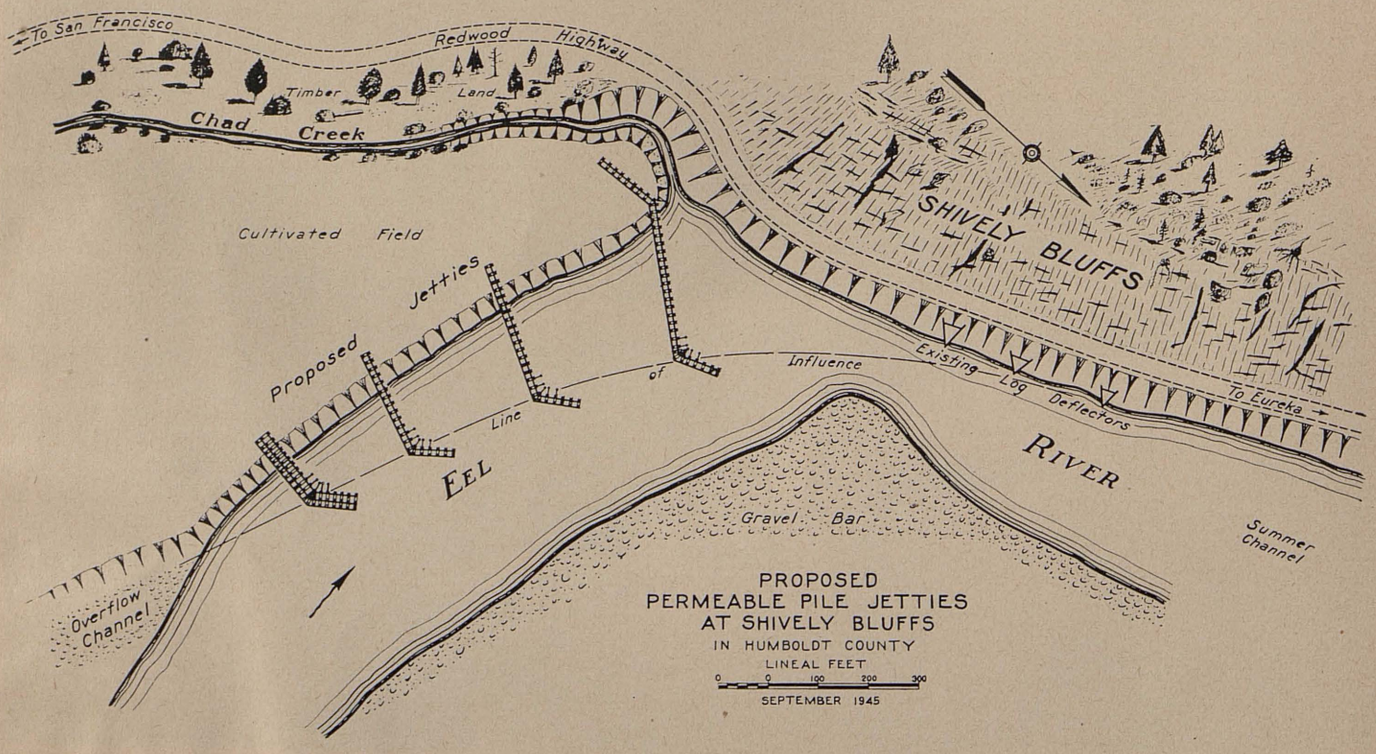
At the point where the wing extension joins the main jetty five additional piles are being driven as brace piles, with cut off 2 feet above stream bed. Diagonal bracing to the line piles gives added strength to the angle point where considerable stress and strain is anticipated.

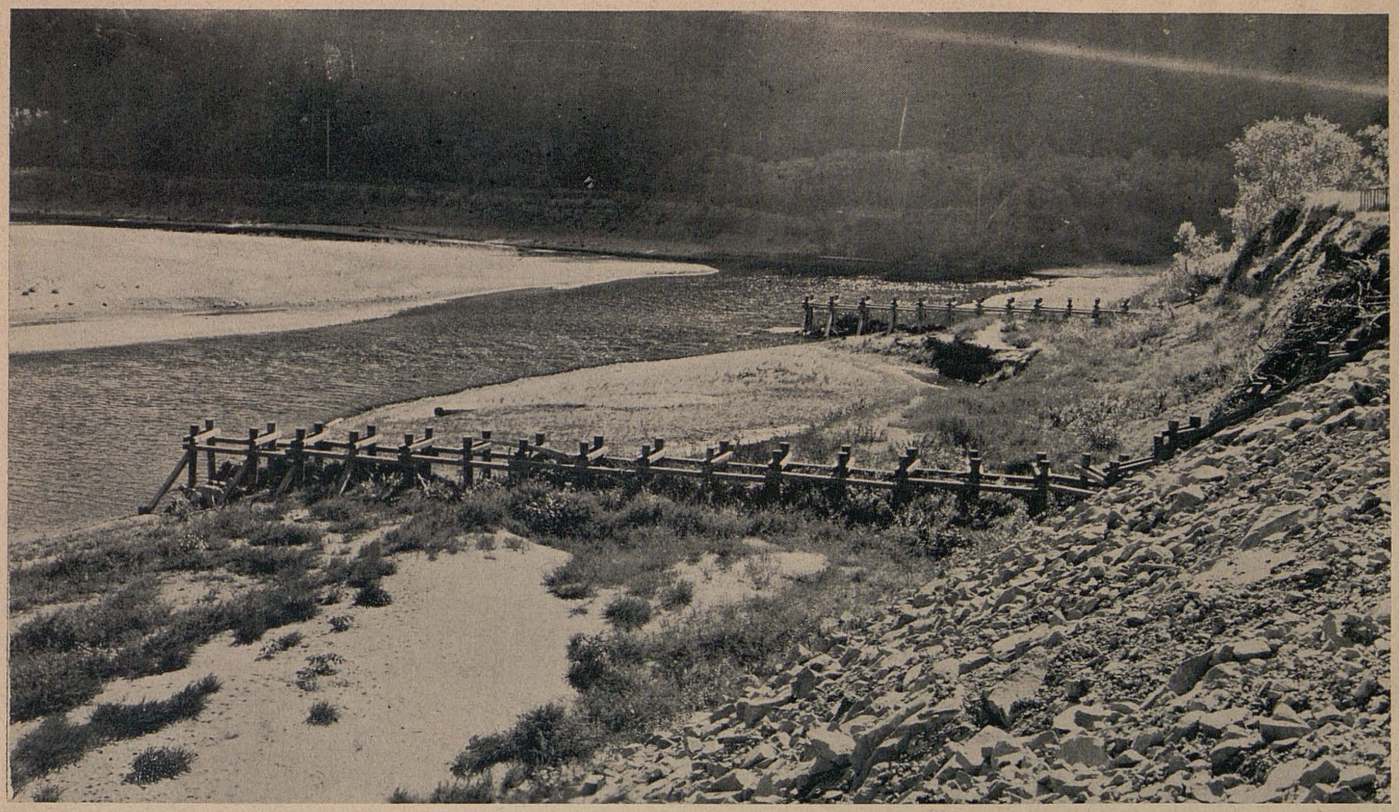
PROTECTION AGAINST HEAVY DRIFT

The "cut-off" elevation for the river bed section of each jetty provides for a gentle slope down on a uniform grade away from the bank, with the outer end variously 2 feet to 9 feet lower than the inner end. The piles extend 9 feet to 15 feet above the bed of the river, depending on its contour. Heavy rock riprap is placed around the piles 2 feet to 3 feet thick to minimize "bed" scour around the piles.

The question may occur as to why the piles in the jetties extend only 9 feet to 15 feet above the river bed, while the extreme high water is 40 feet or more above low water stage.

This is done so that heavy drift most common at maximum stage may float over the jetties without damaging them. Such enormous trees possess a terribly destructive force when carried swiftly by the current,





View of permeable pile jetties constructed during 1944 at Dyerville. Area between jetties, as well as area downstream from near jetty has filled in several feet as result of one winter's deposition

hence the importance of providing adequate clearance over the jetties. If debris of such magnitude struck against a jetty, failure would be a foregone conclusion. Moreover, the primary function of the jetty, as above explained, is to induce and encourage the formation of a gravel bar from the bed load carried by the stream, and hence no useful purpose would be served by extending it up to maximum flood elevation. As a matter of fact such construction might only insure the failure of the jetty from the destructive forces of the current, if not from drift.

GRADE OF JETTY

From the inshore end of the riverbed section, and structurally a continuation of it, the grade of the jetty rises steeply, conforming approximately to the slope of the bank, and extending above it 6 feet to 15 feet. At the top of the bank the grade again changes, with the top of the jetty being level, and about 5 feet above the ground. The three upstream jetties extend back of the top of the bank 25 feet to 30 feet to effect an anchorage; the fourth jetty extends 128 feet back of the top of the bank to minimize the influence of a small stream which enters the river immediately down stream from jetty.

