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California Highways and Public Works

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

FRANK B. DURKEE
Director

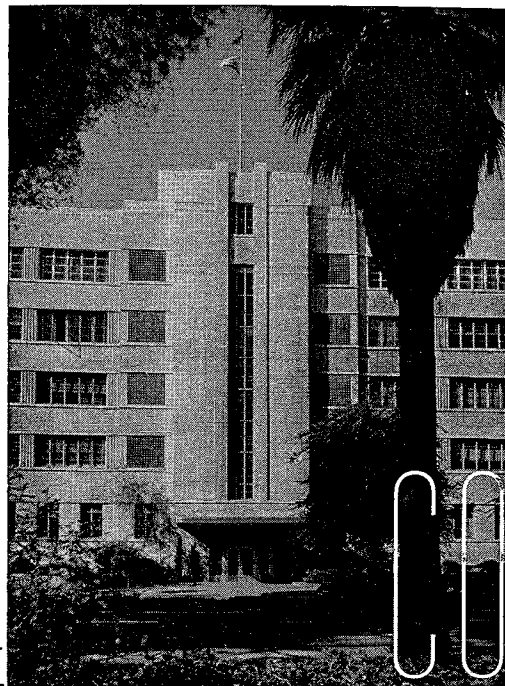
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CONTENTS

	Page
Indian Head. For Ages These Travertine Rocks on What Formerly Was the Shore of Salton Sea Were Under Water Which Over the Years Carved Out This Perfect Indian Head. Travertine Rocks May Be Reached Over State Sign Route 111 and U. S. 99. Each Year Combined Churches of Indio, Riverside County, Hold Easter Sunrise Services Here. Photo by Robert A. Monroe, Photographic Section, Merritt R. Nickerson, Chief.....	Cover
On-Job Training, Illustrated.....	1
By Earl E. Sorenson, Equipment Engineer	
Cajon Pass, Illustrated.....	7
By J. Dekema, Assistant District Engineer	
Fill Construction, Illustrated.....	11
By G. L. Richardson, Senior Highway Engineer	
Example of Use of Analysis of Variants in Investigation of Some Properties of Portland Cement Concrete.....	15
By W. E. Haskell, Associate Materials and Research Engineer	
Salute to Road Workers.....	17
Dunsmuir to Big Canyon, Illustrated.....	18
By F. E. Baxter, Assistant District Engineer	
An Explanation.....	21
Roadside Cleanup Campaign Launched.....	21
Experience Report, Illustrated.....	22
By D. G. Evans, Construction Engineer	
Gaviota Tunnel, Illustrated.....	27
By John E. Witte, Resident Engineer	
Four Years After, Illustrated.....	34
By John F. Kelly, Headquarters Right of Way Agent	
Cost Index.....	39
By Richard H. Wilson, Assistant State Highway Engineer H. C. McCarty, Office Engineer, and J. D. Gallagher, Assistant Office Engineer	
Roadside Trash, Illustrated.....	41
New Sign Routes Added to State Road Map.....	42
Early Days.....	44
By R. C. (Cass) Kennedy, Secretary, California Highway Commission	
Retirements From Service.....	48
George M. Webb, in Post of Traffic Engineer.....	50
Fred Bagshaw, New Assistant to Director Durkee.....	50
C. E. Bovey Named to Post Vacated by L. V. Campbell.....	50
Safety Council Program Stresses Highway Needs.....	51
Basic Photogrammetry for Highway Engineers.....	52
By Rex H. Fulton, Senior Highway Engineer	
Out of the Mail Bag.....	54
Highway Pioneers Indulge in Reminiscences, Illustrated.....	56
Gas Tax to Cities.....	58
Highway Bids and Awards.....	61
Second Annual Bonneroo Stag, Illustrated.....	64

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KENNETH C. ADAMS, Editor
P. O. Box 1499
Sacramento, California

On-Job Training

Division of Highways
Equipment Department

By EARL E. SORENSON, Equipment Engineer

THE RAPID expansion of the State Highway System in scope, complexity, and number of vehicles served is directly reflected in the increased activities and responsibilities of the Equipment Department.

