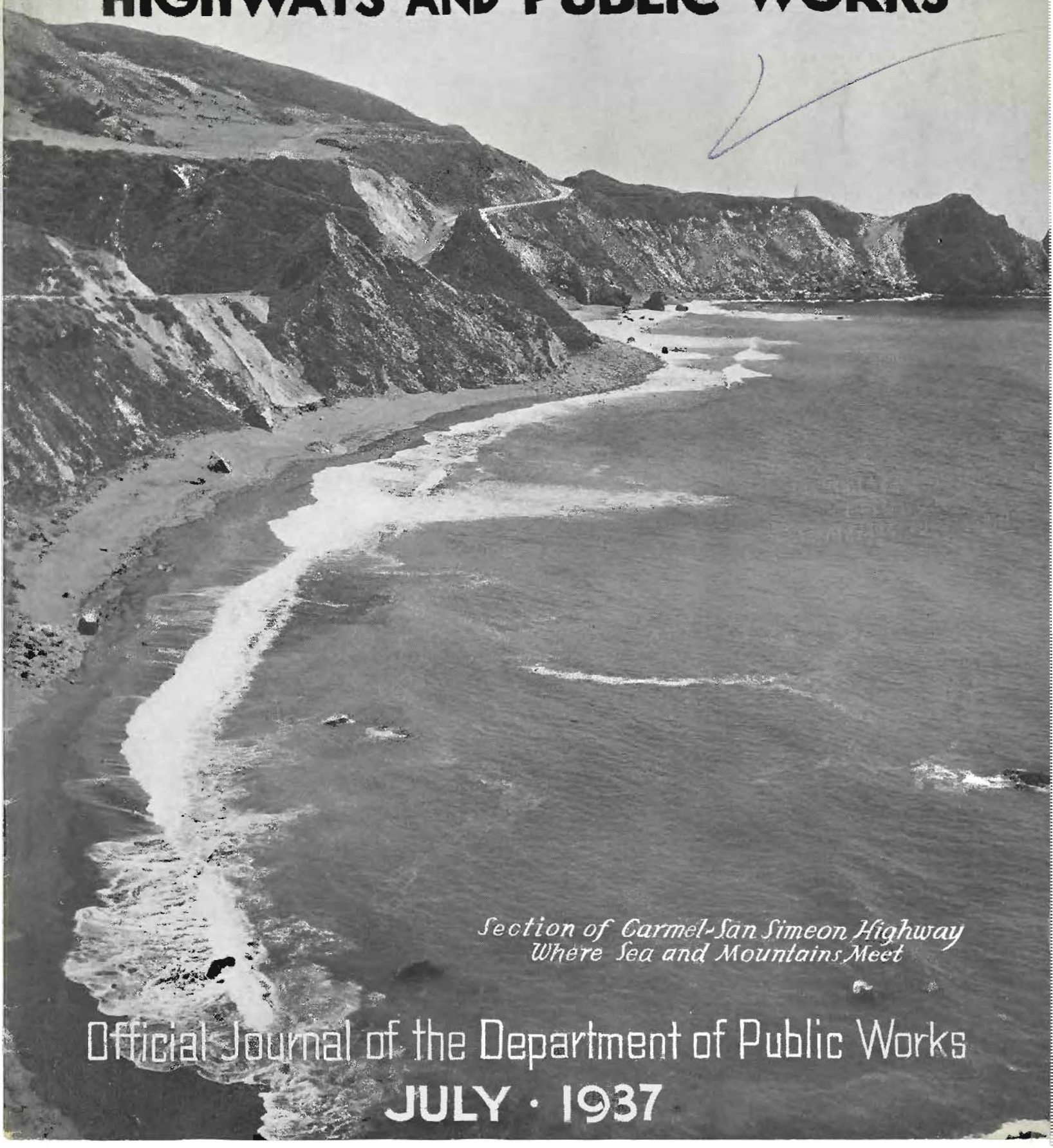
CALIFORNIA
HIGHWAYS AND PUBLIC WORKS



Section of Carmel-San Simeon Highway
Where Sea and Mountains Meet

Official Journal of the Department of Public Works
JULY · 1937

CALIFORNIA HIGHWAYS AND PUBLIC WORKS

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

EARL LEE KELLY, Director | C. H. PURCELL, State Highway Engineer | JOHN W. HOWE, Editor

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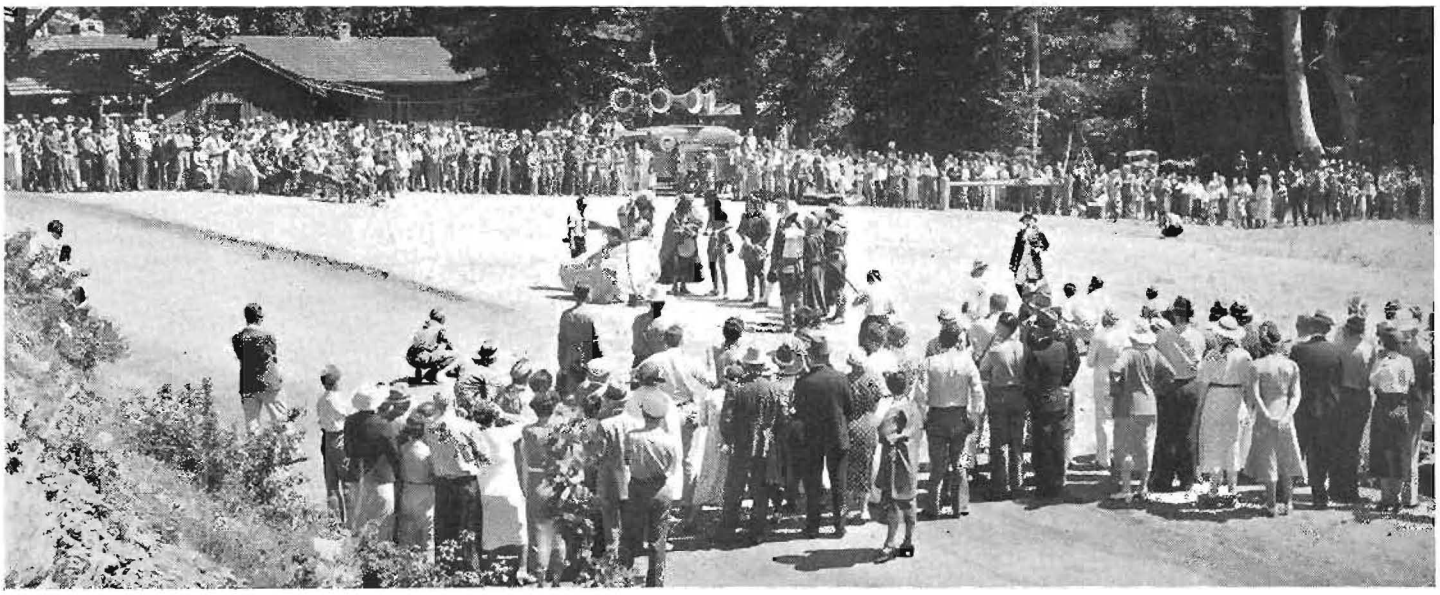

Scene at Pfeiffer Park in Big Sur where Governor Merriam set off dynamite blast to remove large boulder shown in center foreground, thus officially opening Carmel-San Simeon Highway while costumed characters of the past looked on.

A Dream Comes True

By LESTER H. GIBSON, District Highway Engineer

A COLORFUL pageant in which costumed actors depicted the history of the Big Sur country from the period when it was the bed of the Pacific Ocean and through the years of the California aborigines, the Franciscan padres, the Spanish and Mexican conquests, the coming of the British and the pioneers of early days preceding American occupation and leading up to the road builders of the State Division of Highways marked the final dedication of the nine million dollar Carmel-San Simeon Highway at Pfeiffer Park in Monterey County on Sunday, June 27.

Lighting a fuse to a dynamite charge that blasted a huge boulder, symbolical barrier of the new State Highway, Governor Frank F. Merriam officially opened the completed road to traffic. State Director of Public Works Earl Lee Kelly and the Governor then operated a bull-dozer which removed the huge rock from the road and a dream of 40 years came true.

GOVERNOR DEDICATES MONUMENT

The occasion also was the dedication of the Pfeiffer redwood grove and surrounding acres as a State Park. Ceremonies concluded with a barbecue at which talks were made by the Governor, Mr. Kelly, Harry A. Hopkins, chairman of the California Highway Commission; Joseph R. Knowland, president of the California Park Commission; Arthur E. Henning, Chief of the Division of Parks, Dr. John L. D. Roberts, who conceived the idea of the new highway more than four decades ago; Colonel Troop Miller, commandant of the Monterey Presidio; State Senator Edward H. Tickle, Mayor Emmet McMenamin of Monterey and other State, county and civic officials.

Previously, Governor Merriam had dedicated the highway in San Luis Obispo County and a monument at Cambria to the late State Senator Elmer S. Rigdon who fathered legislation twenty years ago appropriating funds to start the highway.

The opening of the Carmel-San Simeon link of the Roosevelt Highway on June 27th, between Carmel and San Simeon brought to a successful culmination the dream of many far-sighted men who, in spite of opposition and lethargy, have carried through the fight to open up to the people of California and of the entire United States this section of coast country which is outstanding in its beauty and scenic grandeur. While we can not give credit to all those who were instrumental in bringing this achievement through to a reality, there are two men who are being credited with the early pioneering work, who should be mentitoned in any story having to do with the history of this development.

One of these, Dr. John L. D. Roberts, a young practicing physician of Monterey, at the time, was impressed with the beauty of this coast country during his trips afoot or horseback to attend the families of the early settlers. As early as 1897 this young doctor made a five day trip on foot through the rugged western slope of the Santa Lucia mountains. He obtained data and pictures which twenty years later, in 1917, through the instigation of Senator Elmer S. Rigdon, were presented to the State Legislature with the result that the legislature provided an appropriation for making surveys and engineering studies for this highway, together with other additional California State highways.

HONOR SENATOR RIGDON

What a thrill it must have been to "Doc" Roberts when, at the dedica-

tion of the Carmel-San Simeon Highway, he saw Governor Merriam formally open this scenic road to the people of the State of California, and brought to a successful conclusion his dream and efforts covering a 40 year period or more.

While "Doc" Roberts has been spared to actually see the dedication of this road, the other outstanding pioneer, Senator Elmer S. Rigdon, passed away in 1922 just after construction was started. His memory was honored on June 27th by dedication of a memorial plaque at a little park on the highway. The tablet to his memory has been set upon a large rugged stone symbolic of the strength and courage of this pioneering legislator. The untiring efforts of the Senator in obtaining recognition from the State Legislature were as essential to putting this road through to its present completion, as was the vision and zeal of "Doc" Roberts, for neither of these men could have accomplished their entire purpose alone.

FUNDS MADE AVAILABLE

Following the initial appropriation for surveys, the voters of California in July, 1919, ratified a Constitutional Amendment providing for the Third Highway Bond Issue of $40,000,000 which required that the Carmel-San Simeon Highway should be included in the State Highway System and a portion of the bond issue be used for its construction. Subsequent appropriations were made from monies available to the Highway Commission for construction purposes, bringing the total of such authorizations to an amount slightly less than $9,000,000.

At the time of the first appropriation covering surveys for the road, there were only very limited means of ingress to this precipitous country. There was a narrow, winding, steep road from Carmel south for a distance of approximately 35 miles to the Big Sur River. From that point south to San Simeon, it could only be traveled by horseback or on foot. There only exisited the narrow trail, known as the Coast Trail, over which all supplies for the survey crews, as well as the early pioneering settlers, had to be carried on mule or horseback from the nearest shipping or supply point.

The terrain through which this road passes is, generally, a rocky, precipitous country, rising from the ocean to a height of several thousand feet. Interspersed are occasional flats broken by many deep, steep canyons in which there are beautiful growths of redwood and other trees and shrubbery indigenous to this particular section of the country.

SURVEYS AND ENGINEERING STUDIES

Following the appropriation for surveys previously mentioned, a stadia reconnaissance survey was made and completed in 1918, which, while not too closely followed in the final location, formed a basis for the ultimate location and construction. In many places the located line deviated considerably from this early survey, taking advantage of a lower plane which offered a better line and grade and a shorter length.

In October of 1919 a location survey party started to work from Anderson Canyon toward Big Sur, which points are approximately 50 and 35 miles south of Monterey. In February of the following year another location survey was started working northerly from San Simeon. From that time on, location surveys

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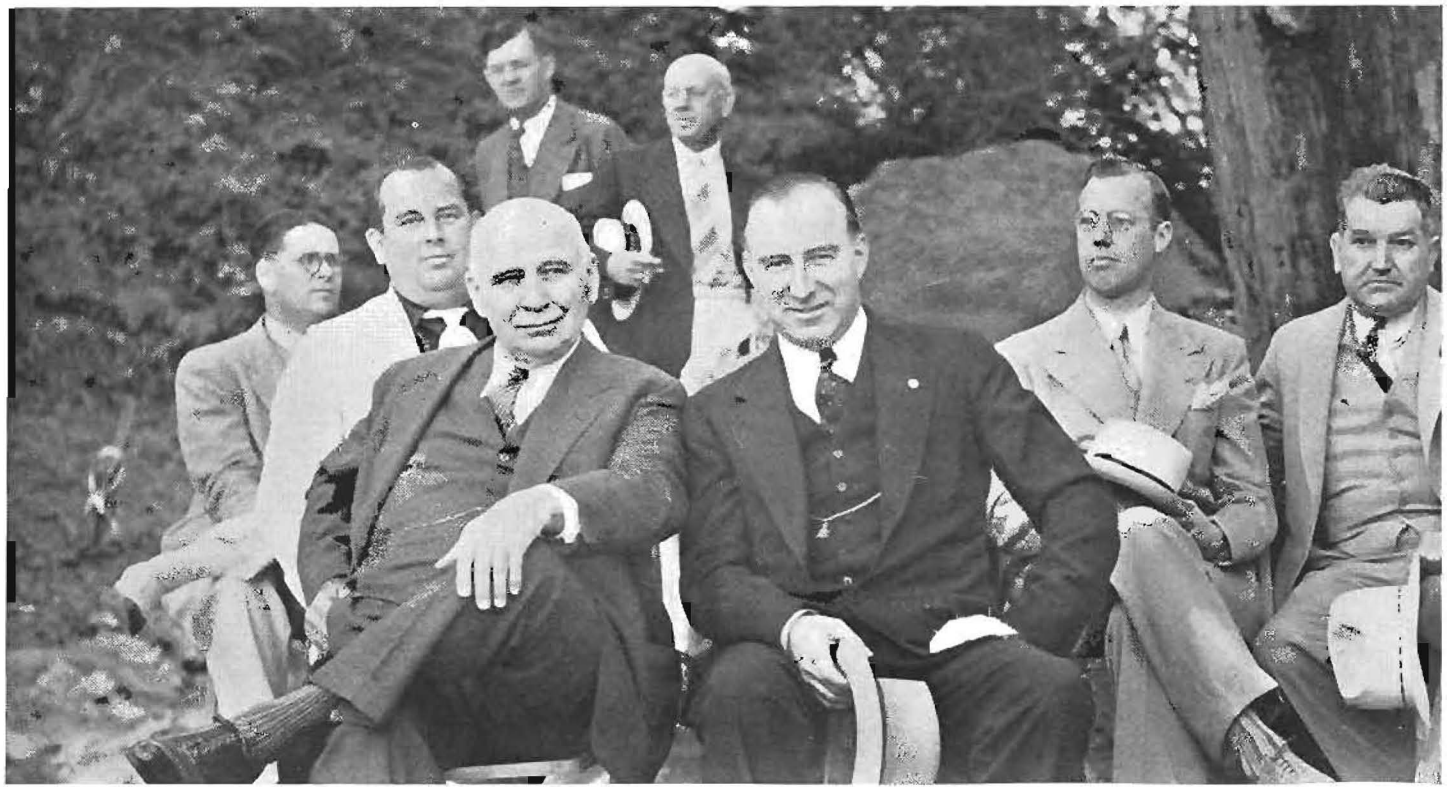


Members of Governor's official party at ceremonies attending dedication of monument to late Senator Elmer S. Rigdon, whose legislative labors helped make Carmel-San Simeon Highway possible. Seated, left to right—Ray W. Shamel, president Cambria Chamber of Commerce; Julien D. Roussel, Secretary, California Highway Commission; Governor Frank F. Merriam, Director of Public Works Earl Lee Kelly, Earl S. Anderson, Registrar of Contractors; Edward J. Neron, Deputy Director of Public Works. Standing—Justus F. Craemer, Assistant Director of Public Works, Highway Commissioner H. R. Judah.

Portion of auto caravan at Carmel-San Simeon Highway dedication.

Governor Merriam places wreath on monument to late Senator Elmer S. Rigdon, early advocate of highway. Left to right: Miss Barbara Edmonson, San Luis Obispo "Outdoor Girl"; Mrs. Elmer S. Rigdon, Miss Joyce Matheson, "Miss Cambria Pines"; Governor Merriam.

Upper—view of section of new highway. Lower—Governor Merriam and Director of Public Works Earl Lee Kelly operate bull-dozer to remove last boulder barricade from new highway. Standing beside them is District Highway Engineer Lester H. Gibson, who supervised building of road.

State Builds 29 Bridges On Carmel-San Simeon Highway

IN BUILDING the Carmel-San Simeon Highway, the design and construction of several of the 29 bridges now in place presented difficult engineering problems. The largest of these structures is the beautiful reinforced concrete open spandrel arch across the mouth of Bixby Creek, 18 miles south of Carmel.