Barbed wire is to be strung at 8 inch centers on the upstream row of piles in each jetty, and the placing of medium to heavy rock riprap around the piles to prevent erosion completes the installation.

The work is being done by Mercer-Fraser, Contractor, at a bid cost of $40,751. H. M. Hansen is Resident Engineer for the State. The work is located in District I of the Division of Highways, whose headquarters is Eureka. C. P. Sweet is District Construction Engineer and A. M. Nash is District Engineer.

Water Problem in Expert Hands

(Continued from page 4)

the All-American Canal. It was the recognition of need which inspired so many other programs within our State. On this occasion we have a larger objective before us—the objective of developing an over-all program covering all our State water problems.

"The main objective of this board is to be the orderly development of a water plan for our entire State—a plan which gives sympathetic consideration to the needs and opportunities of every community—a plan which gives consideration to the fullest possible use of all the water in all our streams.

GIGANTIC PROBLEM

"Quite naturally, in a State as big as ours, there is no simple and immediate answer to be found to many of our water problems. Water is by nature a local as well as a state-wide problem and as a result we find, in any attempt at state-wide planning, many viewpoints and approaches to consider.

"It seems to me, therefore, when we are dealing with such a gigantic and intricate problem we should approach it by first getting the view-

(Continued on page 34)

Record Storm Hits District IX

By J. M. Hodges,
District Maintenance Engineer

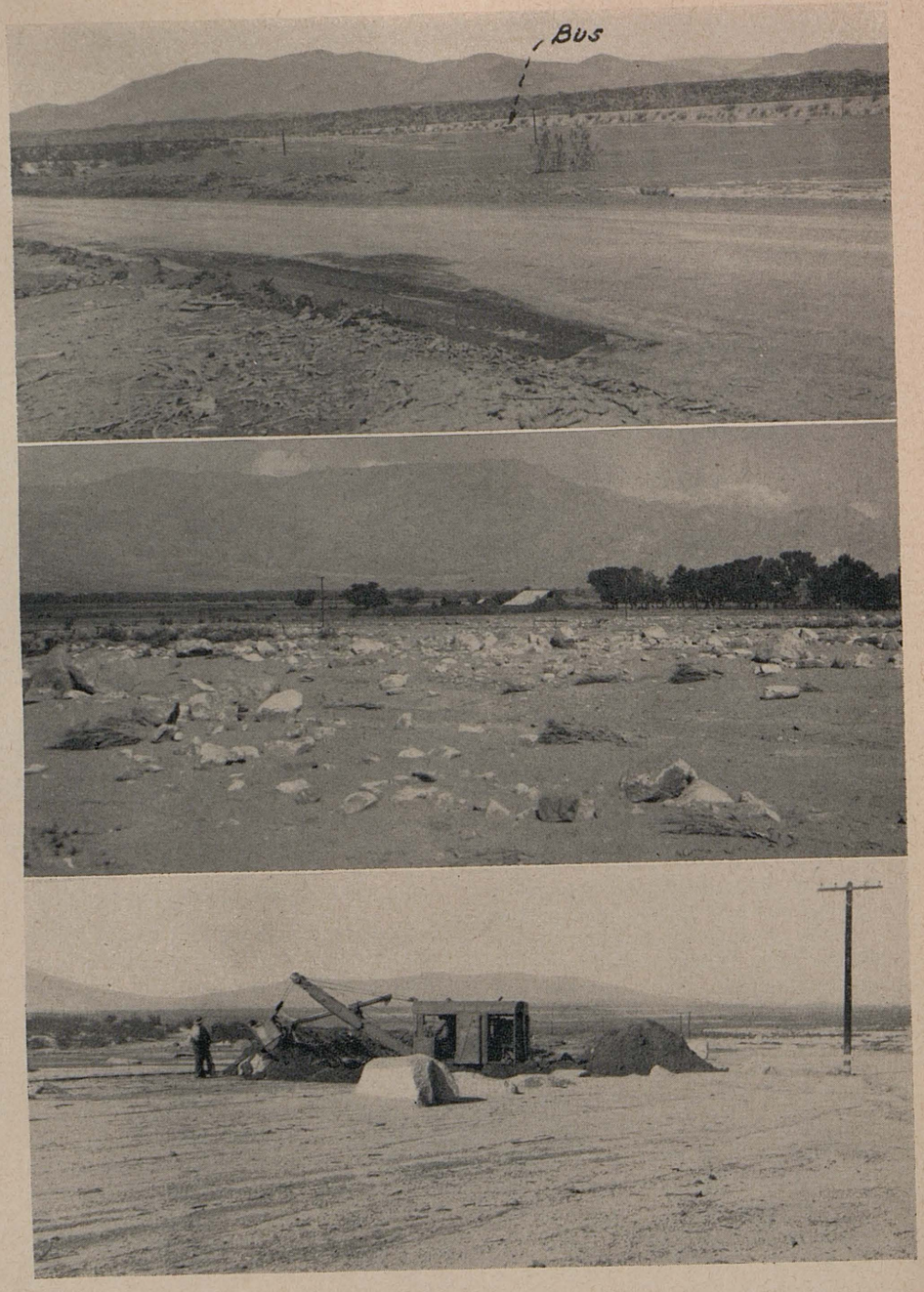
DISTRICT IX is definitely a cloudburst area, and it is not uncommon for the highways of this district to suffer severe damages at several locations during the late summer season. The first weekend in October of this year produced a series of recurring storms throughout the Mojave to Lone Pine area which resulted in loss of life and heavy damage to U. S. Highway Routes 6, 395 and 466.

The only verified loss of life occurring near the highway was at the Cameron Dip near Mojave, where a car towing a trailer attempted the crossing after being warned not to do so, and was swept away downstream, resulting in the death by drowning, of a child. Two elderly people, long-time residents in the solitude of Indian Wells Canyon, were swept with their homes down Indian Wells Canyon and their bodies recovered from the sands not far below the highway. Despite numerous apparently-authentic reports of cars and occupants being completely covered, there have been no other substantiated instances of further loss of life during these storms.

DAMAGE $250,000

Final and complete determination of the extent of restoration protective works have not yet been made, but it is estimated that actual storm damage occurring during this one weekend was approximately $250,000.

A general rainstorm covered most of Southern California beginning Friday, October 5th. The first storm of cloudburst proportions struck the area between Red Rock Canyon and Little Lake on Saturday, temporarily closing the road at numerous locations and isolating groups of traffic at each wayside point. This traffic had only barely moved out and on before another torrential downpour struck the same area, and between the wider limits from Mojave to Lone Pine. This storm, which resulted in an unprecedented amount of debris ranging from sand to house-size boulders and trees, caught a number of cars marooned in the previous day's flooded areas and washed them on across the highway and as far as one mile beyond the highway.



Top—This photo shows bus washed 1,000 feet from highway on State Route 23 in Inyo County. Center—Mud and boulders flowed over roadbed on State Route 23 in Kern County. Bottom—Shovel at work locating debris-covered roadway on State Route 23 in Kern County

VEHICLES WASHED OFF HIGHWAY

Two trucks and trailers loaded with oil were carried away and overturned by the Indian Wells Canyon flood and an empty passenger bus was swept downstream one-half mile without turning over; three automobiles and a small truck were washed from the highway for varying distances to remain buried in the mire until it had dried sufficiently to enable them to be towed away.

Monday morning's single cloud resulted in a sudden rainfall of such violence as to renew the mud flow at each and every location throughout more than 100 miles of main line

highway. The rains of Tuesday and Wednesday were distributed over a much wider area including Death Valley and our Deep Springs territory, but they were only threats of possible repetition of disaster along U. S. Routes 6 and 395 to Reno.