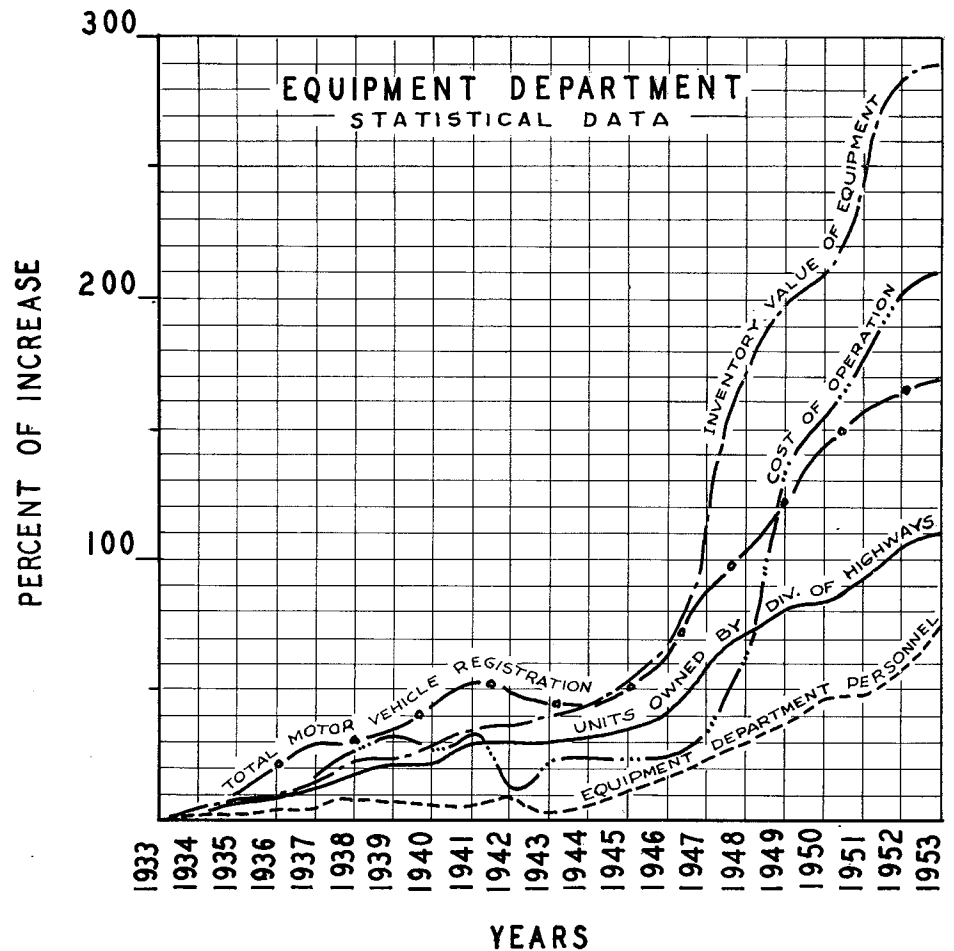
The Division of Highways owns and operates approximately 6,000 units of maintenance, construction, and related equipment, with a value in excess of \$18,000,000. This equipment is controlled and administered by the Equipment Department and operated by the other departments, on a rental basis, to keep the Highway System up to date and operating efficiently.

The accompanying chart illustrates graphically various statistical data related to the Equipment Department's operation, including inventory value of equipment, cost of operation, total motor vehicle registration, units owned by the Division of Highways, and Equipment Department personnel.

Vehicle Registration

The total motor vehicle registration in California has been shown for purposes of comparison. This is a reasonably accurate criterion for establishing the amount of service rendered to the public by the highway system, which, in turn, is also theoretically in proportion to the cost of maintenance of the system. Vehicle registration does not portray an entirely accurate picture, inasmuch as the expansion of the highways has admittedly not kept pace with the registration and needs. Nevertheless, these registration figures do illustrate the growth trend and the relation of this trend to the Equipment Department operations.

It is of interest to note that the various curves on the chart portray clearly the various economic periods through which we have passed. The depression period of the early 30's is indicated, then the gradual rise until the war



period, when the curtailed operations are indicated by either a leveling-off or a slump in the curves.

At the conclusion of the war a gradual rise is again indicated in curves not affected by inflation, whereas those operations affected by inflation show a very abrupt increase.

It is of passing interest to note that the curves for the last year indicates a tapering-off in the inflationary trend.

Effects of Inflation

Note that the increase in personnel has not kept pace with the increase in number of units and inventory value. This is due largely to increased effi-

ciency and productiveness of personnel, as well as improvement in equipment, and is responsible for offsetting a large portion of the inflationary effect on the cost of operation.

The upper curve, indicating inventory value of equipment, shows directly the effects of inflation. It is the abrupt rise in this curve that illustrates the need for still further preserving the large investment in our equipment and justifies the training program, outlined in this brief article, as one step toward accomplishment.

As the size, scope and financial costs of highway operation increase, the need for economies in operation and

the possibilities for effecting them also increase.

Cost Is Justified

A large organization, or operation, can justify the expenditure of more funds for research and training than one operating on a small scale. This is due to the fact that no more expense is involved in setting up an economy move in a large organization than a small one. As an example, it costs no more to seek out and remedy a faulty welding technique for all of the Equipment Department shops, than it does for only one, but the expense spread out over the larger field makes it economically feasible.

This same analysis applies to the training of Division of Highways employees, both in mechanical repairs and equipment operation. Provided sound organizational principles are used, it will cost very little more to provide equipment and personnel to train a large number of employees than it would to provide like training for a small number. We can, therefore, financially justify a centrally operated training system for taking care of all of our employees, whereas the expense would be prohibitive if duplicated in each shop.

Special Training Necessary

The above conditions, together with the fact that machines and operations have become increasingly complex with the passing years, make it almost mandatory that some specialized training be given mechanics and operators to advance their knowledge and technique so that it will be reflected in decreased cost for repairs and upkeep resulting from inadequate repairs and adjustments, and from improper operation.