Placing a bridge across the deep gorge where Bixby Creek empties into the ocean was difficult. The concrete abutments, securely anchored into the sheer rock walls 140 feet above the creek bed, are 330 feet apart and the graceful rings of the open spandrel arch bow above the canyon mouth to carry the deck of the bridge approximately 260 feet above the creek bottom. The total length of the bridge deck is 714 feet, there being three 40-foot reinforced concrete approach spans on the southerly end and six on the northerly end. In the construction of this spectacular arch 6,600 cubic yards of concrete and 600,000 pounds of reinforcing steel were used.

The bridge is so placed that the curving highway approaches afford an excellent view of the structure. The Bixby Creek bridge is the largest concrete arched highway structure in the western states.

BEAUTIFUL STRUCTURES

About one mile north of the Bixby Creek bridge a similar, but smaller, open spandrel arch was constructed across the mouth of Rocky Creek. This graceful structure has an arch span of 239 feet and the 497 feet of total deck length carry the roadway 150 feet above the creek. Similar reinforced concrete arches of shorter spans were built across Granite, Garrapata and Mal Paso creeks and a sixth arch bridge consisting of three short arch spans crosses Wildcat Creek about five miles south of Carmel.

Upper photo shows size of multi-plate culvert used in constructon of Carmel-San Simeon Highway. Lower—Long length of multi-plate culvert used 45 miles north of San Simeon on new road.

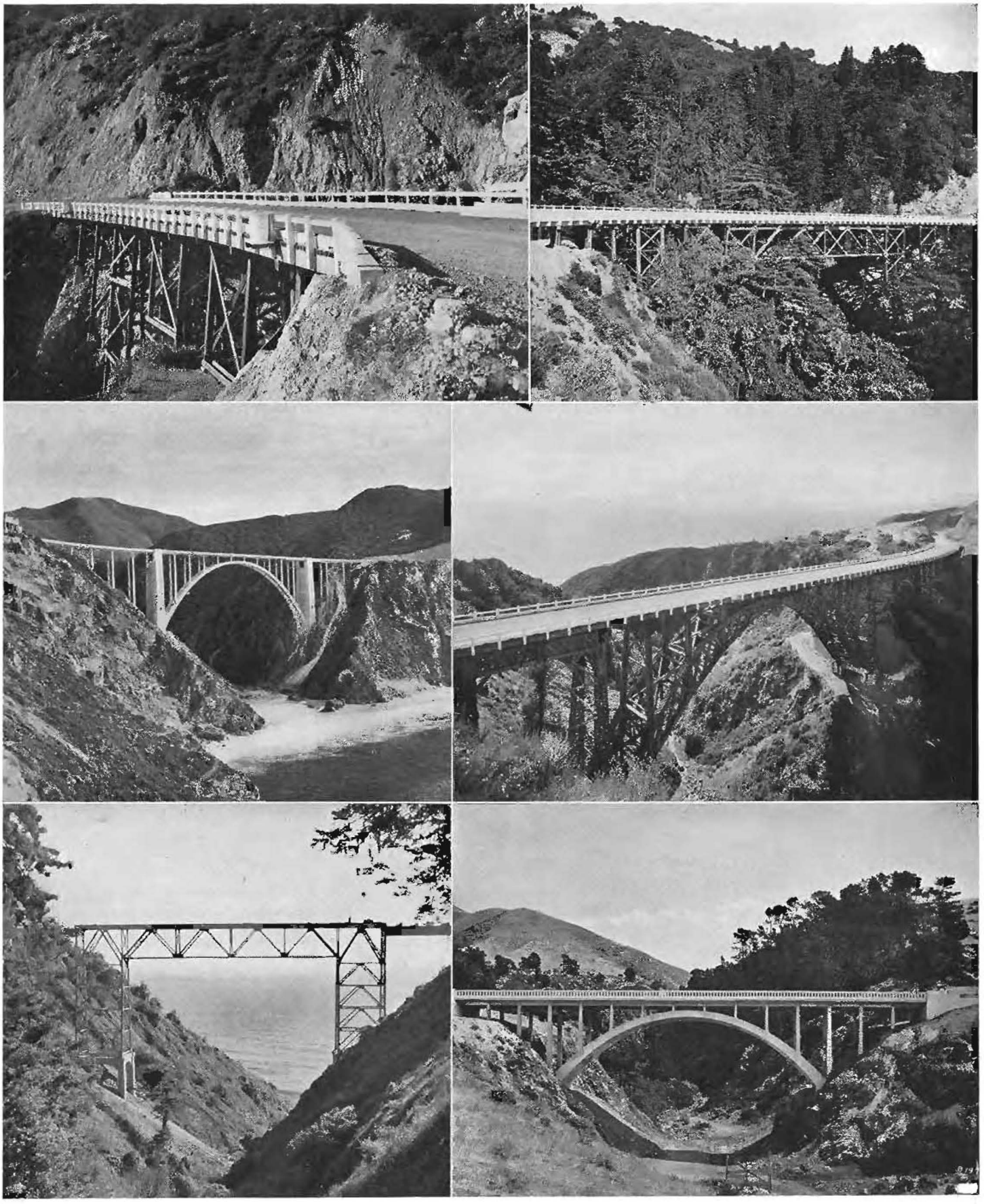
Another bridge of interest, to be built as a unit of the Carmel-San Simeon project, is the 514-foot structure across Dolan Creek with its 180-foot three hinged timber arch span in the center. The depth and width of the Dolan Creek gorge dictated a structure with a long central span and to eliminate long haul of concrete aggregates from Monterey, a timber structure, using the recently developed metal ring connectors for joints, was selected. Built of redwood, the Dolan Creek timber arch is an impressive structure as it carries the roadway 150 feet above the creek bed.

MODERN TOURIST HIGHWAY

Most of the bridges on this scenic ocean highway, such as those across Lime, Prewitt and Wildcattle creeks and Torre Canyon are of the usual timber construction, while others, like the Burns Creek, San Simeon, Pico and Little Pico creeks are of steel.

Completion of the Carmel-San Simeon route opens to the California tourist a modern highway which is replete with the incomparable views obtainable only at those rare locations where the mountains meet the sea. The majesty of rocky promontories with colorful surf breaking at their bases will leave memories never to be forgotten of the natural grandeur of this section of California. Such points as the Point Lobos State Park, picturesque Carmel Highlands, Point Sur with its famous lighthouse and the palatial Hearst estate at San Simeon will all add to the pleasureable interest of the trip along this new State highway.

The work on the 93 miles between Carmel and San Simeon has presented one of the most noteworthy pieces of highway engineering accomplished on the west coast in recent years and has given to the traveling public a modern ocean shore highway of unparalleled beauty with superb views of the Pacific from elevations ranging from sea level to that of Grimes Point at elevation 1058.



Pictorial story of the bridges of the Carmel-San Simeon Highway. Six of the twenty-nine completed structures on the scenic route. Upper left—Lime Creek Bridge. Upper right—Torre Creek Bridge. Center left—Bixby Arch. Center right—Dolan Creek structure. Lower left—Bridge over Burns Creek. Lower right—Mal Paso Bridge.

State Constructing New Road Leading Into Death Valley

This is a story of the building of a desert road; the story of a road through fantastical formations to romantic Death Valley; the story of a road to connect the deepest portion of these United States to the highest peak within our country; the story of the Darwin Cut-Off, the building of which may best be told by the men who directed the stages of its growth.

S. W. Lowden, Acting District Engineer.

RECONNAISSANCE

By J. N. STANLEY, Associate Highway Engineer

A MAP of the existing road from Lone Pine, in the Owens Valley, to Stovepipe Wells, in Death Valley, shows a great bend to the south, with the little settlement of Darwin at its southernmost apex.

It was conceived that distance could be saved if another route could be found, that would cut across this "dog leg," a route that would follow the ridges and be out of the path of cloudbursts, and with alignment that could be constructed economically, yet be an improvement over the existing tortuous grades of Zinc Hill, that nemesis of the tourist.

A narrow, dusty road, approximately 19.9 miles in length, with grades of from 15 to 20 per cent, and curves of 30-foot radius made another alignment imperative.

Each summer cloudbursts descended upon Darwin Wash, down which the old road wound its way, and each summer found the maintenance forces rebuilding a State highway which had been obliterated.

DIFFICULT RECONNAISSANCE

In 1934 heavy footgear was put in order, and a start was made upon a reconnaissance of that country lying north of Darwin. No roads exist in that jagged array of mountains, the few trails made by wild horses and burros led nowhere and horseback riding was out of the question due to the poor footing and lack of grazing and water. Headquarters was established at Darwin, and a Ford express

(Continued on page 27)

Survey and Plans

By MILTON HARRIS Associate Highway Engineer

NOVEMBER of 1935 found our location party in Darwin ready to undertake the task of running a line into Panamint Sink from a point approximately six miles west of that town.

Following the route of the reconnaissance survey of the year previous, centerline was rapidly staked for the first six miles, and the plans completed in our field office. To allow access to that portion of the project lying in proximity to the rim of canyons extending into Panamint Sink, a crude road was built for some eight miles to the head of what was later cristened "Rainbow Canyon" by the party. From the head of this canyon, an old game trail was followed in reaching line. This trail skirted the very edge of this many-hued gorge, estimated to be over 800 feet in depth. Relics of early Indian habitation were discovered along this trail, and as a result of our daily hike that unfolded the colorful strata of the canyon walls, it was decided that at all costs we must locate the new highway so that travelers would enjoy this scenery.

ECONOMY IN CONSTRUCTION

Descending on a steady 6 per cent grade from the rim of the high plateau, we kept our line on the best possible ground, seeking for economy in construction at all times. We managed to swing to the brink of "Rainbow Canyon" after having circled its upper reaches, unfolding,

(Continued on page 27)

CONSTRUCTION

By A. C. BRINEY Associate Highway Engineer

ON DECEMBER 30, 1936, a contract was awarded the Peninsula Paving Company, and on January 12, 1937, the first equipment moved on the project. Operations were started at the westerly end with scraper equipment as the first 5.5 miles were through loose material, easily moved with this type of machinery. Freezing weather added an unexpected obstacle, however, as the loose material congealed to a depth of from 8 to 10 inches, necessitating the use of rooters. Even the desert experiences freezing temperatures, especially at a 5,000-foot elevation.

The next 5.3 miles developed material that was of a rocky, cemented nature, interspersed with ledges of solid rock. The latest type of tractor equipment pulled rooters through this material, and scrapers were able to move the major portion of the excavation into place. The rocky portions were loosened with powder and moved into the embankments with the aid of a power shovel and trucks.

THROUGH VOLCANIC DEPOSITS

The remaining 6.8 miles of the project are composed of rock in all stages of hardness, position and mixtures. Past movements of the earth's crust and volcanic action threw an intricate variety of problems into the hands of the contractor.

A hillside of large boulders piled one above the other, each boulder of a consistency that caused it to ring

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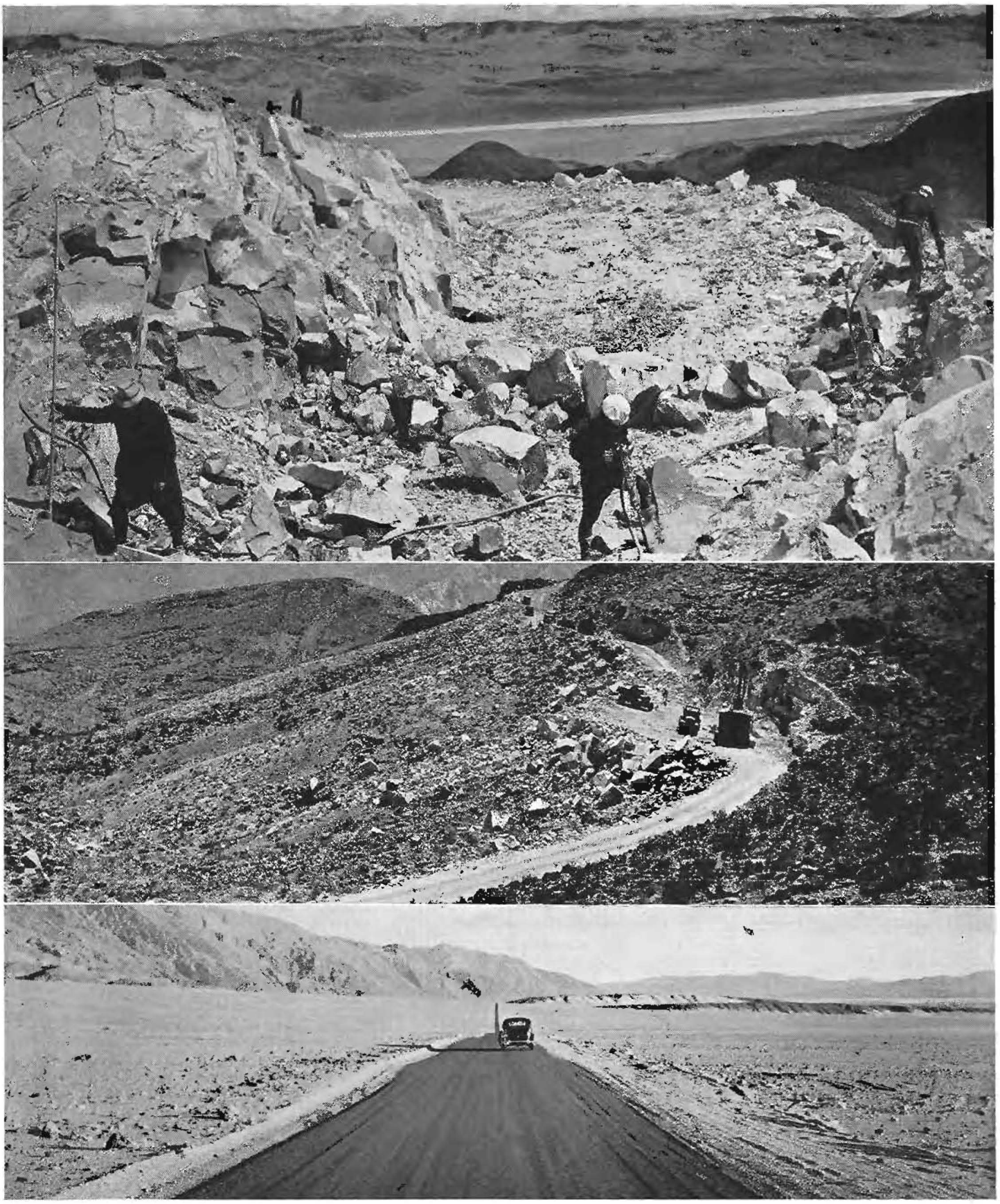

Construction scenes on new highway leading into Death Valley and eliminating Darwin Wash. Drillers at work on difficult stretch with Panamint Sink and Panamint Mountains in distance. Heavy equipment at work on grade which will do away with steep, narrow roadbed over Zinc Hill and Lane Hill. Section of completed desert highway.

Extensive Highway Planning Survey Undertaken By State

By K. A. MacLACHLAN, Assistant Maintenance Engineer

FOR the past year the Division of Highways has been conducting a state-wide highway planning survey in cooperation with the U. S. Bureau of Public Roads. These surveys are being made by forty states for the purpose of collecting data needed to coordinate future highway planning efforts.

On many parts of the present State Highway System which were constructed in the early stages and on parts which were inherited from the counties, the existing degree of improvement is vastly inadequate, made so largely by unpredictable changes in the design and degree of use of motor vehicles.

The nature of such changes, affecting principally the speed of vehicles, determines the character of the road's deficiency. These deficiencies lie to a great extent in grades, alignment and width. These three features are therefore made the subject of a limited feature survey which seeks to list and classify them to the end that their modification may be studied.

SELECTED ROUTES SURVEYED

In California this particular phase of the Highway Planning Survey has been confined to selected routes embracing 9,129 miles of State Highway, Federal Aid Highway, National Park, National Forest, and county roads. The limited features recorded were restricted horizontal and vertical sight distances; curvature, showing location, length and radii of curves; superelevation on curves; percentage and length of all grades of three per cent or more when 500 feet or more in length. In addition, notes were made of the length and type of traffic stripe, and the type of topography of sections traversed.

Much information was readily available on highway plans filed in the office of the Division of Highways. Alignment and grade data for 4,972 miles were transferred from these plans to field check sheets to facilitate the field work.

No plans were readily available on many of the inherited roads. It was therefore necessary to procure all of the required data on 4,157 miles, in the field. To expedite this work, special instruments were designed, constructed and installed in two light sedans. The design and use of these instruments are described here in some detail.

The instrument for measuring the radii of horizontal curves—the curvometer—was attached to the No. 1 car. Those for determining the superelevation on curves and for measuring the rate or per cent of grades were called a superometer and gradometer, respectively, and were attached to the No. 2 car.

The curvometer, of the protractor type, was made of plywood in the form of a half circle of the same diameter as the steering wheel and attached with brackets to the dash about two inches under and parallel to the wheel. A pointer was attached to the top of the wheel on the exact center when the car was driven on a tangent.