PROTECTION WORKS

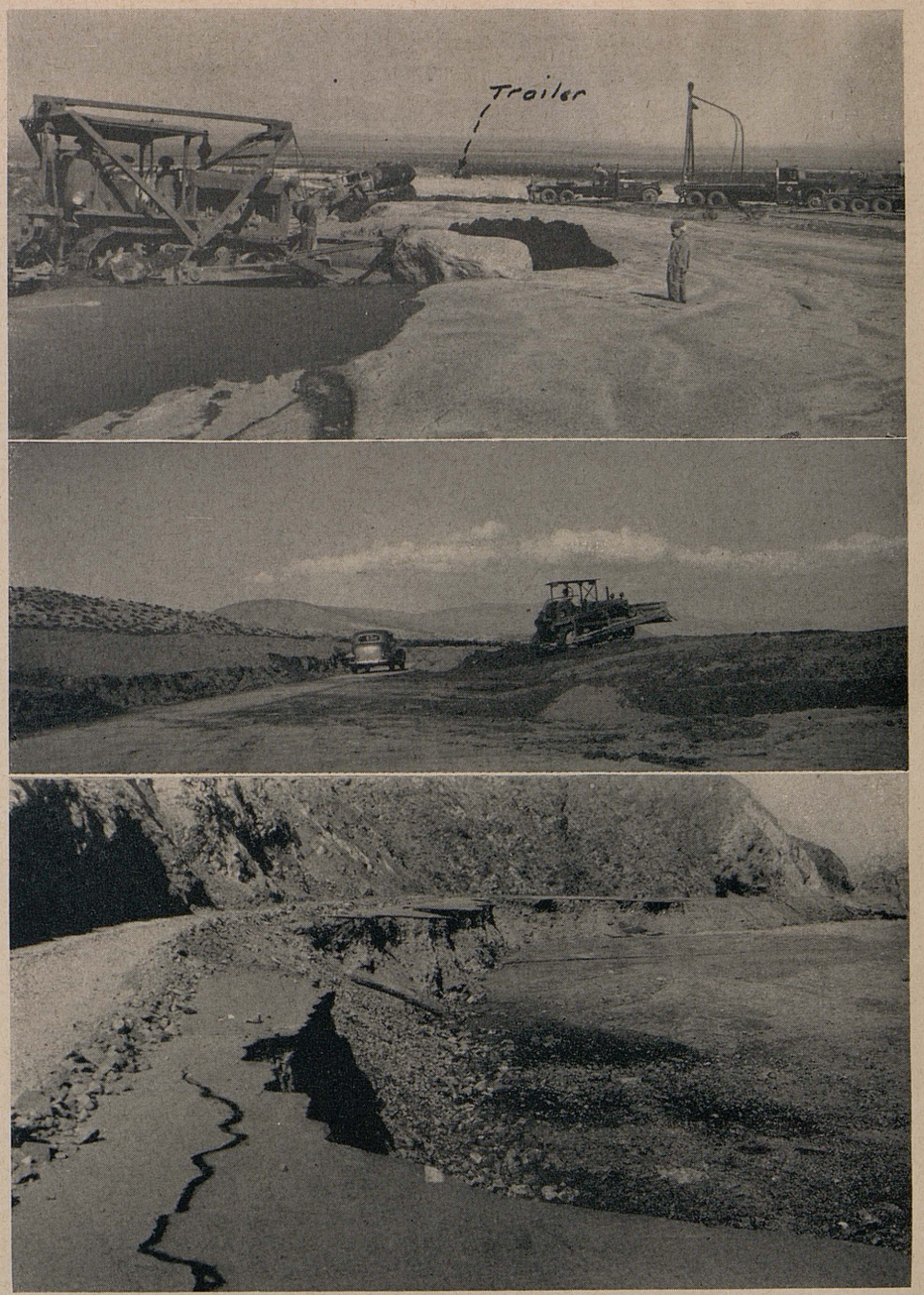
Considerable run-off carrying sand is a normal expectancy throughout the damaged section and numerous allotments had been expended in protection work over a number of years. This protection work has ranged from ditches and dikes, various types of paved dips, to pipe and wire baskets and rock-faced slopes to heavy rock riprap toe walls. All these functioned during early stages of the run-off, and some held throughout, however, as storm followed storm, dikes were overtopped and finally pavement was undermined, culverts were carried away, while on other sections, debris was deposited on the highway to maximum depths of eight feet, for lengths as great as one-half mile.

Cache Creek, flowing out of Cameron Wash above Mojave, presented no unusual difficulties. Pine Tree Dip and Jawbone Canyon left such deposits that for several days it was necessary to carry traffic three feet above the pavement. Lesser deposits between Jawbone Canyon and Cantil were so extensive in length as to make their immediate removal impossible.

RED ROCK CANYON HIT

Red Rock Canyon, which has presented unusual difficulties to location, construction and maintenance since the horse and wagon days, exceeded all past records in destruction, tearing out approximately 50,000 yards of embankment and finally eroding to the solid rock, making the passage of traffic impossible. The upper dips in this notable scenic panorama filled completely with sand. Freeman Wash Bridge, a timber structure built in 1926, and the only bridge on the main highway within a distance of 120 miles, and already in a precarious condition, was overtopped and overburdened with a deposit of sand and gravel.

Indian Wells Canyon, above our Homestead Maintenance Station, added to its original high debris cone, flowed through our beautifully landscaped maintenance yard, cutting a new channel 30 feet deep and escaped across the highway, spreading out in the Indian Wells Valley, where the resulting silt bed disappeared into the sage, leaving a broad expanse of shimmering silt, resembling a vast sheet of ormolu. The silt deposit on the pavement in this area was so extensive that removal by shovel and bulldozer resulted in a canal section, and it will probably be weeks before traffic through this section will be enabled to view the beauty of the desert.



Top—Tractor at work removing deposit from roadway one mile northeast of Homestead, Route 23 in Kern County. Oil truck and trailer in background. Center—Bulldozer working to uncover roadbed on State Route 23 clearing three feet of silt from Pine Tree Dip Bottom—Entire roadway lost. Only portion of center line stripe remaining on this section of State Route 23

WIDE STORM DAMAGE

Sand Canyon, which also broke the aqueduct, spread over the highway for a quarter of a mile and water continues to drain and run from the immense deposit of saturated sands and gravel. The natural dip five miles south of Little Lake carried immense boulders and trees originating from beyond

(Continued on page 34)

CALIFORNIA MISSIONS

By KENNETH C. ADAMS, Editor

Mission San Juan Bautista
June 24, 1797

ON a spot called Popeloutchom by the Indians and San Benito by the Spaniards, the Superior of the Missions, Fr. Presidente Fermin Francisco de Lasuen, on June 24, 1797, founded Mission San Juan Bautista, dedicating it to the Glorious Precursor of Jesus Christ, Our Lord, Saint John, the Baptist.

The site selected was a place near the Rio San Benito, so named by Captain Pedro Fages when he camped there on March 21, 1772, with Fr. Juan Crespi, that infallible discoverer of mission locations.

Until February 12, 1874, Mission San Juan Bautista was in what now is Monterey County, but on that date Governor Booth signed the legislative bill creating San Benito County, which was carved out of Monterey, and the mission town became a part of the new subdivision.

Building operations at San Juan Bautista were launched immediately after the dedication ceremonies by Fr. Joseph Manuel de Martiarena and Fr. Pedro Adriano Martinez, the first resident missionaries. By the end of 1797, the padres reported the erection of a chapel, a dwelling for the priests, a granary, adobe habitations for Indian neophytes, a guardhouse and barracks for the soldiers and a building for unmarried Indian girls and women.

MARRIAGE CEREMONY

The apartment occupied by the native girls was called monjerio (nunnery) and the inmates on account of their segregation were considered monjas (nuns). Fr. Engelhardt, mission historian, says they were free to marry when an opportunity offered itself. When an Indian youth wanted a wife he would apply to the padre, who would ask him the name of his intended. The girl thereupon would be summoned by the priest and if she agreed preparations for the wedding in accordance with church regulations would be made. After their marriage, the couple would be assigned a house of their own and thereafter would enjoy the liberty and independence of fullfledged members of the Indian community.

Before the coming of the padres it was the custom for an Indian youth to select the girl he wished to marry and give presents to her father. Acceptance of these gifts sealed the marriage of the two without any other ceremony.

The San Juan Bautista Missionaries were industrious builders as their annual reports reveal. Some of their work was undone by an earthquake in October, 1800, but repairs were made and increased building activities undertaken. On June 13, 1803, the cornerstone of the new church was laid with impressive ceremonies. Fr. Martiarena retired to Mexico and was succeeded by Fr. Andres Dulanto in 1804.

MISSION BOASTED THREE NAVES

Fr. Dulanto in 1809 reported that "on June 3d the statue of Our Patron San Juan Bautista was placed on the main altar of the sacristy, which serves as a temporary church. The three naves of the temple of Mission San Juan Bautista were also completed this year."

Of all the California missions, San Juan Bautista was the only one that boasted three naves and was the widest of all mission churches. On June 23, 1812, the house of worship was completed after fifteen years of labor by the padres and their Indians and was blessed by Fr. Estevan Tapis, then Presidente of the Missions.

In 1815 and 1816 many Indians of the warlike Tulares who had been induced to come to the mission ran away and subsequently raided San Juan Bautista numerous times, murdering several neophytes. These periodical attacks upon the mission continued long after American occupation in 1847.

Following the Mexican revolt against Spain, 1810-11, the missions in California received no support from Mexico and the pay of the military in the territory having ceased for the same reason, the Franciscan missionaries and their Indian wards were compelled to provide the soldiers with food, clothing and money. San Juan Bautista contributed heavily.