With this in mind, and after thorough study and consultation, it has been decided to make available "On-the-job" training for this department, starting in a small way with the mechanics and related trades within the Equipment Department, and later, with approval and in cooperation with

Collapsible, universal, truck-mounted, one-man hoist. Used for maintaining high roadside and overhead structures.



HILTON F. LUSK



the Maintenance Department, making training available to their operators.

The offering of a program of this kind to adult students presents problems which require special training, experience and skill on the part of the instructors.

Hilton F. Lusk Employed

To implement this program the Equipment Department has secured the services of Hilton F. Lusk, a man with wide and varied experience in both practical and theoretical mechanics. He has had practical experience on construction projects, both as an engineer and in operating heavy construction equipment. He holds degrees in both mechanical engineering and electrical engineering, and life teaching credentials in Vocational Arts and also in General Secondary Education.

From 1926 to 1929 Mr. Lusk was Assistant Professor of Engineering at College of the Pacific in Stockton. While at College of the Pacific, in addition to his teaching duties, he organized a Department of Aeronautics, and designed and constructed an airport adjacent to the campus, using highway construction equipment borrowed from the county.

Mr. Lusk is the author of a textbook, "General Aeronautics," published by The Ronald Press Company, of New York City, and widely used in many schools for classroom purposes.

From 1929 to 1930 he was Dean of the Boeing School of Aeronautics, at Oakland. While holding this position he selected the balance of the faculty, laid out the school building, selected the equipment, and organized the curriculum. He also taught several of the theoretical subjects.

Wide Experience

From 1930 to 1952 he was Instructor of Mechanical and Electrical Engineering at the Sacramento Junior College, where he taught courses in advanced mathematics, engineering drafting, machine design, descriptive geometry, analytical mechanics, and civil and electrical engineering.

The organizing and teaching of night school courses for mechanics, in the Sacramento Adult Evening Junior

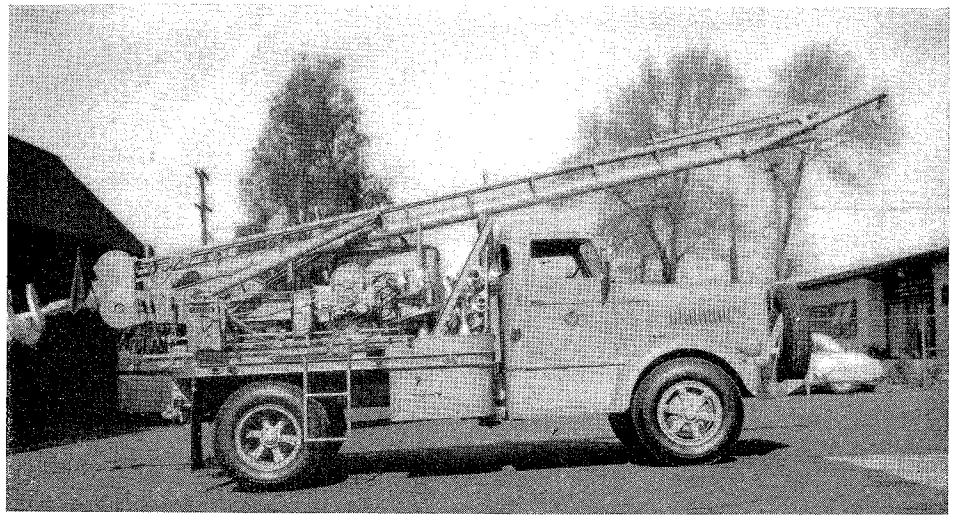
College, for over two decades has provided him with an excellent background for handling practical instruction on the adult level.

Mr. Lusk has always been interested in gas and Diesel engines, as well as in heavy construction equipment and, in following out these interests, has held many summer jobs with large construction companies where he used his summer vacations from school to advance his knowledge in the operating technique of construction equipment.

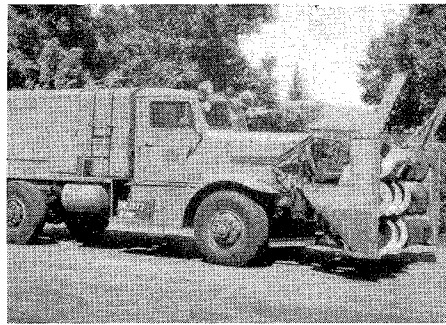
He has been a member of the Society of Automotive Engineers for many years.

We are confident that the wide and varied training and experience of Mr. Lusk, in both theoretical and practical fields, will admirably fit him to carry on the training classes and present, to all those interested, a well-balanced program of both theoretical and practical instruction.

Since taking up his duties as Associate Equipment Engineer with this department Mr. Lusk has been assembling materials, data and equipment for use in the program. Several of the large equipment manufacturers have made available to us their libraries of instructive films and other technical data and charts which will be of great assistance.