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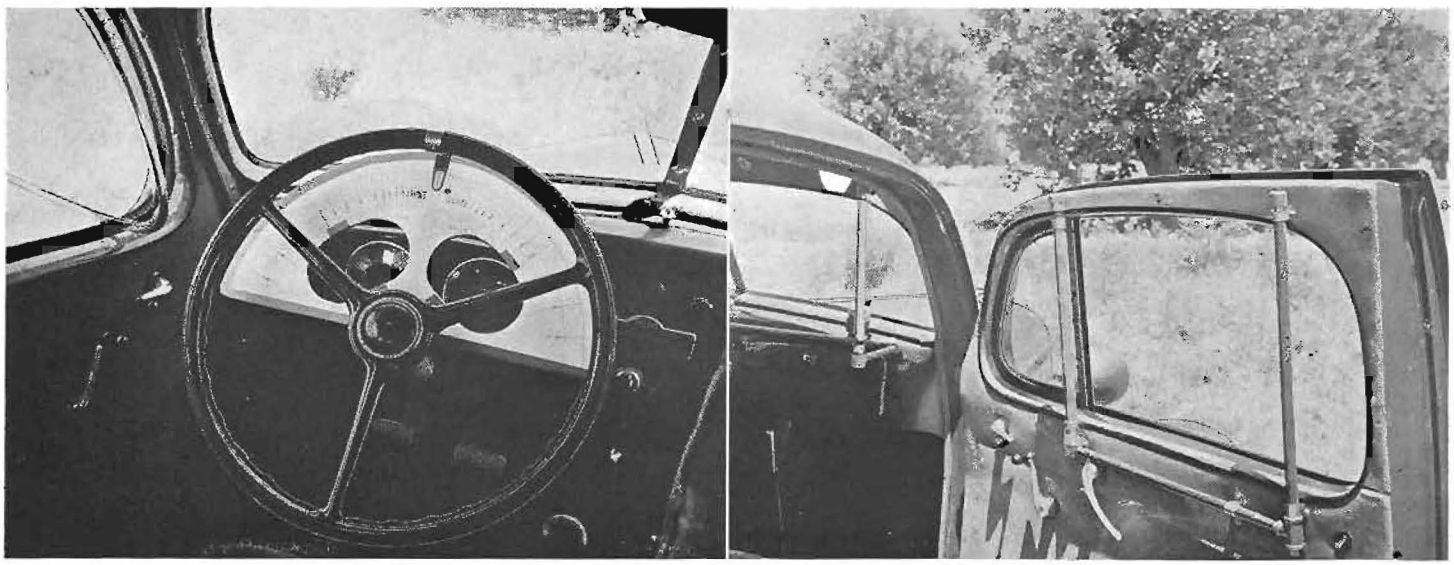
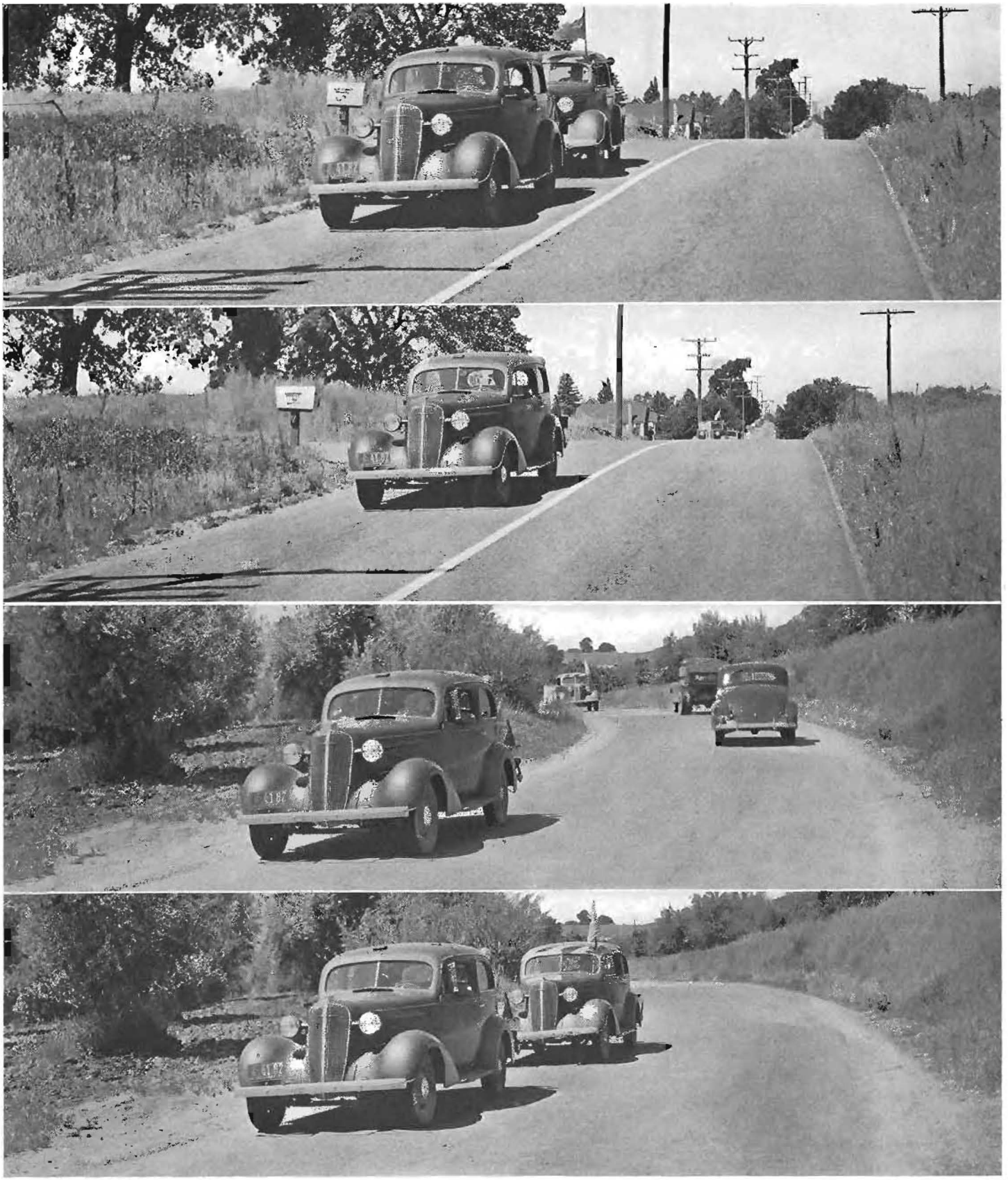


Meters used in sight distance survey. Left—Curvometer attachment on steering wheel of survey car used to measure curvature of highway. Right—Superometer mounted on car dash to measure superelevation and gradometer mounted on door to measure per cent of grade.



These pictures show Division of Highways sight distance survey party at work. Upper—Gradient being measured. Next—Taking measurement of limited sight distance on vertical curve. Next—Measuring limited sight distance on horizontal curve. Lower—Measuring curvature and superelevation.

Construction Progress and Pavement Records for 1936

By EARL WITHYCOMBE, Assistant Construction Engineer

THE outstanding feature in highway construction in California during the year 1936 was the preliminary treatment of subgrade, prior to the placing of pavement, particularly for asphalt concrete and Portland cement concrete types. The improvement of both the foundation and the immediate subgrade are of primary importance, and too much emphasis can not be placed on the most careful and scientific analysis and proper treatment of these factors in pavement construction. A brief description of the methods employed is given below. Details of pavement construction and records are shown in accompanying tabulations.

GRADING AND PAVEMENT FOUNDATION

Foundation Important

The roadway, which is identical to any other engineering structure, should rest on an unyielding foundation in order to secure best results. Insecure foundation conditions are largely the result of subsurface saturation, and wherever possible, areas which can not be readily drained and corrected are avoided in the location stages of highway design. It becomes necessary, however, at times to construct pavements over isolated areas of this description, and by means of boring tests the extent of such instability is approximately determined. Once determined, it becomes a question of economics as to the proper method of correction.

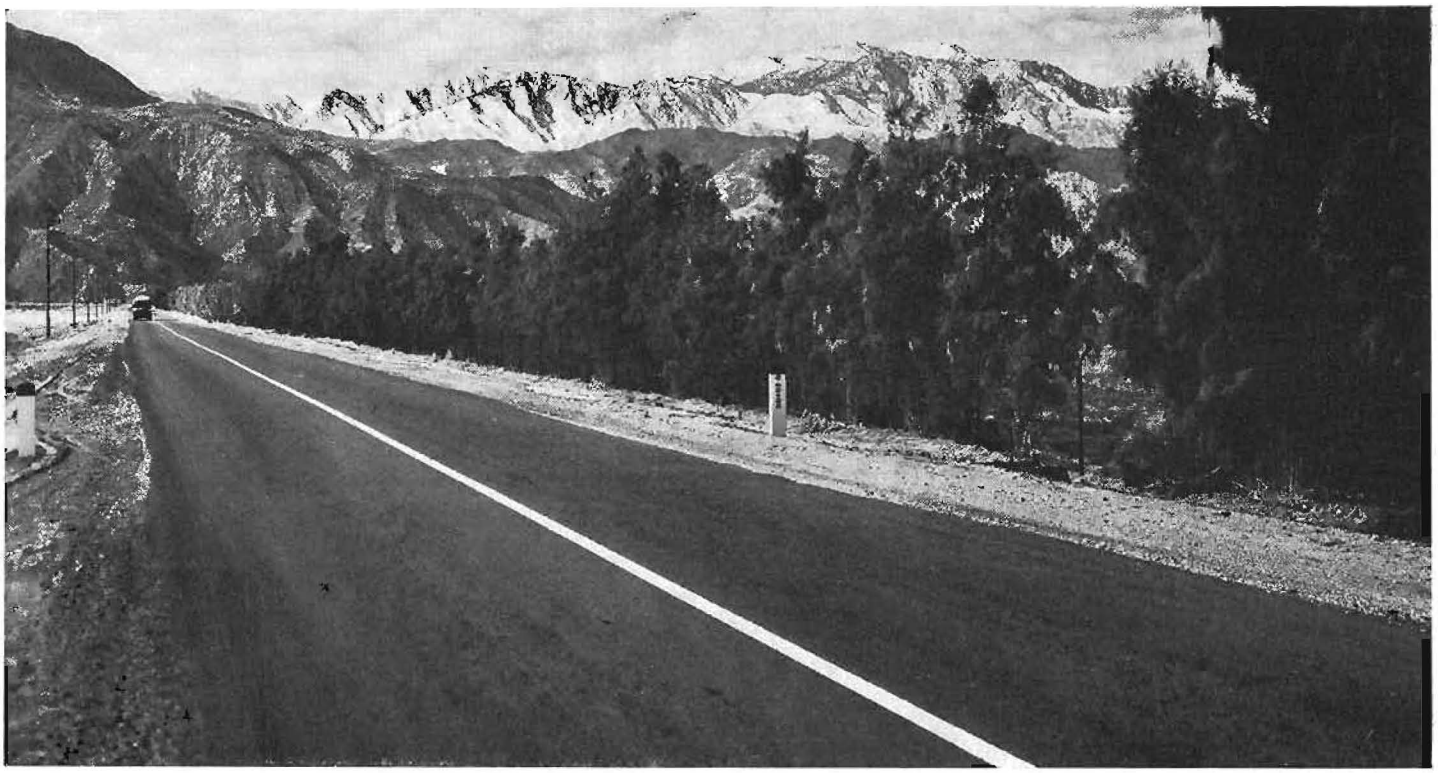
Methods Used

The methods used in California, listed as to their feasibility and order of consideration, are as follows:

(1) Dewatering by gravity flow induced by subsurface drains
(2) Removal and replacement of the unstable material
(3) Building of an embankment strut between the unstable mass, if dry, and an adjacent stable geological structure
(4) Construction of a stable roadbed by means of a systematic overloading of the roadbed area to obtain displacement of underlying mud and followed by removal of surplus overload to the planned elevation
(5) The construction of vertical drains for dewatering underlying mud

The first four of these methods are in quite common use by highway engineers. It has become general practice in California construction to supplement methods (1) and (2), wherever rock is available, by excavating a toe trench to solid foundation on the lower side of the unstable area and backfilling with as coarse rock fragments as are available. This type of submerged gravity rock toe wall is particularly effective under a variety of conditions.

Fine example of 20-foot asphalt pavement laid on a 3.8 mile section of highway near Vacaville in Solano County.



This is a sample of 20-foot road-mix oiled surface on a 10.9 mile section of highway in Riverside County, west of Indio.

New Departure

Method (5) is particularly worthy of description, as it is comparatively new and was originated by the Division of Highways. This method consists of sinking a large diameter well casing to the bottom of the unstable area and as the casing is removed, filling the hole with a porous and granular aggregate. The spacing of the vertical drains must necessarily be on rather close centers, which makes the method rather expensive. On the limited experimental sections constructed to date, it would appear that the rate of consolidation of the unstable material under the load of the superimposed roadway is greatly accelerated, and if sufficient time can be permitted between the construction of the roadway and the final paving, distortion of the riding surface may be minimized. Lateral movement of the unstable area during consolidation, however, may decrease the effectiveness of this method, and reasonable care must be exercised in the construction. It is necessary to connect the tops of the vertical drains, by means of porous subdrains, to a convenient outlet.

"Well, my pal has joined the silent majority."

"Dead, eh?"

"Married."

STABILIZATION OF SUBGRADES

Stabilizing of subgrades is generally accomplished with a blanket course of suitable material of sufficient depth to distribute the load to limits well under the maximum bearing power of the underlying materials. Where suitable blanket material is difficult to obtain, consideration is given as to whether an admixture can economically be added to the native soil, or the road relocated in a more favorable locality.

Even the most economical of foundation treatments is an expensive procedure and has resulted in considerably increased cost of construction. In general, however, the decrease in subsequent maintenance expenditures and the increased convenience to the traveling public have adequately justified the added expense.

PORTLAND CEMENT CONCRETE

Construction Methods

The conventional methods of finishing were used throughout the 1936 season's work. Due to the difficulty in obtaining floatmen with experience, an effort was made to reduce the weight of finishing tools, especially the floats, to make them more workable by the average individual.

Joint Construction

All transverse joints are doweled with $\frac{3}{4}$ inch round steel bars on 14-inch centers. The only other steel used is the $\frac{1}{2}$ inch square reinforcing bar fixed by chairs driven into the subgrade to support each end of the dowels, and the longitudinal tie-bars at selected locations. Wherever subsequent movement was anticipated in high embankments, tie-bars were used across the longitudinal joint consisting of $\frac{1}{2}$ inch square bars in longitudinal weakened plane joints, and threaded sleeve-connected $\frac{3}{4}$ inch bolts placed along longitudinal construction joints.

The joint interval was almost uniformly 20 feet, with provision made for $\frac{1}{2}$ inch expansion at each 60-foot interval.

Mixtures

Considerable reduction in the cement content was undertaken during the past season. Forty-nine per cent of the season's mileage was constructed of concrete with but five sacks to the cubic yard. Provision was made in the specifications to

(Continued on next page)

PORTLAND CEMENT CONCRETE PAVEMENT RECORDS FOR 1936

Location	Contractor	Resident Engineer	Street Assistant	Average cu. yds. laid per 8-hour day	Average strength of concrete, 28 days—lbs. per square inch.	Per cent average daily variation in cement	Roughness index, inches per mile
South Entrance to Red Bluff	N. M. Ball Sons	M. Fredericksen	A. Bigelow	199.0	4589	1.01	11.6
Plumas St., Bridge St.—Scott St., in Yuba City	Leo F. Plazza	J. P. Murphy		48.3	4248	3.80	---
M St. Subway—Sacto. River Brg.	A. Teichert & Son	J. D. Greene	R. T. Williams	126.4	3087a	2.13	18.6
Folger Ave. Subway—9th St.	L. C. Seidel	L. G. Marshall	H. M. Chapman	190.7	4793	1.78	18.0
SF Bay Bridge—Folger Ave.	Hanrahan-Wilcox Corp.	L. G. Marshall	J. O. Dietschy	114.3	4780	.85	8.5
Tajiguas Creek—Arroyo Hondo	Granfield, Farrar & Carlin	V. E. Pearson	F. C. Weigel	370.4	4455	.50	5.2
¼ mi. S. of Kern Co. Line—Fort Tejon	Griffith Company	F. M. Reynolds	C. C. Hinsdale	355.5	3427b	.74	4.9
At Walnut Canyon	C. F. Robbins	G. R. Halton	H. D. Johnson	239.8	4498	2.10	8.9
Little Sycamore Canyon—Encinal Canyon	Oswald Bros.	C. N. Ainley	G. H. Lamb	372.7	4074	.44	10.8
Seal Beach—Newport Beach	Geo. R. Curtis Co.	W. D. Eaton	E. E. Jackson	463.0	4412b	.70	8.0
Oxnard—Hueneme Road	J. E. Haddock	G. E. Farnsworth	G. H. Lamb	444.1	5496	.96	12.7
At Newport Beach	Mundo Engineering Co.	L. R. McNeely	H. D. Johnson	240.8	3980	1.50	12.2
Rosemead Blvd., San Gabriel Blvd.—Ramona Blvd.	C. O. Sparks	C. P. Montgomery	H. D. Johnson	308.5	5172	.86	7.9
Sepulveda Blvd., Lincoln Blvd.—Centinella Ave.	Match Bros.	C. N. Ainley	G. H. Lamb	432.0	3804	.56	5.5
Route 19—Anaheim-Spadra Road	C. R. Butterfield	H. B. Lindley	H. D. Johnson	325.7	5570	.72	12.0
Between Club Road and El Circulo	J. E. Haddock, Ltd.	G. E. Farnsworth	J. R. Rubey	272.0	5039	3.28	13.9
Gypsum Creek—Riverside County Line	Gibbons & Reed	F. B. Cressy	W. T. Lamb	418.8	4306	.65	7.1
Santa Ana River—Alabama St.	Matich Bros.	J. M. Hollister	W. H. Crawford	358.1	3865b	1.08	12.8
Rosemead Blvd., Longden Ave.—Fairview Ave.	J. E. Haddock, Ltd.	C. P. Montgomery	A. G. Black	389.3	5953	1.22	6.1
1 mi. N. of Carquinez Br.—Cordelia	Hanrahan-Wilcox Corp.	A. N. Lund	L. E. Ford	690.0	3636b	.92	25.9
2.2 mi. West of Indio	B. G. Carroll	R. C. Payne	L. B. Munro	290.7	4321	.68	18.2
			Averages	380.5	4180	.85	12.1

[a] 10-day break, early hardening cement.

[b] Class B concrete, average strength, 3740#.
Class A concrete average strength, 4550#.