CONVERTS INCREASE

However, Fr. Tapis and Fr. De la Cuesta continued to win converts at

Mission Meccas

California's famous old missions with their historical and romantic background annually attract thousands of visitors. Twenty-one Franciscan missions were founded by the Reverend Fray Junipero Serra and his colleagues, extending from San Diego to Sonoma. On his way north from San Diego, Father Serra and the mission padres who came after him followed a course which became known as El Camino Real, "The King's Highway." El Camino Real retains to this day its original name and is designated U. S. 101. Along this highway and short distances from it, the founding padres established their missions. U. S. 101, the old "King's Highway," now extends from the Mexican border into northern Washington.

Present day State highways lead to all the mission sites. Now that the war is ended, California looks forward to again welcoming tourists from all over the world. With the resumption of normal automobile travel, it is believed that the missions will be popular meccas for visitors to the Golden State.

Anticipating this traffic, the Division of Highways is publishing in California Highways and Public Works brief histories of the missions with directions on how to reach them over State highways. For the purpose of this series, the missions are taken up in the order of their locations from south to north, rather than in the sequence of their founding.

This is the eighth of the series.

Through peaceful and turbulent years padres have lived at Mission San Juan Bautista, administering to the religious needs of the community

San Juan Bautista and in December, 1821, reported they had baptized 359 Indians during the year. The following year they counted 267 converts. By 1823 the Indian population consisted of 641 male and 607 female neophytes and twenty-two additional adobe dwellings had to be built for the newcomers.

In October, 1825, Jose M. Echeandia, the first native Mexican governor of California, arrived at San Diego. He at once set in motion the political machinations that were to bring about the ruin of all the missions. Fr. Tapis, who had done so much to build up San Juan Bautista, died there on November 3d of that same year so that he did not live to see the wrecking of the Franciscan missionary stations.

One of Governor Echeandia's first acts was to issue a proclamation on January 1, 1826, requiring all missions, as a "New Year's gift," to pay ten per cent of their income for the benefit of the "well-deserving troops who conserve the peace of the territory." Thus began the impoverishment of the missions by the military.

LETTER OF PROTEST

In the summer of 1826, Fr. De la Cuesta, alone at San Juan Bautista with the care of 1,200 Indians upon his shoulders, wrote to Jose M. Herrera, Collector of Customs at Monterey:

"I see your application for supplies of all kinds in behalf of the troops. Some of the articles are not on hand. There are difficulties all around, and I am over-burdened with cares which render life wearisome. There is hardly any of the Religious in me, and I scarcely know what to do in these troublous times. I made the vows of a Friar Minor; instead, I must manage temporalities, sow grain, raise sheep, horses and cows. I must preach, baptize, bury the dead, visit the sick, direct the carts, haul stones, lime, etc. These are things incompatible, thorny, bitter, hard, unbearable. They rob me of time, tranquility, and health of both body and soul. I desire that lively anxiety to devote myself to my sacred ministry and to serve the Lord."

For many years there has been a tradition that Mission San Juan Bautista was founded with the aid of a barrel organ the music of which attracted the Indians to the station on the day of dedication in 1797. The story is that when the natives first heard the organ they fell down in fear then gradually gathered about the singing box with delight. It is a charming tale and it seems a pity it can not be sustained by old mission records. However, Fr. Engelhardt, mission historian, felt impelled to quote a report made by Fr. De la Cuesta at the end of 1829 in which the padre notes that the mission had been presented with a barrel organ that had been made in London. Fr. Englehardt believes the "music box" was donated to the Fathers at Monterey by some English skipper. One tune that the Indians liked was unknown to the padres. It was not until years later that its name was learned. It was "The Siren's Waltz."

Fr. De la Cuesta's last report was dated December 31, 1832. There were at the mission 529 male and 396 female Indians. The station owned 6,000

head of cattle, 6,004 sheep, 20 pigs, 12 mules and 296 horses.

MISSIONS TRICKED

In 1833 the College of San Fernando de Mexico turned over to the College of Guadalupe Zacatecas the 10 California missions from San Antonio de Padua to San Francisco Solano in what is now Sonoma County and the Mexican padre, Fr. Antonio Anzar, succeeded aged Fr. De la Cuesta at San Juan Bautista, the latter retiring to Mission San Miguel.

Youthful California politicos joined with Echeandia and Jose M. Padres in plans to confiscate the missions and on July 15, 1834, the then Governor Jose Figueroa issued his proclamation secularizing the missions. Historian H. H. Bancroft says that Figueroa tricked the missions as he knew that he and his legislature had no authority to issue such a decree without the sanction of the Mexican Government. Indeed, the action was repudiated by the Government of Mexico on November 7, 1835.

Nevertheless, Figueroa and the young Californians proceeded with their scheme and Mission San Juan Bautista became a curacy of the second class under a civil administrator.

SAN JUAN BAUTISTA RUINED

On May 9, 1835, Commissioners Antonio Buelna and Jose T. Castro filed an inventory taken at San Juan Bautista and placed a valuation of $138,723.37 upon the mission and its property. The Indians were proclaimed to be "free," they were given shares of land and some money and equipment and were expected to support themselves under the supervision of a paid Mayordomo.

However, the Indians were helpless to do for themselves and gradually began withdrawing to the country of the Tulares where they could, in truth, be free. Bancroft says that "while at the end of 1836 the mission estate had still about 900 cattle and 4,000 sheep, with a crop of 900 bushels, and a debt of $1,300, there were no traces of a community. Constant depredations by savages, aided by ex-neophytes, from 1837 on contributed to the work of ruin."

"Thus," says Fr. Engelhardt, "a flourishing Indian mission headed by an unsalaried missionary was, under secular management, ruined in less than two years."

TURBULENT TIMES

In place of the Indian mission village a little settlement of whites came into existence near the church of San Juan Bautista, which by the end of 1839 numbered some 50 inhabitants. The new pueblo became the town of San Juan Bautista, the history of which is one of romance, stirring pioneer days and much bloodshed. During the 50's there occurred a number of lynchings by a Vigilante's Committee and such famous bandits as Joaquin Murietta, "Three Fingered Jack," Vasquez and Chavez frequented there, the two latter committing many raids and a number of murders.

Through all these turbulent times, kindly padres lived at the Mission, as they do today, administering to the religious needs of the community.

In 1842, Governor Manuel Micheltorena returned to San Juan Bautista, as well as the other missions, to the Franciscans, but the act brought about his overthrow by Pio Pico and other enemies of the missions.

In September, 1845, Governor Pico appointed his brother, Andres, and Juan M. Manso as commissioners to make mission inventories preparatory to sale of the missionary stations at public auction. The two placed a valuation of $7,860 upon San Juan Bautista, its lands and other properties. In May of the next year, Pico began disposing of the mission lands.

AMERICAN PROTECTION

Following the raising of the American flag at Monterey, U. S. Army officers

Attractive spot in gardens of Mission San Juan Bautista

set about protecting the missions and establishing their rightful ownership. In March, 1847, General Stephen W. Kearny, American Military Governor, issued an order in which he said that "inasmuch as there are various claimants to the missions of San Jose, Santa Clara, Santa Cruz and San Juan Bautista, I do hereby decree that until the proper judicial tribunals shall decide upon the same, the above-named missions and property appertaining thereto shall remain under the charge of the Catholic priests, as they were when the United States flag was raised in this territory."

On November 19, 1859, President James Buchanan returned San Juan Bautista Mission to the church. From the day of its founding, San Juan Bautista never lacked a spiritual guide or pastor.

Fr. Francis Mora became resident missionary at the mission in June, 1856, and Fr. Engelhardt tells an interesting story handed down by the young priest. It seems that the Indians who composed the choir at San Juan Bautista found they could not keep sober on Saturday nights, due to the widespread distribution of the white man's whiskey and consequently were in no condition to sing at High Masses on Sunday. So one Saturday they went to the priest and inquired: "Padre, do you want to have a High Mass tomorrow?" To which Fr. Mora replied: "To be sure, Amigos. Why do you ask?" The leader replied: "Padre, if you want a High Mass tomorrow you will have to lock us up, for we can not keep sober."

SISTERS ARRIVE

The astonished padre agreed, told them to get their suppers and return to the guardhouse with their blankets. He locked them up for the night. This practice was followed with the consent and approval of the Indian choir singers for years.

Fr. Antonio Ubach, who succeeded Fr. Mora, in 1861 induced some Sisters of Charity of Emmitsburg, Maryland, to establish an orphanage and day school at the mission. In 1871, the Sisters and orphans moved to the orphanage at Santa Cruz. In the same year, six Sisters of the Immaculate Heart of Mary, newly arrived from Spain, arrived at San Juan Bautista, two school buildings were erected for them and they conducted a school for orphaned girls until 1906. The earthquake of that year did considerable damage to the church and orphanage.