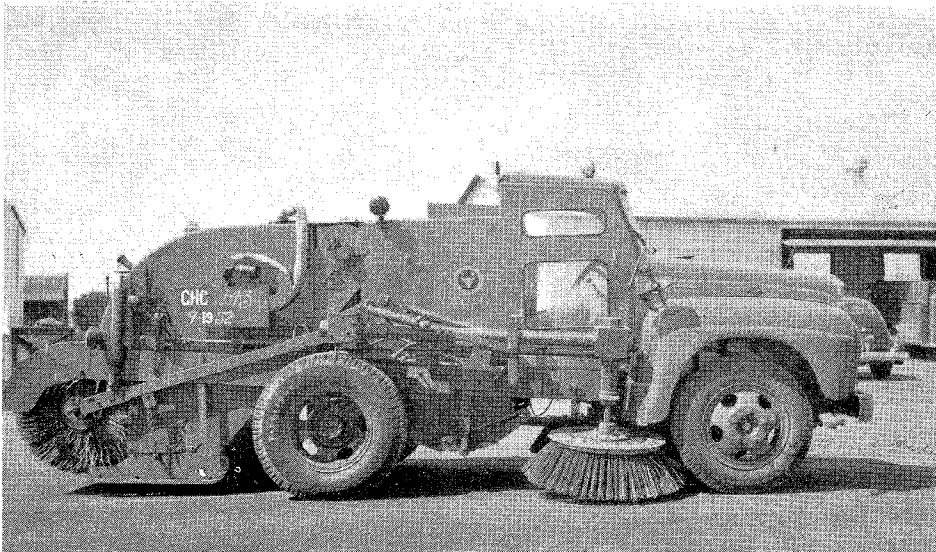


Hydraulically controlled truck-mounted, universal, auger-type earth-drilling machine mounted on four-wheel-drive truck. Used for soil testing and subsurface exploration.



Auger-blower type snow plow. These units, mounted on four-wheel-drive truck chassis steering on all four wheels, blast the snow far to the side of the roadway.

High-speed street sweeper used to maintain long distances of freeway in immaculate condition



Manufacturers Help

Many of our problems are directly connected with certain makes and types of mechanisms and the charts, diagrams and plans needed for instruction would be costly to make. The manufacturers' willingness to supply them from their files is, therefore, appreciated, particularly in view of the fact that we will be unable to give them any publicity. Some of the larger automobile companies have offered to supply us with complete subassemblies such as automatic transmissions, special differentials, power dividers, etc.

We have also been given access to the large library of data and films maintained by the American Public Works Association.

One of our major problems is that of adequate and proper lubrication. Several of the major oil companies have made available to us large amounts of both technical and practical data, together with illustrative charts and films, covering this complicated, but much neglected, subject. The matter of lubrication will be one of the first subjects to be offered the employees and we expect to obtain much indirect benefit from a better understanding of this problem.

Accumulating Record Library

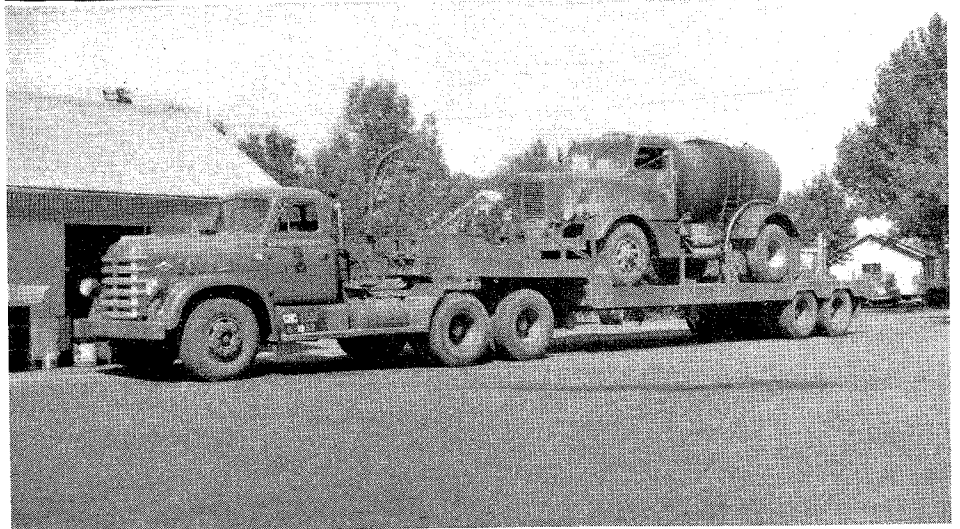
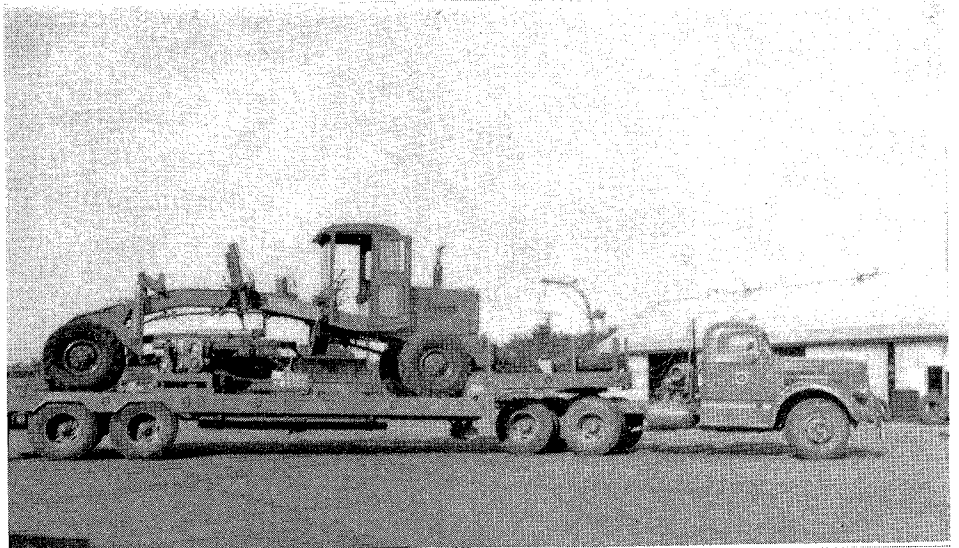
In addition to the data made available to us by outside firms, we are also planning on accumulating a library of practical and technical lectures on subjects by using our own recording devices. This will permit us to record and repeat valuable lectures by our own personnel, as well as those that may become available from technical meetings, and other like sources.