ASPHALT CONCRETE PAVEMENT RECORDS FOR 1936

Location	Contractor	Resident Engineer	Street Assistant	Average tonnage laid per day	Average stability of surface mixture in lbs.	Average relative specific gravity of surface mix %	Roughometer index, inches per mile
Corning—Proberta	Peninsula Paving Co.	M. Fredericksen	W. M. Douglas	247.4	32%*	93.9	11.6
C Street—American River	A. Teichert & Son	J. P. Murphy	W. J. Braker	472.0	35%*	91.2	19.3
Yolo Causeway—M St. Subway	A. Teichert & Son	J. D. Greene	W. W. Greer	526.0	2358	92.7	19.1
SF Bay Bridge—Folger Ave.	Hanrahan-Wilcox Corp.	L. G. Marshall	J. W. Smith	488.7	2185	96.0	14.6
34th St.—7th St., Oakland	Hanrahan Company	F. W. Montell	J. W. Smith	601.7	26%*	95.9	11.5
12th St., 20th Ave.—29th Ave.	Healey-Moore Co.	F. W. Montell	E. W. Strandberg	185.9	2825	87.0	17.2
Richfield Tower—Santa Maria River	Healey-Moore Co.	H. J. Doggart	B. G. Stone	305.0	2930	96.1	11.5
Approach to Marengo St. Bridge	Tomei Construction Co.	W. D. Eaton	E. H. Dewing	256.8	3462	---	105.8
Verdugo Road—Flintridge Country Club	Geo. R. Curtis Paving Co.	W. J. Calvin	A. L. Hawkins	579.7	2960	95.6	14.9
San Fernando Road through Newhall	Geo. R. Curtis Paving Co.	E. L. Seitz	A. W. Carr	504.9	3550	96.1	11.4
At Newport Beach	Mundo Engineering Co.	L. R. McNeely	H. D. Johnson	422.0	39%*	94.3	31.7
Fenwick St.—Scoville Ave., Sunland	Southwest Paving Co.	M. H. Mitchell	H. C. Loose	304.2	2470	97.7	21.5
San Fernando Rd.—Central Ave., Glendale	Southwest Paving Co.	G. E. Farnsworth	A. W. Carr	292.1	3250	96.7	50.8
Traffic Circle—Los Angeles St.	Sully-Miller Co.	E. A. Parker	A. W. Carr	642.2	2764	97.3	14.6
Chapman Ave. and Glassell St.	C. O. Sparks	H. B. Lindley	A. W. Carr	173.6	3344	96.2	16.1
Camarillo State Hospital roads	Oswald Bros.	P. E. Ruplinger	A. W. Carr	261.7	3444	92.0	18.8
3.7 mi. N. of Fairfield—0.8 mi. S. of Vacaville	Union Paving Co.	A. K. Nulty	E. D. Bulton	694.0	2975	93.9	13.0
			Averages	447.0	2650	94.3	14.7

* Stabilometer Test.

blend fine sand with the ordinary commercial product, but on only one job was this found necessary. These mixtures are somewhat harsh, but it was demonstrated during this season that excellent results could be obtained with such reductions in cement.

The vibration method of placing concrete was set up as an alternate method in the specifications, but no contractor has seen fit to avail himself of this opportunity. An attempt was made to substitute vibration along the side forms in lieu of spading by means of trailing individual

BITUMINOUS TREATED SURFACE RECORDS FOR 1936

Location	Contractor	Resident Engineer	Roughness, inches, per mile
Plant Mix			
S. City Limits Eureka—Wabash Ave.	Mercer-Fraser Co.	J. C. Black	26.8
1.5 mi. E. of Bella Vista—Diddy Hill	Peninsula Paving Co.	L. H. Williams	31.3
Kyburz—Strawberry	Union Paving Co.	W. G. Remington	25.9
4 mi. N. Willows—1 mi. S. of Artois (por.)	N. M. Ball Sons	E. Hay	76.3
Donner Lake—Truckee	Pacific States Const. Co.	G. M. Leatherwood	32.0
Walnut Grove—Freeport (por.)	A. Teichert & Son	J. D. Greene	15.8
4.5 mi. NE. of Tahoe City—Nevada Line	Hemstreet & Bell	J. C. Womack	38.1
Dunnigan—Arbuckle	Hanrahan Co.	H. D. Ragan	48.2
Main St., Second St.—Elm St.	A. Teichert & Son	J. D. Greene	41.8
Orland—Northerly boundary	N. M. Ball Sons & Larsen Bros.	A. P. Bosworth	22.7
Folger Ave.—Camellia St.	Hanrahan Co.	L. G. Marshall	33.5
In Oakland at Berkeley Line	Hanrahan Co.	L. G. Marshall	18.3
Soledad—Gonzales	A. J. Raisch Co.	J. C. Adams	28.8
Lincoln St.—W. City Limits, Salinas	Granite Construction Co.	A. L. Lamb	70.1
Somis—Saticoy	Oswald Bros.	P. E. Ruplinger	35.4
Clark—Sudden Barrancas	Kovacevich & Price	B. N. Frykland	25.8
At Teague—McKevett Crossing	Dimmitt & Taylor	B. N. Frykland	35.2
Beaumont—San Bernardino County Line	Oswald Bros.	D. J. Stout	48.2
Verdemont—0.8 mile west	Geo. Herz & Co.	G. E. Malkson	14.2
At Little Mountain Entrance to San Bernardino	Geo. Herz & Co.	J. M. Cowgill	29.2
In Benicia	Louis Biasotti & Son	A. L. Tschantz-Hahn	220.9
Turlock—Keyes	S. M. McGaw	R. C. Clarke	43.2
4 mi. W. of Westmorland—Trifolium Canal	Oswald Bros.	F. B. Stewart	23.7
1.4 mi. S. of Thermal—Jct. Rte. 26	R. E. Hazard & Sons	J. M. Hodges	22.1
		Average	33.5
Road Mix			
Adin—Rush	Fredericksen & Westbrook	H. F. Caton	68.2
Ede's Ranch—Beckwourth Pass	A. Teichert & Son	C. A. Potter	19.7
1.5 mi. N. of Meyers	J. R. Galbraith & D. A. Canevari	H. F. Sherwood	---
Knights Landing—Robbins	Hanrahan Co.	J. W. Corvin	32.8
Lewis Creek—Priest Valley	Young & Son	E. F. Carter	90.8
3 mi. N. of Big Sur—Molera Ranch	Granfield, Farrar & Carlin	K. B. Knudsen	54.0
Bear Valley—1 mi. N. of Willow Creek	Union Paving Co.	R. Windele	43.3
1 mi. E. of Santa Inez—Los Olivas	Oswald Bros.	V. E. Pearson	64.2
1 mi. E. of Cholame—Kern Co. Line	A. Teichert & Son	C. R. Burns	33.4
Hollister Ave.—Painted Cave Road	Granfield, Farrar & Carlin	V. E. Pearson	14.8
4.5 mi. S. of Shafter—Shafter	Southern Calif. Roads Co.	J. W. Cole	26.0
Eric—La Rose	A. Teichert & Son	D. G. Evans	16.5
3 mi. NE.—4 mi. NE. of Taft	John Jurkovich	R. M. Reynolds	37.9
Yokohl—1 mi. N. of Lemon Cove	Union Paving Co.	C. F. Oliphant	39.4
West Casitas Pass—East Casitas Pass	Daley Corporation	W. L. Welch	22.9
East Casitas Pass—Coyote Creek	C. F. Robbins	W. J. Calvin	49.7
Camarillo State Hospital roads	Dimmitt & Taylor	B. N. Frykland	26.2
Santa Ana River—M St. Colton	B. G. Carroll	E. A. Bannister	20.5
Los Angeles County Line—Pipe Line Ave.	Dimmitt & Taylor	D. J. Stout	33.0
1 mi. NW. of Lake Arrowhead—Lake Arrowhead	Geo. J. Bock Co.	G. E. Malkson	21.1
Westerly Bdy.—Route 59	Basich Bros.	C. V. Kane	41.0
Near Third St., Barstow—0.6 mi. East	Matich Bros.	O. B. Brinkerhoff	45.8
10 mi. W. of Indio—Indio	Sharp & Fellows	E. L. Evans	18.3
Big Pine—Keough Hot Springs	Basich Bros.	A. C. Briney	12.1
3 mi. N.—12 mi. N. of Mojave	A. S. Vinnell Co.	C. M. Rose	23.0
2 mi. S. of Rush Creek—2 mi. N. of Leevining	Basich Bros.	A. C. Briney	29.4
Sullivan Creek—3.5 mi. East	Union Paving Co.	G. R. Hubbard	32.3
3.5 mi. E. of Sullivan Creek—Pooley's	M. J. B. Construction Co.	G. R. Hubbard	29.4
		Average	30.0
Miscellaneous Types			
Putah Creek—Davis	E. F. Hilliard	M. E. Ryan	83.4
Scott's Valley—1 mi. N. Santa Cruz	Peninsula Paving Co.	A. Walsh	28.9
Stony Point Road—Cotati	N. M. Ball Sons	H. A. Simard	144.2
Across Thompson Gulch	A. Teichert & Son	H. J. Doggart	75.6
Bolsa Ave., Bay Blvd.—Bolsa Chica Rd.	Sulley-Miller Co.	F. B. Cressy	47.9
		Average	60.0

units over the surface adjacent to the side forms, but this proved to be unsuccessful.

Construction Records

The maximum average daily output of Portland cement concrete pavement, reduced to an 8-hour comparative basis, was placed on Contract 810TC2-510TC2-410TC8, road X-Sol, Nap-7, 8-FGHA, 1 mile north of Carquinez Bridge to Cordelia, by Hanrahan-Wilcox Co., 690 cubic yards being produced by two pavers. A. N. Lund was the resident engineer with L. E. Ford as street assistant. The maximum output for one paver was 463 cubic yards per day, on Contract 87VC9, road VII-Ora-60S1B,A, NptB, Seal Beach to Newport Beach,

(Continued on page 20)

Manchester-Firestone Boulevard Is Opened By Governor Merriam

By P. A. McDONALD, Assistant Engineer

Upper—Governor Merriam cuts ribbon to formally open Manchester-Firestone Boulevard, being assisted by Miss Bernice Legg and Miss Susanna Dudlex. On the Governor's right are Frank C. Balfour, Master of Ceremonies, and Chairman Harry A. Hopkins of the California Highway Commission. Lower—View of section of new highway.

GOVERNOR Frank F. Merriam, officials of the Department of Public Works, prominent Los Angeles County officials and civic leaders aided the citizens of Downey Saturday, June 26, in formally dedicating and celebrating the completion of Manchester-Firestone Boulevard through that community.

A program of speaking was held at the intersection of Firestone Boulevard and Downey Avenue, and the official opening of the boulevard took place in front of the speakers' stand when Governor Merriam cut a red ribbon held by two "ribbon girls," Bernice Legg, daughter of Los Angeles County Supervisor Herbert C. Legg, and Susanna Dudlex, daughter of Sam Dudlex, chairman of the day and prominent Downey citizen.

Following dedication ceremonies, a luncheon was served to one hundred and fifty guests at the Downey Women's Clubhouse, where Governor Merriam again spoke.

Supervising Right of Way Agent Frank C. Balfour acted as master of ceremonies at both programs.

Governor Merriam, in his address, told of the inauguration of the gasoline tax, of the many highways it has built, and of the fact that the demand for greater and more highways keeps well ahead of the ability to create the new traffic lanes, and urged that this source of revenue be retained for its intended purpose and not diverted to uses other than building and maintaining highways.

Assistant Director, Justus F. Craemer, in a short talk spoke of the traffic toll and highway accidents and urged greater caution in driving.

Carmel-San Simeon Highway at Last Becomes Reality

(Continued from page 2)

were almost continuously in progress. Great credit is due these engineering survey parties for their stout-heartedness in connection with this location work for they were at many places only able to obtain their information by being lowered over cliffs on ropes. It was surprising how quickly the engineers adapted themselves to this rugged country and acquired an agility resembling that of the mountain goat.

FIRST CONTRACT WORK

The first contract for construction was awarded to the firm of Blake & Heaney, who started in 1921 to grade between Piedra Blanca Lighthouse, approximately six miles north of San Simeon, to Salmon Creek. This contract was completed in December of 1924, having graded a road width 21 feet wide in cuts and 24 feet wide in fills.

In September of 1922, George Pollock & Company started work on a contract to grade between Anderson Canyon and Big Sur. This contract covers one of the most rugged areas along the coast and was fraught with difficulties such as have been experienced in but few places elsewhere in the State. When the natural slopes were disturbed great quantities of rock material came down in slides which caused considerable delay as well as danger to the men and equipment doing the work.

In one of these slides a power shovel was carried from the roadside down to the ocean 500 feet below where it was so completely wrecked it had to be abandoned. Great difficulty was encountered by this contractor in getting his equipment and supplies to the job on account of the very limited hauling facilities and finally he brought most of his materials through by launch and barge to a sheltered cove about midway of the job, where his camp was established.

CONVICT LABOR WORK

Following the completion of the Pollock contract in October of 1924, no further work was done on the Carmel-San Simeon highway, except maintenance, until 1927, when the

decision was made to utilize prison labor for the construction. The first prison labor camp was established near Salmon Creek in March, 1928, with accommodations for 120 convicts and 20 free men, who worked northerly from this point which was the northerly end of the first named contract above. The original intention in establishing the prison labor camp was to construct the road principally by hand methods, but this was found to be so slow and inefficient that it was later decided to bring in equipment, including shovels, scrapers, etc., and confine the convicts' operations to purely hand labor work such as drilling, constructing masonry walls, parapets, etc.

In July of 1928 another prison labor camp was established near the mouth of the Little Sur River about 18 miles south of Carmel, from which point the grading of the roadbed along the coastal cliffs between Molera's Ranch and Rocky Creek, a distance of 8 miles, was carried on. When this section of road was completed the camp was moved to Anderson Canyon where it remained until the completion of the work in June, 1937. Work from this camp was carried southerly from Anderson Canyon to Big Creek, which is approximately 46 miles south of Carmel.

Upon the completion of this section the same crew started working north towards Big Sur. The reconstruction and realignment of this section was the final work accomplished from the Anderson Canyon convict camp. The southerly convict camp working north from Salmon Creek carried construction through to Big Creek, moving the camp ahead as the work progressed to Willow Creek and later establishing the camp at Kirk Creek, which is about midway in the portion of road constructed by convict labor.

HUGE BLASTING JOB

One of the outstanding construction features on the work handled was, undoubtedly, the carving of a roadway around Limekiln Bluff, about 37 miles north of San Simeon. This is a massive promontory of solid granite rock, rising several hundred feet, nearly vertically from the ocean. A single charge of dynamite and black powder, totaling 34 tons, dislodged approximately 97,000 cubic yards of solid rock, of which, about 70,000 cubic yards was blown into the ocean. A total of 163,000 yards was eventually removed at this point, within a distance of 1,000 feet.

The two convict camps working toward each other met in September, 1934, and on the 18th day of that month, the final barrier was removed and a few official cars were driven through the entire distance from San Simeon to Carmel for the first time, although a considerable portion of the road was still what is known as a construction road, and only wide enough for one car, with steep detour roads down into the various deep canyons traversed.

BRIDGES ARE NUMEROUS

While this road work progressed from either end, it was necessary to construct short detour roads down into the canyons and cross the streams with short temporary bridges, which were later replaced with permanent structures. A total of 29 bridges have been completed between Carmel and San Simeon. There are still three structures to be completed to span the various streams along this route.

All bridges were designed and constructed under the direction of F. W. Panhorst, Bridge Engineer.

RIGHTS OF WAY

The Division of Highways is glad to acknowledge the generous cooperation of most of the land owners along the route. Rights of way in the undeveloped sections were generally donated and but few selfish individuals were encountered.

The most serious right of way problem, and the most costly right of way, was through the highly developed Carmel Highlands subdivision, about 4.5 miles south of Carmel. Through this subdivision the engineers made every effort to avoid destroying any of the features which tend to make the area one of the outstanding attractions on the route.

The Carmel-San Simeon section of the Roosevelt Highway either passes through or is in close proximity to the Pfeiffer Redwood Park and Point Lobos Reserve.

SUMMARIZATION

When construction work is completed the State will have moved 13,000,000 cubic yards of material, built 32 bridges, varying in size from small timber structures to the stately reinforced concrete arch at Bixby Creek, and have expended close to $9,000,000. The money expended covers all construction costs, the cost of engineering, and payments for right of way.

Another Needed Link of Olympic Boulevard Opened

FORMAL opening of Olympic Boulevard, between Bronson Avenue and Rimpau Boulevard in Los Angeles, was celebrated on July 1 by State, county and city officials and business groups of the Olympic Boulevard Improvement Association and other organizations.

The dedicated project, completion of which will be realized toward the end of July and in anticipation of which festivities were held, is one of the most essential lengths of the Olympic Boulevard undertaking. The new section is an opened and improved stretch, approximately three-quarters of a mile in length, between Bronson Avenue and Rimpau Boulevard, entailing a cost of around $100,000, financed out of gasoline tax funds, and is 100 feet wide between property lines, with a 74 foot roadway.

NEEDED DEVELOPMENT

Opening of this stretch between Crenshaw and Lucerne boulevards was through an area that had been about 95 per cent built up. The Olympic Boulevard development extends from Route 60 at Santa Monica, easterly to the east city limits of Los Angeles at Indiana Street, where it makes connection with Route 166, locally known as Anaheim-Telegraph Road.

Much credit for the progress made in this important project has been given to the Olympic Boulevard Improvement Association under the leadership of James C. Dolan, its president, also to Dr. J. Dryden Davenport, President of the Los Angeles Street Property Owners Association, and to the many individual property owners who have donated right of way for the improvement, of which approximately $1,200,000 of the State cooperative and ½-cent gas tax funds have been set aside out of the 1937-39 biennium.

