

# CALIFORNIA HIGHWAY BULLETIN



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CALIFORNIA STATE HIGHWAY SOUTH OF SAN FRANCISCO

# CALIFORNIA HIGHWAY BULLETIN

## CALIFORNIA HIGHWAY COMMISSION

FORUM BUILDING, SACRAMENTO

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### Maintenance

To construct, then to maintain—divide that motto when modern highway building is planned, and it would be as well to wipe out the slate entirely. Construction and maintenance must both be considered, and construction without adequate maintenance plans is in great part a loss of the money expended. Traffic is more exacting and less patient than it was a few years ago, and there is more of it and it insists on going farther. All that means wear and tear, which makes it impossible to stop merely with the building, for nowadays no road can be built that is self-preserving.

Bonds issued to provide funds for a permanent road should not be drawing interest after the expiration of the road itself, but that very situation has occurred in America. Perhaps the first thing in road building to-day is the long look ahead. That is peculiarly the case in the West, where development is so promising, and, too, where the traveling instinct which impelled the settler remains with him. The road engineer to-day has human problems of equal importance with engineering problems; he must ask himself what will be the probable travel of a decade or two in the future, and he must consider how to conserve this year's expenditure so that it may be in the useful class for a long time to come.

A road is like a horse or automobile in that it will last longer if treated rationally and looked after regularly; that costs money, but it costs considerably less than to go out and buy an entirely new road. Maintenance must be vigilance, and it is largely the ounce of prevention.

Construction and maintenance are dovetailed in the plans of the California Highway Commission, so that the road is built to the best advantage and maintained as nearly as possible to the condition at the time of completion. Taking into consideration the fact that the eighteen millions are by no means the end of California's expenditure for highways, the present State Highway is planned so that it may be widened, or otherwise improved, through later appropriations without tearing out and losing the present expenditures. Mileage of the permanent form of construction is lengthened by planning improvement along with maintenance.

The maintenance crews will be kept busy and on a permanent lineup by supplementing their repair work in widening the roads. It is not desirable that a maintenance employee should be idle part of the time, nor is it economy to pick up men now and then as maintenance may make their employment possible. Hence the maintenance crews will be more efficient and profitable to the State by being trained to the work and employed permanently through the addition of tasks that will keep them on full time. They will make the needed repairs and will meet emergencies at once, and will also improve the roads by building the hardened rock shoulders on either side of the pavement. This will widen the road of minimum width, fifteen feet to twenty-one feet, will protect the edges of the pavement and will give room for passing and turning. In that way it will be possible to keep up the standard of maintenance without losing the full day's work of the crews in addition to extending the constructing power of the original highway fund.

When the first contracts were started it was not economical to employ a high class road engineer to check the local work, but as soon as the number of contracts justified the expenditure the California Highway Commission secured an expert trouble finder—a high type of road engineer who is constantly on the road, inspecting one contract after another and checking on all phases of the work. He gives the resident engineers and others an exchange of practical experience materially affecting the value of their work, and checks closely on all phases of the construction.

The State Highway is homemade so far as materials go. California cement and California asphaltic oils are utilized.

### "Safety First"

California's State Highway is laid out much as a railroad is planned. It provides for new ideas in traffic, for the 200-mile day of the individual traveler, for the motor truck train, and for access to and through sections where the varied topography of this State means a jump from sea-level to snow-level in a day's tour.

As with a railroad, safety is given consideration not thought of in ordinary road building. Grades are eliminated as much as possible, crossings of railroads at grade are abolished when that can be done, curves are made more sweeping and less blind, and mountain roads are protected and made over, so that touring in California will be a delight, never a menace, no matter what section of the State Highway may be traversed by motorists.

When one considers that the automobile traveler will be able to enter the State from Oregon, surmount that old barrier of Bailey's Hill, pass Mount Shasta on the north, and leaving the Great Valley in the south, take a panoramic road over the mountains into Los Angeles and roll into San Diego without having shifted gears once from Oregon to Mexico so far as grades are concerned—when one mentally reviews the old road and compares with the new the safety feature of the State Highway, the economical feature and the feature of "city streets in country places" all become apparent as contributions to the luxury of "seeing California."

### Protecting the Highway

In some sections of California the necessity for cooperation in maintaining the State Highway is not appreciated by every user of the roads. Disc harrows, traction engines and other implements not built for travel on an improved highway or a paved road have been driven wantonly along the concrete road in spite of warnings and requests of representatives of the California Highway Commission.

A damage of more than one thousand dollars may be inflicted in a few minutes, and a totally unnecessary damage as well, even from the viewpoint of a man who may care nothing at all for highway improvement. Instances have been reported of traction engines taking the highway and causing damage where the engine might have been run as easily by the side of the road. In one case, near Los Angeles, a harrow or other implement which cut a sharp line into the pavement turned off the road entirely to pass a vehicle and was driven back again, showing that the driver might have avoided the damage if he had possessed any patriotic regard for good roads.

While the State Highway is new, education may be necessary to arouse a proper regard for its maintenance. Users of the highway who witness palpable damage being inflicted should exercise their prerogative as citizens, and at least remonstrate with ignorant or vicious destructionists. Instances of damage are being followed up promptly by the Highway Commission, and, when wilful, prosecutions will be instituted.

### The Highway Bulletin

The Highway Bulletin is published by the California Highway Commission as a report to The People on progress in construction of the State Highway. It is issued quarterly, and is for free distribution. Constant requests come for information about the State Highway, and most of these are answered by the articles presented in the Highway Bulletin.

Day labor is utilized on the State Highway only when the contract system fails through inability to obtain contractors under the requirements of the law, or if a failure of the contractor compels the State to complete the work. It is regarded by the Highway Engineer as a policy to be followed only when essential to substitute it for the letting of contracts.

Traveling men in California are now making up parties and taking automobiles to go from one city to another, making a saving of time at little more expense because of good roads. The railroad loses nothing, for the extra hauls resulting from improved highways more than offset what the roads may take in passenger travel.

California's State Highway has been termed an exhibit of the World's Expositions of 1915, since it stretched from the doors of the Panama-Pacific Exposition at San Francisco to the Panama-California Exposition at San Diego, and must be seen by every 1915 visitor to California whether he travels on it or not.

A motoring authority has compiled estimates on which he bases the prediction that fifty thousand to seventy-five thousand automobiles will travel on the State Highway between southern California and San Francisco in 1915.

# BUILDING THE STATE HIGHWAY

## How the System of Roads Under the \$18,000,000 Bond Issue Is Being Financed and Apportioned

Extracts from Addresses and Extemporaneous Talks by CHARLES D. BLANEY  
Chairman California Highway Commission



When one considers that a single through line of the California State Highway, starting at the Oregon boundary and running through the Great Valley to San Diego, is eight hundred and twenty-five miles long, or about the distance from New York to Savannah, Georgia, on the Atlantic seaboard, the fact may be appreciated that the California Highway Commission has found this State one of magnificent distances. On top of this is the fact that every conceivable condition of highway building from the snowfalls of the mountain sections to the intense heat of the desert and from the mountain barriers to sea-level conditions. Hence it must be evident that the construction of the California State Highway is full of more than ordinary problems.

Governor Johnson realized that when he made a selection of the members of the Highway Commission. "You face a tough job," he told us when he called us together; and he said, "you are expected to build for eighteen million dollars a highway system which the best engineers of the country have estimated will cost thirty-five to fifty million dollars."

We started this work with the establishment of a complete system. We inaugurated a merit system for our employees, and every man in the highway work has been appointed solely on his ability to "deliver the goods." We made exhaustive inquiries in the selection of applicants for responsible positions, and every man has had to show a high, efficient rating. We have about eleven hundred men, and there have not been a half dozen changes in the superintending force in the two years.

The men on the State Highway work possess an *esprit de corps* second only to those engaged in digging the Panama Canal, and this has been a marked feature in every department of the work of the Highway Commission.

The State Highway was first planned by an actual observation of the State's needs. The Commissioners and the Highway Engineer traveled up and down the State with an automobile, following the probable roads and visiting, sometimes three counties a day, picking up the county surveyor and perhaps the chairman of the board of supervisors at the county lines and taking them over their county roads. Our idea was to abolish many of the natural barriers and run two big trunk roads from Oregon to the Mexican line with no greater grade than six per cent. We covered six thousand eight hundred fifty miles on these tours. We were kicked off mountain roads by mules, we were stuck in river fords, and we slid around dangerous mountain grades; we broke our windshield and punched holes in the bottom of our gasoline tank on the rocks on the desert, and after we had covered the trunk lines and laterals of California from Oregon to Mexico we went back to Sacramento and drew the state highway routes on a big map of the State. We kept a daily log of our trips and every night we went over the day's travel and apportioned to each mile of the road what we believed to be its just share of the eighteen million dollar bond issue. We were endeavoring to give all the counties as fair an allotment as possible of the money apportioned for this state highway.

It was mandatory under the State Highways Act to build one trunk line through the Sacramento and San Joaquin valleys and one along the coast, and also to connect the various county seats by laterals with the main trunk lines. In the selection of roads, too, we had not only to figure on the present population and needs of the districts served, but equally on the probable needs of the future in what is no doubt the fastest growing state in the union; we had to be prophets in a large way. We have taken this up from the outset in a fair and unbiased way, and feel that the fair thing has been done in laying out the State Highway.

The attorney for the Highway Commission has given the following summary of the object of the State Highways Act:

"The act, undoubtedly, contemplates, *first*, the construction of two main or trunk roads, one along the coast and the other traversing the Sacramento and San Joaquin valleys; and, *second*, that the county seats of such counties as lie east and west of the trunk lines shall be connected to the trunk lines by lateral and tributary highways.

"The object of the statute, in so far as the two trunk lines are

concerned, is by directness to afford a means of communication so that the people of the north may be in touch with the people of the south in the shortest interval of time and space, and at the same time linking together those county seats and centers of population which can practicably, and without materially sacrificing directness, be so joined in a trunk line running north and south through the State.

"The laterals are provided for in the State Highways Act for the express purpose of furnishing ingress and egress to and from the trunk lines for such county seats as can not practicably be reached by a direct trunk line; and the ultimate scheme of the state highway system is to cover the State of California with a network of highways which will compact the whole State for the purpose of intercommunication of the residents of every part of the State, and so that no longer will counties be spoken of as being 'remote and inaccessible.'

"The State Highway of California under the present legislation at least, will be but the skeleton for the road system of the State, and local county needs must be supplied by county systems."

When the State Highway shall have been completed, California will have two main trunk lines, coast and interior, traversing the State with practically a six per cent maximum grade, with paved roadways, built and maintained for the most exacting traffic, and with dangerous grade crossings and blind curves eliminated. Any automobile may run over any mile of the completed State Highway on its high speed, and there will be no place on the entire length where the road can not be seen for one hundred yards ahead.

The State alone could meet satisfactorily the problem placed before us, as no private concern or local community could build its roads in accordance with the mandates of the statute.

Our highways are being built for an average of six thousand dollars a mile. When we started out, we were told by various engineers that if our road system was to involve between twenty-six and twenty-seven hundred miles, as we understand it would involve, that we could not build it for less than thirty million dollars. We went into this very carefully, and with a recollection of the manner in which road building problems had been faced elsewhere in this country and in other parts of the world. Some of us have traveled all over the world and studied varying road conditions in the United States and abroad. Our Highway Engineer was an executive on the Massachusetts Road Commission, and is recognized internationally as one of the best road engineers of to-day. So, we were not absolutely without experience, and when we had made the whole route of the system from Oregon to Mexico, from east to west, we revised our apportionment, and to-day we are working on that apportionment.

We took up the fact that backed by its eighteen million dollars, the State can buy its materials in immense quantities and can pay cash for them, and therefore should have the lowest price in the market. We went at it as thoroughly as we could to augment the eighteen million dollars and bring it as nearly thirty million dollars in construction as possible. We said to the cement men who are operating their plants at from fifty to sixty per cent of capacity: "We can increase your output by twenty-five to forty per cent; we are going to pay cash; we are introducing a valuable type of road which will make for increased use of cement in the West, and it is only a business proposition for you to meet this on a business basis and cut your price to the State accordingly." The cement men responded at once, and the State to-day buys cement at an extremely low price, and other materials at a proportionately low figure, probably effecting a saving in buying materials of two million dollars. By furnishing materials to the contractors, equivalent to a credit of fifty thousand dollars, we stimulate competition among contractors, and give a better chance to local men in the various communities, and reduce the price of construction. If we were compelled to pay the ordinary price for cement, we could not build a concrete base under the present bond issue; as it is, we are expecting to pave the greater part, if not all, of the main trunk lines.

We went at it to effect other savings. We decided that the one hundred or more miles of paving of highways through incorporated cities and towns, naturally of more costly character than elsewhere, would restrict our apportionments entirely too much. Hence we decided to build country highways and not to expend the money inside limits of incorporated cities. Another factor which influenced us in this direction was the fact that cities would be compelled to relinquish

control of their streets to the State where the State Highway might be built, and the State would control all improvement matter, which would be rather obnoxious to the city governments.

Then we made an appeal to the patriotism of the counties—and I desire to emphasize right here that I believe no other state can instance any finer demonstration of patriotic response than the manner in which the boards of supervisors and others in California have augmented the construction funds of the State Highway. From Siskiyou and Humboldt counties on the north, through the State to San Diego and Imperial counties, without exception, the counties have contributed rights of way, furnished bridges and also have helped us meet an embarrassing financial problem, occasioned by the failure of the bond market throughout the world. This is a splendid demonstration of State patriotism, and is something which will have a prominent place in the history of California.

When we started at the Oregon line to inspect the probable highway roads, Siskiyou's county board of supervisors said that they would give us a right of way eighty feet wide, and would build all bridges out of their own funds. This has been uniformly the policy of the counties, and has had the practical effect of adding three and one half millions to the mileage money of the State Highway. This has been good business for the counties because they have been given additional mileage, and thus have made a saving in maintenance. The manner in which the counties of small valuations and a large amount of heavy road construction have lined up beside the richer counties in this regard, is extremely encouraging to the Highway Commission.

Another fine example of patriotic cooperation was shown when the bottom dropped out of the bond market, and the State Treasurer was unable to sell the highway four per cent bonds. Every effort was made to market these in the East and abroad after the demand for four per cent bonds ceased early in October, 1912. We had received at that time only two million one hundred five thousand dollars, and it has been found impossible to sell the bonds at par since then. We put this problem before the different boards of supervisors. We explained that the State Highways Act, a referendum law, was rigid in regard to selling the bonds at par, and that the bond buyers were firm in refusing to take four per cent bonds at par. The State could not handle the shrinkage between the par value and the market demand, and we asked the counties to step in and provide this depreciation. We put this before them as a business proposition; they would aid us in securing more immediate construction, and would be relieved of maintenance on the roads taken over as part of the State Highway.

The supervisors of the different counties appreciated our dilemma and have provided funds for making possible the sale of state highway bonds to a total, on June 15, of seven million five hundred five thousand dollars. This has been taken up in the different counties as follows:

Division.	County.	Bonds taken.
I.	Humboldt	\$250,000 00
	Mendocino	45,000 00
II.	Shasta	205,000 00
	Siskiyou	100,000 00
	Tehama	332,000 00
III.	Butte	175,000 00
	Colusa	125,000 00
	El Dorado	114,000 00
	Glenn	218,000 00
	Solano	150,000 00
	Stanislaus	75,000 00
	Tuolumne	65,000 00
	Yolo	600,000 00
IV.	Alameda	400,000 00
	Contra Costa	300,000 00
	Marin	150,000 00
	San Mateo	200,000 00
	Santa Clara	228,000 00
	Santa Cruz	75,000 00
	Sonoma	220,000 00
V.	Monterey	45,000 00
	San Benito	125,000 00
	San Luis Obispo	250,000 00
	Santa Barbara	419,074 00
VI.	Fresno	150,000 00
	Kern	410,000 00
	Merced	120,000 00
VII.	Imperial	100,000 00
	Los Angeles	695,000 00
	Orange	400,000 00
	Riverside	100,000 00
	San Bernardino	120,000 00
	San Diego	272,000 00
	Ventura	271,926 00
		7,505,000 00

The foregoing list includes only amounts actually purchased either by boards of supervisors or banks. In addition, further purchases have been pledged by numerous counties, to be made as construction may call for the funds. Humboldt County, for instance, stands ready to take additional bonds to a total of more than one million dollars; Los

Angeles supervisors have voted to take five hundred thousand dollars of the bonds, supplementing the amount given, which is a contribution on the part of the Los Angeles banks; Siskiyou County, Colusa County and others will increase their purchases as occasion may require.

It is the intention of the Highway Commission to forward construction as rapidly as possible, consistent with good business judgment and compliance with the legal requirements. The State Highway is not built for a day, but as a permanent road system, and right of way and other preliminaries must be arranged accordingly. In spite of the financial delay the surveys have been carried on without interruption, and nearly two thousand miles of the routes have been surveyed.

## Locating Mountain Roads

By FRANCIS G. SOMNER

Division Engineer, California Highway Commission

On railroad work, adherence to the standards as regards alignment and grades is rigidly enforced, and although the best results are not always insured thereby, as a rule the policy is necessary and proper; but on mountain highway work conditions are encountered where a choice must be made between an extravagant expenditure of money and a more or less sacrifice of grades and alignment. The theory of economic highway location in such cases may be disregarded where the results to be obtained thereby are commensurate with the traffic requirements and the funds available. The same degree of refinement as regards grades and alignments necessary on that portion of route 1, traversing the Marin County hills, would not be justified in the remote and rugged portions of Humboldt and Mendocino counties, because the traffic does not require it, neither does the topography of the country warrant it.

The selection of a route through the mountains is as a rule controlled, not by the centers of population but by the topography and geology of the country. The location is fraught with a multitude of obstacles which can be surmounted by the application of certain engineering principles, a reasonable amount of physical energy and a vast amount of common sense. The field engineer must not only be proficient technically, but be of vigorous being, both mentally and physically. He should be a natural woodsman endowed with the faculty of arising to any emergency in connection with the establishment of camps and transportation of supplies. It is needless to state that this type of engineer is scarce, for, as Trautwine says, "Nature rarely combines mathematical talent with the practical tact and observation of outward things so essential to a successful engineer."

The writer is familiar in general with the mountain ranges throughout the State and can say without fear of contradiction, that the location of a highway through the mountains of Humboldt and Mendocino is controlled to a greater extent by the geological formations than in any other portions of California. If the cost of construction and maintenance are to be considered at all, the sacrifice of grades to a more or less extent is imperative. These conditions are occasioned by the existence of a serpentine formation, the surface of which to a depth of from five to thirty feet is disintegrated and slips on the more solid formation. These slides generally result during the severe storms in the loss of the entire roadbed, which can be replaced permanently only in the course of time, when all of the disintegrated formation has disappeared. When there is no other alternative except the introduction of a summit, the question arises: Shall we combat the slide at an enormous maintenance expense for an indefinite period, or shall we avoid the slide at a sacrifice of grade? In either case, the traveling public is inconvenienced.

An important factor in the location of the highway through the Eel River country, and particularly that portion in Humboldt County, is the redwood forests, the heaviest body of standing timber in the world. The California Highway Commission, having in mind not only the prevention of wastefulness but also the preservation of the scenic features of one of the most picturesque highway routes in the world, has advocated a winding road, the cutting down of timber permissible only when justified by topographical conditions. This policy is part of the conservation plans extending throughout the entire length of the route through the redwoods, and for some distance either side of the highway.

The width of roadbed is a subject that merits the most careful consideration, inasmuch as it affects the cost more than any other item, at the same time being an important factor as concerns the convenience and safety of the traveling public. The width should be governed by the traffic requirements, topography, and geology of the country traversed, and also by the rainfall. The conditions in northern California are such as to justify a roadbed eighteen feet in width; however, along steep slopes of rock formation a width of sixteen feet should be permissible, extended to eighteen feet on blind curves.

## Safety a Factor

Safety for the highway traveler is a dominating factor in the construction of the California State Highway—not safety for the speeder, but for the motorist who uses the roads rationally. Several phases of the safety problem enter into modern highway construction, and they are all exemplified in the State Highway.