The first of a number of fiestas to raise funds for restoration of the mission was held at San Juan Bautista on June 24, 1907, to commemorate the 110th anniversary of its founding. A huge cross was raised on Mount Holy Cross, two miles from the mission, and blessed. June 19-20, 1936, a similar celebration in honor of the 139th anniversary of San Juan Bautista was held.

In August, 1928, the mission was placed in the hands of the Maryknoll Fathers whose resident missionaries have done much to restore and maintain this old Franciscan station.

San Juan Bautista, 16 miles north of Salinas, and formerly on the old Coast Highway, El Camino Real, U. S. 101, now is about two and a half miles off the realigned Coast Highway and is reached over an excellent connecting road built by the State Highway Commission at the solicitation of Father Caffrey of the mission. Elimination of San Juan grade by construction of the Prunedale cut-off took the mission off the main traveled route, but the new connecting road makes it easy for motorists from northern or southern points to turn off for the short run to San Juan Bautista.

Visitors coming from the San Joaquin Valley will turn west at either Chowchilla or Califa and proceed through Los Banos a distance of 78 miles over State Route 124 to its intersection with State Route 22, thence south 8 miles to Hollister and west 8 miles to San Juan Bautista.

Mission San Carlos Borromeo
June 3, 1770

DISCOVERED in 1542 by Don Juan Rodiguez Cabrillo, bold Portuguese navigator in the employ of Spain, ignored by the Spanish crown until 1602, when General Sebastian Vizcaino landed there and wrote glowing accounts of its ideal harbor and back country, and again forgotten by Spain for a period of 168 years, Monterey was destined to be the scene of Father Junipero Serra's greatest missionary efforts and his last resting place.

Fearful that the Russians, who were moving down the North Pacific coast, intended to seize all of what now is California, a new country Spain claimed as a result of the voyages of Cabrillo and Vizcaino, the Spanish Government in 1768 directed Inspector General Joseph de Galvez to send expeditions from Mexico to Upper California to lay claim to the territory and "plant the standard of the holy Cross among the heathens."

We have seen in the story of the founding of the first Franciscan mission at San Diego how Fr. Serra accompanied the forces of Gaspar de Portola from La Paz to San Diego and how he went with the second Portola expedition north in search of Monterey Bay, Portola going by land and Junipero by sea. Portola's first quest had failed, he and his men not recognizing Monterey Bay from the hills surrounding it. However, the second expedition was a success and Portola and Fr. Serra both arrived at Monterey in May, 1770.

PORTOLA LEAVES MESSAGE

It was on his weary march back to San Diego that Portola pitched his camp on a hill overlooking Carmelo Bay near a spot where Mission San Carlos later was established. Here Portola caused a cross to be erected on which was carved: "Dig at the base and thou wilt find writing." A bottle containing an account of the failure to discover Monterey Bay, of the finding of San Francisco Bay and of the necessity of returning to San Diego to escape starvation was buried at the foot of the cross.

On his return expedition, Portola again camped at Carmelo there to await the arrival of Fr. Serra and the sea party in the San Antonio. The two forces were joined on June 1, 1770, and orders were given to remove the camp from the arroyo near the Rio Carmelo to the harbor of Monterey. Portola fixed June 3rd as the day upon which formal possession would be taken of Monterey Bay and its lands in the name of King Carlos III of Spain.

SPAIN CLAIMS MONTEREY

Describing the ceremonies attending the raising of the Spanish flag on what was to be the presidio of Monterey, Fr. Crespi wrote:

"On the same day, June 3rd, Pentecost Sunday, 1770, on which Governor and Commander Gaspar de Portola took possession of the Port of Monterey in the name of the king, and began the presidio of San Carlos, the Rev. Fr. Presidente of all the Missions, Fr. Junipero Serra, in the name of the king, and in the name of the Rev.

Here at Mission San Carlos Borromeo are the tombs of Fr. Junipero Serra, Fr. Crespi, Fr. Lasuen, and Fr. Julian Lopez

Guardian and of the Ven. Discretory of the Apostolic College of the Propagation of the Faith of San Fernando de Mexico, began the new Mission under the title of San Carlos, naming as chief patron of the new church the most holy Patriarch St. Joseph, as he had been directed by the illustrious Inspector-General that two patrons should be assigned, one for the Mission, who was San Carlos Borromeo, and the other for the church, who was the most holy Patriarch St. Joseph. As our ecclesiastical head, he (Fr. Serra) took possession of it in the name of the said College, appointing as his companion missionary Fr. Juan Crespi, his pupil in philosophy, which he had taught him in the royal monastery of our Seraphic Father San Francisco in the City of Palma in the holy Province of Majorca."

An arbor of boughs served as the first church of the new mission and in it was a table for an altar on which holy Mass was celebrated until a temporary chapel was built.

SERRA SOUGHT NEW SITE

As early as July, 1770, two warehouses had been erected and several smaller, primative buildings put up. But it would seem that almost from the start, Fr. Serra felt that the site chosen was not a good one because of its proximity to the presidio and its soldiers and because of a dearth of Indians in that locality. Wherefore, when the San Antonio sailed for Mexico it carried a petition from Junipero to the Viceroy requesting permission to move the mission to the Rio Carmelo across the peninsula of Point Pinos.

Fr. Palou reported at the end of 1770: "On December 26th the first baptism took place in the pagan nation. It was for the fervent and ardent heart of our venerable Father Serra an indescribable jubilee."

On May 21, 1771, 10 Franciscan Fathers from the missionary College of San Fernando in the City of Mexico, who had volunteered for service with the California missions, arrived at Monterey, bringing joy to Fr. Serra, even then dreaming of the great chain of Franciscan stations that was to

(Continued on page 32)

California Highway Problem Is of First Priority, Governor Says

URGED by Governor Warren to make as much speed as will be consistent with a thorough study of California's highway problems, the Joint Fact-Finding Committee on Highways, Streets and Bridges, created by the Legislature, is holding meetings in many sections of the State in order to obtain first-hand information on the highway needs of California.

Hearings have been held in many of the larger cities, in scores of communities from one end of the State to the other, and last month the committee, under the chairmanship of Senator Randolph Collier of Yreka, completed a five-day tour through the counties of the Redwood Empire.

At a meeting in the State Capitol in Sacramento, the committee was addressed by Governor Warren, who told the members that in his opinion the highway problem is one of first priority.

"I think that we have immediate need for an overall highway program," the Governor said. "We do not have such at the present time and haven't had for some years. There was a time about 15 or 20 years ago when California was the envy of the country so far as highways were concerned, but at that time we had probably one-third as many people as we have now.

"As a State, we have entirely outgrown our highway system. Our big cities have absolute bottlenecks in them that can not be cured other than by drastic action. We need freeways in those communities so that they can fill the city up in the morning and empty it at night quickly. We need farm-to-market roads; need them very badly.

"Our country roads are run down in many, many respects. We need highways up into the recreational areas so that we can develop the greatest industry that we have had in the past, our tourist industry. We need every kind of highway conceivable. Now, the questions confronting us are: Where are we going to put them? According to what plan? And how are we going to pay for them? That means study, and we have not had a real highway study for many years.

"I think it is a fine thing that the Legislature has set up this committee. There is only one thing I would urge upon you and that is to make speed, because time is the essence.

"I believe, gentlemen, that the time has come when we have to meet this question head on, not only as to what we are going to do, but as to how we are going to finance it. People in the back counties can not pay for farm-to-market roads. Naturally they can not open up the roads into the recreational areas; it is too expensive. Our

(Continued on page 34)

Members of Joint Fact-Finding Committee on Highways, Streets and Bridges in session. Left to right: Assemblyman Gerald P. Haggerty, San Francisco; Senator Jerrold L. Seawell, Roseville; Senator Randolph Collier, Yreka, Chairman; Assemblyman Charles W. Stream, Chula Vista, Vice Chairman

CALIFORNIA MISSIONS

(Continued from page 30)

stretch from San Diego to San Francisco and on north to Sonoma.

Fr. Serra assigned the newcomers to their fields and sent them to San Diego aboard the San Antonio, only Fr. Juan Crespi and himself remaining at Monterey. He, himself, with a handful of soldiers then set out to locate a suitable new site for Mission San Carlos. He found one to his liking, ordered the felling of trees for lumber and then traveled south into the Sierra de Santa Lucia, where on July 14, 1771, as we have seen, he founded Mission San Antonia de Padua.

MISSION WAS SERRA'S OWN

Desirous of himself founding Carmelo Mission, Fr. Serra lived in a little shack on the site, leading the life of a hermit. Fr. Palou records that the Indians came to love Junipero, whom they called the Old Father. At the end of 1771, Fr. Serra with Fr. Crespi and two Indian neophytes moved to Carmelo which, Fr. Palou says, '''became his (Junipero's) own peculiar mission, where he continued till his death, when he was not bound to visit other missions or make necessary journeys in virtue of his office of Presidente of the Missions.''