Mr. Dolan presided at the dedication which began after the severing by Miss Carlyn Frank of a ribbon stretched across the new boulevard.

From a platform erected nearby, a program of speaking was held in which Director of Public Works Earl Lee Kelly gave the principal address.

Record Made In Building Road Detour

By J. W. VICKREY
District Engineer

THE Division of Highways is at times called upon to do emergency quick-time jobs, in order to maintain uninterrupted traffic service, that tax the resourcefulness of a well trained organization to the limit.

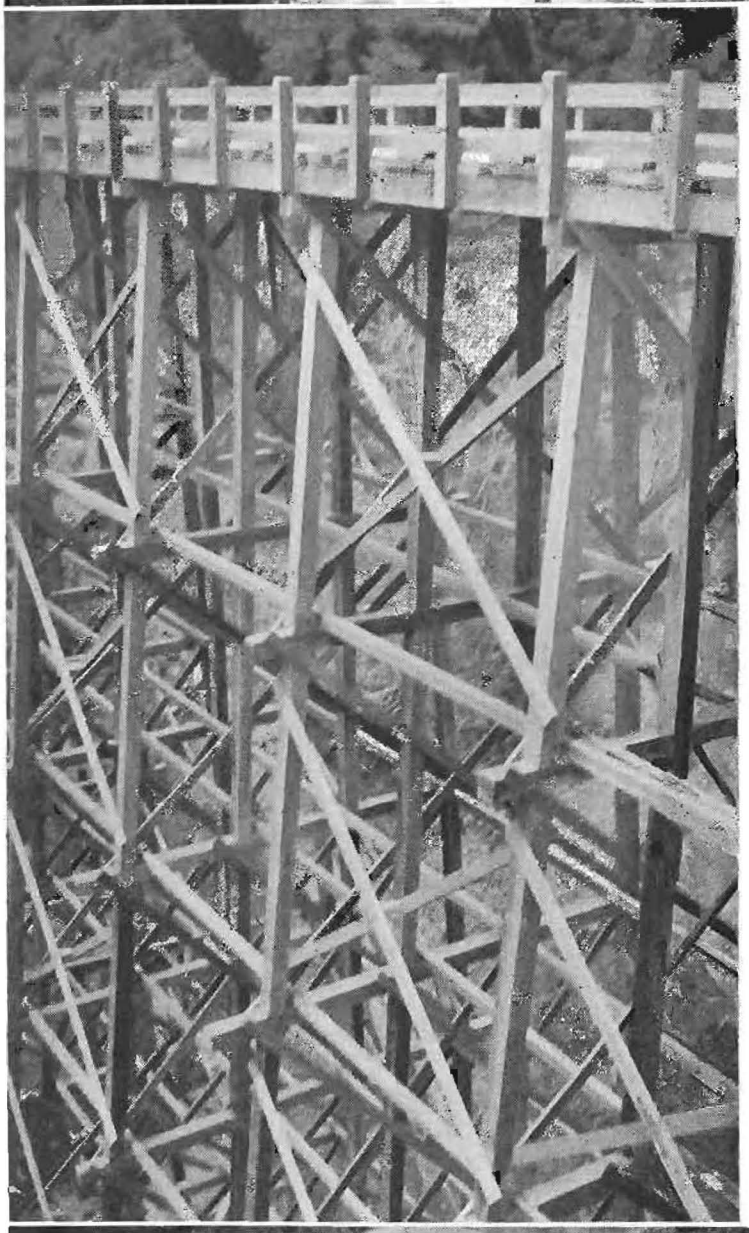
The old wooden truss bridge across Rock Creek, in northern Mendocino County, on the Redwood Highway suddenly and without warning "gave up the ghost" on April 21st. The bottom of the canyon at the bridge site is 150 feet below highway grade, and the sides are steep, rocky, and irregular, in all presenting a very uninviting location for quick bridge replacement.

The construction of a detour around the bridge was, from a practical standpoint, out of the question and there are no roads parallel to the Redwood Highway in this part of the county. The total failure of the bridge meant a complete tie-up of the Redwood Highway and an isolation of Humboldt County from highway traffic almost equal to the "before the road was open" days.

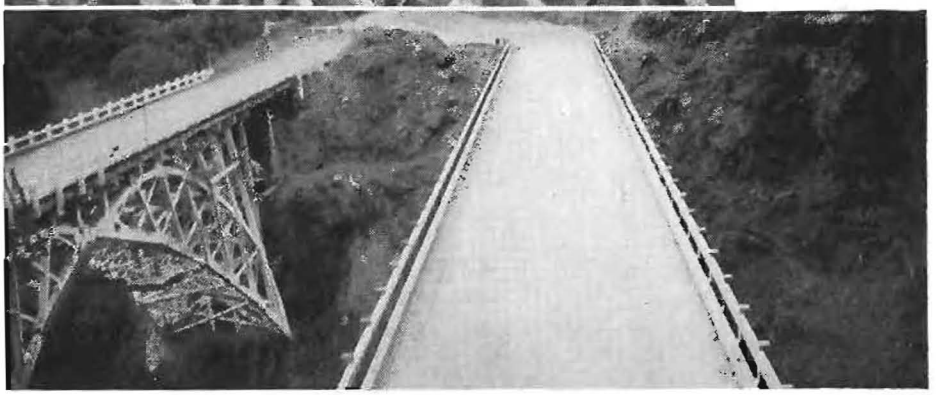
The bridge members that had failed were quickly scabbed and the bridge kept open to automobiles and trucks of not over four tons total load. Excavation for footings for a new frame bent trestle were started on April 26th upstream and parallel to the old bridge.

The almost perpendicular sidewalls of the canyon required the removal of some 3,000 cubic yards of rock and shale in order to secure adequate footings. To accomplish this in quick time, a shovel and truck were dropped into the canyon with the high line that had been hurriedly set up to place the new bridge timbers.

Approach construction and framing of the 175,000 feet of timber proceeded concurrently with the excavation work, and trucks were permitted to cross the new bridge with legal loads on May 29th.



This trestle detour built in record time over Rock Creek was designed on the job by Al Lernhart and was constructed under the direction of Bridge Department engineers. The timber was framed under the direction of Ernie Smith, and the excavation and other necessary work under Carl Miller, Maintenance Superintendent. It is an interesting fact that these gentlemen directed the construction of the old bridge in 1916. The old bridge was designed in the District I office under the direction of Mr. Haselwood, now District Engineer at Redding, and was built by day labor forces. It was designed, so Mr. Haselwood states, to carry a 10-ton roller and to last for twenty years.



View of section of Maze Road between Modesto and Tracy which is boon to agriculturists.

Maze Road Relieves Traffic Problem

By R. E. PIERCE, District Engineer

ONE of the roads added to the State Highway System by the 1933 legislature, under the Breed Act, called locally the Maze Road, and which at present runs westerly from Modesto to the San Joaquin River, will be an important cross artery with the ridge and approaches completed under a previous contract, and further improvement east and west of the river now about completed.

The road originally proposed to be taken into the system, under this act, ran from Modesto to Westley with bridges over the San Joaquin and Tuolumne rivers. In general the roads taken into the State system by the 1933 act were existing traveled roads. The Maze Road is an exception to this rule, as no road existed across and to the west of the San Joaquin River.

The forward-looking people of Stanislaus County and especially of Modesto, had in mind for many years, a direct road connecting the San Francisco Bay area and Modesto, and extending easterly to Yosemite Valley, and action was taken through the board of supervisors to have the Maze Road made a part of this ultimate plan.

The board agreed to secure right of ways from the westerly end of the Maze Road to the westerly county boundary, and grade and oil surface their part of this new road lying east of the river, and with this assurance the Maze Road was made a State highway in lieu of the existing road to Westley, which, as shown on the map, is out of direction and has numerous sharp curves.

The San Joaquin County authorities also agreed to secure the right of ways and grade the road on the portion in their county, from the easterly boundary to Vernalis where it connects with Route 41, the West Side Highway.

Both the boards carried out their agreements except that as the oiling in Stanislaus County could not be completed by them, they turned over an amount of $3,000 to the State as the estimated cost of completing their obligations.

Funds for the construction of a bridge across the San Joaquin River were originally set up in 1934, based on building a fixed span. The War Department refused to grant a permit for the construction of a fixed span, and as no more money was available, it was decided to use this money for building a relocated road between Newman and Crows Landing, a much needed improvement on this important West Side Highway. Later the War Department withdrew their objection to a fixed span and the work was soon advertised and under way.

Funds at first set up were not adequate to complete even a graded and dust oiled road to connect with the West Side Highway at Vernalis, so

(Continued on page 28)

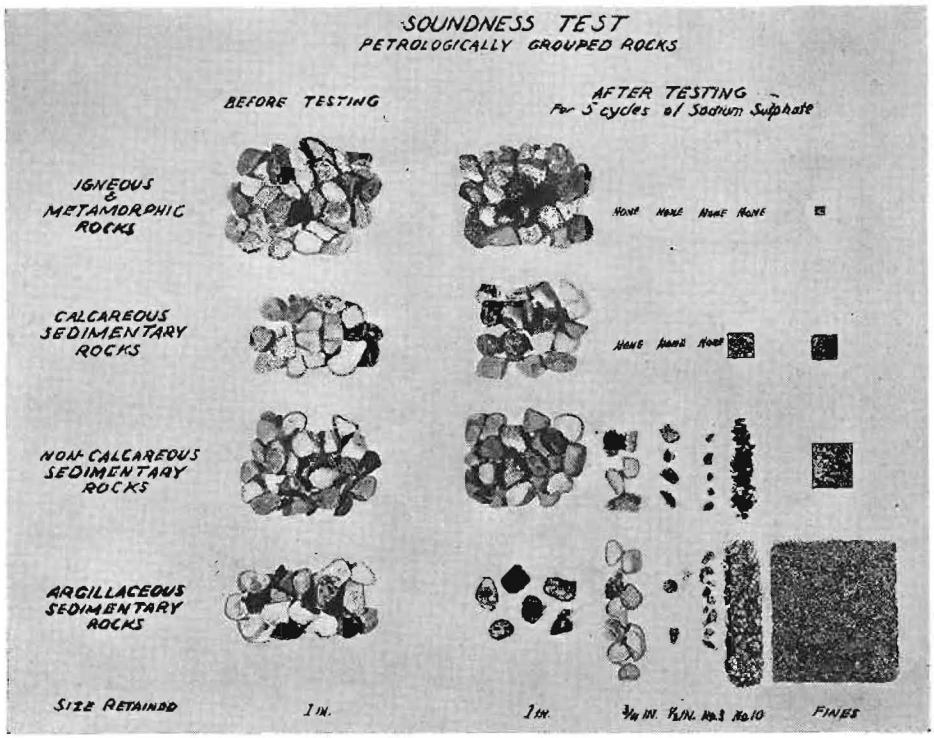
Selection of Aggregates for Portland Cement Concrete

By ALLEN NICOL, Junior Mineralogist, Materials and Research Department

THE purpose of this article is to describe briefly a few of the types of rocks which are commonly found in the aggregates of this State, with a discussion of their origin, mineral composition and suitability in highway use.

Aggregates comprise the coarse and fine rock matter used with water and cement to fabricate concrete. They consist then primarily of rock and sand. The rock particles above a No. 3 mesh are known as coarse aggregate, and below a No. 3 mesh as fine aggregate, chiefly sand.

The aggregates used in the construction of our concrete highways, bridges, subways and overhead structures are most commonly obtained from rivers and streams, or old river channels. A considerable amount of coarse aggregate is obtained from ledge deposits and crushed to suitable size. In ledge deposits the rock is usually of one type, whereas in river gravels the three main types of rock may be found all together.



Showing various forms of rocks before and after testing for Portland cement concrete use.

VARIETIES OF MINERALS

A mineral may be defined as any naturally occurring substance of definite composition forming part of the earth's crust. Rocks are aggregations of minerals, although one mineral alone may sometimes constitute a rock. Of some seventeen hundred known varieties of minerals but very few constitute the bulk of all rocks. One authority states that 99.9 per cent of the earth's crust is composed of only twenty minerals. These are the fundamental rock forming minerals, with which we are vitally concerned from an aggregate standpoint. Of these twenty minerals, a few have been found to possess properties which seriously affect the quality of any rock of which they are a part. Inasmuch as rock quality is our criterion in judging aggregates, the link between mineralogy and sound concrete highways is readily seen.

On the basis of origin there are three main types of rocks: igneous, sedimentary and metamorphic. Igneous rocks are those which have formed by the solidification or consolidation of molten magma, and are therefore primary rocks. Examples are granite, diorite and basalt.

TYPES OF ROCKS

Sedimentary rocks form from igneous rocks through the agencies of chemical action, wind action, freezing and thawing, and water. As these rocks break down, soluble particles are leached out and carried away in solution. Insoluble particles are carried in suspension, and both are eventually redeposited. These rocks are called secondary. Examples are limestone, shale and sandstone. The metamorphic rocks are formed from preexisting igneous or sedimentary rocks and are more or less completely changed from their original condition through the action of great heat, pressure, or both. Examples are gneisses and schists.

The three main types of rocks; i.e., igneous, sedimentary, and metamorphic, are each divided into hundreds of different varieties based on mineral composition, grain size or texture, occurrence, and other properties. No attempt will be made here to treat with the ramifications of these varieties, their peculiarities, and terminology. Considerable attention needs to be given to those streambed aggregates which carry rock types known to be deleterious. Such types may be detected through the abrasion and soundness tests as used in this laboratory. Special attention is given through the use of the petrographic microscope.

The three types of rocks are dis-

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Ribbon-cutting ceremony opening last link in Bay Shore Highway. Left to right are Timothy Reardon, State Director of Industrial Relations; H. Ray Judah of Santa Cruz, State Highway Commissioner; Earl Lee Kelly, with scissors, State Director of Public Works; Adron Beene, assemblyman, 30th district; Richard French, president San Jose City Council; Col. John H. Skeggs, district engineer; L. B. Lundborg, State Chamber of Commerce; Noa Gayle, president San Jose Chamber of Commerce; C. F. Price, resident engineer, and A. J. Raisch, contractor. Photo courtesy San Jose Evening News.

Last Link In Bay Shore Highway Dedicated

VISIONED more than thirteen years ago, the Bay Shore Highway connecting San Francisco and San Jose, heart of the rich Santa Clara Valley agricultural empire, became a complete unit of the State Highway System on June 12 with the official dedication to public service of the final 3.1 mile link from the Agnew Underpass to San Jose.

When Earl Lee Kelly, Director of the Department of Public Works, representing Governor Frank F. Merriam, snipped the ribbon stretched across the road his action signalized the completion of this $10,000,000 highway project.

The new unit connects the Agnew Underpass with the Oakland Highway near Gish Road. It is a divided highway with two 20-foot strips of concrete separated by an eight-foot section of bituminous surface.

FINEST HIGHWAY

"I consider this the finest highway in the State of California," said Col. Jno. H. Skeggs, Fourth District Highway Engineer, under whose supervision the road was built, who was one of the speakers at the dedication ceremonies. "There are no grade crossings, aside from spur tracks, except one in San Jose, which we hope to eliminate within the next year and a half. This highway link cost $230,000 to construct and is not designed as a high speed road, but a safe thoroughfare for all classes of traffic."

In a brief dedicatory talk, Director Kelly said:

"We have the finest highway system in the world, but so great has been the increase in automobile travel in California that we are ten years behind the times. The San Jose-Oakland and San Jose-Gilroy routes need new highways and we are now going ahead with plans for an east-shore highway on the Oakland side of the bay to San Jose."

OFFICIALS CUT RIBBON

With a pair of scissors, Director Kelly cut the barrier ribbon, which was held by Irene Tripp and Gladys Scott. He was assisted by Nao Gayle, president of the San Jose Chamber of Commerce, and Richard French, president of the San Jose City Council, who also wielded snippers.

Highway Commissioner H. Ray Judah of Santa Cruz; Timothy Reardon, Director of the Department of Industrial Relations, and Col. Skeggs made brief addresses.

Short talks were made by Mr. Gayle, Assemblyman Adron A. Beene, Richard French, president of the city council; Joseph M. McKinnon, supervisor; City Manager C. B. Goodwin; George Glans, president, Merchants' Association; L. B. Lundborg, manager of the central coast district, State Chamber of Commerce; Russell Pettit, manager of the local Chamber of Commerce, and I. B. Wright, assistant secretary, highway division of the State Chamber.

The dedication ceremonies were held under the auspices of the San Jose Chamber of Commerce and the California State Chamber of Commerce and were in charge of M. R. Bookwalter, chairman of the highway committee of the San Jose Chamber of Commerce.

A gentleman was walking down the street with his little boy at his side when the youngster cried out, "Oh, Pa! There goes an editor."

"Hush, hush," said the father. "Don't make sport of the poor man. Who knows what you may come to yourself some day."

Construction Progress and Pavement Records for 1936

(Continued from page 13)

Geo. R. Curtis Co., contractor, W. D. Eaton, resident engineer. The average daily output for the State during 1936 was 385.7 cubic yards, compared to 343.3 cubic yards in 1935.

Strongest Concrete

The **strongest concrete** placed during 1936 was on Contract 87XC18, road VII-LA-172-C, Route 19 to Anaheim-Spadra Road, with an average compressive strength of 5570 pounds. C. R. Butterfield was the contractor and H. B. Lindley, resident engineer.

Out of a total of 134,900 cubic yards of concrete pavement laid, 69,270 cubic yards, or 51.3%, was Class "A" mix, with an average strength of 4550 pounds, compared to 4965 in 1935. Four large pavement projects used 65,628 cubic yards of Class "B" concrete, being 48.7% of the total yardage placed, and having an average strength of 3740 pounds at 28 days.