Perhaps the most appreciated will be the elimination so far as possible of railroad crossings at grade. Grade crossings where the traffic is heavy, both on railroad and highway, tend to become constantly more dangerous, and where possible the State Highway is constructed over or under the railroad tracks. Where it is not found possible to eliminate the crossing at grade care is taken to make it as open as it can be located and with the best possible view along the track in both directions. In numerous sections of the State grade crossings are cut out where the traffic will be much heavier after the completion of the highway.

In the mountain sections the roads often cross the railroad tracks near a tunnel or cut, where an approaching train can not be seen one hundred feet away. The contour likewise makes it easily possible to stall a motor on the track, so that on the old roads there are numerous crossings with extra hazards. Thirty-four such crossings in the Sacramento canyon division of the State Highway have been eliminated in the survey work of that division.

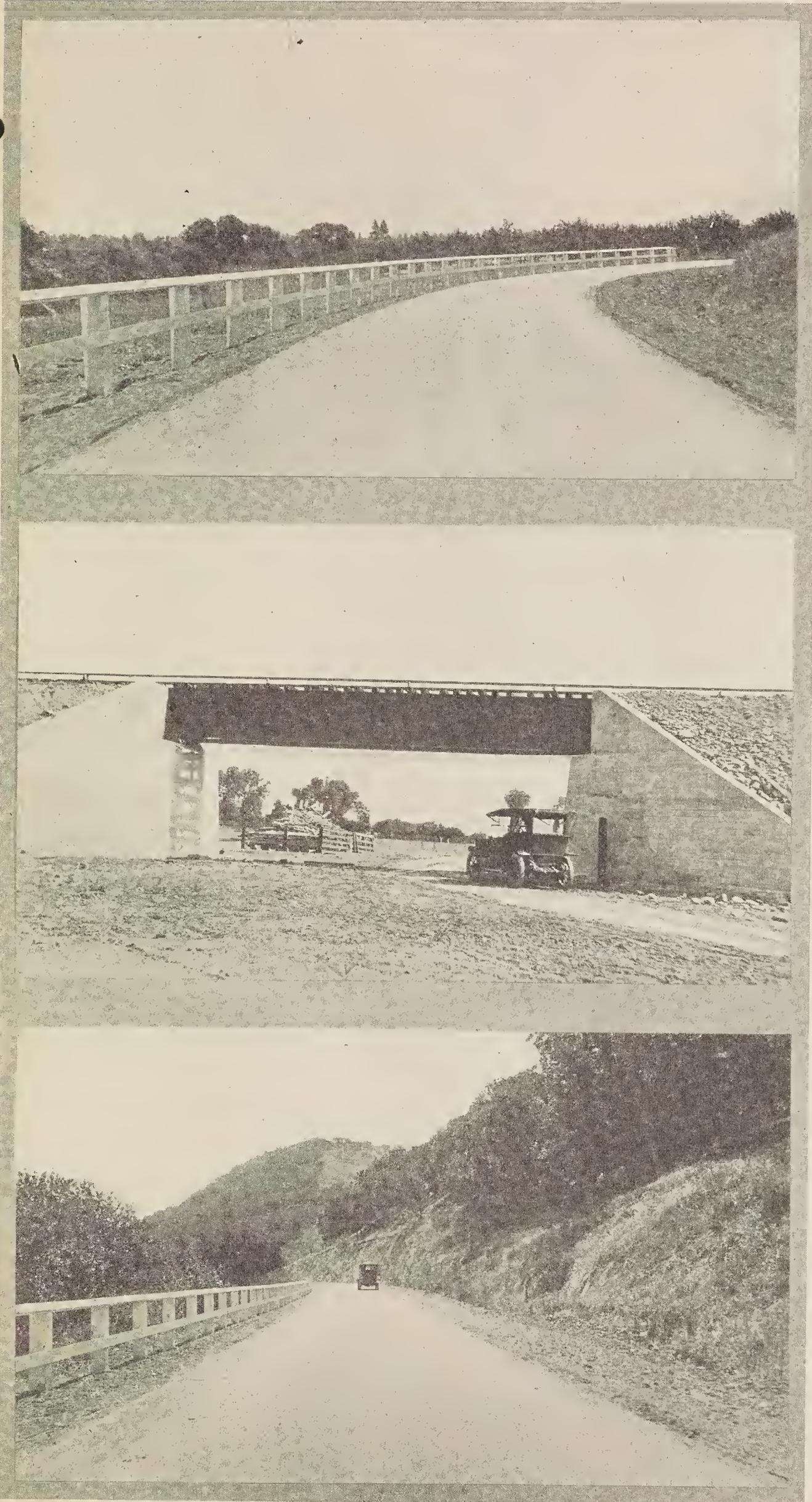
Heavy fog is often a menace along the seacoast to the motorist who may cross railroad tracks at night, and this hazard would be accentuated if the crossings were allowed to remain at grade on the route near the coast in southern California. The Southern Pacific has co-operated in eliminating eleven crossings of that sort where the fog is especially dense, and this policy has been followed elsewhere.

Safety is also advanced in laying out curves, taking into consideration the necessities of modern vehicles. Some automobile dealers have urged that curves be banked to permit taking them at rapid speed, but all travelers do not care for that excessive precaution, and the curves are made wide and effective for the general traveler. Supervisors, chambers of commerce and officials have co-operated in a number of instances to substitute graceful, sweeping lines for right-angled turns, thus adding to the pleasure and beauty of touring.

The mountain roads will show the greatest safety improvement, and the mountain sections of the State Highway will appeal to the most timid women who have heretofore rejected touring in some of the most delightful portions of California because of the danger involved. The State Highway will be wide enough in the mountains, its edge will be protected, and nowhere will there be a dangerous grade. Nearly all the grades will be within a six per cent maximum, and there will be a few miles of seven per cent. That is easy enough for a horse and delightful for an automobile.

Safety is also promoted where flood conditions are apt to affect roads in winter. Bridges are constructed as permanently as possible, and efforts are made to avoid flood damage.

From the very beginning the aim has been to make the State Highway "safe, sane, and economical."



Safety Features of the State Highway

## Road Oil Specifications and Tests

By CLARENCE B. OSBORNE,  
Geologist, California Highway Commission.

The finished road surface will be subjected to the pounding impact of the iron-shod horse, the pulverizing grind of the steel-rimmed wheel and the pulling-upward suction of the rushing rubber tire; these make up the modern forces of traffic which forever tend to crush, grind, displace and scatter the road surface. There is no material that can, unaided, continue to withstand such an attack. To these destructive agencies of traffic are added the erosive action of storm waters, the disrupting forces of frost, the theft of material by the sweeping winds, and the melting and drying action of the hot sunshine.

In the preparation of specifications for asphaltic oil for road building the road engineer has three problems presented: *first*, he must have requirements controlling the chemical purity of the oil, *i.e.*, he desires an oil that is free from foreign material and products of decomposition produced during refining; *second*, he must control the chemical composition of the oil; *third*, he must control the physical properties of an oil so that it will actually perform its proper function in the road construction.

Specifications for chemical purity of road oil are as follows:

1. *It shall not contain more than one half of one per cent of sediment by volume.*

The presence of even ten times this amount of sediment is not detrimental, as the oil in use on the road eventually carries as high as ninety per cent of mineral aggregate. This specification is used to prevent the buying of sediment at the price of road oil.

2. *It shall not contain more than one per cent of water by volume.*

The presence of water in a road oil makes the oil difficult to handle when heated above 212 degrees Fahrenheit, because the steam formed makes the oil boil or froth. Also, as in the case of sediment, unless the proper deduction is made water will be paid for at the price of road oil.

3. *It must, when freed from water, be soluble to at least ninety-nine and five tenths per cent (99.5%) in pure carbon disulphide.*

This will give the per cent of bitumen in the road oil.

4. *The bitumen soluble in carbon disulphide must be soluble in carbon tetrachloride to the extent of at least ninety-nine per cent (99.0%).*

The failure to pass this specification is supposed to be an indication of an over-heated or "cracked" oil. Carbon tetrachloride is not a stable solvent in bright light and the solubility test is influenced if the test is performed in bright light.

Another specification sometimes used to determine a "cracked" oil is as follows:

5. *In CS<sub>2</sub> bromide solution. The bitumen soluble in carbon disulphide must be soluble to the extent of at least ninety-nine and eighty-five one hundredths per cent (99.85%) in a solution of one hundred and thirty-five (135.0) milligrams of bromine to one hundred (100.0) cubic centimeters of the carbon disulphide, when twenty-five (25.0) cubic centimeters of the solution are poured on two (2.0) grammes of the oil in an Erlenmeyer flask, which is then shaken in the dark for three (3.0) minutes, the solution being immediately filtered through a Gooch crucible using a suction equal to a column of mercury more than eight (8.0) inches high.*

*When the solution has all passed through the crucible, the crucible is washed with pure carbon disulphide, dried at from two hundred and twelve (212.0) to two hundred and twenty degrees Fahrenheit and weighed.*

This test had its origin in the examination of vegetable and animal fats. The unsaturated fatty acids form insoluble bromides. This bromide carbon disulphide solvent is not stable, however. An oil having an excess of fifteen hundredths of one per cent of insoluble material would fail to pass this specification, and yet this failure might be due entirely to the unstable solvent.

The specifications to govern the different constituents that make up the bitumen of the road oil are partly included in the specifications numbered 3, 4 and 5.

The road oils are generally classified as to their asphalt content. This asphalt is not a definite chemical compound determined by chemical analysis. To determine the asphaltic content, the road oil is hardened by heating it in an asphalt oven at a high temperature. Part of the light or volatile oils, is driven off in this heating and the residue is hardened. The degree of hardness is measured by the depth of penetration of a No. 2 needle when acting under a load of 100 grams for five seconds, the residue being maintained at 77 degrees Fahrenheit. If the needle penetrates 8 millimeters in this test the residue, called asphalt, is said to be asphalt of 80 penetration. As can readily be seen, this residue may contain many different bitumens. The test is not a measure of a definite chemical compound.

If the assayer for copper should call all the metal extracted "copper" when the metal was of a certain hardness, then it can readily be seen that any alloy of soft and hard metals that made this certain hardness would be classified as copper. This is the practical result of the specification for a road oil when it is required to contain a certain percentage of asphaltum.

The early oil bound macadam roads built with asphaltic oils usually required an oil containing 70 to 75 per cent of asphalt of 80 penetration. This oil was not heavy, that is, it lacked body (*i.e.*, low viscosity), and it was a weak binder but it was easily applied to the road surface.

The use of pressure tank wagons with sprayers for applying heated road oil has made it possible to use an oil of much higher asphalt content and of higher viscosity. The road oil that is now commonly demanded for oil bound macadam, or for bituminous covered concrete highways, is one that contains 90 per cent of 80 penetration asphalt. The following specifications are suggested for such an oil:

6. *It shall contain 90 per cent of 80 penetration asphalt.*

This per cent of asphalt is determined by heating 20 grams of the road oil in a two ounce salve tin in a standard asphalt oven, the temperature of the oven being maintained at 400 degrees Fahrenheit. When the asphaltic residue has a penetration of 80, the oil shall not have lost in excess of 10 per cent by weight.

The asphaltic content is the classification of the oil refineries of their different grades of road oil. The specification is of value more on this account than for any information of practical value furnished to the road builder.

7. *It shall show an open flash point not less than 350 degrees Fahrenheit.*

This requirement prevents the use of an oil carrying very volatile constituents that would readily evaporate and might also be dangerously combustible at the time the oil was being sprayed on the road at the high temperature necessary for spraying.

The physical properties of a road oil are of the greatest importance to the road builder. The following specifications deal directly with the measurement of the important physical properties:

8. *It shall show a float test of not over 1000 seconds when tested at 90 degrees Fahrenheit. This test is described in Bulletin No. 38 issued by the Office of Public Roads, United States Department of Agriculture.*

This float test is the measurement of the viscosity of a road oil. The requirement will prevent the use of excessively viscous road oil, one that is difficult to apply and is slow to absorb the mineral aggregate necessary to the building up of the proper wearing surface.

9. *The oil shall show a specific viscosity of not more than one hundred (100) when tested with the Engler viscosimeter at a temperature of two hundred and twelve (212) degrees Fahrenheit.*

This test will prevent the use of an oil that is too viscous to be readily applied to the road surface from the oil spraying wagon.

10. *It shall show an adhesive test of not less than 300 seconds for three revolutions with the Osborne adhesive machine, when the oil is tested at a temperature of 77 degrees Fahrenheit, the load being 3 kilograms.*

This test is the measure of the oil's power to prevent relative motion of two concentric cylinders when the oil acts as a binder between the surfaces of the two cylinders. The inner cylinder is 1.995 inches in diameter, the outer cylinder is 2.000 inches in diameter, the outer cylinder being in the form of a loose collar two inches wide. Its inner surface is coated with the oil to be tested. The outer surface of the inner cylinder is coated with oil and the collar then forced on the inner cylinder, which is maintained in a stationary position. The outer collar is wound with cord to which a three kilogram weight is attached; the pull of this weight causes the collar to revolve; the thin film of road oil between the two cylinder surfaces offers a resistance to this turning. The temperature of the oil being tested is maintained at 77 degrees Fahrenheit by means of water circulating in the inner cylinder. The measurement of the adhesive value of the oil is the length of time required for three complete revolutions of the collar.

Oils containing the same percentage of asphaltum will often show the greatest difference in their binding properties. Oils possessing the same viscosity will likewise often show a wide difference in adhesiveness.

As an example, one oil may be largely made up of heavy lubricating grease, another may be very free from lubricating material but they may both flow through a given-sized orifice at the same rate, when heated to the same temperature, that is, they have the same viscosity. The lubricating oil would lack binding power and be unsatisfactory for road construction; the other would be desirable. The adhesive specification would prevent the use of the unsatisfactory lubricating oil.

The asphalt contained in a road oil is required by some road builders to possess a certain ductility.

11. *The ductility of the asphalt which has been reduced to a penetration between 75 and 85 shall not be less than 110 centimeters.*

This test is made with asphalt maintained at 77 degrees Fahrenheit and the pulling shall be at the rate of five centimeters per minute, using the Dow ductility machine.

There is a woeful lack of uniform specifications for road oil and uniform methods of performing the tests. In the determination of the asphaltic content of an oil, the temperature for the asphalt oven is specified sometimes at 325 degrees Fahrenheit, and from that to as high as 500 degrees Fahrenheit. The dish containing the road oil during the reduction is in some laboratories as small as a thimble, and in others, large enough to hold 500 grams; sometimes cylindrical, and other times semispherical in shape. Some tests require the use of an oven, others require heating in the open air. As has been shown, the "asphaltic content of an oil" is, at best, a rather indefinite term, and when we have added to this the different methods used and the wide range of equipment used, the "asphaltic content" becomes even more of a vague description.

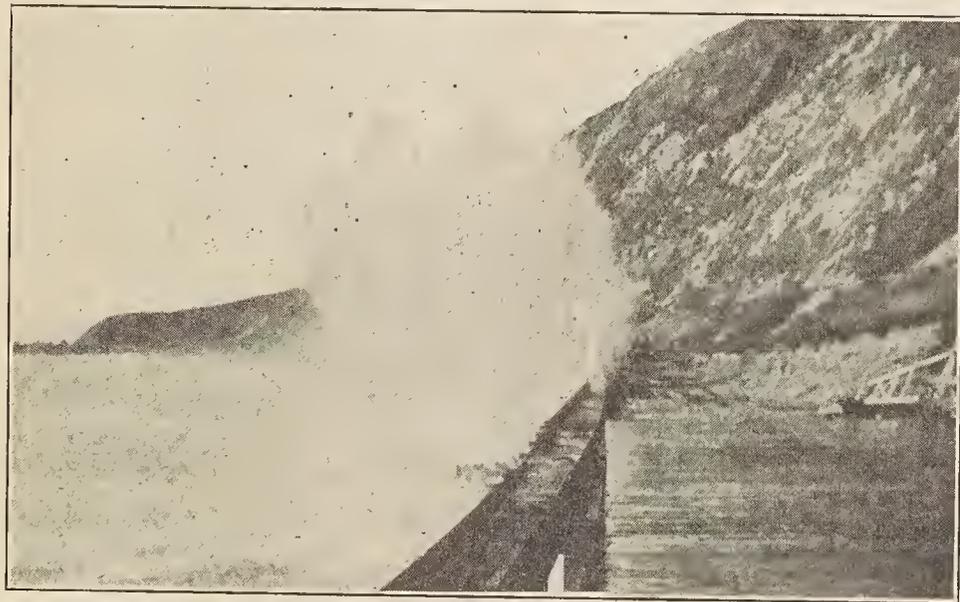
The asphaltic road oils are, for the most part, a by-product of the oil refineries. They are a relatively cheap material. This cheapness saves the road oils from being adulterated with other material. It is expensive to add anything to the oil. The natural oil itself rarely carries undesirable material. The tests for water and sediment will take care of foreign materials brought in by the crude oil.

Some road engineers have regarded oil containing sulphur as dangerous to use because the sulphur is supposed to make the product unstable. Many oils and asphalts carrying sulphur have given good service for long periods of time, and if sulphur does tend to make the oil unstable, this action is too slow to be of importance in the life of the oil used in the road construction.

## SURVEYOR INSPECTS HIGHWAY

Expert Report of W. L. Luning, of Tehama County,  
Commends Construction and Specifications

When the board of supervisors of Tehama County was requested by the California Highway Commission to cooperate in making marketable a sufficient number of state highway bonds to finance construction in that county, it was deemed just to the people of Tehama County to make a close investigation of the character of the state highway construction. Since no construction has been completed in Division II, the people of Tehama County have no close opportunity to investigate



Forty-foot Wave on Rincon Route, State Highway. During Last Winter's High Tides This Sea Level Road Withstood Severe Onslaughts of Ocean and Flood Waters.

the character of work, and they have been assailed by conflicting reports as to methods of construction.

The Supervisors and the Red Bluff Chamber of Commerce accordingly joined in requesting W. L. Luning, county surveyor of Tehama County, to make a personal investigation of the State Highway. Mr. Luning has been county surveyor of his county for a quarter of a century, and is well known all over northern California as an authority on highway construction. He made, on his own initiative, a thorough investigation and on his return submitted his report to the Red Bluff Chamber of Commerce, of which the following is an extract:

"There being publication and criticism to the effect that the Highway Commission were constructing some inferior roads, and in some instances there were portions of the road going to pieces, and they were not constructed in a permanent manner, the part of

the committee work allotted to me was to inspect some of that portion of the State Highway that has been criticised.

"We went all over the State Highway constructed between San Francisco and Santa Clara. The State Highway is not continuous between the two points above mentioned. It is disconnected by corporations and portions that have not yet been constructed. We traversed twenty-three miles of constructed State Highway, while we were from where we started forty-eight miles.

"A portion of this State Highway is paved twenty-four feet wide and a portion twenty feet wide. The road paved varies in width according to the amount of travel. I find the worst-paved road between Centerville and Santa Clara. There were three or four places where the concrete was broken, each place being about two feet in diameter. This may have been caused by an improper mixture, or by being used before the concrete had time to set. On this same piece of road there were numerous places where the



Farthest North on California State Highway. Hills in Foreground Are in California; Those at Right Are in Oregon

asphalt did not adhere to the concrete base and the concrete was exposed but not broken. This may have been caused by the concrete being wet, as I was informed that this road was constructed in wet weather.

"I met John MacBain, a supervisor of San Mateo County, whose post-office address is Menlo Park. I told him my mission; in conversation with him he told me that there was not a particle of constructed State Highway in San Mateo County that was bad. I found his statement to be true.

"While I think there is no need for me to go into all minor details of construction, I will say that I find this portion of the State Highway in good condition except the small portion above referred to, and it was not caused by faulty specifications. Because there were three or four holes in the roadbed and the asphalt finish did not adhere in a few places, the whole road should not be condemned.

"The specifications for the construction of the State Highway are good. I myself thought the four-inch concrete base was too thin, but I saw the road in places constructed on high fills which have been thoroughly water-soaked this winter and the paved road bed has withstood it all, and is in fine condition."