Our operations, which reach all far-flung corners and out of the way places in the State, make it impractical to bring the students in to a centralized location where proper facilities would be available. It therefore becomes necessary to literally take the school and instructors to them, and this is the premise upon which we are proceeding.

We plan on instituting some form of attendance records for those taking part in the classroom activities.

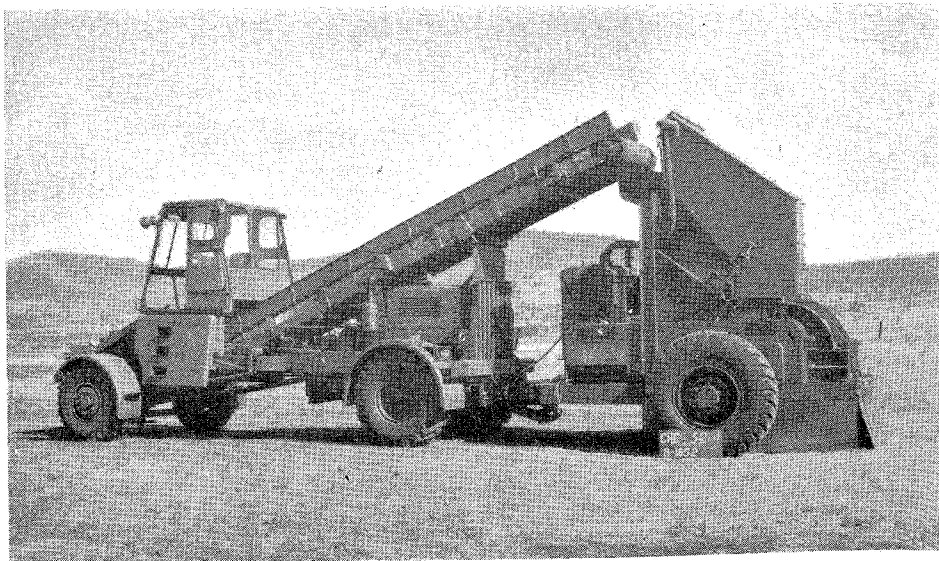
We hope by this method to see that the employee participating will receive proper credit and recognition for the interest shown.

A modern 35-foot classroom trailer has been constructed for us in Los Angeles. It is fitted with desk seats for some 18 trainees, and will be equipped with up-to-date audio-visual aids to assist the instructors.



Heavy truck-tractor and semi-trailer unit used in expediting movement of highway maintenance and emergency equipment

Self-propelled, self-feeding loader with portable crushing equipment. Used to reclaim road surfaces, using existing materials already in place.