Cement Control

The record for **cement control** was made on Contract 67VC24, road VII-Ven,L.A.-60-A, Little Sycamore Canyon to Encinal Canyon, with an average variation of 0.44%. Oswald Bros. were contractors, C. N. Ainley, resident engineer, with G. H. Lund, street assistant. The average variation for the State was 0.85%, compared to 0.93% in 1935.

Surface Smoothness

The record for **surface smoothness** was obtained on Contract 86VC1-46VC4, road VI-LA,Ker-4-DA, ¼ mile south of Kern County line to Fort Tejon, where the average roughness per mile was 4.9 inches. The contractor was the Griffith Company, F. M. Reynolds, resident engineer, and C. C. Hinsdale, street assistant. The average for the State was 12.1 inches per mile, compared to 9.3 inches in 1935. During 1936, the smoothest and the roughest riding qualities were encountered on projects constructed with 5-sack concrete, which seems to indicate that especial care must be exercised with reduced cement content mixtures in order to get good results. With the elimination of one such Class "B" rough project, the average roughness for the year is reduced to 9.0 inches per mile, which is comparable with previous years' records.

ASPHALT CONCRETE

Construction Methods

A decided improvement has been made in the average riding qualities of asphalt concrete during the past season, which is largely due to the improved equipment used to spread and to roll the mixtures, to the use of better methods in straightedging, and to better-trained personnel. Contractors have generally discarded obsolete equipment and provided the latest improvements when replacements were made. The marking straightedge, similar to that described in the February, 1937, issue of California Highways and Public Works, has been generally used throughout 1936.

The large amount of asphalt concrete pavement laid during 1935 has given our construction personnel a wider training in laying this type of pavement, and that training has been reflected in the past season's work. It has been found necessary to increase asphalt contents to compensate for the inert asphaltenes which are disclosed in the petroleum ether solubility test. These increases in asphalt are contributing to the workability of mixtures and likewise aiding in obtaining smoother riding pavements. The increased asphalt should insure a longer service life in this type of pavement.

Construction Records

The **maximum daily output** of asphalt concrete was obtained on Contract 810TC1, road X-Sol-7-C, 3.7 miles north of Fairfield to 0.6 mile south of Vacaville, by Union Paving Co., 694 tons being produced per 8-hour day. A. K. Nulty was the resident engineer with E. D. Bulton as street assistant. The average daily output for the State was 447 tons during 1936, compared to 520.5 tons in 1935, the reason for the decreased

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Photograph of portion of 5.5 mile section of 30-foot Portland cement concrete pavement near Fort Tejon in Kern County.

How Aggregates for Portland Cement Concrete Are Selected

(Continued from page 18)

tinguished by different properties. Igneous rocks are composed of crystalline minerals interlocking with one another, are usually massive, unstratified and without fossils. Sedimentary rocks are composed of clastic, organic, and precipitated materials, usually welded into solid rock through the effect of pressure or cementation, but often lacking coherence or consolidation, and commonly distinguished by the presence of bedding or stratification and fossils. Metamorphic rocks often retain some trace of original structure, but their most distinguished feature is banding or foliation.

In classifying the durable rocks, most of the igneous and metamorphic types may be included.

Durable rock for Portland Cement Concrete is a type which has not been altered to any extent, and which contains no minerals likely to undergo alteration after incorporation into concrete. Further, the rock must be free of joints, fissures, or weak cleavage planes. These requirements apply to both igneous and metamorphic rocks. Due to their foliated character, however, a higher percentage of metamorphic rocks exhibit weak cleavages along which they may break. Schists show this weak tendency to a greater extent than do gneisses. The Los Angeles Rattler test is advantageous in determining these types of metamorphics. Soft decomposed igneous rock will also be detected in the rattler tests. The fine grained igneous rocks are generally more durable than the coarse grained.

ACIDIC ROCKS

Acidic rocks (those high in percentage of silica) are generally more resistant to normal weathering than the basic rocks (those deficient in silica and high in silicates of iron and magnesium). The reason for this is that silica (quartz, formula SiO_2) is a hard, resistant mineral that undergoes negligible change. The silicates of iron and magnesium, however, readily undergo oxidation, with the formation of new compounds. These minerals are not stable chemically, hence any rocks of which they are a part must of necessity be easily altered. The amphibole and pyroxene groups of minerals are examples of this class.

Mention has before been made that sedimentary rocks are the least durable of the three main types. Of the sedimentary types, shales are particularly unsatisfactory. They are of many different kinds, depending upon origin and composition. A shale is a compact rock composed of welded argillaceous material in which the average size of grain is less than .01 mm., and shows good bedding along which it splits readily.

The minerals of shales are often difficult of positive identification because of their extremely fine state of subdivision, but consist mostly of hydrated silicates of aluminum, hydrated iron oxides, finely divided mica, some calcareous and carbonaceous matter, sulphide of iron, and other fine particles liberated by rock weathering. In spite of the enormous variations in shales according to their parentage and composition, they are to be regarded as nondurable so far as use in Portland Cement Concrete is concerned.

The sandstones are also sedimentary rocks of questionable durability. However, a well cemented sandstone, one in which each mineral grain is cemented to its neighbor, may be a durable type of rock for concrete. The nonporous sandstones and conglomerates also do not allow permeation of any soluble salts that may hasten breakdown either in actual use in concrete or in the soundness tests. The porous sedimentary rocks have shown, however, a decidedly weak resistance to the soundness tests as made in the Research Laboratory. In California, where large areas are covered by a mantle of sedimentary rocks from the Jurassic up to the Pliocene, shales, sandstones and conglomerates constitute the bulk of the beds. Shales of the Tertiary, particularly the Miocene, have been found to be extremely nondurable from observations based upon tests and upon field performance.

1936 Paving Records

(Continued from page 20)

average tonnage being the increased number of small projects.

The highest **average stability** of surface mixture was 3550 pounds, obtained on Contract 87VC2-67VC27, road VII-LA-23-H, San Fernando Road through Newhall, by Geo. R. Curtis Co., Contractor; E. L. Seitz was resident engineer with A. W. Carr, street assistant. The average stability for the State was 2650 pounds, compared to 2908 pounds in 1935.

The densest surface mixture was placed on Contract 87VC5-57-VC6, road VII-LA-9-LA, Fenwick Street to Scoville Avenue, Sunland, with a relative specific gravity of 97.7%. Southwest Paving Co., was the contractor and M. H. Mitchell, resident engineer. The State average was 94.3%, compared to 95% in 1935.

The **smoothest asphalt surface** was placed on Contract 87VC2-67VC26, road VII-LA-23-H, San Fernando Road through Newhall, with 11.4 inches per mile. The contractor was Geo. R. Curtis Paving Co., E. L. Seitz, resident engineer, and A. W. Carr, street assistant.

The average smoothness for the State was 14.7 inches as compared to 21.1 inches per mile in 1935.

BITUMINOUS TREATED SURFACES

The mileage of road-mix surfacing again predominated in 1936, there being constructed some 126 miles of this type as compared to 82 miles of plant-mix.

The record for surface smoothness of plant-mix, 14.2 inches per mile, was made on Contract 88VC7 in San Bernardino County, from Verdemont to 0.8 mile west, Contractor, Geo. Herz Co., and Resident Engineer, G. E. Malkson. The average roughness index for the State during 1936 was 33.5 inches per mile, compared to 36 inches in 1935.

For road-mix type, the smoothest surface was obtained on Contract 89VC1-49CS6 in Inyo County between Big Pine and Keough Hot Springs, with 12.1 inches per mile. The Contractor was Basich Bros., and Resident Engineer, A. C. Briney. The average roughness index for the State during 1936 was 30 inches per mile, compared to 37 inches in 1935.

Redwood Log Crib Saves Large Sum

By E. M. CAMERON, District Maintenance Engineer

DURING the winter of 1935-36 a portion of the highway constructed by the Bureau of Public Roads on Route 84 on the Trinity River, in Humboldt County, between Willow Creek and the Hoopa Indian Reservation, was washed out.

The location of the wash was such that to have thrown the line into the hillside to obtain sufficient width of roadway would have cost approximately $21,000 for original construction, without considering what would have to be expended later for removal of slides, as the material is of a very unstable nature. Protection of the slope from future erosion from the river was included in the above cost. It was decided, therefore to place a crib, constructed of redwood logs, as a protection from future erosion, which would act also as a retaining wall and permit the center line of the highway to remain in its original location.

This portion of Humboldt County is not in the redwood belt and it was therefore necessary to haul the logs in from the coast. The Hammond Redwood Company was low bidder on a contract to supply redwood logs for the crib at a price of $1.25 per lineal foot for logs 32 feet long with an average butt diameter of 30 inches. The length of haul was 90 miles.

The crib is approximately 120 feet long and the height 36 feet. The photographs show the crib at a time when it was nearing completion and gives an indication of the size of the structure as well as the location with respect to the Trinity River. The bottom log of the crib is below the ground elevation shown in the pictures. Construction was done by State forces under the direction of E. M. Cameron, District Maintenance Engineer, and G. W. Lane, Maintenance Superintendent.

The work involved and the cost, including the furnishing of logs, is given below:

Excavation	1633 Cu. Yds.	$1,273.71
Backfill	4576 Cu. Yds.	1,130.62
Logs in place	3688 Lin. Ft.	7,436.65
Total cost		$9,840.98

Upper picture shows size of Redwood crib on Trinity River to protect highway. Lower—View of river bed and road above where erosion occurred.

State Makes Extensive Highway Survey

(Continued from page 8)

To compensate for the play in the steering gear of the car, two zero points were drawn near the top center of the protractor. The car was then taken to a flat cleared area and, with the pointer on the wheel held at the one-quarter point on the protractor, driven in a complete circle. The radius of the circle was then measured and noted.

The car was next driven in complete circles with the pointer on the one-eighth and one-half points and the radius of each circle measured. From these measurements the protractor was calibrated and marked. It was later checked many times on highway curves of known radii and found to check within about 10 per cent on curves of 1,000 feet radius or less and about 25 per cent on curves from 1,000 feet to 1,500 feet radius. Radii of curves of more than 1,500 feet were estimated.

SUPEROMETER CONSTRUCTION

The superometer was constructed as follows. A piece of one-quarter inch diameter pipe, three feet long was attached horizontally to the dash of the car. A vertical pipe fifteen inches long was connected to the left end of the horizontal pipe with the necessary fittings, the upper end being capped and vented. On the right end of the horizontal pipe, a water gauge glass, 15 inches long, was connected vertically with specially made fittings. The top of the glass was also capped and vented. The pipes and glass were then filled with light valve oil to the middle of the glass. An adjustable vernier, calibrated to hundredths of a foot per foot, was attached to the gauge glass. It was found that when the car stopped on a curve, the oil came to rest at once, thus enabling the recorder to note the superelevation at a glance.

The gradometer was made on the same principle as the superometer and was attached to the inside of the right front door of the No. 2 sedan. The instrument was sturdy, easily read, and reasonably accurate.

TWO SURVEY CARS

The No. 2 car was equipped with an odometer registering to the hundredth of a mile, and frequent check was made of its accuracy. Car No. 1 had the usual type which shows tenths of a mile.

To facilitate intercommunication between the cars, spot lights, by which signals could be exchanged, were mounted on the top rear of No. 1 car and top front of No. 2 car.

With this equipment the party, consisting of four men, took the field on February 4, 1937. The survey was at first confined to the Sacramento and San Joaquin valleys and to routes in the southern part of the state where winter road conditions would not affect the progress of the work.

METHOD OF SURVEY

In surveying sections for which plans were available the party proceeded as follows: The odometers were set at zero at the beginning of a road section. Number 1 car then preceded No. 2 car at a distance of about 1,000 feet. When a curve was reached where the horizontal sight distance appeared to be less than 1,000 feet, Car No. 1 would stop at what, from the plans and the driver's own observation seemed to be the critical point of obstruction. Number 2 car would then close up until No. 1 car was again in sight. The odometer reading was recorded at this point, then recorded again after coming up to the position of No. 1 car. The intervening distance was recorded as the horizontal sight distance. The type of obstruction was also described on the log sheets.

Vertical sight distances previously computed in the office were checked by the field observations, and where not previously computed, were measured in the field in a manner similar to that used for horizontal sight distances.

RECORDERS MAKE NOTES

Car No. 2 was stopped on curves to record superelevation. The recorder in this car also noted length and type of traffic stripes, and the general topography of the country.

The recorder in the first car had a duplicate set of notes and by observing the odometer reading he kept the chief of party informed as to the beginning and end of curves, radius and vertical sight distances. Thus the chief of party was enabled to note any discrepancies between the notes and the road as constructed. In some instances it was found that curves had been omitted from the notes or that changes in alignment, which did not show on the plans, had been made under maintenance. These changes were recorded and later transferred to the original set of notes which was kept in the second car.

CLOSE FIGURING

On sections of road for which no plans were available the chief of party in Car No. 1, upon reaching the beginning of a curve, would read the odometer, estimating the nearest hundredth of a mile, and record this reading on the duplicate set of notes. As the car proceeded around the curve, the chief of party would call out the radius, as shown by the protractor, and this would be recorded opposite the beginning of the curve.

Where a curve was compounded, the first car would be stopped at the approximate point of compound and, by a prearranged signal with the spot light, the driver of the second car would be advised to note this point to the nearest hundredth of a mile when it was reached.

Practically all the work in Southern California has been completed. Route No. 1 to the Oregon line and many routes in the west central part of the State are also included in the total, to date, of 4,816 miles of highway that have been covered.

TABLES WILL BE PREPARED

From the data secured tables will be prepared which will list the county, route and section, the Federal aid number, the U. S. Route number, the general topography, the location, sight distance and type of obstruction at each restricted sight. The type and width of surface, the type and location of traffic stripes, the number of lanes, the radii and length of horizontal curves, the length and per cent of all grades of three per cent or more will also be listed.

Preparation of these tables is simplified by the use of card punching and sorting machines.

The tables will later be consolidated into four principal tables for comparison with conditions in other States, by the Bureau of Public Roads.

Highway Bids and Awards for June, 1937

ALAMEDA COUNTY—Between Warm Springs and Irvington, 3.2 miles to be surfaced with plant-mixed surfacing and shoulders to be constructed of crushed run base and oil treatment applied thereto. District IV, Route 69, Section A. Union Paving Co., San Francisco, $24,978; Leo F. Piazzi, San Jose, $35,406; Chas. L. Harney, San Francisco, $26,185. Contract awarded to Jones & King, Hayward, $23,173.75.

ALAMEDA COUNTY—Crusher run base to be constructed and armor coat applied between Sunol and Dublin, about 2.4 miles. District IV, Route 107, Section B. Granite Constr. Co., Ltd., Watsonville, $17,786; E. A. Forde, San Anselmo, $19, 915; Jones & King, Hayward, $15, 947; Lee J. Immel, Berkeley, $18,105; Independent Constr. Co., Ltd., Oakland, $15,420. Contract awarded to Piazza & Huntley, San Jose, $14,847.50.

ALAMEDA COUNTY—Between Mountain House and Greenville, 8.4 miles, grade, surface with crusher run base and road-mix surfacing. District IV, Route 5, Section E. Chas. L. Harney & Piombo Bros., & Co., San Francisco, $960,124; D. McDonald, Sacramento, $932,054; A. Teichert & Son, Inc., Sacramento, $872,356; Morrison-Knudsen Co., Inc., and Geo. W. Condon Co., Los Angeles, $1,107,522; The Utah Construction Co., San Francisco, $1,137,433; Healey Moore Co., and Fredrickson & Watson Const. Co., Fredrickson Bros., Oakland, $850,299; George K. Thompson and Company, La Canada, $993,969; Lewis Const. Co.-Odenhamer Const. Co., Oakland, $931, 579; Metropolitan Construction Co., Los Angeles, $882,093; George Pollock Co., Sacramento, $984,537; Macco Const. Co., Clearwater $882,267; Guy F. Atkinson Co., San Francisco, $927,800; D. W. Thurston, Los Angeles, $1,139,224. Contract awarded to Granfield, Farrar & Carlin, San Francisco, $848,193.40.

AMADOR AND ALPINE COUNTIES—Furnishing and applying liquid asphalt to 24.5 miles of roadway between Bartons and Picketts. District X, Route 34, Sections E, F, G, H, A&E. Lambs Transfer Co., Long Beach, $9,533; Garcia Const. Co., Irvington, $13,440; A. Soda & Son, Oakland, $12,765; Oilfields Trucking Co., Bakersfield, $10,582; Lee J. Immel, Berkeley, $10,320. Contract awarded to Sheldon Oil Co., Suisun, $8,940.

COLUSA, YOLO AND BUTTE COUNTIES—Between Route 15 and Madison, and between Oroville and west branch of Feather River; about 27.5 miles, penetration oil treatment to be applied. District III, Routes 50 and 21, Sections A, ABC, B. E. F. Hilliard, Sacramento, $9,220; Lee J. Immel, Berkeley, $9,563; J. P. Breen, Sacramento, $10,420; Hayward Building and Material Co., Hayward, $9,472; Garcia Construction Co., Irvington, $9,905. Contract awarded to E. A. Forde, San Anselmo, $9,196.75.

CONTRA COSTA COUNTY—Between Walnut Creek and 3.5 miles northerly, about 3.5 miles to be surfaced with plant-mixed surfacing and shoulders to be constructed of crushed run base and oil treatment applied thereto. District IV, Route 75, Section B. Jones & King, Hayward, $27,145; Union Paving Co., San Francisco, $31,486; Leo F. Piazza, San Jose, $28,306; Pacific States Const. Co., San Francisco, $34,934; Contract awarded to Frederickson & Watson Const. Co., & Frederickson Bros., Oakland, $26,613.40.