The supervisors of Tehama County are financing the construction of \$450,000.00 of State Highway through that county.

## Highway an Empire Developer

The Shasta County Promotion and Development Association recently made the State Highway and irrigation as the main planks in its platform, and an active county campaign has been carried out along those lines by the secretary, R. J. Anderson. A leaflet has been printed and widely distributed with the heading, "Opening and Developing an Empire," and beginning with the following paragraphs:

"The building of the California State Highway, which means a paved street from San Francisco entirely through Shasta County on to Portland, is opening up an immense empire for settlement.

"Such a road as this will bring into our county the very best class and character of settlers, people who have the money to help us develop our vast resources, and who will take a pride in seeing that our development is on a substantial and profitable line."



CONSTRUCTION PROGRESS ON CALIFORNIA STATE HIGHWAY

# FEATURES OF THE STATE HIGHWAY

## Conquering Oldtime Barriers, Opening Rich Sections for Motor Truck Traffic, and Other Benefits Considered in Highway Construction

By N. D. DARLINGTON

Member, California Highway Commission



The State Highway is primarily designed to meet the commercial needs of the State of California and to provide better means of communication than is afforded by our present road system. In planning highway construction under the authorization of the State Highways Act, and with the foregoing in mind, there have been developed, of course, features of special interest in road building. There are as well other features only indirectly allied to the state highway work, but which are important to the people of California.

In conquering the mountain barriers changes are required to produce a modern highway which may be considered features of the state highway work. The Commission has met several problems of this sort in different parts of California, and has endeavored to solve them with a maximum grade of six per cent where practical, or, at the most, six and one half or seven per cent. This policy has been criticized, but no doubt the critics have not fully realized that the word "permanent" is prominent in the mandates of the Highways Act, and that the roads as laid out must be planned to be good roads for years in the future.

Our mountain ranges heretofore have been veritable barriers to travel on account of the excessive grades on the present roads. These obstructions to the flow of traffic have been overcome by replacing the present tortuous roads with their steep grades with modern highways of good alignment and easy grades. Bailey's Hill, at the northern entrance to California, has had such a road winding down from Oregon; it will be supplanted by a highway with a grade not over six to seven per cent, and the Oregon road builders have taken California's standard and are coming over the Siskiyou mountains to our state line with a six per cent maximum. In the Santa Cruz mountains a splendid road with no steep or dangerous grades will form part of the State Highway. Across the range between the San Joaquin Valley and southern California the new highway will eliminate many miles of distance as well as bad grades, and will offer a magnificent panoramic road. The dangerous Casitas Pass is supplanted by the sea-level Rincon route along the coast between Santa Barbara and Los Angeles, a feature in which the state highway work has been materially aided by public spirited citizens. The road from El Centro to San Diego will furnish those living in Imperial Valley with a direct outlet to the coast over a road which will be unsurpassed for beauty and interest.

The mountain roads of the State Highway will prove more valuable, I believe, in their purely commercial aspect than in the pleasure they give to tourists. The commercial motor vehicle is a most important factor, and its development has but started. In Los Angeles County, following the establishment of a comprehensive system of good roads,

the number of motor trucks increased from sixty-four to thirty-two hundred in four years, and the best informed motor truck men of Los Angeles regard six thousand trucks as a normal number for use in that county. A similar, although not so rapid increase, is to be observed in all parts of California. The State Highway will make the motor truck an adjunct of the rancher, and thus will come an important development of California's resources. The same thing is true of the county highway systems which are planned in this State.

During the past rainy season numerous ranchers found it necessary to make three and four trips on unimproved roads as far as the State Highway, where they piled the loads until they had enough for one load to take into town on the paved highway. That experience demonstrated the commercial value of a good road. There are numerous rich sections of California where hauling economically all winter is out of the question without a road that will give good service in bad weather—when it is most needed.

A feature of special importance is the shortening of routes between sections of the State. The Yolo causeway across the by-pass of the Sacramento River west of Sacramento is a feature of this sort. It will require about three miles of concrete trestle, but will be of service to the entire State and will materially shorten the distance between Sacramento and the San Francisco bay cities.

In opening up a permanent route through the redwoods to Humboldt and Del Norte counties there will be provided an important feature of the State Highway. In addition to advancing the commercial interests of the northern California coast the route will prove a magnificent touring attraction. It will run for miles through stately redwoods, giant trees several thousand years old, where at times the sun is obscured by the forest, making a trip long to be remembered. This is a feature of California which by all means should be preserved. The redwoods of northern California tell the magnificent proportions of the State's resources in so stately a way that a state park ought to be planned comprehensively while it is feasible to do this, and it should be planned so that the tourists who take that route of the State Highway should realize the importance of this feature of touring in California. This is a matter of conservation and beautification which the women of California should take up through their various organizations and carry to an achievement.

The greatest feature about California's State Highway is that the expenditure of eighteen millions as a precursor of the State's complete road development fits into the new era of California so remarkably. We can not realize the development California has just ahead, and yet in all parts of the State preparations are being made now for that development. The State Highway will be completed just at a time when it will prove an invaluable factor to the communities and counties in facilitating the development of the next decade.

### ACCEPTANCE OF BRIDGES B

Walter C. Howe, division engineer, California Highway Commission, said in discussing "County Bridges," at the March, 1914, Seminar of Highway Department Heads:

"I believe that the acceptance of all long span bridges by the State should be very carefully considered. The recent floods took out many heavy steel bridges in Division V. The lesson taught was a very valuable one to the counties. Many of the bridge failures were due to faulty pile foundations and consequent settling of piers; others were due to improperly designed abutments, but the principal and most important lesson taught was the urgent necessity for proper protection of the river banks to prevent continued erosion. On every river in this division the erosion of the banks from the 1914 floods is the one big problem, and this problem should be solved before the acceptance of bridges menaced by this danger, for it may easily happen that a 700-foot bridge accepted to-day may be an isolated structure to-morrow, and the expense of all the additional spans necessary to bridge this gap made by the flood waters, would, I assume, have to be borne by the State if the original structure and its approaches had been fully taken over and accepted."

In discussing the same subject, R. E. Dodge, office engineer of the Highway Commission, gave the following summary of the method of changing plans for county bridges:

"At present most of the plans and specifications for county bridges are being submitted to the headquarters office for examination. The plans are checked sufficiently to detect any dangerous weakness in design and to find out whether the structure will carry the Commission's prescribed loading at safe working stresses. The attention of the county officials is called to any defects, and sometimes remedies are suggested. No attempt is made to have plans revised so that the structures may be the best or most economical for the place. The specifications are looked over, and any parts that do not call for proper material or work are criticised. It is not possible, however, to study specifications sufficiently to make sure that nothing is omitted, or that they are in the best form for the job. The responsibility for field inspection in behalf of the State, is placed upon the division offices. The inspection which appears to be contemplated is not for the purpose of enforcing specifications or insuring good work, but for the purpose of gathering data upon which to base, in part, acceptance or rejection."

# PROBLEMS OF HIGHWAY CONSTRUCTION

## Difficulties in the Work of the California Highway Commission in Building the State Highway

By AUSTIN B. FLETCHER, Highway Engineer.



The State Highways Act, under which the state roads are being constructed, provides in no uncertain words that the State is to maintain the roads after they are built. The Motor Vehicle Act, through the fees which it specifies for the registration of motor vehicles, will provide the money, since one half of the net receipts goes to the counties for the maintenance of county roads and the balance to the state highways for their upkeep. Estimating conservatively, there should be available from this source for the state highways during the year 1914 from \$350,000 to \$400,000.

The chief immediate use which the Commission has for a maintenance fund is for placing gravel or macadam shoulders along the paved portions of the roads built and to be built. In many localities the natural soil under and beside the paved portion of the roadway is not sufficiently stable during wet weather to sustain even the occasional wheel which gets upon it, and it is of course necessary that at times the shoulders of the roads should be able to carry some traffic.

It did not seem possible to provide for such shoulders in the original construction because of the cost of such work and the necessity for conserving as much as possible of the eighteen million dollars appropriated for construction purposes. The maintenance fund also permits of the purchase of equipment for repairing and maintaining the roads, which is costly and which can not be rented economically. Maintenance problems and those of construction, in highway work particularly, are almost inseparable, and in choosing a type of road or pavement the future must always be reckoned with.

The greatest problem of all confronting the California Highway Commission is how to build nearly two thousand seven hundred miles of state highway with eighteen million dollars in such a manner that the people will be reasonably satisfied, and so that the roads will not cost excessively for maintenance. This means that on the average, including administration expenses, the roads must not cost more than six thousand six hundred dollars per mile, which is obviously too little if the whole system is to be paved.

As a result of much deliberation the Commission adopted as a standard type of paving to meet the average conditions a Portland cement concrete roadway fifteen feet wide, protected by a thin surfacing of asphaltic oil combined with stone screenings. This does not mean that all of the state roads are to be so constructed, for some of the roads have already been paved to a width of twenty-four feet, where the traffic seemed to require it, and surfaced with asphaltic concrete. Nor does it mean that all of the roads will be paved, for in some of the mountain counties such a treatment would be absurd under present traffic conditions.

There are now under contract about three hundred fifteen miles of concrete road on which the thin top is to be placed. About fifty miles of the thin top has been put on, and on all but a very few miles it is giving admirable service.

The history of the thin top or carpet is interesting. For many years, and until about the year 1906, the broken stone road first developed in England by John L. Macadam, and perfected for American requirements by William E. McClintock of Massachusetts, was considered the last word in rural road building. The Eastern States were all constructing their state highways of that type, and the roadbuilders were a self-satisfied lot. In 1906 the writer was chosen by the Government Office of Public Roads to prepare a bulletin on the subject, and he well remembers his feeling of pride when he was told that over two hundred thousand copies of his bulletin were to be printed and distributed. The writer also well remembers that but two years later at a road meeting at Buffalo he was obliged to confess that "the macadam road is a thing of the past" because of the ubiquitous automobile.

The case, however, turned out to be not so bad as was then predicted, for after experimenting with applications of hot asphaltic oil or refined tars and sand spread upon the cleaned macadam roadways, a method which the French probably first discovered, it was found that a thin bituminous carpet from one fourth to one half an inch in thickness was developed, which served to prevent the raveling of the stones com-

posing the pavement. There are thousands of miles of macadam road in the Eastern States treated in this manner, which are now giving ample satisfaction even to that most captious critic, the automobile owner.

In the year 1908, almost simultaneously in Ann Arbor, Michigan, and in Spencer, Massachusetts, sections of concrete roadway were covered with a similar bituminous carpet of refined tar and stone screenings. In the Massachusetts case, with which the writer is more familiar since the work was done under his direction, the bituminous covering was applied to lessen the roughness of a section of concrete pavement built by the Hassam process. Both the Ann Arbor experiment and that in Massachusetts were successful, and the carpets gave good service, lasting two years and more with almost no expense until it came time to renew them by precisely similar applications of tar and screenings. Within the last few years many thousands of square yards of concrete have been so covered with bituminous carpets, and the Ann Arbor engineer who thought out the scheme has even applied for letters patent on the process. The patent has not been granted yet, so far as the writer is aware.

It was these experiments in the Eastern States which led the California Highway Commission to consider the bituminous carpets for the California roads. The only essential difference between the work in the East and that here lies in the use of heavy asphaltic oil instead of tar. It was not possible to use coal tar in California without long railroad carriage and correspondingly high cost, for it is not produced here in any considerable quantity. The writer, however, has no regret on that account. The bituminous carpets, using California asphaltic oil on ninety per cent of the work already done, are far superior in his judgment to the tar and screening carpets of the East which he has inspected. They are also far superior to the bituminous carpets usually applied to the macadam roads in the East, and he asserts, after more than twenty years' experience in state highway work, that no eastern state is to-day getting its state highways constructed so cheaply, so thoroughly, or surfaced so satisfactorily as is California.

Two trips made by the writer to England and France during the past five years have convinced him also that in the construction of our roads we can learn little there. They are still laying the bituminous carpets on waterbound macadam roads, or, where the traffic is heavy, mixing tar with slag or broken stone and forming a crude bituminous macadam roadcrust not nearly so good, in the writer's opinion, as the asphaltic concrete work done in California. As to maintenance problems, that is another story.

California started late with its state highways. Its people, with the changed conditions of traffic brought about by the automobile, are demanding what to all intents and purposes is city street work out in the country. And California is getting it, to all intents and purposes.

The Commission has had some poor work foisted upon it. In Sonoma County there was some concrete thinner than called for by the specifications, but that has not been paid for, and the poor work will be done over before the road is completed. In Santa Clara County the writer made the error of allowing some asphaltic oil of too heavy grade to be used, which, because of the climatic conditions at the time of its application, did not make the bituminous carpet of the thickness and quality desired or expected.

Based upon these instances the report has been circulated widely that the state highways are crumbling; that they are a laughing stock. Almost any expression of contempt has served. It has even been said—God save the mark!—that they have been hastily built. Mark Twain said somewhere: "The chief difference between a cat and a lie is that the cat has only nine lives."

The people on the peninsula do not believe such nonsense, nor do the people in the San Joaquin Valley, nor in Los Angeles County, nor in San Diego. Nor, indeed, do the people of the State generally, or their actions belie their deeds. They believe in the kind of roads the Commission is building to such an extent that since October, 1912, they have financed the construction by purchasing state highway bonds to the extent of nearly seven million dollars.†

The Commission has had some difficulty in making the people of some localities believe that the law [State Highways Act] means what it so plainly says. Many hearings have been given and much time consumed

\*Extracts from a paper read before the Commonwealth Club of San Francisco, March 14, 1914, on "Some of the Problems and Accomplishments of the California Highway Commission."

†The sale of state highway bonds made possible through the cooperation of California counties and banks amounted on June 15, 1914, to a total of \$7,505,000.00. There is not at this date a market demand at par for the bonds because they yield but four per cent interest.

in listening to advocates for particular routes who wished the course of the state highway diverted from what the Commission considered to be the most direct and practicable lines. It is believed that the people of the State have now come to a better understanding of this matter and realize that the State Highway is to be built for all of the people and that it can not be diverted from its course for purely local requirements.

The writer, in closing, feels that it is but fair to recite briefly some of the other achievements of the Commissioners in the promotion of state highway work, for which he thinks that they are entitled to the everlasting thanks of the people of California:

They have brought about the policy that the counties shall furnish without cost to the State all land needed for the right of way of the State Highway.

They have induced the counties to build and pay for all new bridges exceeding twenty feet in span along the line of the State Highway.

They have caused the cities and incorporated towns along the route to agree that the streets within their corporate limits should be paved and maintained by the municipalities.

They have induced the railroads, over which hundreds of thousands of tons of materials must be transported, to reduce their freight charges so that such materials will be moved at approximately one half rate.

They have saved many thousands of dollars by purchasing road materials in large quantities.

They have, by careful studies of the location of the State Highway, obviated crossings with railroads at grade in many places. In Ventura County alone, within a length of twelve miles, nine grade crossings will be abolished.

They have provided for two trunk lines between San Francisco and Los Angeles, one by the coast and the other by the valleys, the first requiring about three hundred and eighty-four miles of construction and the latter three hundred and twenty-three miles, which will be paved, and which will nowhere have a grade in excess of six and one half per cent and not more than two or three miles in excess of six per cent.

## SEMINAR OF HIGHWAY HEADS

### Engineers and Other Officials of Highway Commission Hold Meeting for Exchange of Experiences in Construction

A seminar of department heads of the California Highway Commission was held at Sacramento March 26th and 27th, on call of the Highway Engineer. Those attending had been assigned topics affecting the constructing of the State Highway, and others were given discussions so that a general interchange of views and experiences resulted.

Chairman Charles D. Blaney of the Highway Commission made the opening address welcoming the department heads, who came from all sections of the State where the highway is under construction.

At the opening session the following papers were presented and discussed: "Civil Service as It Affects the Employees of the Commission," by Charles C. Carleton, attorney for the Commission, with discussion by W. Lewis Clark, division engineer; "Accounting," by J. H. Small, chief accountant, with discussion by T. E. Stanton, Jr., principal assistant engineer of Division VI; "Purchasing," by H. L. Warren, purchasing agent, with discussion by George Mattis, principal assistant engineer of Division V; "Surveys and Drafting," by T. A. Bedford, division engineer, with discussions by S. V. Cortelyou, principal assistant engineer of Division VII, F. W. Haselwood, principal assistant engineer of Division I, Samuel S. Stahl, principal assistant engineer of Division III, and Russell H. Stalnaker, principal assistant engineer of Division II; "The Testing of Materials," by C. B. Osborne, geologist for the Commission, with discussion by J. B. Woodson, division engineer.

The second session composed the following papers and discussions: "County Bridges," paper by Walter C. Howe, division engineer, with discussion by R. E. Dodge, office engineer at headquarters; "Rights of Way," by C. C. Carleton, attorney, with discussion by George B. Harrison, chief of right of way department; "Day Labor versus Contracts," by William S. Caruthers, division engineer, with discussion by F. G. Somner, division engineer; "Publicity," by George B. Harrison, editor of the "California Highway Bulletin," with discussion by Wilson R. Ellis, secretary of the Commission.

Papers presented at the second day's meeting were as follows: "Drainage," by Arthur E. Loder, division engineer, with discussion by W. Lewis Clark, division engineer; "Mountain Roads," by Francis G. Somner, division engineer, with discussion by T. A. Bedford, division engineer; "Inspection on Contract Work; How May Its Cost Be Lowered?" by L. H. Gibson, second assistant Highway Engineer, with discussion by A. E. Loder, division engineer; "Extra Work Orders and Permits," by George R. Winslow, first assistant Highway Engineer,

with discussion by William S. Caruthers, division engineer; "Concrete Bases," by J. B. Woodson, division engineer, with discussion by L. H. Gibson, second assistant Highway Engineer; "Thin Bituminous Tops," by W. Lewis Clark, division engineer, with discussion by J. B. Woodson, division engineer; "Asphaltic Concrete," by A. E. Loder, division engineer, with discussion by Walter C. Howe, division engineer; "Cost Data," by A. B. Cleaveland, assistant engineer, with discussion by R. K. West, principal assistant engineer of Division IV; "Maintenance," by J. B. Woodson, division engineer, with discussion by A. E. Loder, division engineer.

Officials and department heads of the Highway Commission were entertained at a dinner at the Sutter Club by the Highway Engineer, with Governor Hiram W. Johnson as the guest of honor. The Governor, State Engineer McClure, and Commissioners Blaney, Darlington and Stern, made informal talks.