We know of the famine that struck San Carlos and other missions due to delay in the arrival of foodships from Mexico, of Captain Fages expedition into the Valley of Bears, where Mission San Luis Obispo was to be established, of the thousands of pounds of bear meat he sent back to Monterey, of Fr. Serra's journey south with him to San Diego and of Junipero's trip to Mexico in 1773 to confer with the viceroy on plans for future missions. Fr. Serra returned to San Carlos in May, 1774.

Fr. Palou records that for eight months in 1774 ''milk was the manna for all from the commandante and the Fathers down to the least individual. * * * At this Mission of San Carlos for thirty-seven days we were without a tortilla or as much as a crumb of bread. The meals consisted of a gruel made of garvanzos or beans ground to flour with which milk was mixed.''

On June 27, 1775, the San Carlos dropped anchor in Monterey Bay bringing a letter from the viceroy to Fr. Serra explaining that it was desired that the country around San Francisco Bay be examined for sites for a presidio and mission. Fr. Palou and Fr. Campa were sent north with an expedition to choose a site for Mission San Francisco.

GOVERNOR DE NEVE'S ENMITY

Felip de Neve arrived at Monterey in February, 1777, with the title of Governor of California. Two years later, without consulting Fr. Serra he ordered that the Indian neophytes at every mission should elect from among them an alcade or magistrate and two regidores or councilors, and be instructed in self-government. From Carmelo the Fr. Presidente waged his long fight against this move, foreseeing exactly which came to pass; which was that the Indians, but recently ignorant savages, would not know how to use and would abuse the authority given to them.

Fr. Engelhardt, Mission historian, says that ''at Mission San Carlos, Fr. Serra's own mission, and in the very neighborhood of Neve's headquarters, the experiment proved especially disastrous.'' He then goes on to tell how one Baltasar, elected alcade, drunk with authority, broke all the laws of the church and the civil government. The same situations were developing at the other missions.

Governor Neve evidently was determined to affront Fr. Serra in every possible way and ordered him to cease administering the Sacrament of Confirmation, basing his action on the inability of Junipero to produce the Bull of the Pope, document of his right to confirm. Fr. Serra refrained from visiting any of the missions for a year because he knew the Indians would wonder why he did not confirm. Finally Viceroy Mayorga notified Neve that Fr. Serra was duly authorized to confirm. The incident added to Neve's dislike of the missionaries.

SERRA MAKES FAREWELL TOUR

Worn out by his long fight to protect his missions, Fr. Serra felt that his end was near and, aged and poor in health, he made a farewell tour of the Franciscan stations in 1783. Back in Monterey in July, 1784, he sent for Fr. Palou, who was in San Francisco. The latter hastened at once to San Carlos.

Of the last illness and death of Fr. Serra, his faithful biographer, Fr. Palou, left a touching account. Fr. Serra died a little before two o'clock the afternoon of August 28, 1784, at the age of seventy years and nine months, after fifty-four years devoted to his church.

Fr. Palou became temporary presidente of the missions and took up his residence at San Carlos. He served until September, 1785, when he retired to Mexico and was succeeded by Fr. Fermin Francisco de Lasuen. Fr. Palou wrote four volumes, Noticias de la California, and his history of Fr. Serra and the Franciscan missions is a notable contribution to literature and to California history.

It is not necessary to follow the fate of San Carlos through the years of its decay under Mexican civil government rule. It is tragically similar to that of the other California missions. It is recorded that the first stone of the new church was laid on July 7, 1793. Then followed the years of Governor Echeandia and his successors, the dispersing of the Indians at San Carlos, the sufferings of the neophytes and the padres and final confiscation of San Carlos by Governor Pio Pico in 1845. Fr. Engelhardt says that poor Mission San Carlos had been so bled that there was nothing to auction off so that ''Father Serra's Mission did not suffer the disgrace of having to come under the hammer'' as did the other missions.

MISSION RETURNED TO CHURCH

San Carlos was returned to the Catholic church by President James Buchanan on October 19, 1859.

In 1852 the tiled roof fell in, the walls collapsed and grass and weeds covered the floor of the old mission church. It was in ruins in 1868 when Fr. Angelo D. Cassanova was appointed to the parish of Monterey. He at once set about having the debris cleared and planned for the restoration of the mission. On July 3, 1882, with about 400 persons present, Fr. Cassanova had the tombs of Fr. Serra, Fr. Crespi, Fr. Lasuen and Fr. Julian Lopez opened to determine if the Father of the California Missions and his brother padres really slept there in the mission church as ancient records indicated.

The priests were there in redwood coffins and all the coffins except that of Fr. Lasuen were excellently preserved.

In October, 1924, Monterey held a fiesta in honor of Fr. Serra the prin-

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Bridge Maintenance Practice On California Highway System

(Continued from page 16)

RIO HONDO BRIDGE

A somewhat similar accident occurred at the bridge across the Rio Hondo on Anaheim-Telegraph Road, State Route 166, in Los Angeles County. A truck and semi-trailer loaded with bulk oranges and towing a trailer also loaded with bulk oranges, was proceeding across the structure when the trailer broke loose and struck the southeasterly end of the upstream truss in Span 4. This knocked out the endpost and resulted in failure of the truss, as shown in **Photograph 6.** Repairs similar to those described for the West Fork of the San Gabriel River were made; however, in this case, the lower chords were built of steel. The damaged piece was cut off, straightened and reinstalled by making a welded splice.

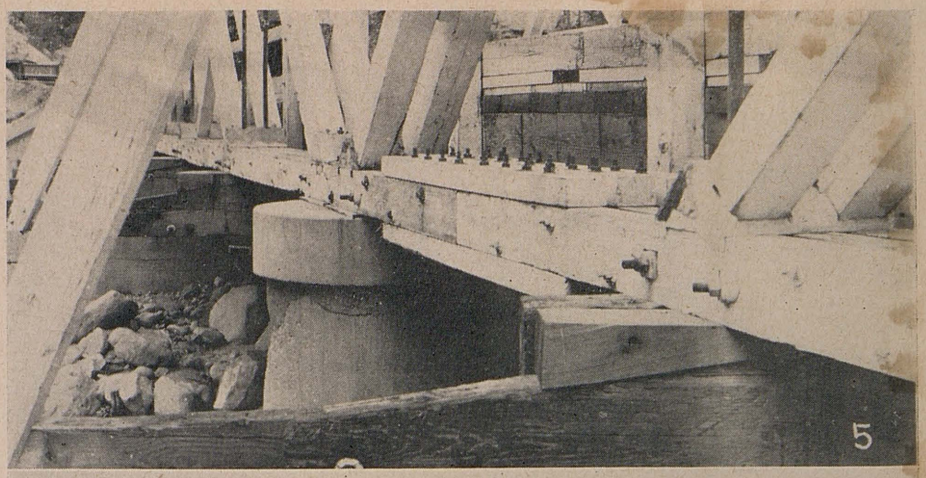
SAN FELIPE CREEK BRIDGE

The bridge across San Felipe Creek on State Route 198 between Julian and Kane Springs, was struck by a trailer which damaged an intermediate post (U2-L2). The post was knocked out of its lower seat and the joint was raised about 6 inches due to absence of the compressive force normally furnished by such post, but the truss did not collapse, due probably to the vertical shear resistance offered by the top chords. The structure was underpinned as shown on **Photograph No. 7,** the damaged post was replaced with a sound timber and the bridge was returned to service, at nominal cost, in a reasonably short time.

Continued use of these old, light and outmoded bridges demands constant vigilance and ingenuity in keeping them safely in service until a program of reconstruction will permit their replacement.

Due to progressive deterioration and general loss of strength of some materials with time, it is generally expedient to make critical periodic reviews of all stress analyses in order to maintain a load rating which will be consistent with the known capacity and physical condition of the truss members and materials. It is only through close periodic field inspection that such conditions can be properly determined and corrected and an engineering organization equipped to do just such work is mandatory is proper checks along this line are to be realized.