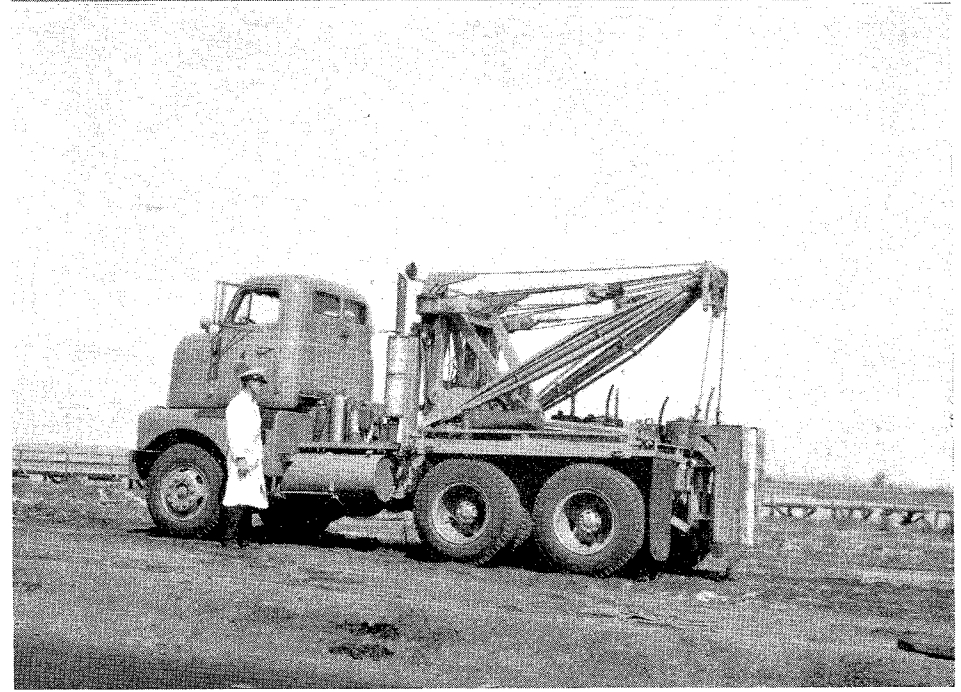
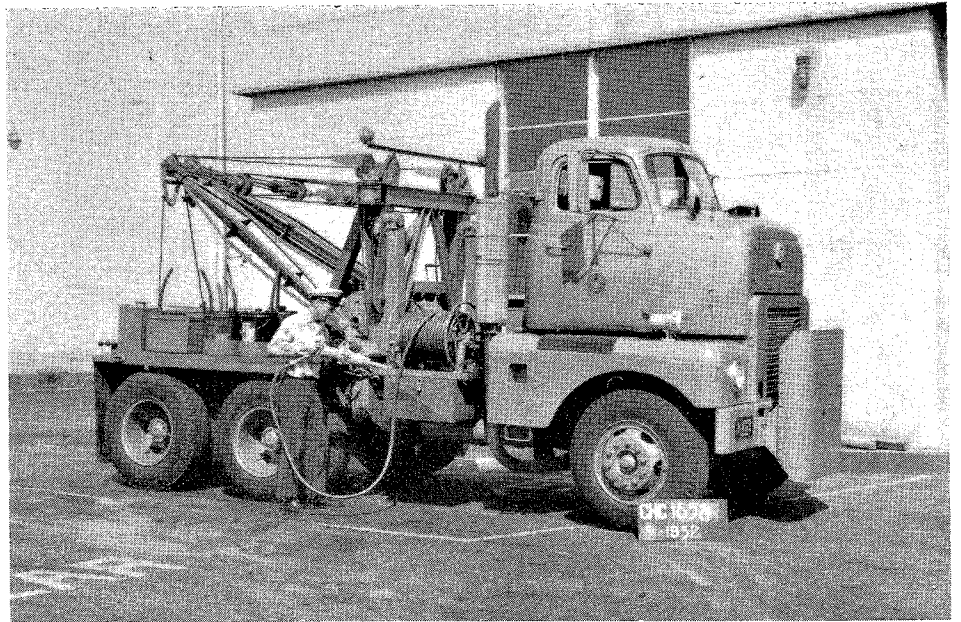
Uniform Basic Program

Tape recording and duplicating equipment will be supplied so that lessons, demonstrations by experts, and other instructing data can be prepared on the road as the need arises, and as the material becomes available. This will permit a uniform basic training program for state-wide use.

The discussion of the application of these various aids to the program will be of much interest to many, and as our experience and knowledge progresses will be made the subject of future articles in this publication. We make this statement, for undoubtedly the instructors and personnel presenting this program will be the recipients



Hydraulically-raised truck-mounted lift, used in maintaining high voltage freeway lighting systems



Fifteen ton wrecking truck used on San Francisco-Oakland Bay Bridge handles heaviest types of disabled trucks and trailers

of valuable information on techniques brought out by this method of operation.

In order that the program may be carried out, without hindrance by climate or weather, the school trailer is equipped with both heating and cooling facilities. It will be comfortable in cold climates as well as in the desert, this in recognition of the fact that good mental work cannot be