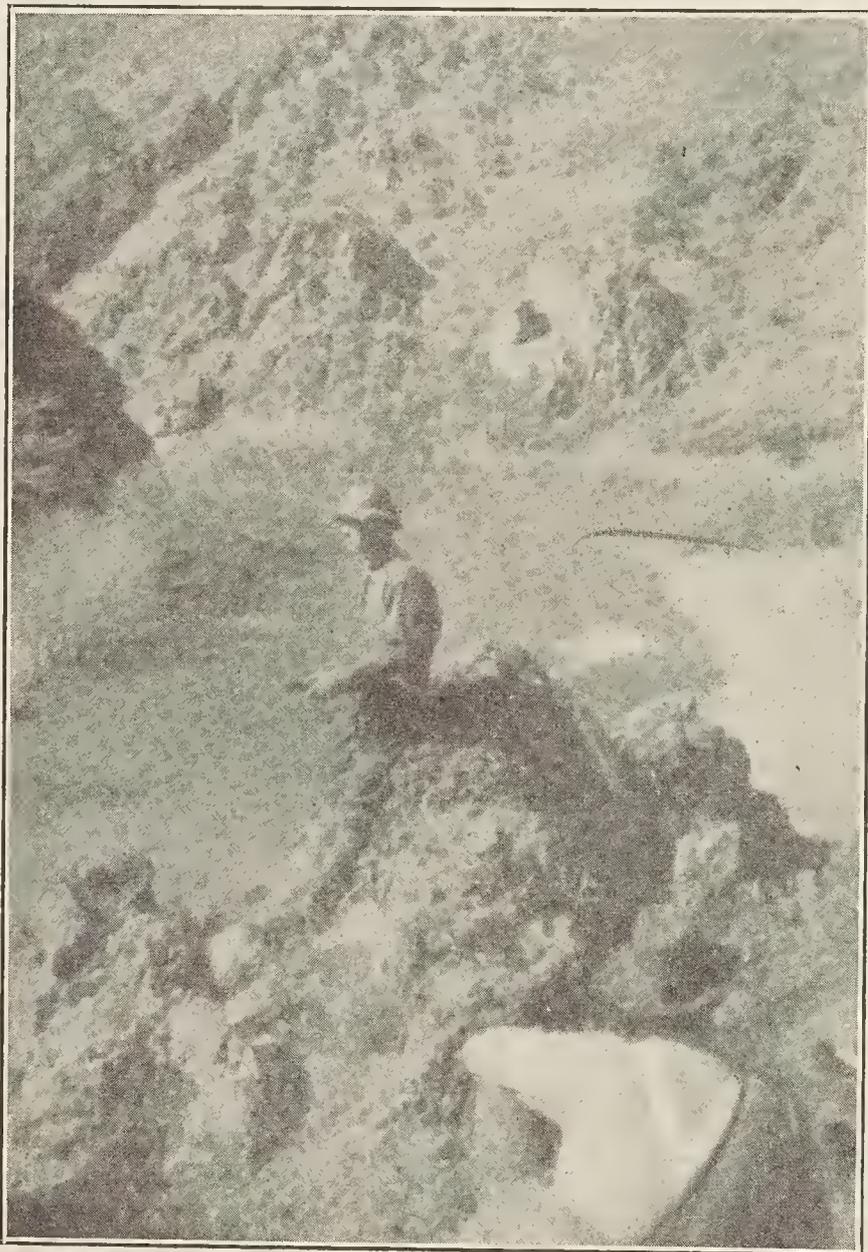
All the sessions of the seminar were given over to a running discussion of the subjects, and the members of the Commission and department heads exchanged views freely at all times, resulting in a valuable series of experiences. The seminar will be repeated at a future date.

Several of the articles appearing in this number of the "Highway Bulletin" are taken from the papers and discussions at the March seminar.

## Changes

Burton A. Towne has resigned as a member of the California Highway Commission and an appointed member of the Advisory Board of the State Department of Engineering, owing to the pressure of private affairs. Mr. Towne was one of the original members of the Commission, and was elected chairman upon its organization, holding that place until his resignation was accepted. Governor Johnson appointed Charles F. Stern, of Eureka, in Mr. Towne's place, and the Highway Commission elected Commissioner Charles D. Blaney as its chairman.

Wilson R. Ellis, who has served as Secretary of the Highway Commission since its organization, has requested and been granted a leave of absence until November 1st, and Charles C. Carleton has been made Acting Secretary. Mr. Carleton will continue his duties as Attorney for the Commission while serving as Acting Secretary.



Reconnoitering along Shasta River; Commissioner Stern in Center of Illustration.



Surveying and Building Mountain Roads of State Highway

## PERMANENT ROAD CONSTRUCTION

In answer to an inquiry for information on permanent road construction, Highway Engineer A. B. Fletcher recently made the following reply to a California correspondent:

"At the outset I have to confess that I know of no type of pavement which can truly be called 'permanent,' and the expression must be considered as only relative. I know of no pavement or roadway which does not require from the day it is constructed more or less expenditure for maintenance. If no other work is needed for the first few years the roadsides, gutters and culverts have to be looked after.

"As concerns the pavement proper, I believe of the types within the means of the more opulent states and counties at the present time that most nearly approaching the ideal consists of a concrete base of thickness sufficient to properly sustain the traffic which it must carry with a wearing surface of asphaltic concrete from one and one half to two inches thick.

"Such a pavement twenty feet in width and with the base only four inches thick would probably cost under the conditions in your county not less than \$14,500 per mile for the paved portion of the road, assuming that the concrete can be laid for \$6.25 per cubic yard and the asphaltic concrete surface for six cents per square foot. To this must be added the cost of grading, culverts, drains and any special treatment of the shoulders or beams on the sides of the pavements.

"Few of the states and hardly any of the counties with which I am familiar can afford so great an expenditure per mile.

"In the instance mentioned a thickness of concrete base of four inches was assumed. In my opinion so thin a base should be adopted only when the subgrade is of excellent quality both as concerns the material composing it, and the rolling done upon it to make it compact and unyielding, and when the inspection of the construction is adequate. Eternal vigilance is necessary to prevent construction of the base thinner than the specifications provide for.

"If the base be increased in thickness to say five inches, one fourth must be added to its cost or about \$2,000 per mile, making a total probable cost of \$16,500 per mile.

"It was early apparent to the Commission in its State Highway work that no such road as has been discussed above was possible if justice was to be done to all parts of the State. The main routes, requiring paving aggregating about 1,300 miles in length (less than one half of the total mileage called for by the State Highways Act), if built as above described, but with the paving only fifteen feet wide, would cost, grading and culverts included, more than \$16,000,000 and adding the overhead expense there would be almost nothing left for the other half of the system.

"This consideration led the Commission to seek a type of road cheaper in first cost, notwithstanding a consequential higher maintenance expenditure during the early years of its existence and the type called 'concrete base with bituminous top' was adopted rather generally.

"In this method of construction, the base is the same as if the one and one half to two inches covering were to be applied, but instead a thin coating of asphaltic oil of special quality is put on to the concrete by spraying machines at the rate of about one half gallon to the square yard. Clean stone screenings or coarse sand are then added in sufficient quantity to absorb the oil. The process requires much care in the selection of the materials used and in their manipulation, but the result is a bituminized coating about three eighths of an inch thick. The cost of such surface work ranges from five to ten cents per square yard, or

\$600 to \$1,200 per mile, roughly, for a twenty-foot pavement, depending on the cost of materials and local conditions. This means that more than ninety per cent of the cost of the work on the road goes into grading, culvert work and the concrete base, all of which may be considered as practically permanent, and the remainder into the thin wearing surface.

"Such a wearing surface should last from two to four years before it requires renewal, which renewal should cost considerably less than the original application. The thin surface is best adapted to rubber-tired vehicles, but it wears well under a considerable volume of mixed traffic consisting of both rubber and iron-tired vehicles.

"I would have no hesitancy in recommending the thin road surface for a road covering as many as from five to six hundred vehicles a day, provided a considerable portion of the vehicles are rubber tired.

"If the concrete is covered with a thick one and one half to two inch coating of asphaltic concrete, under ordinary conditions, there will be but little cost for maintenance except on the roadsides and for cleaning culverts for the first five years, but after that period the surface will require attention from time to time in patching and applying seal coats, and when the road needs a new surface, it will doubtless be found that the maintenance cost has been in excess of two and one half cents per square yard per annum.

"Another type of road which the Commission has constructed to the extent of nearly twenty miles is the so-called 'oil macadam' road. When properly built, I consider this type of work worthy of adoption in many cases, but it has been found, in this State at least, that it is very difficult to secure uniformly good results. There are many contributing causes to the failures or partial failures and the Commission has favored the cement concrete type because of the greater certainty of result and because also the concrete so far has cost about the same as 'oil macadam.'

"My experience in the East leads me to believe that the 'oil macadam' pavement costs for maintenance not much less per mile per year than the cement concrete base with thin asphaltic top, and this is borne out in the case of the San Joaquin County work here in California. Los Angeles County has constructed many miles of this sort of road and the costs of maintenance there should be easily obtainable.

"Much work is being done in the cities and to some extent in the country of the type known as 'asphaltic concrete'. This pavement in its original form was patented and is often called 'bitulithic'. With a hard, unyielding base a thickness of four inches may be used with good results, but unless the subgrade is nearly perfect, the upper surface of the road is likely to become wavy under the traffic. This sort of pavement costs from twelve to sixteen cents per square foot, \$12,500 to \$17,000 per mile, twenty feet wide, for the pavement alone. About twenty miles of such pavement was put down several years ago in San Joaquin County of an average width of eleven feet. I am told that, including the grading, this work cost about \$11,000 per mile.

"In Alameda County, in the vicinity of Dublin, at the present time a road of this general type is being built at a cost of about \$30,000 per mile, including the grading, the pavement being, if my information is correct, thirty feet in width.

"My personal preference is for a concrete base with an asphaltic concrete top from one and one half to two inches thick rather than for the full thickness of asphaltic concrete.

"I am sorry that this letter is so long, but explanations seemed necessary. To answer your questions categorically is nearly impossible, but

in my judgment a 'first class all-the-year-round highway' can be constructed to stand the mixed traffic on our county highways and continue of durable character at a reasonable cost for upkeep but I question if the cost can be kept below \$300 per mile per annum on a twenty-foot roadway.

"Such a road as before discussed with a concrete base four inches thick and twenty feet wide covered with the thin coat of asphaltic oil and screenings will probably cost under your conditions not less than \$9,000 per mile for the pavement alone."

## Concrete Bases

By J. B. WOODSON,  
Division Engineer, California Highway Commission.

The four-inch base of Portland cement concrete, consisting of a proper mixture of one, two and one half, and five, if constructed upon a perfectly prepared subgrade, should afford sufficient strength to carry all traffic and any type of road vehicle now existing.

Except in alkali, quicksand or marsh-land soil, the four-inch thickness is as good as a foot, so far as sustaining qualities are concerned. Through unstable soil sections the pavement should be increased in thickness according to the degree of firmness of subgrade.

Some soils make a firm subgrade, but warrant extra thickness of pavement.

For example, adobe makes the hardest kind of subgrade if the clods are pulverized, but "wet streaks" in an adobe fill would, upon evaporation, have a tendency to settle locally; this in effect would require greater spanning power, which virtually means a heavier beam.

Under the heading of adobe should be classified alkali and dry bog. This latter, when thoroughly dry, resembles volcanic ash and the difference in its displacement under dry compression and when it is wet and heavy would produce an appreciable stress up under the pavement. All forms of adobe, however, have the cracking qualities in the dry season, and it is doubtful whether the extra thickness of concrete would prevent the cracks breaking through the pavement above.

Pavement construction on a low grade line, over marsh-land or wet sandy soil should be augmented by increased thickness of concrete.

Concrete for four-inch pavement should be mushy, but not "sloppy." It should be dry enough to require considerable tamping before it looks wet on top.

When the mixture flows out on the chute as if under pressure resembling a fire hydrant, the work should be stopped until the water feed can be adjusted. Some contractors claim that with a certain type of mixer the concrete will not discharge down the chute unless the mixture is very wet. This is a mistake, and when the water runs down the pavement in little rivulets floating away from the mortar, it won't be long

under traffic until the rocks begin to break loose. The concrete should be tamped until the individual rocks disappear in the mortar, and the final floating should leave the pavement smooth and true to section. The floating is done with a wooden float, and from twenty to fifty feet in the rear of the placing of concrete. Some men soon become skilled in making a good finish.

A ten-ton roller is used in preparing the subgrade to shape. Sufficient rolling is done to compact the rough-grade firmly. The rough-grade is left from one half to one inch high for compression.

When finished, the subgrade is theoretically parallel and four inches lower than the desired elevation of pavement. The section drops three eighths of an inch per lineal foot each side of the crown, the bottom of header board being two and three fourths inches lower than the crown.

When the concrete is sufficiently set, which varies according to the weather from six to twelve hours, two to four inches of loose dirt is thrown over the pavement and is kept wet for a period of six days, and on later contracts ten days. During the hot weather, great care should be exercised in seeing that the concrete is moist under the covering of earth. A more satisfactory method of curing the concrete is by building little dykes about twenty feet apart and along the edge of the pavement, and flooding the concrete twice a day, or oftener if needed. This latter method always shows if the concrete is wet, is cheaper for the contractor, and is much more easily cleaned off.

Cleaning off the pavement is usually done with a road grader; the dirt being thrown out on the shoulders, again shaped, and rolled.

An approximate cost, as shown by our records, of covering with dirt is 2.5 cents per lineal foot, or 13.4 cents per cubic yard of concrete. The cost of dyking with dirt is 1.25 cents per lineal foot, or 6.75 cents per cubic yard of concrete.

When all the dirt is taken off that can be removed with the road grader, horse brooms are run over a pavement. If the dirt still remains in patches, shovels and stable brooms are applied.

The natural transverse cracks appear about twenty-eight feet apart. This varies considerably, according to the materials used and the care in keeping the concrete wet. With all forms of cracking that have developed so far no serious trouble is noticeable in wearing of concrete or appearances, and the bituminous wearing surface enters the crevices and covers them until they are scarcely perceptible.

Artificial construction joints do not seem to warrant the expense attached to them in the construction of concrete pavements in California. Where they have been used by means of redwood strips placed between strips of tar paper, the joint wears away under traffic and the regular crack appears at its natural interval. The cost of steel expansion joints is practically prohibitive for the benefit derived, and they do not eliminate the cracks. Steel reinforcing is not desirable for

(Continued on page 14.)

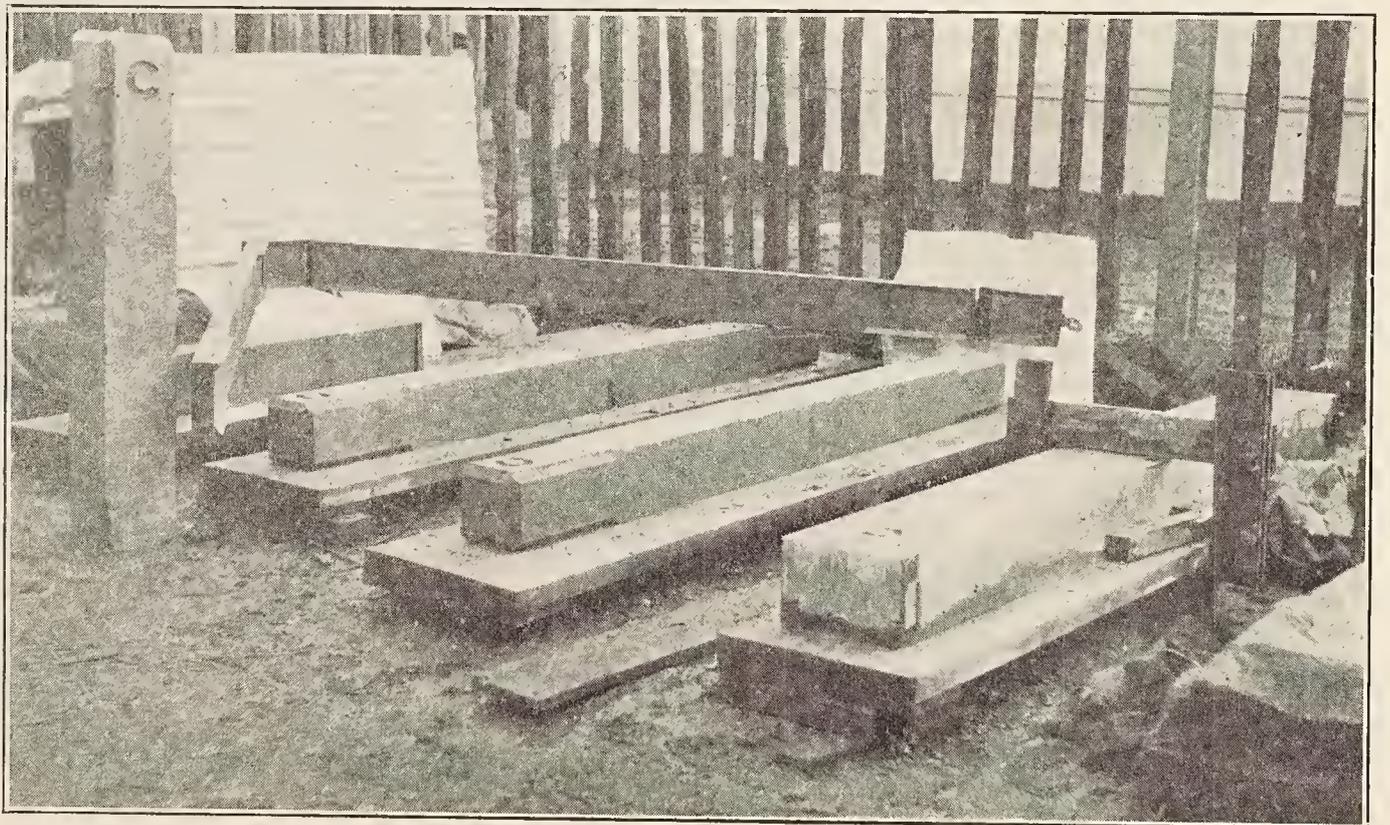
## MONUMENTS MAKE PERMANENT STATE HIGHWAY BOUNDARIES

Much difficulty is frequently experienced in determining the location of the side lines of roads. These roads have been laid out in the past when the land was of little value and the surveys were carelessly made or the descriptions carelessly recorded. With the lapse of time buildings, trees, and other similar features, which formerly marked the location of the road, have entirely disappeared, and the traveled ways have shifted from place to place as the action of the elements or the whims of the travelers have directed. Fences, if they exist, have been so moved about that they in no way indicate the original line of the road.

To guard against a similar condition on the state highways, the California Highway Commission not only makes very careful surveys and plans and files said plans in several localities, but it also places monuments on the side lines of the roads at each and every angle or curve point, and at intervals on long straight lines.

The monuments project six inches above the surface of the ground. They are made of concrete six inches square and three and one half feet long. The edges of the upper portion are beveled to present a neat appearance, and on one face there is indented a letter "C"

for the purpose of identification. In the center of the top is a copper plug which marks the exact point of the angle.



Monuments for California State Highway

pavements, owing to the expense. It would seem more practical to increase the thickness of pavement over sections of doubtful subgrade.

Out of five days' run on a contract near Fresno, at an average of 762 lineal feet of fifteen-foot pavement, the following force was used:

Foreman, 5 days at \$4.00	20 00
Labor, 5 days at \$3.50	17 50
Labor, 6 days at \$2.50	15 00
Labor, 132½ days at \$2.00	265 00
Wagon and driver, 5 days at \$4.50	22 50
Concrete mixer, fuel, etc., 5 days at \$5.00	25 00
Water pump and engineer, 5 days at \$6.00	30 00

Total \$395 00

Total length of run, 3,808 lineal feet, or 705 cubic yards of concrete; 56 cents per cubic yard.

On a cubic yard basis the cement cost \$2.17, the stone cost 71 cents, and the sand cost 43 cents.

The average cost of unloading and transportation of material was 68 cents.

The total cost per cubic yard of concrete in place was \$4.55.

Costs of Concrete Bases 15 Feet Wide at Various Prices Per Cubic Yard.