DEL NORTE COUNTY—A reinforced concrete bridge across Myrtle Creek, 10 miles north of Crescent City and 0.24 miles of roadway to be graded and treated with asphalt. District I, Route 1, Section C. Contract awarded to F. O. Bohnett, San Jose, $50,644.50.

GLENN COUNTY—Between Willows and Artois, about 7.0 miles—portions to be graded and surfaced with asphalt concrete. District III, Route 7, Section B. Union Paving Co., San Francisco, $201,760; Hanrahan Co., San Francisco, $239,412. Contract awarded to N. M. Ball Sons, Berkeley, $193,698.30.

INYO COUNTY—Between Bishop and Owens River, 2.2 miles to be graded and road-mix surface treatment applied. District IX, Route 76, Section A. Oswald Bros., Los Angeles, $33,022; Young & Son Co., Ltd., Berkeley, $33,210; Claude Fisher Co., Ltd., Los Angeles, $34,270; A. S. Vinell Co., Los Angeles, $35,608; Triangle Rock & Gravel Co., San Bernardino, $36,801; Leo F. Piazza, San Jose, $38,392. Contract awarded to Basich Bros., Torrance, $27,-736.

KERN COUNTY—East of Monolith, 0.8 mile to be graded, roadmix surface treatment applied and a timber bridge to be constructed. District VI, Route 58, Section G. Wm. C. Horn Co., Pomona, $21,470; Dimmitt and Taylor, Los Angeles, $19,823; Basich Bros., Torrance, $20,119; A. S. Vinnell Co., Los Angeles, $20,396; Rexroth and Rexroth, Bakersfield, $21,436; Claude Fisher Co., Ltd., Los Angeles, $22,140; Triangle Rock and Gravel Co., San Bernardino, $24,940; John Jurkovich, Fresno, $24,980; United Concrete Pipe Corporation, Los Angeles, $25,156. Contract awarded to Young and Son Co., Ltd., Berkeley, $17,-110.60.

KERN COUNTY—Railroad Grade Crossing and approaches over Central Pacific Railroad between 3.03 and 2.56 miles south of Invokern, 0.5 mile to be graded and treated with liquid asphalt. District IX, Route 145, Section C. A. S. Vinnell Co., Los Angeles, $4,911; Oswald Bros., Los Angeles, $4,710; Rexroth & Rexroth, Bakersfield, $5,592; Young & Son Co., Ltd., Berkeley, $5,999. Contract awarded to Basich Bros., Torrance, $4,661.50.

KERN COUNTY—Between Maricopa and Taft, about 5.5 miles in length to be graded; plant mixed surfacing to be placed; road-mix surface treatment to be applied and a bridge with concrete deck to be constructed. District VI, Route 138, Section A. A. Teichert & Son, Inc., Sacramento, $133,640; Harms Bros. & N. M. Ball Sons, Berkeley, $141,508; Oswald Bros., Los Angeles, $146,034; Union Paving Co., San Francisco, $172,363; George Pollock Company, Sacramento, $178,339; Basich Brothers, Torrance, $162,600; Geo. K. Thompson Company, La Canada, $138,991; Southern California Roads Co., Los Angeles, $155,693; J. E. Haddock, Ltd., Pasadena, $154,951; Dimmitt & Taylor, Los Angeles, $145,277; Atlas Construction Co. and C. F. Robbins, Pasadena and Los Angeles, $156,159; Stewart & Nuss, Inc., and Oilfields Trucking Co., Fresno, $146,932; Hanrahan Co., San Francisco, $153,839. Contract awarded to Griffith Co., Los Angeles, $128,573.20.

KERN COUNTY—Between Rosedale and Route 141, 5.5 miles to be surfaced with plant-mixed surfacing and borders to be constructed. District VI, Route 58, Section L. Union Paving Co., San Francisco, $40,445; Oswald Bros., Los Angeles, $41,860; Griffith Co., Los Angeles, $42,266; Hanrahan Co., San Francisco, $42,795. Contract awarded to Piazza & Huntley, San Jose, $37,931.50.

KERN COUNTY—At Rademmacher, about 2.8 miles in length, to be graded and road-mix surface treatment applied. District IX, Route 145, Section B. Young & Son Co., Ltd., Berkeley, $14,895; M. J. Ruddy, Modesto, $15,905; A. S. Vinell Co., Los Angeles, $15,922; F. Embleton, Albany, $17,461; George K. Thompson & Co., La Canada, $18,102; Rexroth & Rexroth, Bakersfield, $18,447; William C. Horn Co., Pomona, $19,182. Contract awarded Basich Bros., Torrance, $13,465.

KINGS COUNTY—Between Kings River Slough and Halls Corner, 8.6 miles to be surfaced with plant-mixed surfacing and borders to be constructed. District VI, Routes 10, 125, Sections B. E. Stewart and Nuss, Inc., Fresno, $44,672; Union Paving Co., San Francisco, $46,351; Oswald Bros., Los Angeles, $48,205; N. M. Ball, Sons, Berkeley, $49,388.50; Hanrahan Co., San Francisco, $49,524; L. A. Brisco, Arroyo Grande, $51,468; Leo F. Piazzi, San Jose, $53,188. Contract awarded to Griffith Co., Los Angeles, $42,521.

LASSEN COUNTY—Road-mix surfacing to be applied. District II, Routes 29-73, Sections D. A, B. Harms Bros., Litchfield, $11,530; Garcia Constr. Co. Irvington, $14,-220. Contract awarded to George French, Jr., Stockton, $9,365.

LASSEN COUNTY—Between Termo and Madeline about 14.2 miles to be surfaced with crusher run base and penetration oil treatment applied. District II, Route 73, Section F. A. Teichert & Son, Inc., Sacramento, $44,418; Clifford A. Dunn, Klamath Falls, $44,500; J. A. Casson, Hayward, $44,265; Frederickson & Westbrook, Lower Lake, $46,587; E. B. Bishop, Orland, $45,690; Harms Bros., Litchfield, $47,112; Louis Biasotti & Son, Stockton, $49,452; Hemstreet & Bell, Marysville, $50,517; Lee J. Immel, Albany, $55,811; Hanrahan Co., San Francisco, $58,594. Contract awarded to Geo. Pollock Co., Sacramento, $38,327.50.

LOS ANGELES and ORANGE COUNTIES—At various locations about 33.9 miles, road-mix surface treatment to be applied to the shoulders. District VII, various routes. Oilfields Trucking Co., Bakersfield, $43,416; Matich Bros., Elsinore, $31,730; Griffith Co., Los Angeles, $34,752; Dimmitt & Taylor, Los Angeles, $33,672; A. S. Vinnell Co., Los Angeles, $33,936; Oswald Bros., Los Angeles $28,608. Contract awarded to So. Calif. Roads Co., Los Angeles, $26,244.

LOS ANGELES COUNTY—Between east limits of Los Angeles and west limits of Monterey Park, about 3.8 miles of existing roadbed shoulders to be road-mix surface treated. District VII, Route 26, Section D. So. Calif. Roads Co., Los Angeles, $10,493; Dimmitt & Taylor, Los Angeles, $8,687; Vido Kovacevich, South Gate, $8,155; Road Mix, Inc., South Pasadena, $9,576; A. S. Vinnell Co., Los Angeles, $9,715. Contract awarded to Oswald Bros., Los Angeles, $7,853.75.

LOS ANGELES COUNTY—Between Las Flores Canyon and West Channel Road, 7.1 mile road-mix surface treatment to be applied to shoulders. District VII, Route 60, Section B. LA. Oilfields Trucking Co., Bakersfield, $19,101; J. E. Haddock, Ltd., Pasadena, $18,474; Oswald Bros., Los Angeles, $16,799. Contract awarded to A. S. Vinnell Co., Los Angeles, $15,956.

MADERA COUNTY—Between Kelshaw Corners and Coarse Gold, 8.0 miles underdrains to be installed. District VI, Route 125, Section C. Bodenhamer Const. Co., Oakland, $29,469. Contract awarded to Milton A. Purdy, Oakland, $27,958.70.

MENDOCINO COUNTY—Between Sapp Creek and Pepperwood School, 3.1 miles to be graded and surfaced with plant-mixed surfacing. District I, Route 1, Section H. Piombo Bros. & Co., San Francisco, $161,572; Union Paving Co., San Francisco, $230.181; A. Teichert & Son, Inc., Sacramento, $189,068; Chas L. Harney, San Francisco, $241,254; D. McDonald, Sacramento, $155,875, Donald Arkinson, San Francisco, $184.864; John Carlin, San Francisco, $185.188; Harms Bros. and Larsen Bros., Sacramento. $188,138. Contract awarded to Hemstreet & Bell, Marysville, $155,753.

MODOC COUNTY—Between 1.4 miles west of Hot Creek and Alturas, 10.1 miles to be graded and surfaced with plant-mixed surfacing. District II, Route 28, Section B, Alt., Union Paving Co., San Francisco, $282.559; Harms Bros. and Larsen Bros., Sacramento, $196,097; A. Teichert and Son, Inc., Sacramento, $195,736; George Pollock Co., Sacramento, $249,266; Hemstreet and Bell. Marysville, $193.435; Harold Blake, Portland, Oregon, 217,862; D. McDonald, Sacramento, $219,299. Contract awarded to Hanrahan Company, San Francisco, $192,283.55.

MONTEREY COUNTY—Various locations between Greenfield and Salinas River, about 1 3 miles to be surfaced with plant-mixed surfacing. District V, Route 2, Section D. Contract awarded to Granite Construction Co., Ltd., Watsonville, $9.247.

MONTEREY COUNTY—Between San Ardo and King City and between Santa Rita and northerly boundary, 25.7 miles, roadmix surface treatment and seal coat to be applied to shoulders and class "B" seal coat to be applied to portions of existing pavement. District V, Route 2, Section J. Granite Construction Co., Ltd., Watsonville, $22,538. Contract awarded to L. A. Brisco, Arroyo Grande. $22,201.00.

NAPA COUNTY—Surfacing with imported surfacing material and Penetration Oil Treatment between Summit of Mt. St. Helena and Northerly boundary about 3.3 miles. District IV, Route 49, Section A., Lee J. Immel, Berkeley, $12,128; A. Soda & Son, Oakland, $14,380; Frank Embleton, Berkeley, $12,863; E. A. Forde, San Anselmo, $12.490; Rock & Gravel Trucking Co., Oakland, $12,402. Contract awarded to Harold Smith, St. Helena, $10,254.50.

NAPA COUNTY—Between west boundary and Napa, 4.7 miles surface with crusher run base and plant-mixed surfacing shoulders to be constructed. District IV, Route 8, Section A. Jones & King. Hayward, $48,150; Chas. L. Harney, San Francisco, $48,350; Granite Const. Co., Ltd., Watsonville, $51,446; Pacific States Const. Co., San Francisco, $52,402; Piazza & Huntley, San Jose, $52,468. Contract awarded to E. A. Forde, San Anselmo, $48,104.

ORANGE COUNTY Newport Beach grade separation, existing southwest ramp to be widened and paved. District VII, Route 60, Section A. Sander Pearson, Santa Monica, $3,360; Vido Kovacevich, South Gate, $3,186; Thomas Construction Co., Burbank, $3,166; C. O. Sparks & Mundo Eng. Co., Los Angeles, $3,016; Mojave Corporation, Los Nietos, $2,993. Contract awarded to J. E. Haddock, Ltd., Pasadena, $2,420.

PLUMAS COUNTY—Between Howels and ½ mile south of Keddie, 20.0 miles seal coat to be applied. District II, Route 21, Sections B, C. Lee J. Immel, Berkeley, $31,160; E. A. Forde, San Anselmo, $31,380; Healey Moore Co. and E. F. Hilliard, Sacramento, $31,791; Geo. French, Jr., Stockton, $32,750; Frank Embleton, Albany, $33,245; Hemstreet and Bell, Marysville, $34,725. Contract awarded to Hayward Building Material Co., Hayward, $30,870.

PLUMAS COUNTY—A reinforced concrete girder bridge across Spanish Creek, ½ mile north of Quincy to be constructed. District II, Route 21, Section C. F. C. Amoroso & Sons, San Francisco, $43,025; F. O. Bohnett, San Jose, $45,282; Bodenhamer Const. Co., Oakland, $45,614; A. Soda & Son, Oakland, $49,004. Contract awarded to S. D. Bechtel, San Francisco. $41,750.50.

PLUMAS COUNTY—Between Feather River Inn and Beckwourth, 16.1 miles to be surfaced with road-mix surfacing and seal coat applied thereto. District II, Route 21, Section F. Geo. French, Jr., Stockton. $45,820; Harms Bros., Litchfield, $46,466; Pacific States Const. Co., San Francisco, $46,636; A. Soda & Son, Oakland, $49,389; F. A. Forde, San Anselmo, $51,605. Contract awarded to Fredericksen & Westbrook, Lower Lake, $37,014.

PLUMAS COUNTY—Between Almanor Inn and Route 29, 7.0 miles to be surfaced with road-mix surfacing. District II, Route 83, Section D. Lee J. Immel, Berkeley, $7,625; George French, Jr., Stockton, $7.740; Frederickson & Westbrook, Lower Lake, $9,380. Contract awarded to Harms Bros., Litchfield, $7,110.

RIVERSIDE COUNTY—Furnish and apply liquid asphalt to existing shoulders between Indio and Desert Center, 45.1 miles. District XI, Route 64, Section H.I.B. Square Oil Co., Los Angeles, $16,383; Paulsen & March, Los Angeles, $11,372; Gilmore Oil Co., Los Angeles, $13,775; Lamb Transfer Co., Long Beach, $11,565; Oilfields Trucking Co., Bakersfield, $14,623. Contract awarded to Morgan Brothers, Maywood, $11,089.55.

RIVERSIDE COUNTY—Edom to 3 miles S. of Coachella; Indian Wells to Indio, liquid asphalt to be applied for a distance of 28.6 miles. District XI, Route 26-64, Section E, F, Q, Ind. Consumers Oil Co, Los Angeles, $4,834; Morgan Bros., Maywood, $4,833; Lamb Transfer Co., Long Beach, $4,703; Regal Oil Co., Long Beach. $5,215. Contract awarded to Paulsen & March, Los Angeles, $4,635.50.

SAN DIEGO COUNTY—Furnish and apply liquid asphalt to existing roadbed between Jamul and White Star, 13.5 miles. District XI, Route 200, Sections B, C, D, E. Square Oil Co., Los Angeles, $3,600; Paulsen & March, Los Angeles, $3,500; Oilfields Trucking C o.,Bakersfield, $14,623. Con-Oil Co., Los Angeles, $3,789; Morgan Brothers, Maywood, $3,654. Contract awarded to Regal Oil Co., Long Beach, $2,955.

SAN LUIS OBISPO COUNTY—Bridge to be constructed across Arroyo Laguna about 2 miles north of San Simeon. District V, Route 56, Section A. F. C. Stolte Co., San Simeon, $5,965; F. O. Bohnett, Campbell, $6,188. Contract awarded to Valley Const. Co., San Jose, $5,820.

SAN LUIS OBISPO COUNTY—At California Polytechnic School at San Luis Obispo, constructing tennis courts; furnishing and erecting court fence and nets; and painting playing lines. District V. F. C. Stolte Co., San Simeon, $4,164. Contract awarded to Granite Construction Co., Ltd., Watsonville, $3,212.24.

SANTA BARBARA and SAN LUIS OBISPO COUNTIES—Between Santa Maria and Gary and between Route 56 and 3 miles easterly, about 7.5 miles, road-mix surface treatment and seal coat to be applied to existing roadbed. District V, Route 148, 125. Section B, A. Harry L. Foster, San Diego, $12,280; Road Mix, Inc., South Pasadena, $13,071; L. A. Brisco, Arroyo Grande, $14,900. Contract awarded to Oilfields Trucking Co., Bakersfield, $12,238.

SHASTA COUNTY—Between Antler and north boundary 34.5 miles in length, mineral aggregates and screenings to be furnished. District II, Route 3, Section C, D. E. R. Bishop, Orland, $20,025. Contract awarded to Geo. Pollock Co., Sacramento, $19,404.

SHASTA COUNTY—At China Gulch, 0.7 mile to be graded and surfaced with crusher-run base and road-mix surfacing. District II, Route 3, Section A. Louis Biasotti and Son, Stockton, $28,627.25; A. Soda and Son, Oakland, $29,258.80; J. P. Brennan, Redding, $23,673; Piazzi and Huntley, San Jose, $23,209.75. Contract awarded to Lee J. Immel. Berkeley, $23,118.50.

SIERRA COUNTY—Between Sierra City and Route 83, about 17.6 miles liquid asphalt to be furnished and applied. District III, Route 25, Section B, C. C. F. Frederickson & Sons, Lower Lake, $13,205; Sheldon Oil Co., Suisun, $12,988; Edward F. Hilliard, Sacramento, $12,580; Lee J. Immel, Berkeley, $11,968; Garcia Const. Co., Irvington, $13,872. Contract awarded to J. P. Breen, Sacramento, $11,764.

TEHAMA COUNTY—Between Route 86 and Morgan Springs, 3.8 miles to be surfaced with road-mix surfacing and seal coat applied thereto. District II, Route 83, Section A. A. Teichert and Son, Inc., Sacramento, $16,258.05; Louis Biassotti and Son, Stockton, $17,292.75; A. Soda and Son, Oakland, $17,461.25; Leo F. Piazzi, San Jose, $19,436. Contract awarded to Lee J. Immel, Berkeley, $14,881.

TULARE COUNTY—Constructing steel structure bridge across Kaweah River, 3.0 miles south of Woodlake. District VI, Route 129, Section E. Bodenhamer Const. Co., Oakland, $29,028; F. O. Bohnett, San Jose, $29,127; Peter J. McHugh, San Francisco, $29,739; R. R. Bishop, Long Beach, $30,642; F. C. Amoroso & Sons, San Francisco, $33,591; Sebulec & McDonald, Inc., Oakland, $36,333. Contract awarded to N. M. Ball Sons, Berkeley, $27,331.80.