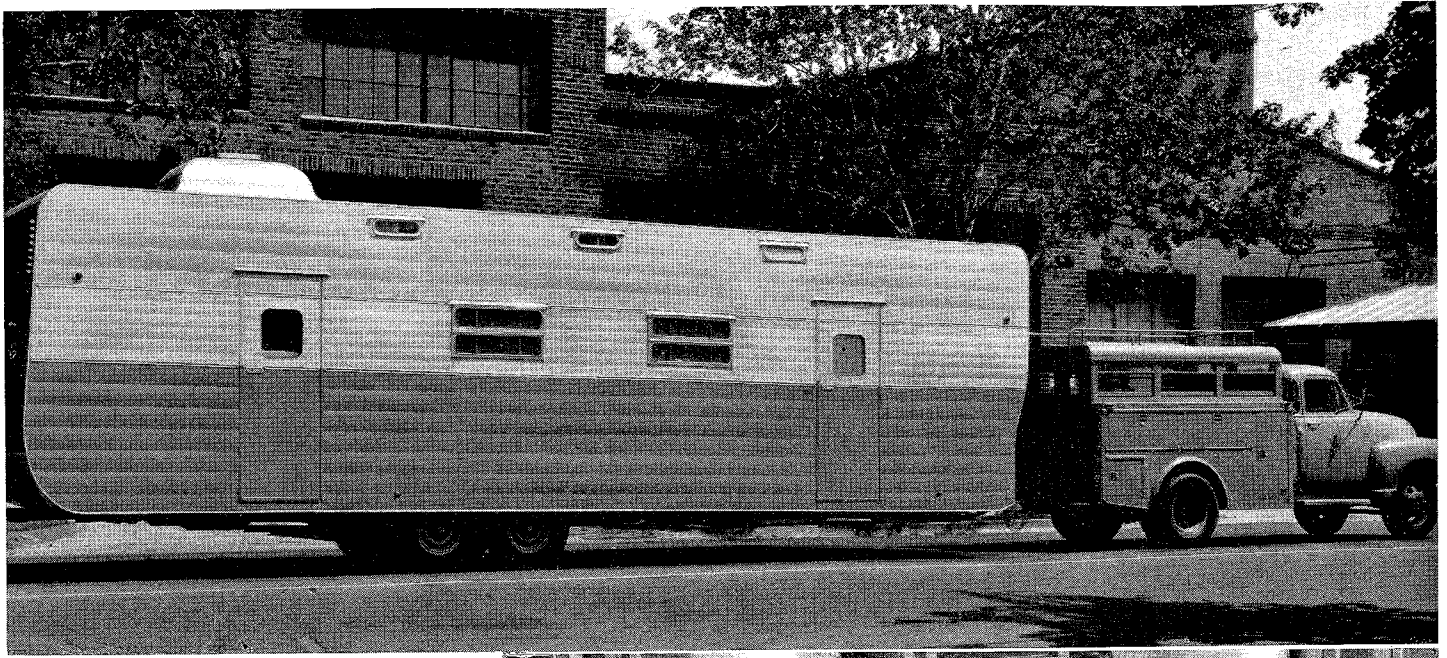
accomplished under uncomfortable physical conditions.

Truck and Trailer Unit

The trailer will be towed by a truck unit fitted with a special body equipped for safe storage of the complex and valuable equipment used. The towing unit will carry an ample-sized electric generating unit to provide electric current for operation where

public utility service is not available. It will also carry many mechanical and machine parts as well as subassemblies needed for illustrative lectures and for actual practical use in instructing.

It is planned that as the unit travels from one location to another, local talent competent to present some phases of specialized training will be uncovered and used to good advantage. Often problems are peculiar to certain



Exterior and interior photos of the school trailer mobile unit

locations and their solution is understood by some of our personnel. This information can then be broadly disseminated to other employees through the use of this traveling school system.

As previously mentioned we expect to present specialized features of this program from time to time through the medium of these pages. Illustrations will be used and, if practical, lectures of general interest to employees may be presented in their entirety.

FROM NEW JERSEY

STATE HIGHWAY DEPARTMENT
R. J. Abbott, Commissioner
Trenton 1

May 15, 1953

K. C. ADAMS, *Editor*

DEAR SIR: It has been my good fortune to occasionally secure a copy of your excellent publication. It is one of the most interesting and outstanding magazines of its type and I should appreciate it very much if I were placed on your mailing list.

Very truly yours,

STATE HIGHWAY DEPARTMENT
RALPH L. FISHER
Engineer of Design



NEW RADIO SET-UP

The new \$850,000 FM radio communication set-up recently completed by the State Division of Highways is already paying for itself with interest. Although the use of the system is dramatically spotlighted during storms and emergency periods, its real money-saving value lies in normal everyday use such as ordering materials and equipment.

MANY BRIDGES POSTED

At the end of the 1951-52 Fiscal Year, 116 state highway bridges were posted for restricted load or speed, according to the State Division of Highways. New construction during the year eliminated 11 posted bridges, but nine additional postings were made necessary by the continued deterioration of some of the remaining older spans.

Cajon Pass

Reconstruction of Historic Road From Trail to Expressway

By J. DEKEMA, Assistant District Engineer, District VIII

SPRING OF 1953 marks another milestone in the development of the historic Cajon Pass from the original trail to an expressway capable of carrying thousands of high speed automobiles daily.

The first white man to have used the pass is believed to have been Pedro Fages, military Governor of California in 1772. Governor Fages trailed a group of deserters from San Diego into the Colorado Desert, but instead of turning back he continued north along the San Jacinto Mountains and discovered the San Bernardino Valley. As far as can be ascertained, he left by way of the Cajon Pass and proceeded into the Southern San Joaquin Valley, finally arriving at the San Luis Obispo Mission.