	Depths.	Cubic yards per mile.	Cost per mile.	Cost per square foot.	Cost per square yard.
\$5.00 per cubic yard	4 in.	978	\$4,890	\$0.062	\$0.556
	4½ in.	1,100	5,500	.069	.625
	5 in.	1,222	6,110	.077	.694
	5½ in.	1,344	6,720	.085	.764
	6 in.	1,467	7,333	.093	.833
\$5.25 per cubic yard	4 in.	978	5,135	.065	.584
	4½ in.	1,100	5,775	.073	.656
	5 in.	1,222	6,416	.081	.729
	5½ in.	1,344	7,056	.089	.802
	6 in.	1,467	7,700	.097	.875
\$5.50 per cubic yard	4 in.	978	5,379	.068	.611
	4½ in.	1,100	6,050	.076	.687
	5 in.	1,222	6,721	.085	.764
	5½ in.	1,344	7,392	.093	.840
	6 in.	1,467	8,066	.102	.917
\$5.75 per cubic yard	4 in.	978	5,624	.071	.639
	4½ in.	1,100	6,325	.080	.719
	5 in.	1,222	7,027	.089	.799
	5½ in.	1,344	7,728	.098	.878
	6 in.	1,467	8,433	.106	.958
\$6.00 per cubic yard	4 in.	978	5,868	.074	.667
	4½ in.	1,100	6,600	.083	.750
	5 in.	1,222	7,332	.093	.833
	5½ in.	1,344	8,064	.102	.916
	6 in.	1,467	8,800	.111	1.000
\$6.25 per cubic yard	4 in.	978	6,113	.077	.695
	4½ in.	1,100	6,875	.087	.781
	5 in.	1,222	7,637	.096	.868
	5½ in.	1,344	8,400	.106	.955
	6 in.	1,467	9,166	.115	1.042
\$3.50 per cubic yard	4 in.	978	6,357	.080	.722
	4½ in.	1,100	7,150	.090	.812
	5 in.	1,222	7,943	.100	.903
	5½ in.	1,344	8,736	.110	.993
	6 in.	1,467	9,533	.120	1.083

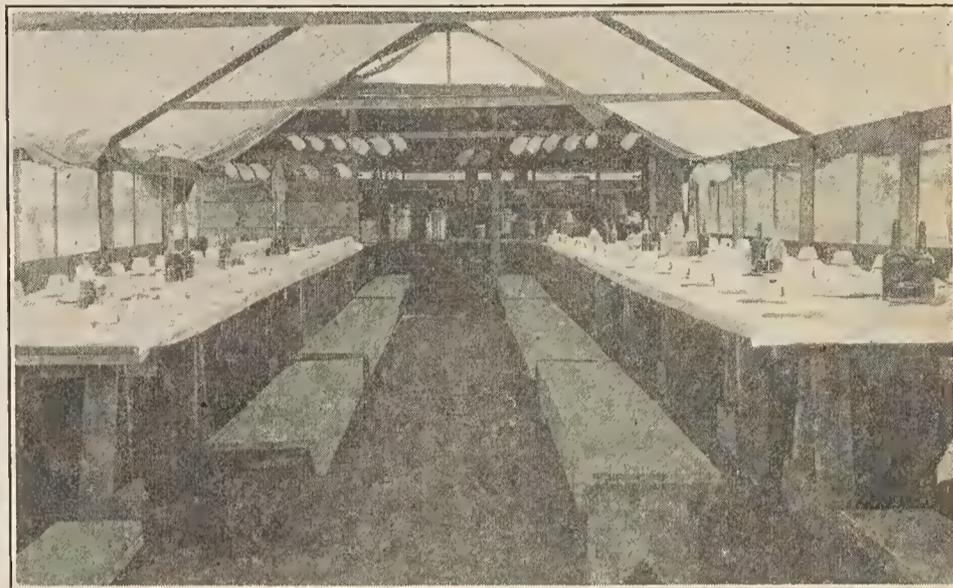
Costs of 15-foot Pavements.

(79,200 sq. ft. to mile.)  
(8,800 sq. yds. to mile.)

Per square foot.	Per square yard.	Per mile.	Per square foot.	Per square yard.	Per mile.
\$0.001	\$0.009	\$79 20	.115	1.035	9,108 00
.002	.018	158 40	.120	1.080	9,504 00
.003	.027	237 60	.125	1.125	9,900 00
.004	.036	316 80	.130	1.170	10,296 00
.005	.045	396 00	.135	1.215	10,692 00
.006	.054	475 20	.140	1.260	11,088 00
.007	.063	554 40	.145	1.305	11,484 00
.008	.072	633 60	.150	1.350	11,880 00
.009	.081	712 80	.155	1.395	12,276 00
.010	.090	792 00	.160	1.440	12,672 00
.020	.180	1,584 00	.165	1.485	13,068 00
.030	.270	2,376 00	.170	1.530	13,464 00
.040	.360	3,168 00	.175	1.575	13,860 00
.050	.450	3,960 00	.180	1.620	14,256 00
.060	.540	4,752 00	.185	1.665	14,652 00
.070	.630	5,544 00	.190	1.710	15,048 00
.080	.720	6,336 00	.195	1.755	15,444 00
.090	.810	7,128 00	.200	1.800	15,840 00
.100	.900	7,920 00			
.105	.945	8,316 00			
.110	.990	8,712 00			

Workmen's Modern Camp

Especial pains is taken in the construction camps, where work on a day labor basis is necessary on the part of the State, to provide comfortable and sanitary accommodations for the workmen. The camp at Shingle Springs, El Dorado County, is an example. Here the workmen



Meal Tent at Shingle Springs Camp.

have been provided large, airy tents, which are kept scrupulously clean. The dining-room is made clean and attractive, a wholesome variety of well-cooked food is served in abundance, and the flies are excluded carefully. Bathing facilities are provided for the use of the men.



Workmen's Tents at Shingle Springs Camp.

Manure is hauled away from the corral tent three times a week. A sanitary engineer was sent to Shingle Springs by the Commission of Housing and Sanitation, and with his cooperation all pains were taken to make this camp a model for the comfort and health of the workers.

Grades of Mountain Highways

"The maximum grade for a mountain highway," said Division Engineer F. G. Somner, in discussing that subject before the department heads of the Highway Commission, "should be established with reference to the kind and volume of traffic; the existing transportation facilities, and the topography of the country traversed. The effect of steep grades on the cost of transportation is always an important consideration. A discussion of the loss of energy, traction resistance, etc., in connection with grade reduction is unnecessary, being always undisputed, but nevertheless, the questions always arise: Will it pay? How much will it cost? Whether horse-drawn vehicles or motor vehicles predominate?"

"In the writer's opinion it does not pay to exceed a 6 per cent grade, which is a trotting grade for a buggy team, and accommodates any of the gears of the average automobile.

"As a rule, the establishment of a minimum grade on mountain highways is unnecessary for the reason that the culverts are generally placed at such short intervals as to admit of surface drainage even on a level grade. It may be considered impracticable to maintain unbroken grade lines, such refinement affecting economy of quantity and engineering cost."

PREPARING STATE HIGHWAY PLANS

The data turned in by the surveyors include location notes of all structures, tracks, trees, poles, and other similar objects, within one hundred and fifty feet of the base line; cross-section notes of the road taken at intervals of fifty feet or less; computa-

tions of a traverse, one side of which is the base line of the survey; and notes as to soil, drainage, location of desirable materials, railroad sidings, local wages, etc. So far as may be these notes are computed and checked before they leave the field.

On receipt of the notes in the division office the plan and profile are plotted on thirty-inch brown detail paper of such lengths as are convenient for flat filing when folded, and the cross-sections are plotted on specially prepared cross-section paper. This specially prepared cross-section paper is of map bond, 20-inch by 30-inch sheets, printed in orange ink from a "zinco" engraving with co-ordinate lines one tenth of an inch apart. At one end the margin reserved is wider for the purpose of binding.

The Contract Plans.

The contract plans are blue prints from the layout plans and from the cross-section sheets, but for the convenience of the engineering force pocket size photographic reductions of the layout plans are made also. These photographic reductions are 4 3/4 inches by 7 1/2 inches in size, and are printed on glossy velox paper. They are remarkably legible, even without the use of a reading glass.

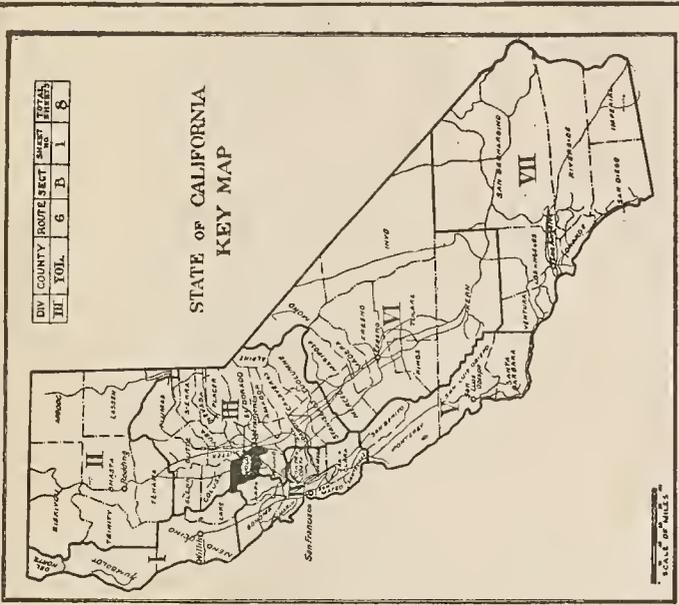
The layout plans, contract plans, and cross-section sheets are all bound in temporary binders for their protection and preservation. These binders are composed of two heavy covers hinged by cloth to metal strips, and five bolts for clamping together the metal strips and the intervening plans.

Plans, Etc., Are Carefully Bound.

The binders are canvass and leather finished, and the back or lower cover is sufficiently long to permit of the steel binding strip being folded in between the plans and the cover, thereby concealing the bolt heads and insuring a non-scratching lower surface. The nut used is a brass, round-headed one, with a threaded sleeve projecting one half inch through the top binding strip, and the screws are stove bolts of the many varying lengths. Great elasticity is obtained by this combination. Binders of similar design, but of lighter weight and clamped with paper fasteners, are used for the "form" papers, etc. They are of two sizes, letter size and note size.

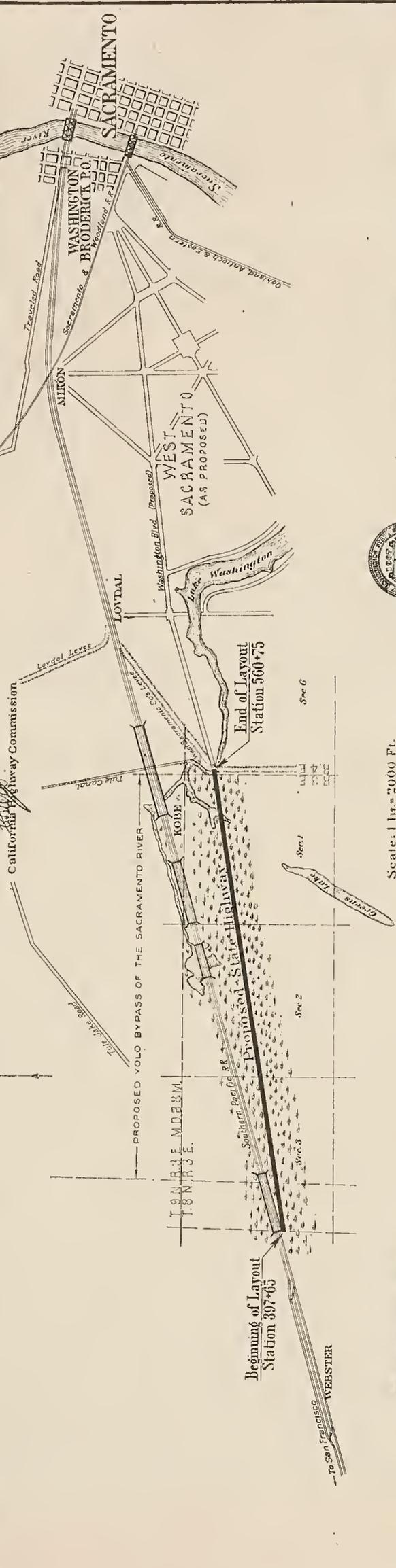
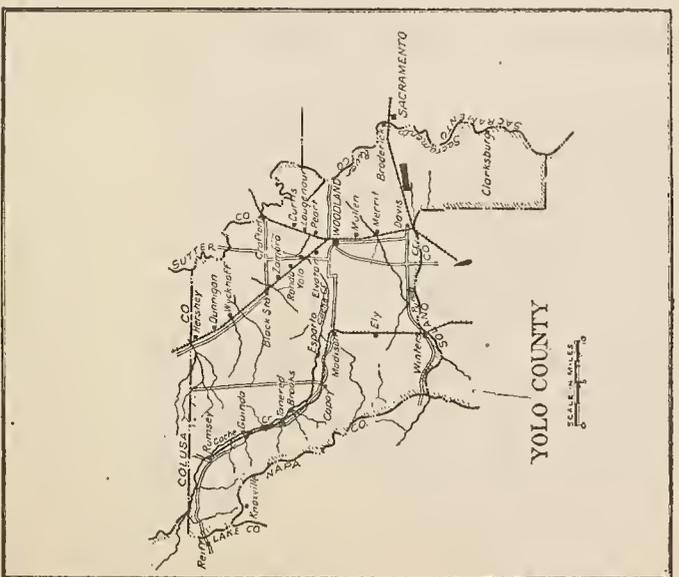
The Filing System.

The basis of most of the filing is the road location, whether the filing be of plans, field books, papers, letters, or something else. The State has been divided into seven divisions, each of which is designated by a roman numeral. Each of the trunk lines or routes as determined is given an arabic number, and within each county these routes are divided into convenient contract lengths and lettered. The division number, county abbreviation, route number, and section letter are entered on all plans and papers, and they are filed according to this entry.



STATE OF CALIFORNIA DEPARTMENT OF ENGINEERING CALIFORNIA HIGHWAY COMMISSION PLAN AND PROFILE OF PROPOSED STATE HIGHWAY In Yolo County, across the Yolo Bypass.

Scales: Plan: 1 in. = 100 Ft. Profile: Hor. 1 in. = 100 Ft. Vert. 1 in. = 20 Ft. Approved: [Signatures] Division Engineer February 16, 1914 Highway Engineer



STATE OF CALIFORNIA State Highway Layout No. 90 WHEREAS, this board, in behalf of the Department of Engineering of the State of California, adjudges and determines that public necessity and convenience require that the State of California take over and lay out as a State Highway... Secretary of the Department of Engineering

- CONVENTIONAL SIGNS: County Line, City or Town Limits, Township Line, Grade Line, Fence on Guard Rail, Right of Way Line, Traveled Way, Railway Tracks, Bank or Retaining Wall, Level, Culverts, Drop Inlet, Trolley Pole, Power Pole, Telephone or Telegraph Pole, Marsh, Leader, Bridge, Ground Elevation, Water Elevation.

## Progress on the State Highway

The following details are complete regarding awards of contracts to July 1, 1914, with one or two exceptions, as noted, and are complete regarding percentage of work done to May 15, 1914, the date of the last progress reports from the various divisions prior to going to press with this issue:

Routes under way are located in the counties as follows, the figures in parentheses indicating the divisions: Alameda, Division IV) route 5; Alpine (III); Butte, (III) 3 and 21; Calaveras, (III); Colusa, (III) 7 and 15; Contra Costa, (IV) 14; Del Norte, (I) 1; El Dorado, (III) 11; Fresno, (VI) 4; Glenn, (III) 7; Humboldt, (I) 1; Imperial, (VII) 12; Inyo, (VI); Kern, (VI) 4; Kings, (VI) 10; Lake (I) 16; Lassen, (II); Los Angeles, (VII) 2, 4 and 8; Madera, (VI) 4; Marin, (IV) 1; Mariposa, (VI) 18; Mendocino, (I) 1 and 16; Merced, (VI) 4 and 18; Modoc, (I); Mono, (VI); Monterey, (V) 2; Napa, (I); Nevada, (III) 17; Orange, (VII) 2; Placer, (III) 3 and 17; Plumas, (III); Riverside, (VII) 19; Sacramento, (III) 3, 4 and 11; San Benito, (V) 2; San Bernardino, (VII) 8, 9 and 19; San Diego, (VII) 2 and 12; San Francisco, (IV) touched by 2 and within ferry reach of 1, 5, 7 and 14; San Joaquin, (III) 4 and 5; San Luis Obispo, (V) 2; San Mateo, (IV) 2; Santa Barbara, (V) 2; Santa Clara, (IV) 2 and 5; Santa Cruz, (IV) 5; Shasta, (II) 3 and 20; Sierra, (III); Siskiyou, (II) 3; Solano, (III) 7; Sonoma, (IV) 1; Stanislaus, (III) 4 and 13; Sutter, (III) 3; Tehama, (II) 3 and 7; Trinity, (II) 20; Tulare, (VI) 4 and 10; Tuolumne, (III) 13; Ventura, (VII) 2; Yolo, (III) 6 and 7; Yuba, (III) 3.

### ROUTE 1. BETWEEN SAUSALITO AND CRESCENT CITY.

MARIN COUNTY, Section A, from the north boundary of Marin County to the west boundary of San Rafael (IV—Mrn.—1—A): Surveys complete. Plans in progress. Length, 16.8 miles.

MARIN COUNTY, Section B, from the west boundary of San Rafael to the ferry slip at Sausalito (IV—Mrn.—1—B): Laid out as State Highway May 27, 1914. Contract (No. 65) awarded May 27, 1914, to O'Brien Brothers. Length, 6 miles. Road to be graded and part surfaced with gravel. Probable cost, \$66,365; probable cost per mile, \$11,060.

SONOMA COUNTY, Section A, from the north boundary of Sonoma County to the south boundary of Healdsburg (IV—Son.—1—A): Laid out as State Highway April 22, 1914. Contract (No. 68) awarded May 27, 1914, to Hard Brothers. Length, 4.45 miles. Road to be graded 21 feet wide. Probable total cost, \$43,550; per mile, \$9,790.

SONOMA COUNTY, Section B, from the south boundary of Healdsburg to the south boundary of Santa Rosa (IV—Son.—1—B): Laid out as State Highway September 25, 1912. Contract (No. 16) awarded Oct. 22, 1912, to Richard Keatinge & Sons. Length, 13.7 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$108,761; per mile, \$7,939. Amount of contract complete May 16, 1914, 84 per cent.

SONOMA COUNTY, Section C, from the south boundary of Santa Rosa to the south boundary of Sonoma County (IV—Son.—1—C): Surveys completed. Plans in progress. Length, 18.7 miles.

MENDOCINO COUNTY, Section A, from the south boundary of Mendocino County to Hopland (I—Men.—1—A): Laid out as State Highway May 21, 1912. Contract (No. 2) awarded July 23, 1912, to the General Contracting Corporation. Length, 13.2 miles. Road graded 18 feet wide, but not paved. Probable total cost, \$66,540; per mile, \$5,040. Contract completed.

MENDOCINO COUNTY, Section B, from Hopland to Ukiah (I—Men.—1—B): Surveys and plans completed. Length, 14 miles.

MENDOCINO COUNTY, Section C, from Ukiah to Forsythe Creek (I—Men.—1—C): Laid out as State Highway February 4, 1913. Contract (No. 24) awarded March 26, 1913, to D. I. Sawyers and Chas. Whited. Length, 7.6 miles. Road to be waterbound macadam and gravel, 15 feet wide. Probable total cost, \$55,651; per mile, \$7,288. Contract practically completed.

MENDOCINO COUNTY, Section D, from Forsythe Creek to Ridgewood (I—Men.—1—D): Surveys completed. Length, 7.9 miles.

Contract D<sub>1</sub>, Laid out as State Highway September 24, 1913. Length, 7.8 miles. Road to be graded 18 feet wide, but not paved. No. D<sub>1</sub>, 1.25 miles of this layout graded by day labor; work completed.

Contract D<sub>2</sub>, Laid out as State Highway September 24, 1913. Contract (No. 57) awarded April 22, 1914, to Hard Brothers. Length, 6.6 miles. Road to be graded 18 feet wide. Probable total cost, \$57,802; per mile, \$8,825.

MENDOCINO COUNTY, Section E, from Ridgewood to Willits (I—Men.—1—E): Laid out as State Highway October 22, 1912. Contract (No. 20) awarded February 4, 1913, to Fairbanks & Baechtel. Length, 6.9 miles. Road graded 18 feet wide. Probable total cost, \$38,855; per mile, \$5,630. Contract completed.

MENDOCINO COUNTY, Section F, from Willits to Arnold (I—Men.—1—F): Surveys and plans completed. Length, 8.5 miles.

MENDOCINO COUNTY, Section G, from Arnold to Sherwood-Laytonville Junction (I—Men.—1—G): Surveys and plans completed. Length, 10.4 miles.

MENDOCINO COUNTY, Section H, from Sherwood-Laytonville Junction to Rattlesnake Summit (I—Men.—1—H): Surveys and plans completed. Length 14.2 miles.

MENDOCINO COUNTY, Section I, from Rattlesnake Summit to Little Dan Valley (I—Men.—1—I): Surveys and plans completed. Length, 13.6 miles.

MENDOCINO COUNTY, Section J, from Little Dan Valley to Low Gap (I—Men.—1—J): Surveys completed. Plans in progress. Length, 10.5 miles.

MENDOCINO COUNTY, Section K, from Low Gap to the north boundary of Mendocino County (I—Men.—1—K): Surveys completed. Length, 13 miles.

HUMBOLDT COUNTY, Section A, from the south boundary to Garberville (I—Hum.—1—A): Survey completed. Length, 10.3 miles.