TUOLUMNE COUNTY—Between Stoddard Springs and McCoy Saddle, 6.2 miles to be surfaced with untreated crushed gravel or stone base and road-mix surfacing. District X, Route 13, Section E. George French, Jr., Stockton, $64,210. Contract awarded to Beerman and Jones and A. R. Maestretti, Stockton, $57,890.

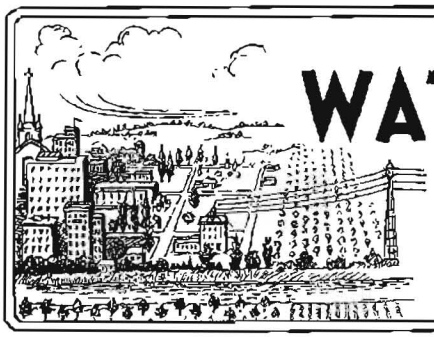
VENTURA COUNTY—Between 3.2 and 4.5 miles east of Santa Susana, about 0.5 mile in length, to be graded and paved with plant-mixed surfacing. District VII, Route 9, Section C, C. O. Sparks & Mundo Eng. Co., Los Angeles, $33,425; Dimmitt & Taylor, Los Angeles, $26,320; J. E. Haddock, Ltd., Pasadena, $25,629; C. F. Robbins, Los Angeles,, $28,337; Griffith Co., Los Angeles, $26,785; Oswald Bros, Los Angeles, $29,046. Contract awarded to A. S. Vinnell Co., Los Angeles, $23,380.

An 8.1 per cent increase brought the 1936 motor vehicle registration in Los Angeles county near the one million mark with a total of 994,927 passenger cars, trucks, trailers and motorcycles registered, according to State figures just released. Nearest competitor to Los Angeles was Alameda county with a total registration of 172,351. Entire registration throughout the State during 1936 was 2,448,925.

Mr. Brown was astounded to see in the paper an announcement of his death. He rang up his friend Smith.

"Hello, Smith," he said, "have you seen the announcement of my death in the paper?"

"Er—yes," replied Smith, "where are you talking from?"



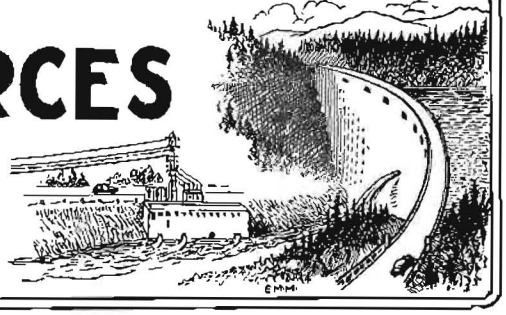
DIVISION OF WATER RESOURCES

OFFICIAL REPORT

FOR THE MONTH OF

June, 1937

EDWARD HYATT, State Engineer



At an election held June 16, the Imperial Irrigation District voted by a large majority for acceptance of contracts with the Federal Government and for issuance of revenue bonds to develop and distribute hydroelectric power from the All-American Canal. In addition to a grant of $1,242,000, the government has approved two loans to the district for this project. One in the amount of $1,518,000 from PWA for construction of power plants and main transmission lines, the other of $700,000 from REA for extension of distribution lines to rural areas in Imperial Valley.

Excavation work on the All-American Canal is 70 per cent completed. The balance of 11 miles is now under contract. Imperial diversion dam and desilting works on the Colorado River are reported to be 65 per cent completed.

IRRIGATION DISTRICTS

La Mesa, Lemon Grove and Spring Valley Irrigation District entered into contract and started work during the month on El Monte pumping plant which will link the district with the pipe line from El Capitan reservoir and eliminate the last stretch of old wooden flume constructed in 1888.

FLOOD CONTROL AND RECLAMATION

Relief Labor Work

Owing to lack of men all WPA projects have been discontinued, with the exception of WPA Project No. 6654 in Yolo County, on which an average of 25 men have been engaged during the period in cleaning levees and clearing brush in the Sacramento By-Pass.

Bank Protection Program

R. L. Jones, deputy in charge of Flood Control and Reclamation, with B. A. Etcheverry, consulting engineer for the Reclamation Board, appeared before the Board of Engineers for Rivers and Harbors on May 24th in Washington, D. C., and presented arguments to support a request that a modification be made in the recommendation of the California Debris Commission in its report of March 20, 1937, in respect to the division of cost and maintenance, particularly as to bank protection of the Sacramento Flood Control Project.

SUPERVISION OF DAMS

Application was filed on May 26, 1937, for approval of the Cannon Ranch Dam in Butte County. This is a small dam which was constructed many years ago.

Application was filed by the City and County of San Francisco on May 4th for permission to install observation wells on the San Andreas Dam. This application was approved on June 14, 1937.

Application was filed by the City and County of San Francisco on May 4th for permission to install observation wells on the Pilarcitos Dam. This application was approved on June 14, 1937.

Construction on the Mad River Dam for the city of Eureka has been resumed.

The enlargement work at the O'Shaughnessy Dam of the City and County of San Francisco is progressing rapidly and satisfactorily.

The Metropolitan Water District of Southern California is continuing work on the Cajalco Dam and work is being started on the Gene Wash and Copper Basin Dams.

Work of placing fill on the San Gabriel Number One Dam of the Los Angeles County Flood Control District is rapidly nearing completion and work is actively in progress on the construction of the spillway.

Repairs on several dams throughout the State are being made and a considerable amount of maintenance work is being done. Most reservoirs are practically full and maintenance and operations inspections are in full progress.

WATER RIGHTS

Supervision of Appropriation of Water

Twenty-seven applications to appropriate water were received during May, five were denied and thirteen were approved. During the same period, four permits were revoked and thirteen passed to license.

Inspection of projects under permit are being made during the current month in Plumas, Nevada and Sierra counties.

SACRAMENTO-SAN JOAQUIN WATER SUPERVISION

Field work is now being carried on in full force. measurements are being made of diversions, stream flow and return flow, and records of the same are being obtained.

The irrigation plants along the river are nearly all operating. Rice, fruit and sugar beets are the main crops being irrigated and when the grain is removed, additional land will be flooded for beans.

The Sacramento River has fallen rapidly but the rain in the valley on June 15-16 caused about a six foot rise in the vicinity of Knights Landing. However, this is only a temporary condition and the river should continue to fall. The flow at Sacramento on May 24th was 35,000 cubic feet per second, while on June 21st it was 17,500 cubic feet per second.

The flow of the San Joaquin River at Lathrop on June 19th was 13,500 cubic feet per second.

CALIFORNIA COOPERATIVE SNOW SURVEYS

With the opening up of the mountain roads at high elevations during the past month, the snow surveying equipment that had been kept at the shelter houses during the winter was gathered up and collected at convenient central locations. Here it will be put in good repair, and stored away for distribution to the shelter cabins again next fall.

Work in the office has continued; previous forecasts are being given a final overall check, snowpack-runoff curves are being revised and brought up to date, and all supporting data gathered during the past autumn and winter are being reviewed and put into shape for permanent filing. Research work is being done regarding the snowpack-runoff relations in certain areas, where it is believed forecasts even more accurate than those obtained at the present time may be obtained by modifying the procedure at present followed in forecasting for these areas.

WATER RESOURCES

South Coastal Basin Investigation

Work on the South Coastal Basin Investigation, Southern California, continued along routine lines in the field and office during the month of June.

CENTRAL VALLEY PROJECT

The United States Bureau of Reclamation continued work during the month on the preparation of plans necessary for starting construction on the initial units of the project. Preliminary investigations and exploration work have been continued.

New Highway Leads to Death Valley

Reconnaissance

(Continued from page 6)

furnished transportation across country until boulders too large and numerous to permit further travel were encountered. From there on exploration was conducted on foot.

Reconnoitering the easterly side of this plateau was fairly simple, the terrain allowing easy alignment and gentle grades, but descending from this plain into Panamint Sink, which lies at an elevation below 2,000 feet, brought one face to face with a variety of canyons extending westerly into the range from the floor of the sink. To overcome the difference in elevation meant much looping and curving of line, but by hanging precariously to lava rims, dodging basalt cliffs, and meandering around cinder cones, a satisfactory route was obtained at last, and one that joined the present road at the mouth of Darwin Wash. Alignment and gradient standards were met at economical cost, cloudburst conditions were minimized, and the first step in a new road into Death Valley was accomplished.

Survey and Plans

(Continued from page 6)

first, a far glimpse of Panamint Sink from between its high walls, then a clear view of its colorful depths from a closer point of vantage.

Steadily dropping, we followed our grade contour into and out of canyons, around ridges, across washes, reversing our direction time after time in an effort to lose elevation on ground that would lend itself to easy construction, yet maintaining a minimum radius curvature of 200 feet.

In this broken area, we experienced some difficulty in walking to and from our work, as it was found to be shorter to drive down Darwin Wash on the existing road, and then climb the escarpment above the wash to the site of our work. This entailed climbing approximately 2,000 feet and carrying all the paraphernalia of a survey party, including our water, which is at a premium in that country.

In the latter part of April, 1936, the field work was completed, a june-

(Continued on page 38)

Construction

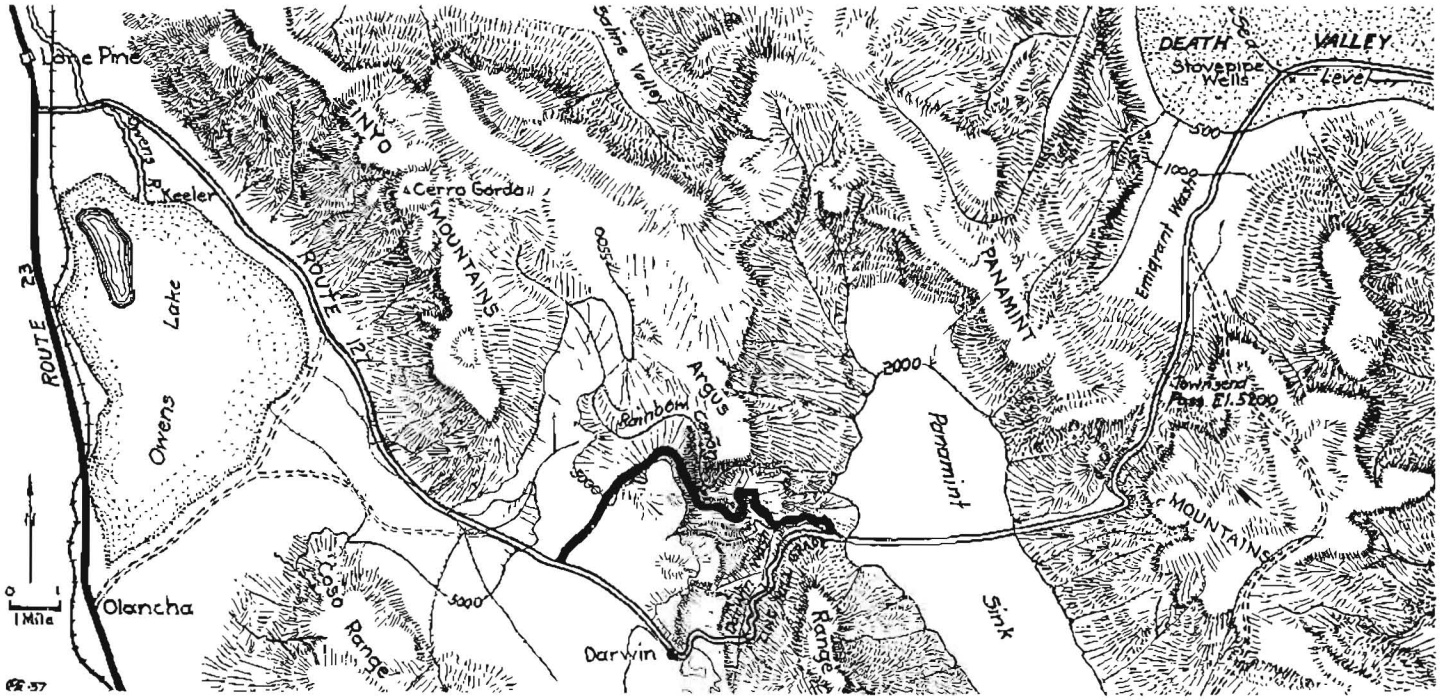
(Continued from page 6)

like a bar of steel when struck with a hammer, proved to be only a few feet thick and overlying a loose deposit of cinders.

A stratified limestone outcrop developed layers of such tenacity that a few inches of hole per hour was considered good progress, and drill bits had to be changed at the rate of 9 per foot of hole drilled.

Steady progress has been maintained by the contractor by means of double shifts, with the result that the completion of the work is scheduled for early in September of this year.

Local organizations are planning a jubilee pageant to mark the completion of this highway, commemorating the evolution of various modes of transportation into Death Valley. The passage of burro and miner, mule-team and freighter, truck and automobile over this new road, on that day, will mark the final step in the complete building of a safe and modern highway.



Sketch map shows location of new highway leading to Death Valley and avoiding Darwin Wash. Black line is realigned route.

Locating Death Valley Highway Was Hard Task

(Continued from page 27)

tion with the existing road established at the mouth of Darwin Wash, and the preliminary survey proved the fact that an economical line was possible with a maximum grade of 7.3 per cent for the last three miles, and a minimum radius curvature of 200 feet. This work was completed just in time, as the heat waves rising from the baked ground and glassy rocks were proving a factor which might prevent the completion of the work.

As the field work was progressing, the maps were being constructed in the field and district offices, and after the completion of the survey, the design of the final location was attacked in earnest. Aside from the usual procedure of balancing the excavation quantities, several factors arose that were of interest, and entailed a study to determine their relative values.

CLOUDBURST AREA

Here was a road through a cloudburst area, subject to an intense deluge concentrated in relatively small space, yet whose point of impact was as unpredictable as the striking of a bolt of lightning. Tons of water down a small wash—and dry ground a quarter of a mile away! Culverts to accommodate all drainage would cost a fortune, so the fills across the various depressions were designed to be permeable, and so allow whatever water struck them to pass through with but little restriction. In some of the larger washes which showed signs of having carried floods recently, a relief pipe was designed to be placed close to the top of the fill, just as a precautionary measure.

Cognizance was taken of the geological formations and wherever strata was encountered that was inclined in such a direction as to be in a position to slip into the roadway during construction, allowance was made for its removal and disposal.

FLOOD PROTECTION

To further the stability of fills under the action of rushing water, the upstream faces were flattened by the placing of additional material. In those localities where an unusually large amount of water would be expected, dips in the grade line were designed to allow the water to pass across the surface of the roadway instead of through the fill, and in these cases, the upstream faces were flattened to the extent of filling the washes level with the grade of the highway.

Due to the inaccessible location of the project, specifications were drawn so the project would be as attractive as possible to prospective bidders. Close finishing of the slopes was eliminated in this region as it was felt that the severe windstorms, which are prevalent, would soon undo whatever work man could accomplish, and so would be a total loss to the State.

End-dumping in the construction of fills was allowed as the material was, in general, very rocky, and subsoil investigation disclosed the fact that but little subsidence would result and shrinkage would be negligible. The time limit was placed at a very liberal date, and the requirement of water in compacting embankments was entirely eliminated due to its scarcity.

CURVATURE STATISTICS

As a result of this design, bids were opened on December 6, 1936—the Peninsula Paving Company of San Francisco being low bidder, and offering to complete the project for approximately 6.7% under the Engineer's Estimate.

Another step toward a highway into Death Valley was completed.

The following statistics of curvature and length afford a graphic picture between the old and the new:

Present	245	12.065°00'00"	30	19.900
Proposed	72	4,111°48'20"	200'	17.541
Difference	173	8,953°11'40"	..	2.359

Indications that as many as 100,000 new house trailers will be produced in the United States during 1937 are contained in reports received from various sources in the trailer industry.

Motor trucks in use in the United States last year numbered approximately 4,020,000.

Maze Road Proves Aid to Tracy and Modesto Traffic

(Continued from page 17)

the first contract stopped at the River Road, about 2½ miles short of the West Side Highway.

DISTANCE IS SHORTENED

This new cross-valley road westerly from Modesto, and using the existing West Side Highway into Tracy, will shorten the distance between Modesto and Tracy about one mile, as compared with the present State highway from Modesto through Salida, Ripon and Manteca to Tracy. There will be a considerable saving in time due to the new road avoiding all cities and built-up areas. A change in the West Side Highway east of Tracy would save another one and one-half miles.

The first contract included building a bridge over the San Joaquin River and grading and oil mix surface treatment of about 3.1 miles, between River Road and two miles west of Gates Road. This bridge has a total length of 1573 feet 7¾ inches and consists of two steel truss spans at 135 feet 3 inches each over the main channel and sixty-eight 19-foot trestle spans, sixty-three east of and five west of the Main Channel.

The steel spans are supported on concrete piers founded on wooden piling. All trestle piles are creosoted. The deck is concrete, 24 inches between guard rails. There is a two-foot walk on each side of the structure.

This contract was completed by the Pacific Bridge Co. The contract price was $162,973.50.

The second contract, let to Basich Bros. for a contract price of $46,-285.80, consisted of grading and road mix surface treatment for about 4.7 miles of roadway. 1.85 miles lies east of and adjacent to the first job and 2.83 miles lies to the west; the westerly 1.39 miles is in San Joaquin County, the balance is in Stanislaus County.

This road should relieve to a considerable degree the traffic congestion on the present highway between Modesto and Tracy, and mean a considerable saving in time to traffic using it.

STATE OF CALIFORNIA

Department of Public Works

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

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SACRAMENTO, 1937

MAP
SHOWING
STATE HIGHWAY SYSTEM