This article has covered only some of the more usual kinds of trouble which are generally encountered in such timber truss bridges and has indicated several methods which have successfully been employed in handling problems of this nature.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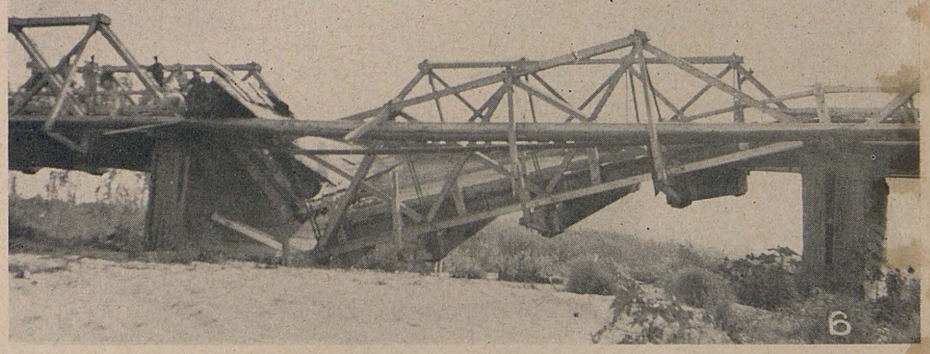
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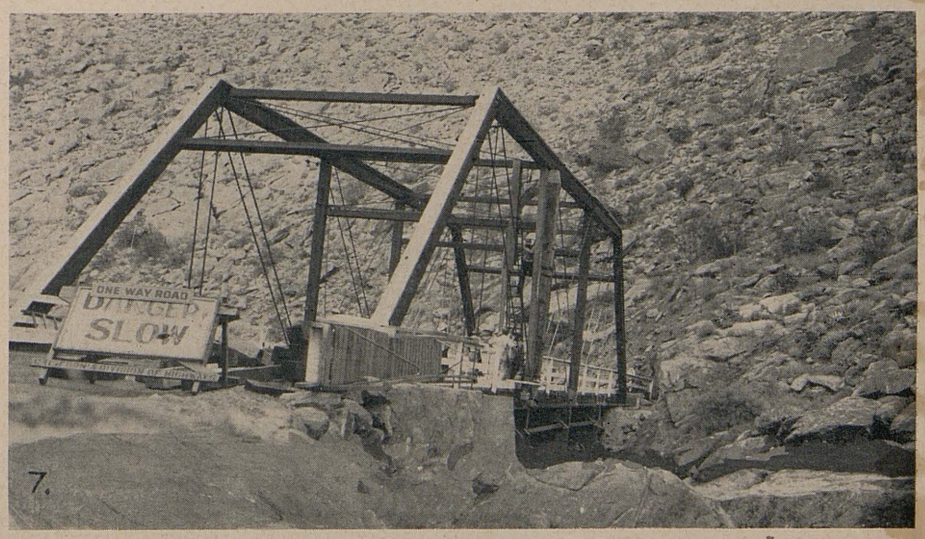

7.

One morning some university students brought a donkey into the lecture room.

"Take your seats, gentlemen," said the professor. "I see there's one more of you this morning."

Record Storm Hits District IX

(Continued from page 25)

sight of the highway and blocked traffic during each violent downpour. During the last storm 623 cars were counted as awaiting the ebbing of this torrent. The storm damage extended for 50 miles north of this point, but traffic delays and total obliterations of the highway were only sporadic and not too unexpected as to locality.

It was necessary to detour traffic 40 miles easterly from Mojave to Cramer Junction and northerly through the old mining town of Johannesburg from Sunday noon until Wednesday morning. Some venturesome and more impatient wayfarers traversed the tortuous route through Trona to Wild Rose or Darwin before the shorter paved detour through Inyokern could be adequately cleared and signed. The hill above Inyokern remained impassable and necessitated detouring via Inyokern until the following Saturday evening. Numerous short sections were so narrowed as to permit only one lane traffic for as long as three weeks.

LIGHTNING CAUSES HAVOC

The storm struck over a weekend during vacation, deer and trout season, and was concentrated in the superintendent's section where, due to manpower shortage, only 11 employees below the grade of foreman, were on the payroll. Telephone lines were repeatedly struck by lightning, thus presenting a startling display of burning and exploding poles, but more prosaically interfering with calls for additional help. However, as fast as word of the debacle could be spread throughout the district, employees from top to bottom, almost without exception, responded enthusiastically and persistently to rush equipment, labor and supplies to the scene of disaster.

Inyokern naval authorities supplied and manned more and larger road-building equipment than the district could supply. The Marines from the Mojave Base transported State equipment and continued to furnish a much needed guard detail.

All of these resulted in abetting the resumption of traffic on our main line as expeditiously as was possible, although the restoration of pavement, roadbed and roadsides to their former condition and the construction of more adequate protection will undoubtedly necessitate several months.

C. H. Purcell is Again Honored By Profession

RECIPIENT in 1944 of the highly prized George S. Bartlett award for outstanding contributions to highway progress, C. H. Purcell, Director of Public Works, has had another high honor conferred upon him by the American Society of Civil Engineers in recognition of his outstanding professional accomplishments by election as honorary member of the society.

The award of honorary member will be made to Mr. Purcell at the Society's annual meeting January 14th and 15th in New York.

Mr. Purcell has been a member of the society since 1916 and has been affiliated with the Sacramento section since 1928.

Prior to coming to Sacramento he was District Engineer for the Public Roads Administration in Portland, Oregon. The district included the States of Oregon, Washington, Idaho, Montana and the Territory of Alaska.

Mr. Purcell came to California as State Highway Engineer in 1928. After 15 years of service as State Highway Engineer he became Director of Public Works on January 5, 1943.

In addition to his many duties as State Highway Engineer, he became chief engineer in 1933 of the $75,000,000 San Francisco-Oakland Bay Bridge. In 1941 the President of the United States appointed him a member of the Interregional Highway Committee.

Mr. Purcell served as president of the American Association of State Highway Officials in 1938. He holds honorary degrees of Doctor of Laws from the University of California and Doctor of Engineering from the University of Nebraska.

A lawyer asked a prospective juror:

"Who influences you the most—the witnesses, the judge or the lawyers?"

And the prospect replied.

"I ain't influenced by anything said by the witnesses, the judge or the lawyers. I just look at the prisoner and say to myself: 'If he ain't done anything wrong, why is he here?' and I vote 'em all guilty."

California Highway Problem Is of First Priority, Governor Says

(Continued from page 31)

cities can not pay entirely for freeways; the State has got to step in and do something about it. The question is: How are we going to finance such programs? We can not finance them from the General Fund. There just isn't enough money coming in. We can not finance them from the present funds that are coming into the Highway Department; everybody knows that.

"So, the thing we have to do is find a way to finance the programs and then go about financing them. I think this can be done. I think the people of the State in every walk of life are sufficiently interested in getting highways to reconcile their differences and agree upon a way of financing. This is the first step and the principal obstacle. If we can get over that hurdle we can solve the other problems, and I know that you gentlemen with the facilities that are available to you in the State, and with the appropriation you have, can do it in a comparatively short time. I urge you above all things to make as much speed as is possible under the circumstances."

Water Problem in Expert Hands

(Continued from page 23)

points of those who are interested in the use of water and its by-products, and also the thinking of those who have vision for the future of our State and its ultimate development through the utilization of water.

"I know of no better way to get a bird's-eye view of thinking in regard to water resources in California than to invite all who are concerned to come to the capital of our State and express themselves on the subject, and endeavor to reconcile their views with those who may be seeking the same ultimate objective but who, because of their own special problems, may differ in approach.

WATER CONFERENCE

"I believe we should have a water conference at Sacramento at the

(Continued on page 36)

California State Highway System, Its Needs, Problems, and Outlook

(Continued from page 2)

axle load of loaded trucks jumped from 6,600 pounds in 1936 to 12,000 pounds in 1944, an 81.1 per cent increase.

The improvements in construction standards, namely: wider lanes; multiple lanes; divided highways; thicker pavements; heavier bases to carry the increased pavements and loads; improved alignment and grades, with more sight distance at both horizontal and vertical curves; together with the decided rise in cost of materials and labor have all materially increased highway construction costs.

COST OF CONSTRUCTION UP

In years gone by, State highway construction was almost entirely limited to rural locations. Now a very large portion is located in urban areas, much of it through congested portions of cities. These changes in locale also have greatly increased costs of construction, particularly in the phase of right of way acquisition, and, in freeway development, the added expense of structures necessary for elimination of cross traffic.

Twenty-five years ago an acceptable highway following the general contour of the countryside could be graded and surfaced at a cost of $30,000 per mile. Fifteen years ago, excellent two-lane highways built to vastly improved line and grade, were placed at construction costs of $60,000 a mile. Simple four-lane divided highways coming into use seven or eight years ago ran the costs up to $100,000 per mile and more. Today, freeway construction through congested metropolitan areas, with high right of way costs, multiple lanes and complicated structures, may run a million dollars or more per mile.

MEETING PROBLEMS

The problems of State highway administration do not diminish as the years and demands of traffic progress.

Undoubtedly there has arisen in your minds the question of what is the State of California doing to meet these multiplied problems of motor transport.

Three years ago, when it became apparent that highway construction operations would be drastically curtailed during the war and that the Division of Highways program of progressive State highway development would be suspended during the emergency, plans were laid for the resumption of State highway development at the earliest possible time. Funds on hand and revenues anticipated from existing sources were appraised and it was determined that with the money in sight at that time a postwar highway construction program totaling $80,000,000 could be undertaken. Such a program was selected and approved by the California Highway Commission. It comprised projects which had been budgeted but which were deferred because of the war; of projects which had been programmed and for which plans and specifications were well advanced; of projects which were indicated as essential for traffic; and of critical bridges.