A<sub>1</sub>, Laid out as State Highway September 24, 1913. Contract (No. 44) awarded Oct. 29, 1913, to Fairbanks & Baechtel. Length, 5.5 miles. Road to be graded 18 feet wide. Probable total cost, \$56,360; per mile, \$10,266. Amount of contract completed May 16, 1914, 4 per cent.

A<sub>2</sub>, Laid out as State Highway March 25, 1914. Contract (No. 60) awarded April 22, 1914, to Berry, Mackie & Co. Length, 4.6 miles. Road to be graded 18 feet wide. Probable total cost, \$52,535; per mile, \$11,470.

HUMBOLDT COUNTY, Section B, from Garberville to Miranda (I—Hum.—1—B): Surveys completed. Plans in progress. Length, 16.1 miles.

HUMBOLDT COUNTY, Section C, from Miranda to Dyerville (I—Hum.—1—C): Surveys completed. Plans in progress. Length, 13.9 miles.

HUMBOLDT COUNTY, Section D, from Dyerville to opposite Elinor (I—Hum.—1—D): Survey completed. Length, 11.3 miles.

D<sub>1</sub>, Laid out as State Highway May 27, 1914. Contract (No. 71) awarded June 10, 1914, to Smith & Connors. Length, 7.3 miles. Road to be graded 18 feet wide. Probable total cost, \$47,690; per mile, \$6,530.

HUMBOLDT COUNTY, Section E, from opposite Elinor to Rio Dell (I—Hum.—1—E): Surveys completed. Plans in progress. Length, 10 miles.

HUMBOLDT COUNTY, Section F, from Rio Dell to Fortuna (I—Hum.—1—F): Survey completed. Length, 11 miles.

HUMBOLDT COUNTY, Section G, from Fortuna to Eureka (I—Hum.—1—G): Survey completed. Length, 17 miles.

HUMBOLDT COUNTY, Section H, I, J and K, north from Eureka. Surveys ordered.

DEL NORTE COUNTY, Section A, from south boundary of Del Norte County to Crescent City (I—D. N.—1—A): Survey ordered.

### ROUTE 2. BETWEEN SAN FRANCISCO AND SAN DIEGO.

SAN MATEO COUNTY, Section A, from the north boundary of San Mateo County to San Mateo City (IV—S.M.—2—A): Survey completed. Length, 10.7 miles.

Contract A<sub>1</sub>, from South San Francisco to Burlingame: Laid out as State Highway May 21, 1912. Contract (No. 1) awarded July 23, 1912, to F. R. Ritchie & Co. Length, 5.4 miles. Sheet asphalt 24 feet wide on concrete base. Probable total cost, \$93,004; per mile, \$17,223. Contract completed.

Contract A<sub>2</sub>, from Burlingame to Hillsborough: Laid out as State Highway October 22, 1912. Contract (No. 29) awarded April 23, 1913, to Clark & Henery Construction Co. Length, 0.2 mile. Road 24 feet wide. Asphaltic concrete on Portland cement concrete base. Probable cost, \$5,637; per mile \$28,184. Contract completed.

Contract A<sub>3</sub>, north boundary of San Mateo County to south line of Daly City: Laid out as State Highway March 26, 1913. Contract (No. 26) awarded April 23, 1913, to Flinn & Treacy. Length, 1.02 miles. Road 24 feet wide. Asphaltic concrete on Portland cement concrete base. Probable total cost, \$20,303; per mile, \$19,866. Amount of contract completed May 16, 1914, 85 per cent.

Contract A<sub>4</sub>, Cypress Lawn Cemetery to South San Francisco: Laid out as State Highway May 21, 1913. Contract (No. 34) awarded July 3, 1913, to Mahony Brothers. Length, 2.1 miles. Road to be graded 40 feet wide, for future pavement of 24 feet width. Probable total cost of grading, \$27,847; per mile, \$13,260. Contract completed.

Contract A<sub>5</sub>, south line of Daly City to South San Francisco: Laid out as State Highway February 26, 1914. Contract (No. 54) awarded Feb. 26, 1914, to Bates, Borland & Ayer. Length, 4.0 miles. Road to be asphalt surface on concrete base, 24 feet wide. Probable total cost, \$85,813; per mile, \$21,220. Amount of contract completed to May 16, 1914, 1 per cent.

SAN MATEO COUNTY, Section B, from San Mateo City to the south boundary of San Mateo County (IV—S.M.—2—B): Surveys and plans completed. Length, 9.4 miles.

Contract B<sub>1</sub>, Redwood City to south boundary of county: Laid out as State Highway Oct. 22, 1912. Contract (No. 22) awarded March 26, 1913, to S. P. Doyle. Length, 3.3 miles. Road to be asphaltic concrete on macadam base, 20 feet wide. Probable total cost, \$50,990; per mile, \$15,450. Contract completed.

Contract B<sub>2</sub>, San Mateo to Beresford: Laid out as State Highway March 26, 1913. Contract (No. 27) awarded April 23, 1913, to Raisch Improvement Co. Length, 1.8 miles. Road to be asphaltic concrete on macadam base, 20 feet wide. Probable total cost, \$28,245; per mile, \$15,690. Contract completed.

SANTA CLARA COUNTY, Section A, from the north boundary of Santa Clara County to San Jose (IV—S.Cl.—2—A): Surveys and plans complete. Length, 15.1 miles.

Contract A<sub>1</sub>, Palo Alto to Stevens Creek bridge: Laid out as State Highway July 23, 1912. Contract (No. 14) awarded Oct. 22, 1912, to City Street Improvement Co. Length, 6.4 miles. Road to be asphaltic concrete on macadam base, 20 feet wide. Probable total cost, \$43,274; per mile, \$6,726. Amount of contract completed to May 16, 1914, 100 per cent, but not fully paid.

Contract A<sub>2</sub>, Stevens Creek bridge to Saratoga-Lawrence road: Laid out as State Highway July 23, 1912. Contract (No. 15) awarded Oct. 22, 1912, to A. Teichert & Son. Length, 5.5 miles. Pavement, oiled concrete, 20 feet wide. Probable total cost, \$54,294; per mile, \$9,854. Contract completed.

Contract A<sub>3</sub>, Saratoga-Lawrence road to Santa Clara: Laid out as State Highway April 23, 1913. Contract (No. 32) awarded May 21, 1913, to John Doyle. Length, 1.2 miles. Pavement, oiled concrete, 20 feet wide, with broken stone shoulders 5 feet wide. Probable total cost, \$15,168; per mile, \$13,190. Contract completed.

SANTA CLARA COUNTY, Section B, from San Jose to Morgan Hill (IV—S.Cl.—2—B): Surveys and plans completed. Length, 17.3 miles.

Contract B<sub>1</sub>, Edenvale to Morgan Hill: Laid out as State Highway Oct. 22, 1912. Contract (No. 23) awarded March 26, 1913, to Richard Keatinge & Sons. Length, 13.0 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$87,880; per mile, \$6,786. Amount of contract completed May 16, 1914, 100 per cent, but not fully paid.

Contract B<sub>2</sub>, San Jose to Edenvale: Laid out as State Highway March 26, 1913. Contract (No. 28) awarded April 23, 1913, to Richard Keatinge & Sons. Length, 4.3 miles. Pavement, oiled concrete, 15 to 20 feet wide. Probable total cost, \$32,397; per mile, \$7,451. Amount of contract completed to May 16, 1914, 100 per cent, but not fully paid.

Contract B<sub>3</sub>, San Jose to Mulia: Laid out as State Highway March 26, 1913. Contract (No. 64) awarded April 22, 1914, to John W. McDonald, Jr. Length, 1.8 miles. Asphalt surfacing on portion of Contract No. 28. Probable total cost, \$13,820; per mile, \$7,510.

SANTA CLARA COUNTY, Section C, from Morgan Hill to south boundary of Santa Clara County (IV—S.Cl.—2—C): Survey complete. Length, 13.9 miles.

Contract C<sub>1</sub>, Morgan Hill to Gilroy: Laid out as State Highway May 21, 1913. Contract (No. 35) awarded July 3, 1913, to E. O. Burge. Length, 7.6 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$50,801; per mile, \$6,693. Amount of contract completed to May 16, 1914, 59 per cent.

Contract C<sub>2</sub>, Gilroy to Sargent: Laid out as State Highway May 27, 1914. Contract (No. 72) awarded June 10, 1914, to H. L. Petersen and A. J. Grier. Length, 6.0 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$67,720; per mile, \$11,287.

SAN BENITO COUNTY, Section A, from the north boundary to the southwest boundary of San Benito County through San Juan Bautista (V—S.Bt.—2—A): Survey completed. Length, 9.2 miles.

Contract A<sub>1</sub>, Laid out as State Highway Aug. 27, 1913. Contract (No. 42) awarded Oct. 29, 1913, to E. O. Burge. Length, 4.2 miles. Road to be graded 21 feet wide, not paved. Probable total cost, \$27,647; per mile, \$6,551. Amount of contract completed May 16, 1914, 26 per cent.

Contract A<sub>2</sub>, from San Juan Bautista to the northern boundary. Length, about 4.0 miles. Bids will be received July 6, 1914, for construction of Portland cement concrete.

MONTEREY COUNTY, Section A, from the northeast boundary of Monterey County to Salinas (V—Mon.—2—A): Length, 10.45 miles.

Contract A<sub>1</sub> Laid out as State Highway August 27, 1913. Contract (No. 41) awarded October 29, 1913, to E. O. Burge. Length, 4.3 miles. Road to be graded, 21 feet wide, not paved. Probable total cost, \$30,828; per mile, \$7,103. Amount of contract completed to May 16, 1914, 67 per cent.

MONTEREY COUNTY, Section B, from Salinas to a point 1,800 feet south of Chualar (V—Mon.—2—B): Surveys, plans and estimates complete. Length 10.3 miles.

MONTEREY COUNTY, Section C, from a point 1,800 feet south of Chualar to Camphora (V—Mon.—2—C): Surveys complete. Plans in progress. Length, 11.0 miles.

MONTEREY COUNTY, Section D, from Camphora to Greenfield (V—Mon.—2—D): Surveys completed. Plans in progress. Length, 12.2 miles.

MONTEREY COUNTY, Section E, from Greenfield to a point 4 miles north of King City (V—Mon.—2—E): Laid out as State Highway October 22, 1912. Length, 7.3 miles. Pavement, oiled concrete, 15 feet wide.

MONTEREY COUNTY, Section F, from a point 4 miles north of King City to San Lucas (V—Mon.—2—F): Surveys completed. Length, 12.7 miles.

MONTEREY COUNTY, Section G, from San Lucas to San Ardo (V—Mon.—2—G): Surveys completed. Plans under way. Length, 10.8 miles.

MONTEREY COUNTY, Section H, from San Ardo to a point 1½ miles north of Bradley (V—Mon.—2—H): Surveys, plans and estimates complete. Length, 11.0 miles.

MONTEREY COUNTY, Section I, from a point 1½ miles north of Bradley to the south boundary line of Monterey County (V—Mon.—2—I): Surveys completed. Plans under way. Length, 10.4 miles.

SAN LUIS OBISPO COUNTY, Section A, from the north boundary of San Luis Obispo County to Paso Robles (V—S. L. O.—2—A): Laid out as State Highway October 29, 1913. Bids received Nov. 17, 1913; action thereon postponed. Contract (No. 56) awarded February 26, 1914, to W. A. Dontanville. Pavement, oiled concrete, 15 feet wide. Length, 10.6 miles. Probable total cost, \$117,254; per mile, \$11,060.

SAN LUIS OBISPO COUNTY, Section B, from Paso Robles to a point where Atascadero Creek crosses the Highway west of Atascadero Station (V—S. L. O.—2—B): Surveys completed. Plans in progress. Length, 10.1 miles.

SAN LUIS OBISPO COUNTY, Section C, from a point where Atascadero Creek crosses the Highway west of Atascadero Station to Santa Margarita (V—S. L. O.—2—C): Laid out as State Highway October 29, 1913. Bids received Nov. 17, 1913; action thereon postponed. Contract (No. 55) awarded Feb. 26, 1914, to W. A. Dontanville. Pavement, oiled concrete, 15 feet wide. Length, 8.4 miles. Probable total cost, \$81,626; per mile, \$9,780. Amount of contract completed to May 16, 1914, 24 per cent.

SAN LUIS OBISPO COUNTY, Section D, from Santa Margarita to San Luis Obispo (V—S. L. O.—2—D): Surveys, plans and estimates completed. Length, 10.0 miles.

Contract D<sub>1</sub>, laid out as State Highway October 22, 1912. Bids received and rejected November 18, 1912. Bids received and rejected June 30, 1913. Work now under construction (No. D<sub>3</sub>) by the State, using day labor. Length, 6.4 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$63,972; per mile, \$10,038. Amount completed to May 16, 1914, 90 per cent.

SAN LUIS OBISPO COUNTY, Section E, from San Luis Obispo to Arroyo Grande via Pismo (V—S. L. O.—2—E): Surveys completed. Plans in progress. Length, 14.5 miles. Bids will be received July 6, 1914, for construction of Portland cement concrete.

SAN LUIS OBISPO COUNTY, Section F, from Arroyo Grande to the south boundary line of San Luis Obispo County (V—S. L. O.—2—F): Surveys completed. Plans in progress. Length, 12.4.

SANTA BARBARA COUNTY, Section A, from the north boundary of Santa Barbara County to a point 1 mile north of Bicknell (V—S. B.—2—A): Surveys completed. Plans in progress. Length, 10.6 miles. Bids will be received July 6, 1914, for construction of Portland cement concrete with asphaltic wearing surface.

SANTA BARBARA COUNTY, Section B, from a point 1 mile north of Bicknell to Los Alamos (V—S. B.—2—B): Laid out as State Highway May 21, 1913. Contract (No. 36) awarded July 3, 1913, to Mayer & Lewis. Length, 11.9 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$125,808; per mile, \$10,585. Amount of contract completed May 16, 1914, 30 per cent.

SANTA BARBARA COUNTY, Section C, from Los Alamos to Zaca Station (V—S. B.—2—C): Surveys completed. Plans in progress. Length 8.5 miles.

SANTA BARBARA COUNTY, Section D, from Zaca Station to Gaviota Pass (V—S. B.—2—D): Surveys completed. Length, 11.8 miles.

SANTA BARBARA COUNTY, Section E, from Gaviota Pass to Alcatraz school house (V—S. B.—2—E): Surveys completed. Plans in progress. Length, 8.3 miles.

SANTA BARBARA COUNTY, Section F, from Alcatraz schoolhouse to El Capitan crossing (V—S. B.—2—F): Surveys complete. Plans in progress. Length, 10.4 miles.

SANTA BARBARA COUNTY, Section G, from El Capitan crossing to Stony Creek (V—S. B.—2—G): Surveys completed. Plans in progress. Length, 9.4 miles.

SANTA BARBARA COUNTY, Section H, from Carpinteria to the south boundary of Santa Barbara County (V—S. B.—2—H): Laid out as State Highway October 29, 1913. Contract (No. 45) awarded November 21, 1913, to Occidental Construction Co. Length, 2.4 miles. Grading 15 feet wide for 0.9 mile; remainder, pavement, oiled concrete, 15 feet wide. Probable total cost, \$17,340; per mile, \$7,379. Contract completed.

SANTA BARBARA COUNTY, Section I, from Stony Creek to Glen Anne canyon road (V—S. B.—2—I): Surveys, plans and estimates completed. Length, .8 mile.

VENTURA COUNTY, Section A, from Ventura-Los Angeles county line to Newbury Park (VII—Ven.—2—A): Laid out as State Highway March 26, 1913. Bids received and rejected April 21, 1913. Bids received May 19, 1913. Contract (No. 31) awarded May 21, 1913, to Leigh G. Garnsey. Length, 7.3 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$71,526; per mile, \$9,739. Amount of contract completed May 16, 1914, 99 per cent.

VENTURA COUNTY, Section B, from Newbury Park to Springville (VII—Ven.—2—B): Surveys, plans and estimates completed. Length, 11.2 miles. Bids will be received July 6, 1914, for construction of Portland cement concrete.

VENTURA COUNTY, Section C, from Springville to Ventura (VII—Ven.—2—C): Surveys completed. Plans in progress. Length, 10.2 miles.

VENTURA COUNTY, Sections D, from Ventura to Padre Juan canyon, and E, from Padre Juan canyon to Sea Cliff (VII—Ven.—2—D—E): Laid out as State Highway January 21, 1914. Contract (No. 52) awarded February 26, 1914, to Carl Leonardt. Length, 8.0 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$109,644; per mile, \$13,670. Amount of contract complete May 16, 1914, 1 per cent.

VENTURA COUNTY, Section F, from Sea Cliff to Rancho El Rincon (VII—Ven.—2—F): Laid out as State Highway August 27, 1912. Length, 4.4 miles. This section includes a long timber trestle which was taken over by the State. See Section G.

VENTURA COUNTY, Section G, from Rancho El Rincon to the Ventura-Santa Barbara county line (VII—Ven.—2—G): Laid out as State Highway March 25, 1914. Contract (No. 73) awarded for Sections F and G June 10, 1914, to Modern Construction Co. Length, 5.0 miles. Pavement, 15 feet, oiled concrete, not including the trestle. Probable total cost, \$52,860; per mile, \$10,572.

VENTURA COUNTY, Section H, alternate route from foot of Conejo grade to Oxnard, length 10.1 miles; and Section I, alternate route from Oxnard to El Rio, length 2.2 miles: Survey completed.

LOS ANGELES COUNTY, Section A, from County Highway No. 3 to Rancho El Encino (VII—L. A.—2—A): Laid out as State Highway Sept. 25, 1912. Contract (No. 17) awarded October 22, 1912, to Rogers Brothers Co. Length, 6.6 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$55,127; per mile, \$8,353. Contract completed.

LOS ANGELES COUNTY, Section B, from Rancho El Encino to Calabasas (VII—L. A.—2—B): Laid out as State Highway February 4, 1913. Contract (No. 21) awarded March 4, 1913, to John D. Marsh. Length, 10.1 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$81,690; per mile, \$8,063. Amount of contract completed May 16, 1914, 83 per cent.

LOS ANGELES COUNTY, Section C, from Calabasas to the Los Angeles-Ventura county line (VII—L. A.—2—C): Laid out as State Highway April 23, 1913. Contract (No. 33) awarded May 21, 1913, to Gillette, Montgomery & Tracy. Length, 11.3 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$133,291; per mile, \$11,818. Amount of contract completed May 16, 1914, 70 per cent.

Remainder in Los Angeles County outside Los Angeles is County highway.

ORANGE COUNTY, Section A, from the Orange-San Diego county line to the Santa Fe crossing 4 miles north of San Juan Capistrano (VII—Ora.—2—A): Surveys completed. Plans in progress. Length, 15.4 miles.

ORANGE COUNTY, Section B, from the Santa Fe crossing 4 miles north of San Juan Capistrano to Irvine (VII—Ora.—2—B): Surveys completed. Plans in progress. Length, 9.4 miles.

ORANGE COUNTY, Section C, from Irvine to Santa Ana (VII—Ora.—2—C): Surveys completed. Plans in progress. Length 7.6 miles.

ORANGE COUNTY, Section D, from Santa Ana to Anaheim (VII—Ora.—2—D): See Section F following.

ORANGE COUNTY, Section E, from Anaheim to Fullerton (VII—Ora.—2—E): See Section F following.

ORANGE COUNTY, Section F, from Fullerton to the Orange-Los Angeles county line (VII—Ora.—2—F): Laid out as State Highway August 27, 1913. Contract (No. 40) awarded October 29, 1913, to Conner Contracting Co. Length, 11.2 miles. Pavement, oiled concrete, 18 feet wide. Probable total cost, \$86,902; per mile, \$7,787. Amount of contract completed May 16, 1914, 64 per cent.

SAN DIEGO COUNTY, Section A, from the north city limits of San Diego to C street, Encinitas (VII—S. D.—2—A): Laid out as State Highway July 23, 1912. Contract (No. 7) awarded August 27, 1912, to M. L. Curtis & Co. Length, 8.4 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$69,157; per mile, \$8,213. Contract completed.