POSTWAR APPROPRIATION

As of vital assistance in formulating this program, the 1943 Legislature, at the instance of Governor Warren, appropriated a sum of $12,000,000 for preparation of plans and specifications and for the acquisition of rights of way.

During the war, personnel of the Division of Highways was drained by military leaves and losses to war industry, particularly from the younger men on the engineering staff. At the same time, even though Federal restrictions practically limited State highway activity to maintenance and repair, the Division of Highways at the request of the Public Roads Administration, the Army and the Navy undertook the planning and construction of access road projects to military, naval and industrial establishments totaling $30,000,000 and for the U. S. Air Force construction of flight strips amounting to more than $2,000,000.

This was an undertaking which nearly equaled normal prewar State highway construction programs. However, so that preparation of the postwar program would not lag, all members of the organization not required for State highway and access road projects were assigned to survey parties and drafting tables in the preparation of postwar plans, specifications and estimates and to work in connection with the acquisition of right of way.

CONGRESSIONAL ACTION

Preparation of the program progressed and with time it became apparent that the revenue which would be available was not static but progressive. Congress considered, debated and passed in 1944 a $1,500,000,000 Postwar Federal Aid Program—$500,000,000 for each of three postwar years, which to California means yearly apportionments of $17,000,000 for rural and urban Federal aid routes and $5,000,000 for Federal aid secondary or feeder roads. Wartime revenues from the gasoline tax did not drop quite as low as had been expected and the "come back" since V-E and V-J days has been rapid.

The net result from this fluid condition of expected available revenues makes it now appear that from all sources of State highway revenue: gasoline tax, motor vehicle registration, regular Federal aid and urban Federal aid will be provided a total of about $145,000,000 for construction during this and the next three fiscal years.

As stated, the condition is fluid. In preparing this latest estimate of $145,000,000, the July and October apportionments of gas tax revenue were given projected consideration. The full effect of the end of gasoline rationing, however, was not completely manifest in the October apportionment, but it is expected that the January, 1946, apportionment will provide a firmer base for projected estimates of revenue.

GAS TAX COLLECTIONS CONFUSE

In this connection, may I call attention to the fact that newspaper releases on receipts from gas tax collections may be misinterpreted, as the figures given are usually the total collections and by the time the State Controller actually apportions the funds to the Division of Highways, the counties and the cities, a shrinkage of some 10 per cent in refunds and collection expense normally occurs.

This Postwar State Highway Program for the coming four years will not, of course, completely solve the transportation problems on the system, but the $145,000,000 will make more than an appreciable start in correction of those critical deficiencies which it is estimated will require $695,000,000 in construction and reconstruction.

The California Highway Commission has adopted a flexible program

which may be expanded by addition of critical projects as additional funds become available. For the first postwar year, the commission approved an initial partial program totaling $40,000,000 in construction cost.

POSTWAR PROGRAM PROGRESSES

Progress on this program is well advanced. On September 28th, Congress passed its concurrent resolution authorizing the Public Roads Administration to enter into agreements with the State for postwar construction and on October 29th the Public Roads Administration approved California's Federal Aid Program and portions of the Federal Aid Urban Program. Immediately thereafter, the Division of Highways, on November 9th, published the first call for bids on construction of postwar projects. During the past three weeks advertisements have been published by the State Highway Engineer for 23 projects totaling estimated costs of approximately $11,000,000. Bids on the first of these were opened in Sacramento November 28th and others are being opened here in Los Angeles today.

It is planned to continue placing the postwar State highway projects under construction at a projected rate of approximately $2,000,000 per week until the entire initial program is in the hands of the construction industry. For the second and third postwar years, advertising for bids will keep pace with each year's $17,000,000 Federal aid apportionment as it becomes available on July 1, 1946, and July 1, 1947.

FREEWAY DEVELOPMENT

Included in the initial $40,000,000 program is development of the Bay Shore and East Shore Freeways in the San Francisco Bay area; the Hollywood and Santa Ana Freeways in Los Angeles, the Balboa Freeway in San Diego; portion of the four-lane divided arterial between Sacramento and San Francisco; sections of main highway construction in the San Joaquin and Sacramento Valleys; parts of the coastal arterials north of San Francisco, between Los Angeles and San Francisco and between Los Angeles and San Diego; as well as work on other inland arteries. In addition will be included replacement of many bridges throughout the system.

Besides the State Highway Program, the early postwar years will see the well-rounded $25,000,000 program of county road improvement financed with the $15,000,000 in Federal funds apportioned to California for Federal Aid Secondary roads and the $12,000,000 appropriated by the last Legislature for the use of the counties in matching the Federal aid secondary funds. The State enactment providing these matching dollars stipulated that 87½ per cent of the Federal apportionment be used for improvement to county roads.

In closing, may I emphasize the inadequacies of the State highway system today and the fact that with a wartime increase in population of 2,000,000 and further large increases expected from returning men who will want to settle in California, the motor transport problems of the State will multiply as never before.

If California highways are to function in furnishing adequate service to present and future traffic immediate provision must be made for financing a program of $695,000,000 for the correction of critical deficiencies on the State Highway System.

CALIFORNIA MISSIONS

(Continued from page 32)

cipal event of which was the unveiling of the Serra sarcophagus at Carmel on Sunday, October 12th. The sarcophagus stands in the adobe chapel to the left of the entrance of the church, which, largely through the efforts of Fr. Raymond Mestres has been restored and made a fitting place for the tomb of Fr. Serra. It is a panel work depicting the history of California and presents Fr. Serra, Fr. Crespi, Fr. Lasuen and Fr. Lopez. It is by the artist, J. J. Mora.

Mission Trail motorists coming either from the south or north will leave U. S. 101, El Camino Real, at Salinas and turn west over State Route 117 to Del Monte and Monterey, 18 miles, thence southwest 4 miles to Carmel. Or coming from the north to Santa Cruz the route is over No. 56 to Watsonville, Castroville and Monterey to Carmel.

Mission visitors from the San Joaquin Valley will turn west at either Chowchilla or Califa and follow Route 32 west to Gilroy, thence to Watsonville and south over Route 56 to Monterey and Carmel.

Next—Mission Santa Cruz and Mission Santa Clara.

Water Problem in Expert Hands

(Continued from page 34)

earliest convenient date in order that all of us who are charged with responsibility in this field will have the views of those directly affected by our findings and policies.

"In making my appointments to this board I can assure you I kept in mind what I sincerely believed was the intent of the Legislature, that men possessed of special training and experience be selected. I believe that each of you brings to this board understanding and ability which will enable you to render your State exceptional service. Big as the problem before you may seem, it is not too big for men to solve in a State which is willing to seek the solution. All of us have confidence in our State and I know that through your service on this board you will both add to, and speed, the fulfillment of the visions for the future which all of us hold."

Richard S. Badger Retires After 31 Years of Service

Bringing to a close 31 years of service with the Division of Highways, the last 15 of which he was Construction Engineer for District VI, Richard S. (Dick) Badger retired on October 31st, last.

Mr. Badger was born October 21, 1882, at White Sulphur Springs, Montana. He received his B.S. in Civil Engineering at University of California, Berkeley in 1906.

In February, 1912, he joined the Division of Highways under J. B. Woodson, first Division Engineer in District VI.

In 1913 he started with the first construction operations in Merced County as Assistant to Resident Engineer Dan Chamberlin, later to become Assistant Division Engineer. He met and married Miss Jean Hohenshell, in July, 1916.

Later Mr. Badger worked at headquarters in the Maintenance Engineer's office, then to District V for early preliminary surveys on the Prunedale Cut-off.

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Department of Public Works

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

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~LEGEND~
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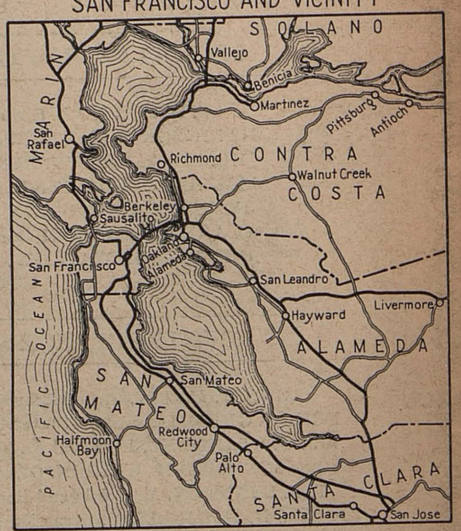
Secondary Routes
Proposed Routes

SAN FRANCISCO AND VICINITY



LOS ANGELES AND VICINITY