SAN DIEGO COUNTY, Section B, from C street, Encinitas to the south city limits of Oceanside (VII—S. D.—2—B): Laid out as State Highway October 22, 1912. Contract (No. 30) awarded May 21, 1913, to J. M. Montgomery. Length, 10.5 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$82,187; per mile, \$7,867. Amount of contract completed May 16, 1914, 98 per cent.

SAN DIEGO COUNTY, Section C, from the north city limits of Oceanside to the Santa Fe crossing 1 mile north of Las Flores station (VII—S. D.—2—C): Laid out as State Highway July 23, 1913. Contract (No. 39) awarded Sept. 24, 1913, to the C. L. Hyde Construction Co. Length, 8.0 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$67,774; per mile, \$8,440. Amount of contract completed May 16, 1914, 92 per cent.

SAN DIEGO COUNTY, Section D, from the Santa Fe crossing 1 mile north of Las Flores station to the San-Diego-Orange County line (VII—S. D.—2—D): Laid out as State Highway February 26, 1914. Contract (No. 58) awarded April 22, 1914, to W. A. Perry. Length, 11.6 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$108,867; per mile, \$9,393.

### ROUTE 3. BETWEEN SACRAMENTO AND THE OREGON BOUNDARY LINE.

SACRAMENTO COUNTY, Section A, from the Auburn road to the north boundary line of Sacramento County (III—Sac.—3—A): Laid out as State Highway August 27, 1912. Contract (No. 12) awarded Sept. 25, 1912, to Burns, Clark & De Roza. Length, 1.8 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$15,057; per mile, \$8,183. Contract completed.

PLACER COUNTY, Section A, from the south boundary line of Placer County to Lincoln (III—Pla.—3—A): Laid out as State Highway Aug. 27, 1912. Contract (No. 13) awarded September 25, 1912, to Burns, Clark & De Roza. Length, 9.9 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$83,600; per mile, \$8,427. Amount of contract completed May 16, 1914, 100 per cent, but not fully paid.

PLACER COUNTY, Section B, from Lincoln to the Placer-Yuba county line (III—Pla.—2—B): Surveys, plans and estimates completed. Length, 9.4 miles.

YUBA COUNTY, Section A, from the south boundary line of Yuba County to Morrison's Crossing (III—Yuba—3—A): Surveys, plans and estimates completed. Length, 3.4 miles.

YUBA COUNTY, Section B, from Morrison's Crossing to Marysville (III—Yuba—3—B): Laid out as State Highway May 21, 1912. Contract (No. 4) awarded July 23, 1912, to F. E. Frey. Length, 9.2 miles. Pavement, oiled macadam, 15 feet wide. Probable total cost, \$67,688; per mile, \$7,341. Contract completed.

SUTTER COUNTY, Section A, from Yuba City to the Sutter-Butte county line (III—Sut.—3—A): Survey and plans completed. Length, 11.7 miles.

BUTTE COUNTY, Section A, from the south county line of Butte County to Biggs (III—But.—3—A): Surveys completed. Length, 7.4 miles.

BUTTE COUNTY, Section B, from Biggs to Nelson (III—But.—3—B): Surveys completed. Length, 10.1 miles.

BUTTE COUNTY, Section C, from Nelson to Chico (III—But.—3—C): Surveys completed. Length, 12.5 miles.

BUTTE COUNTY, Section D, from Chico to the north boundary of Butte County (III—But.—3—D): Laid out as State Highway October 22, 1912. Bids received November 18, 1912. Contract (No. 70) awarded June 10, 1914, to P. L. Burr. Length, 11.2 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$109,690; per mile, \$9,770.

TEHAMA COUNTY, Section A<sub>1</sub>, from the south boundary of Tehama County to Los Molinos (II—Teh.—3—A): Surveys, plans and estimates completed. Length, 10.6 miles. Bids to be received July 6, 1914, for construction of Portland cement concrete.

TEHAMA COUNTY, Section B, from Tehama Junction to Red Bluff (II—Teh.—3—B): Surveys and plans in progress.

TEHAMA COUNTY, Section C, from Red Bluff to the North boundary of Tehama County (II—Teh.—3—C): Surveys, plans and estimates completed. Length 14.02 miles.

SHASTA COUNTY, Section A, from the south boundary of Shasta County to Redding (II—Sha.—3—A): Surveys completed. Plans in progress. Length, 15.88 miles.

SHASTA COUNTY, Section B, from Redding to Baird (II—Sha.—3—B): Surveys completed. Plans and estimates completed.

SHASTA COUNTY, Section C, from Baird to Le Moine (II—Sha.—3—C): Surveys completed. Plans and estimates completed.

Bids will be received July 6 on 16.2 miles of Sections B and C, from Bayha to the Sacramento River, to be graded.

SHASTA COUNTY, Section D, from Le Moine to the north boundary of Shasta County (II—Sha.—3—D): Surveys completed. Length, 21.44 miles.

Contract D<sub>1</sub>, from Le Moine to Hazel Creek: Laid out as State Highway

April 22, 1914. Contract (No. 75) awarded June 10, 1914, to F. Rolandi. Length, 9.9 miles. Road to be graded 18 feet wide. Probable total cost, \$71,600; per mile, \$7,210.

Plans and estimates on remaining portion of Section D are partially complete. SISKIYOU COUNTY, Section A, from the south boundary of Siskiyou County to Weed (II—Sis.—3—A): Surveys completed. Plans in progress. Length, 18.2 miles. SISKIYOU COUNTY, Section B, from Weed to Yreka (II—Sis.—3—B): Surveys completed. Plans in progress. Length, 28.46 miles.

SISKIYOU COUNTY, Section C, from Yreka to the California-Oregon boundary line (II—Sis.—3—C): Surveys completed. Length, 25.35 miles.

Contract C<sub>1</sub>, from Hornbrook to the California-Oregon boundary line: Laid out as State Highway April 22, 1914. Contract (No. 66) awarded May 27, 1914, to W. H. Mason and F. T. Fradenburgh. Length, 8.0 miles. Road to be graded, 18 feet wide. Probable total cost, \$36,200; per mile, \$4,510.

Plans and estimates on remaining portion of Section C are partially complete.

#### ROUTE 4. SACRAMENTO TO LOS ANGELES.

SACRAMENTO COUNTY, built by the County.

SAN JOAQUIN COUNTY, built by the County.

STANISLAUS COUNTY, Section A, from the south boundary of Stanislaus County to a point 1½ miles north of Ceres (III—Sta.—4—A): Laid out as State Highway July 23, 1912. Contract (No. 5) awarded Aug. 27, 1912, to E. O. Burge. Length, 12.0 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$89,429; per mile, \$7,428. Contract completed.

STANISLAUS COUNTY, Section B, from a point 1½ miles north of Ceres to the north boundary of Stanislaus County (III—Sta.—4—B): Laid out as State Highway March 4, 1913. Contract (No. 25) awarded March 26, 1913, to Considine & Bates Co. Length, 9.6 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$67,795; per mile, \$7,077. Amount of contract completed May 16, 1914, 93 per cent.

MERCED COUNTY, Section A, from the south boundary of Merced County to the city of Merced (VI—Mer.—4—A): Laid out as State Highway Oct. 22, 1912. Contract (No. 69) awarded May 27, 1914, to Taylor & Berliner. Length, 14.2 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$115,950; per mile, \$8,170.

Section B has been combined with Section A.

MERCED COUNTY, Section C, from Arena to Merced (VI—Mer.—4—C): Laid out as State Highway Aug. 27, 1912. Contract (No. 11) awarded Sept. 29, 1912, to the Worswick Street Paving Co. Length, 10.9 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$84,712; per mile, \$7,798. Amount of contract completed to May 16, 1914, 85 per cent.

MERCED COUNTY, Section D, from the north boundary of Merced County to Arena (VI—Mer.—4—D): Laid out as State Highway July 23, 1912. Contract (No. 6) awarded Aug. 27, 1912, to the Worswick Street Paving Co. Length, 9.6 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$67,585; per mile, \$7,025. Contract completed.

MADERA COUNTY, Section A, from the south boundary of Madera County to the city of Madera (VI—Mad.—4—A): Laid out as State Highway July 23, 1912. Contract (No. 9) awarded Aug. 27, 1912, to the Worswick Street Paving Co. Length, 9.9 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$64,405; per mile, \$6,473. Contract completed.

MADERA COUNTY, Section B, from Madera to Califa (VI—Mad.—4—B): Laid out as a State Highway May 21, 1912. Contract (No. 3) awarded July 23, 1912, to the Ransome-Crummey Co. Length, 9.9 miles. Pavement, oiled macadam, 15 feet wide. Probable total cost \$68,890; per mile, \$6,952. Contract completed.

MADERA COUNTY, Section C, from Califa to the north boundary of Madera County (VI—Mad.—4—C): Laid out as State Highway July 23, 1912. Contract (No. 10) awarded Aug. 27, 1912, to the Worswick Street Paving Co. Length, 6.8 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$46,100; per mile, \$6,753. Amount of contract completed to May 16, 1914, 36 per cent.

FRESNO COUNTY, Section A, from the south boundary of Fresno County to Fowler (VI—Fre.—4—A): Laid out as State Highway Oct. 29, 1913. Contract (No. 48) awarded Nov. 21, 1913, to A. Teichert & Son. Length, 8.2 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$64,952; per mile, \$7,915. Amount of contract completed to May 16, 1914, 31 per cent.

FRESNO COUNTY, Section B, from Fowler to Fresno (VI—Fre.—4—B): Laid out as State Highway Oct. 29, 1913. Contract (No. 47) awarded Nov. 21, 1913, to A. Teichert & Son. Length, 8.0 miles. Pavement, oiled concrete, 20 feet wide. Probable total cost, \$67,335; per mile, \$8,423. Amount of contract completed May 16, 1914, 53 per cent.

FRESNO COUNTY, Section C, from Fresno to the Fresno-Madera county line (VI—Fre.—4—C): Laid out as State Highway July 23, 1912. Contract (No. 8) awarded Aug. 27, 1912, to the Worswick Street Paving Co. Length, 9.6 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$67,546; per mile, \$7,065. Contract completed.

TULARE COUNTY, Section A, from the south boundary of Tulare County to a point between Pixley and Tipton (VI—Tul.—4—A): Surveys completed and plans in progress. Length, 15.26 miles.

TULARE COUNTY, Section B, from a point between Pixley and Tipton to Tulare (VI—Tul.—4—B): Surveys completed and plans in progress. Length, 12.78 miles.

TULARE COUNTY, Section C, from Tulare to Goshen (VI—Tul.—4—C): Surveys, plans and estimates partially complete.

No Section D.

TULARE COUNTY, Section E, from Goshen to the north boundary line of Tulare County (VI—Tul.—4—E): Laid out as State Highway Jan. 21, 1914. Length, 13.76 miles.

KERN COUNTY, Section A, from the south boundary of Kern County northerly 10.7 miles (VI—Kern—4—A): Surveys, plans and estimates completed.

KERN COUNTY, Section B, from Grape Vine creek to Sections 5 and 6, T. 32 S., R. 28 E., M. D. B. and M. (VI—Ker.—4—B): Surveys, plans and estimates completed. Length, 17.29 miles. Bids will be received July 6, 1914, for construction of Portland cement concrete.

KERN COUNTY, Section C, from Sections 5 and 6, T. 32 S., R. 28 E., M. D. B. and M. to Bakersfield (VI—Kern—4—C): Laid out as State Highway May 27, 1914. Contract (No. 67) awarded May 27, 1914, to John D. Marsh. Length, 13.0 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$142,360; per mile, \$10,970.

KERN COUNTY, Section D, from Bakersfield to Lerdo (VI—Kern—4—D): Laid out as State Highway Jan. 21, 1914. Contract (No. 50) awarded Feb. 26, 1914, to Geo. S. Benson & Sons. Length, 10.1 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$71,209; per mile, \$7,026. Amount of contract completed May 16, 1914, 16 per cent.

KERN COUNTY, Section E, from Lerdo to Famosa (VI—Kern—4—E): Laid out as State Highway Jan. 21, 1914. Contract (No. 51) awarded Feb. 26, 1914, to

Geo. S. Benson & Sons. Length, 8.9 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$56,720; per mile, \$6,343.

KERN COUNTY, Section F, from Famosa to the north boundary of Kern County (VI—Kern—4—F): Laid out as State Highway March 12, 1914. Contract (No. 63) awarded April 22, 1914, to Lynn S. Atkinson. Length, 12.4 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$108,340; per mile, \$8,710.

LOS ANGELES COUNTY, Section A, from Newhall to Castaic schoolhouse (VII—L. A.—4—A): Surveys completed. Plans in progress. Length, 8.8 miles.

LOS ANGELES COUNTY, Section B, from Castaic school house to top of ridge (VII—L. A.—4—B): Surveys completed. Plans in progress. Length, 12.1 miles.

LOS ANGELES COUNTY, Section C, from top of ridge to Liebre Mountain (VII—L. A.—4—C): Surveys completed. Plans in progress. Length, 16.1 miles.

LOS ANGELES COUNTY, Section D, from Liebre Mountain to the Los Angeles-Kern county line (VII—L. A.—4—D): Laid out as State Highway May 27, 1914. Contract (No. 78) awarded June 10, 1914, to Lee Moor. Length, 12.6 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$201,920; per mile, \$16,000.

#### ROUTE 5. BETWEEN THE SAN JOAQUIN VALLEY AND SANTA CRUZ VIA. SAN FRANCISCO BAY.

SAN JOAQUIN COUNTY—Built by the County.

ALAMEDA COUNTY, Section A, from the east boundary of Alameda County to Livermore (IV—Ala.—5—A): Surveys completed. Plans in progress. Length, 14.6 miles.

ALAMEDA COUNTY, Section B, from Livermore to Hayward (IV—Ala.—5—B): Surveys completed. Plans in progress. Length, 17.7 miles.

ALAMEDA COUNTY, Section C, from Hayward to the south boundary of Alameda County (IV—Ala.—5—C): Surveys completed. Length, 17.5 miles.

Contract C<sub>1</sub>, from Hayward to Niles: Laid out as State Highway March 25, 1914. Contract (No. 61) awarded April 22, 1914, to Tieslau Brothers. Length, 3.1 miles. Pavement, oiled concrete, 18 feet wide. Probable total cost, \$38,503; per mile, \$12,340.

Plans and estimates for remaining portion of Section C are completed.

ALAMEDA COUNTY, Section D, from Oakland to Hayward (IV—Ala.—5—D): Laid out as State Highway March 25, 1914. Contract (No. 62) awarded April 22, 1914, to Ransome-Crummey Co. Length, 5.1 miles. Pavement, asphalt on macadam, 24 feet wide. Probable total cost, \$56,955; per mile, \$11,256.

SANTA CLARA COUNTY, Section A, from the north boundary of Santa Clara County to San Jose (IV—S. Cl.—5—A): Surveys, plans and estimates completed. Length, 7.2 miles.

SANTA CLARA COUNTY, Section B, from San Jose to the south boundary of Santa Clara County (IV—S. Cl.—5—B): Surveys completed. Plans in progress. Length, 14.48 miles.

SANTA CRUZ COUNTY, Section A, from the north boundary of Santa Cruz County to the city of Santa Cruz. (IV—S. Cr.—5—A): Survey complete. Length, 16.0 miles.

Contract A<sub>1</sub>, from the north boundary of Santa Cruz County to Glenwood: Laid out as State Highway Jan. 21, 1914. Contract (No. 49) awarded Feb. 26, 1914, to Martin S. Foss and John A. Marshall. Length, 5.7 miles. Road is to be graded 18 feet wide. Probable total cost, \$62,366; per mile, \$10,910. Amount of contract completed May 16, 1914, 10 per cent.

Contract A<sub>2</sub>, from Glenwood to Santa Cruz: Plans and estimates completed. Length, 10.3 miles. Bids will be received July 6 for grading.

#### ROUTE 6. ACROSS YOLO BY-PASS.

YOLO COUNTY, Section A, from 2 miles west of Davis to Southern Pacific bridge 81A (III—Yolo—6—A): Surveys completed. Plans in progress. Length, 7.5 miles.

YOLO COUNTY, Section B, from Southern Pacific bridge 81A to West Sacramento levee (III—Yolo—6—B): Laid out as State Highway April 22, 1914. Bids received June 8, 1914; award pending. Length, 3.1 miles. The road is wooden trestle for about .4 mile, and reinforced concrete trestle with draw span for about 2.7 miles.

YOLO COUNTY, Section C, from West Sacramento levee to the Sacramento River (III—Yolo—6—C): Surveys completed. Plans in progress. Length, 3.9 miles.

#### ROUTE 7. THROUGH THE WESTERN SACRAMENTO VALLEY.

SOLANO COUNTY, Section A, from Benicia to a point 2½ miles south of Cordelia (III—Sol.—7—A): Laid out as State Highway March 25, 1914. Contract (No. 79) awarded June 10, 1914, to Commary-Peterson Co., Inc. Length, 9.1 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$103,770; per mile, \$11,466.

SOLANO COUNTY, Section B, from a point 2½ miles south of Cordelia to Fairfield (III—Sol.—7—B): Survey completed. Plans in progress. Length, 9.6 miles.

SOLANO COUNTY, Section C, from Fairfield to Vacaville (III—Sol.—7—C): Laid out as State Highway May 27, 1914. Contract (No. 74) awarded June 10, 1914, to Commary-Peterson Co., Inc. Length, 8.8 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$90,350; per mile, \$10,265.

SOLANO COUNTY, Section D, from Vacaville to a point three fourths of a mile northeast of Batavia (III—Sol.—7—D): Surveys completed. Plans in progress. Length, 8.2 miles.

SOLANO COUNTY, Section E, from a point three fourths of a mile northeast of Batavia to the north boundary of Solano County (III—Sol.—7—E): Surveys completed. Length, 8.4 miles.

YOLO COUNTY, Section A, from the south boundary of Yolo County to Woodland (III—Yolo—7—A): Plans and estimates completed. Length, 11.7 miles. Bids will be received July 6 for construction of Portland cement concrete.

YOLO COUNTY, Section B, from Woodland to Bretona (III—Yolo—7—B): Surveys completed. Plans in progress. Length, 11.0 miles.

YOLO COUNTY, Section C, from Bretona to the north boundary of Yolo County (III—Yolo—7—C): Surveys completed. Plans in progress. Length, 11.0 miles.

COLUSA COUNTY, Section A, from the south boundary of Colusa County to Berlin (III—Col.—7—A): Laid out as State Highway May 27, 1914. Bids received May 25, 1914; award pending. Length, 10.82 miles.

COLUSA COUNTY, Section B, from Berlin to Colusa Junction (III—Col.—7—B): Surveys completed. Plans in progress. Length, 12.7 miles.

COLUSA COUNTY, Section C, from Colusa Junction to the north boundary of Colusa County (III—Col.—7—C): Surveys completed. Plans in progress. Length, 10.7 miles.

GLENN COUNTY, Section A, from the south boundary of Glenn County to Willows (III—Gle.—7—A): Surveys completed. Plans in progress. Length, 8.6 miles.

GLENN COUNTY, Section B, from Willows to Grapit (III—Gle.—7—B): Surveys completed. Plans in progress. Length, 10.0 miles.

GLENN COUNTY, Section C, from Grapit to the north boundary line of Glenn County (III—Gle.—7—C): Laid out as State Highway April 22, 1914. Contract (No. 77) awarded June 10, 1914, to P. H. Hoare. Length, 6.9 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$60,550; per mile, \$8,725.

TEHAMA COUNTY, Section A, from the south boundary of Tehama County to a point west of Tehama Junction (II—Teh.—7—A): Surveys completed. Length, 15.29 miles.

Contract A<sub>1</sub>, from the south boundary to Corning: Laid out as State Highway April 22, 1914. Contract (No. 76) awarded June 10, 1914, to Jacinto, Burns & Da Roza. Length, 8.8 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$83,460; per mile, \$9,495.

Plans and estimates on the remaining portion of Section A are practically completed.

#### ROUTE 9. LOS ANGELES AND SAN BERNARDINO COUNTIES.

LOS ANGELES COUNTY, Section A, from San Fernando road to La Canada (VII—L. A.—9—A): Surveys completed. Plans in progress. Length, 13.9 miles.

LOS ANGELES COUNTY, Section B, from La Cañada to Pasadena (VII—L. A.—9—B): Surveys in progress.

SAN BERNARDINO COUNTY, Section A, from Upland to Citrus Avenue (VII—S. Bd.—9—A): Laid out as State Highway Oct. 29, 1913. Contract (No. 46) awarded Nov. 21, 1913, to Hudson-Johnson Construction Co. Length, 10.4 miles. Pavement, oiled concrete, 18 feet wide. Probable total cost, \$77,268; per mile, \$7,462. Amount of contract completed May 16, 1914, 36 per cent.

SAN BERNARDINO COUNTY, Section B, from Citrus Avenue to Rialto (VII—S. Bd.—9—B): Survey completed. Length, 4.0 miles. See Section C.

SAN BERNARDINO COUNTY, Section C, from Rialto to San Bernardino (VIII—S. Bd.—9—C): Survey completed. Length, 1.8 miles. Sections B and C laid out as State Highway July 23, 1913. Contract (No. 38) awarded Aug 11, 1913, to C. J. Flower. Length, 5.8 miles. Pavement, oiled concrete, 18 feet wide. Probable total cost, \$45,925; per mile, \$7,879. Amount of contract completed May 16, 1914, 82 per cent.

SAN BERNARDINO COUNTY, Section D, from the San Bernardino-Los Angeles county line to Upland (VII—S. Bd.—9—D): Laid out as State Highway Jan. 21, 1914. Contract (No. 53) awarded Feb. 26, 1914, to Louis Ferrell. Length, 1.7 miles. Pavement, oiled concrete, 18 feet wide. Probable total cost, \$17,375; per mile, \$10,305. Amount of contract completed May 16, 1914, 15 per cent.

#### ROUTE 10. BETWEEN VISALIA AND HANFORD.

TULARE COUNTY, Section A, between Visalia and the west boundary of Tulare County (VI—Tul.—10—A): Surveys, plans and estimates completed. Length, 9.22 miles.

KINGS COUNTY, Section A, between Hanford and the east boundary of Kings County (VI—Kin.—10—A): Surveys, plans and estimates complete. Length 9.28 miles.

#### ROUTE 11. SACRAMENTO AND EL DORADO COUNTIES.

SACRAMENTO COUNTY, Section A, from Folsom to the east boundary of Sacramento County (III—Sac.—11—A): Surveys completed and plans in progress. Length, 6.8 miles.

EL DORADO COUNTY, Section A, from the west boundary of El Dorado County to Shingle Springs (III—E. D.—11—A): Surveys completed. Plans in progress. Length, 10.4 miles.

EL DORADO COUNTY, Section B, from Shingle Springs to El Dorado (III—E. D.—11—B): Laid out as State Highway May 21, 1913. Bids received and rejected June 30, 1913. Now being constructed by the State with day labor (No. D2). Length, 5.3 miles. Pavement, waterbound macadam, 12 feet wide. Probable total cost, \$25,608; per mile, \$4,859. Amount of section complete May 16, 1914: Grading, 100 per cent; macadam, 50 per cent.

EL DORADO COUNTY, Section C, from El Dorado to Placerville (III—E. D.—11—C): Laid out as State Highway Jan. 21, 1914. Bids received and rejected March 30, 1914. Now being constructed by the State with day labor (No. D5). Length, 6.6 miles. Pavement, waterbound macadam, 12 feet wide. Probable total cost, \$61,219; per mile, \$9,318.

#### ROUTE 12. BETWEEN SAN DIEGO AND EL CENTRO.

SAN DIEGO COUNTY, Section A, from East San Diego to La Mesa (VII—S. D.—12—A): Laid out as State Highway March 25, 1914. Contract (No. 59) awarded April 22, 1914, to C. L. Hyde Construction Co. Length, 2.0 miles. Pavement, oiled concrete, 15 feet wide. Probable total cost, \$18,590; per mile, \$9,460.

SAN DIEGO COUNTY, Section B, from La Mesa to El Cajon (VII—S. D.—12—B): Plans and estimates completed. Length, 1.6 miles. Bids will be received July 6 for construction of Portland cement concrete.

SAN DIEGO COUNTY, Section C, from El Cajon to Alpine (VII—S. D.—12—C): Surveys and plans completed. Length, 14.5 miles.

SAN DIEGO COUNTY, Section D, from Alpine to Oak Valley road (VII—S. D.—12—D): Surveys completed. Plans in progress. Length, 16.7 miles.

SAN DIEGO COUNTY, Section E, from Oak Valley road to Glencoe school (VII—S. D.—12—E): Surveys completed. Plans in progress. Length, 6.9 miles.

SAN DIEGO COUNTY, Section F, from Glencoe school to Tecate Divide (VII—S. D.—12—F): Surveys in progress.

SAN DIEGO COUNTY, Section G, from Tecate Divide to the east boundary of San Diego County (VII—S. D.—12—G): Surveys ordered.

SAN DIEGO COUNTY, Section H, from the east city limits of San Diego to the old east city limits of East San Diego (VII—S. D.—12—H): Surveys and plans complete. Length, 3.5 miles.

IMPERIAL COUNTY, Section A, from the foot of Myers Canyon to Coyote Wells (VII—Imp.—12—A): Surveys, plans and estimates completed. Length, 6.1 miles.

IMPERIAL COUNTY, Section B, from Coyote Wells to Dixieland (VII—Imp.—12—B): Surveys and plans completed. Length, 11.8 miles.

IMPERIAL COUNTY, Section C, from Dixieland to El Centro (VII—Imp.—12—C): Surveys and plans completed. Length, 12.3 miles.

IMPERIAL COUNTY, Section D, from the west county line of Imperial County to the foot of Myers Canyon (VII—Imp.—12—D): Survey ordered.

#### ROUTE 13. STANISLAUS AND TUOLUMNE COUNTIES.

STANISLAUS COUNTY, Section A, from Salida to Oakdale (III—Sta.—13—A): Surveys completed. Length, 14.4 miles.

STANISLAUS COUNTY, Section B, from Oakdale to the northeast boundary of Stanislaus County (III—Sta.—13—B): Surveys completed. Length, 12.9 miles.

TUOLUMNE COUNTY, Section A, from the southwest boundary of Tuolumne County to a point 2 miles north of Keystone (III—Tuo.—13—A): Laid out as State Highway Jan. 21, 1914. Bids received and rejected March 30, 1914. To be constructed by the State with day labor (No. D6). Length, 10.9 miles. Road to be graded 18 feet wide. Probable total cost, \$48,700; per mile, \$4,490.

TUOLUMNE COUNTY, Section B, from a point 2 miles north of Keystone to Sonora (III—Tuo.—13—B): Surveys complete. Plans in progress. Length, 11.3 miles.

#### ROUTE 14. CONTRA COSTA COUNTY.

CONTRA COSTA COUNTY, Section A, from the south boundary of Contra Costa County to Pinole (IV—C. C.—14—A): Surveys completed. Plans in progress. Length, 7.86 miles.

CONTRA COSTA COUNTY, Section B, from Pinole to Martinez (IV—C. C.—14—B): Surveys completed. Plans in progress. Length, 12.9 miles.

#### ROUTE 15. COLUSA TO WILLIAMS.

COLUSA COUNTY, Section A, from Colusa to Williams (III—Col.—15—A): Surveys completed. Length, 8.5 miles.

#### ROUTE 16. HOPLAND TO LAKEPORT.

MENDOCINO COUNTY, Section A, from Hopland to the east boundary of Mendocino County (I—Men.—16—A): Reconnaissance made.

LAKE COUNTY, Section A, from the west boundary of Lake County to Lakeport (I—Lake—16—A): Reconnaissance made.

#### ROUTE 17. PLACER AND NEVADA COUNTIES.

PLACER COUNTY, Section A, from Roseville to Penryn (III—Pla.—17—A): Surveys completed. Length, 9.1 miles.

PLACER COUNTY, Section B, from Penryn to Auburn (III—Pla.—17—B): Surveys completed. Length, 6.5 miles.

On remainder of the route reconnaissance has been made.

#### ROUTE 18. MERCED AND MARIPOSA COUNTIES.

MERCED COUNTY: Surveys in progress.

MARIPOSA COUNTY: Surveys in progress.

#### ROUTE 19. LOS ANGELES TO RIVERSIDE.

LOS ANGELES COUNTY: Built by the county.

SAN BERNARDINO COUNTY, Section A, from the San Bernardino-Los Angeles county line to Ontario (VII—S. Bd.—19—A): Survey completed. Length, 2.0 miles. See Section B.

SAN BERNARDINO COUNTY, Section B, from Ontario to the San Bernardino-Riverside county line (VII—S. Bd.—19—B): Survey completed. Length, 4.6 miles. Sections A and B laid out as State Highway June 25, 1913. Contract (No. 37) awarded as a whole July 23, 1913, to Bent & Pennebaker. Length, 6.6 miles. Pavement, oiled concrete, 18 feet wide. Probable total cost, \$52,836; per mile, \$7,994. Amount of contract completed May 16, 1914, 100 per cent, but not fully paid.

RIVERSIDE COUNTY, Section A, from the Riverside-San Bernardino county line to Riverside (VII—Riv.—19—A): Laid out as State Highway Sept. 24, 1913. Contract (No. 43) awarded Oct. 29, 1913, to The M. R. Company, Inc. Length, 10.3 miles. Pavement, oiled concrete, 18 feet wide. Probable total cost, \$59,175; per mile, \$6,338. Amount of contract completed May 16, 1914, 43 per cent.

#### ROUTE 20. REDDING TO WEAVERVILLE.

SHASTA COUNTY, Section A, from the west boundary of Shasta County to Stella (II—Sha.—20—A): Surveys in progress. Length, 13.0 miles.

SHASTA COUNTY, Section B, from Stella to Redding (II—Sha.—20—B): Surveys in progress. Length, 10.9 miles.

TRINITY COUNTY, Section A, from Weaverville to the Trinity River (II—Tri.—20—A): Surveys in progress. Length, 13.0 miles.

TRINITY COUNTY, Section B, from the Trinity River to the east boundary of Trinity County (II—Tri.—20—B): Survey ordered. Length 11.0 miles.

#### ROUTE 21. OROVILLE TO RICHVALE.

BUTTE COUNTY, Section A, from Richvale to Oroville (III—But.—21—A): Survey ordered.

## Notice to Contractors

Sealed proposals will be received at the office of the California Highway Commission, 515 Forum Building, Sacramento, Cal., until the times hereinafter noted, at which times they will be publicly opened and read, for construction in accordance with the specifications therefor, to which special reference is made, portions of State Highway as follows:

(Until 11 o'clock A. M., July 6th, 1914.)

Tehama County from the South Boundary to Los Molinos (II—Teh—3—A), about 10.6 miles in length, to be built of Portland cement concrete.

Yolo County from the Southerly Boundary to Woodland (III—Yol—7—A), about 11.7 miles in length, to be built of Portland cement concrete.

Santa Cruz County from Glenwood to Santa Cruz (IV—S. Cr—5—A), about 10.3 miles in length, to be graded.

Santa Barbara County from Orcutt to Santa Maria (V—S. B.—2—A), about 6.5 miles in length, to be built of Portland cement concrete with asphaltic wearing surface.

San Benito County from San Juan Bautista to the Northerly Boundary (V—S. Bt—2—A), about 4.0 miles in length, to be built of Portland cement concrete.

(Until 2 o'clock P. M., July 6th, 1914.)

Shasta County from Bayha to the Sacramento River (II—Sha—3—B & C), about 16.2 miles in length, to be graded.

San Luis Obispo County from Arroyo Grande to San Luis Obispo (V S. L. O—2—E), about 13.4 miles in length, to be built of Portland cement concrete.

Kern County from Grape Vine Creek to Sections 5 & 6, T. 32 S., R. 28 E. M. D. B. & M. (VI—Ker.—4—B), about 17.3 miles in length, to be built of Portland cement concrete.

Ventura County from Newbury Park to Springville (VII—Ven—2—B), about 11.1 miles in length, to be built of Portland cement concrete.

San Diego County from La Mesa to El Cajon (VII—S. D.—12—B), about 1.6 miles in length, to be built of Portland cement concrete.

Plans may be seen, and forms of proposal, bonds, contract, and specifications may be obtained, at the said office, and they may be seen at the offices of the Division Engineers of the divisions in which the work is situated. The Division Engineers' offices are located at Willits, Dunsmuir, Sacramento, San Francisco, San Luis Obispo, Fresno, and Los Angeles.

No bid will be received unless it is made on a blank form furnished by the Commission. The special attention of prospective bidders is called to the "Notice to Contractors" annexed to the blank form of proposal, for full directions as to bidding, quantities of work to be done, etc.

The Department of Engineering reserves the right to reject any or all bids or to accept the bid deemed for the best interests of the State.

CHARLES D. BLANEY,  
NEWELL D. DARLINGTON,  
CHARLES F. STERN,

Dated June 9, 1914.

California Highway Commission.  
AUSTIN B. FLETCHER, Highway Engineer.  
CHARLES C. CARLETON, Acting Secretary.

"The four most important requirements for a concrete base are: A firm, compact subgrade, true to line and grade; a concrete of a proper consistency; a uniformly finished surface true to line and grade; and the finished concrete constantly and faithfully guarded during the curing period."—L. H. Gibson, *Second Assistant Highway Engineer, California Highway Commission.*

STATE OF CALIFORNIA  
DEPARTMENT OF ENGINEERING  
CALIFORNIA HIGHWAY COMMISSION

CHARLES D. BLANEY, Chairman  
NEWELL D. DARLINGTON  
CHARLES F. STERN

Headquarters of the Commission: Forum Building, Sacramento.

AUSTIN B. FLETCHER, Highway Engineer.  
GEORGE R. WINSLOW, First Assistant Highway Engineer.  
LESTER H. GIBSON, Second Assistant Highway Engineer.

WILSON R. ELLIS,\* Secretary.  
CHARLES C. CARLETON, Attorney and Acting Secretary.  
H. L. WARREN, Purchasing Agent.  
JOHN H. SMALL, Chief Accountant.  
CLARENCE B. OSBORNE, Geologist.  
GEORGE B. HARRISON, Chief of Right of Way Department.

DIVISION I. F. G. Somner, Division Engineer; F. W. Haselwood, Principal Assistant Engineer; Mercantile Building, Willits.

DIVISION II. T. A. Bedford, Division Engineer; R. H. Stalnaker, Principal Assistant Engineer; State Bank Building, Dunsmuir.

DIVISION III. W. S. Caruthers, Division Engineer; S. S. Stahl, Principal Assistant Engineer; Forum Building, Sacramento.

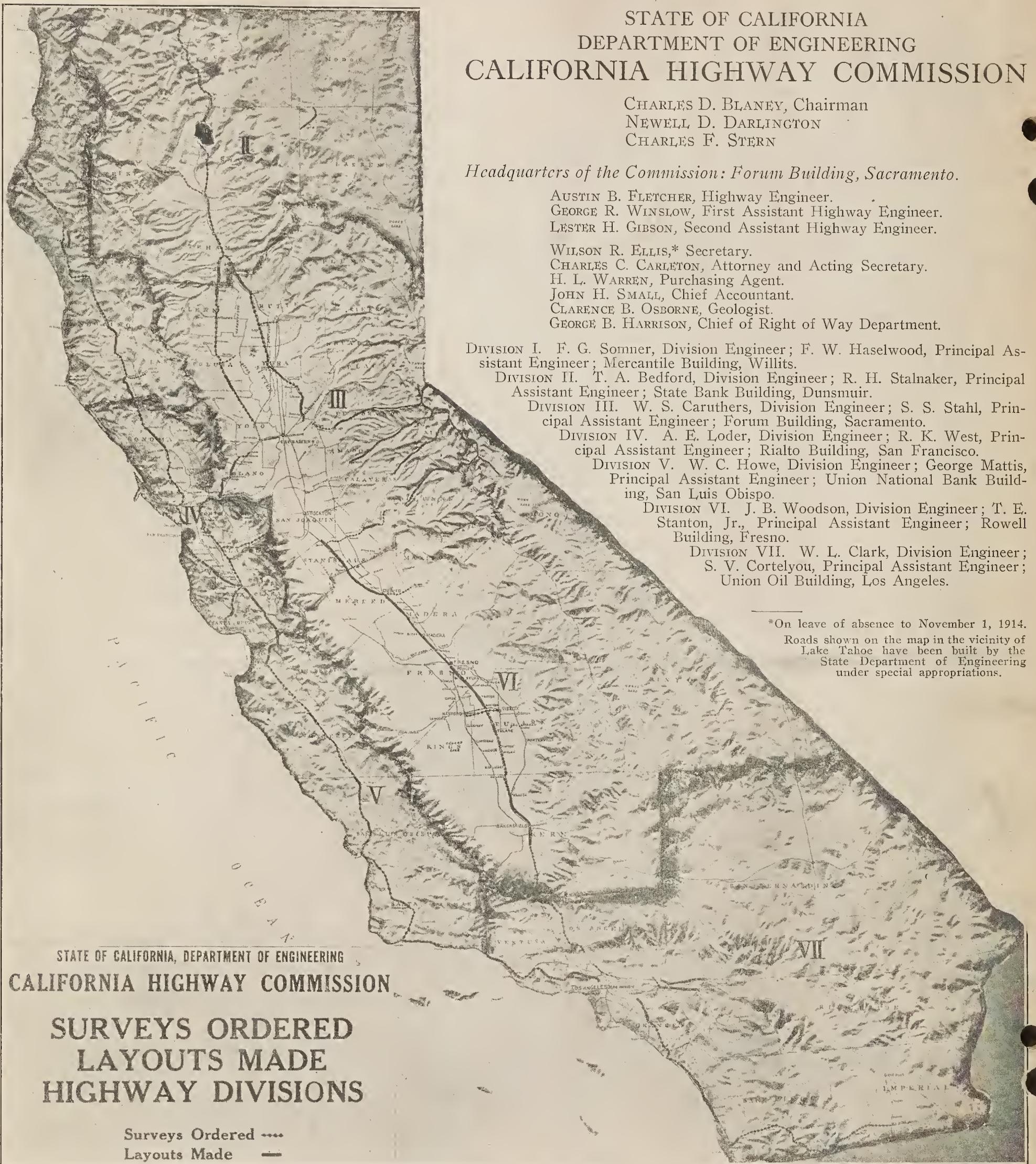
DIVISION IV. A. E. Loder, Division Engineer; R. K. West, Principal Assistant Engineer; Rialto Building, San Francisco.

DIVISION V. W. C. Howe, Division Engineer; George Mattis, Principal Assistant Engineer; Union National Bank Building, San Luis Obispo.

DIVISION VI. J. B. Woodson, Division Engineer; T. E. Stanton, Jr., Principal Assistant Engineer; Rowell Building, Fresno.

DIVISION VII. W. L. Clark, Division Engineer; S. V. Cortelyou, Principal Assistant Engineer; Union Oil Building, Los Angeles.

\*On leave of absence to November 1, 1914.  
Roads shown on the map in the vicinity of Lake Tahoe have been built by the State Department of Engineering under special appropriations.



STATE OF CALIFORNIA, DEPARTMENT OF ENGINEERING  
CALIFORNIA HIGHWAY COMMISSION

SURVEYS ORDERED  
LAYOUTS MADE  
HIGHWAY DIVISIONS

Surveys Ordered ----  
Layouts Made —

Types of Highway Construction

"The Commission has invariably attempted to design the state highways to suit the requirements of topography and traffic and accordingly there are six different types of road construction in the work as planned. The list of road surfaces, some of which are available for use in California and some which are not, is a very long one. Each has its earnest advocates and the persons and corporations which control

patents or who manufacture the materials used are extraordinarily active in presenting their particular types. That any one type of road surface will suit all conditions is absurd. There is no 'most satisfactory' road surface which will answer all the factors of finance, topography, climate and traffic. The question of finance alone has barred out from general use some of the high cost pavements which have been advocated for the California state highways."—A. B. Fletcher, Highway Engineer, California Highway Commission.