Old Indian Trail

The old Indian trail followed by later Spanish explorers crossed the San Bernardino Mountains east of the Cajon Pass on the ridge between Devil and Cable Canyon through present day Cedar Springs, and followed the Mojave River into the desert. This was the route taken by the first American to push into San Bernardino from the east. In 1826, Jedediah Smith, guided by Mojave Indians from Needles, crossed the mountains and was welcomed at the San Bernardino Asistencia, although later jailed at San Gabriel Mission. Returning the following year with another expedition, Smith used the Cajon Pass. He was again welcomed at San Bernardino and jailed at San Gabriel. The Government of Mexico in those days took a dim view of any "invasion" by Americans.

After Smith's explorations, pack trains began to wind their way from Santa Fe, New Mexico, to Southern California. The route curved far north through Colorado and Utah, then south to Las Vegas, Nevada, Tecopa, Barstow, and the Cajon Pass.

One round trip a year was possible under the conditions encountered, the pack train leaving Santa Fe in the fall and returning in the spring.

Horse Thieves Active

With horses scarce and in demand in Colorado and New Mexico, it is little wonder that the vast unguarded horse herds of the California dons became the prey of organized horse-thieving expeditions in those days. The thieves used the Cajon Pass in general, but kept to the ridges and side canyons to avoid ambush. The "Horsethief Trail" has been traced through the mountains.

Mexican commerce through the pass was interrupted by the war with the United States in 1846. Soldiers of the Mormon Battalion leaving Southern California at the end of the war to return to their homes in Salt Lake

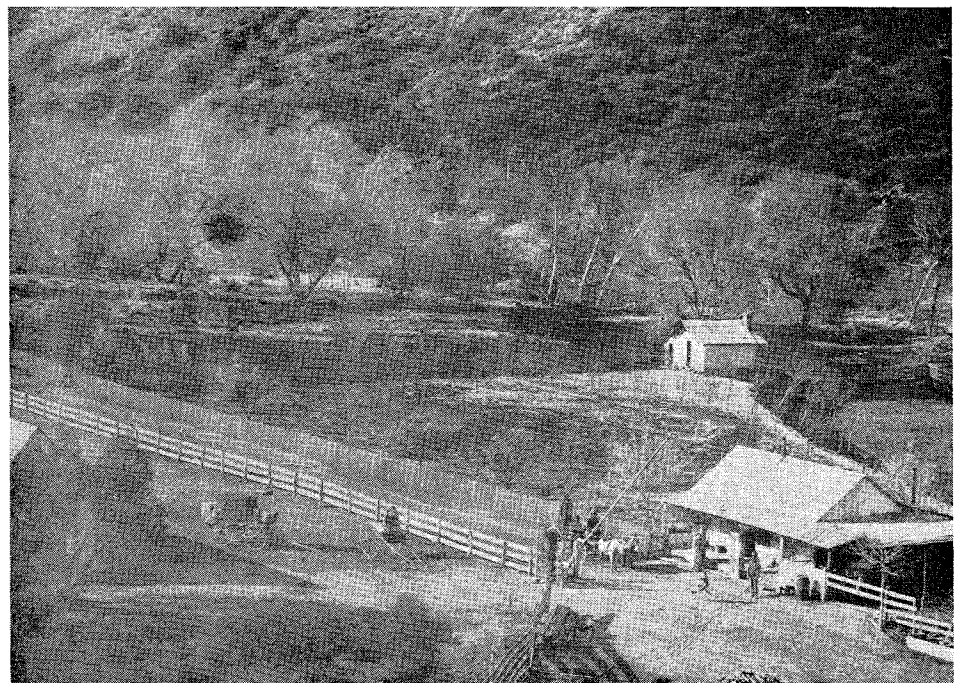
showed that the use of wheeled vehicles was possible through the pass and on into Utah. Thus, the trail gradually developed into a highway.

One of the largest caravans in the history of the West left Payson, Utah, on March 24, 1851. The difficult journey came to a successful end late in June, the pioneers establishing camp at Devore and nearby Sycamore Grove. In the fall of 1851, the Mormons founded the present City of San Bernardino.

Toll Road Built

In 1861, John Brown, Sr., built a toll road from Devore to the Cajon Pass Summit under a state franchise good for 20 years. Tolls ranged from 3 cents per head of sheep to \$1 for a wagon and pair of animals. The lower toll house was located at the Blue Cut, which marks the crossing of the pass

Scene showing the lower toll house just north of the Blue Cut on the Cajon Pass during the 1870's. The wagon and team of horses was charged a toll of \$1. Ordinarily, it would be necessary for two teams to be used for the ascent, in which case the toll would have been \$1.25.



by the great San Andreas Fault. The frequent washouts that plagued the road can be appreciated by modern maintenance men, but we wonder how our resourceful crews would respond to a repetition of the Indian attacks occurring in the early days of the road.

Railroads Compete

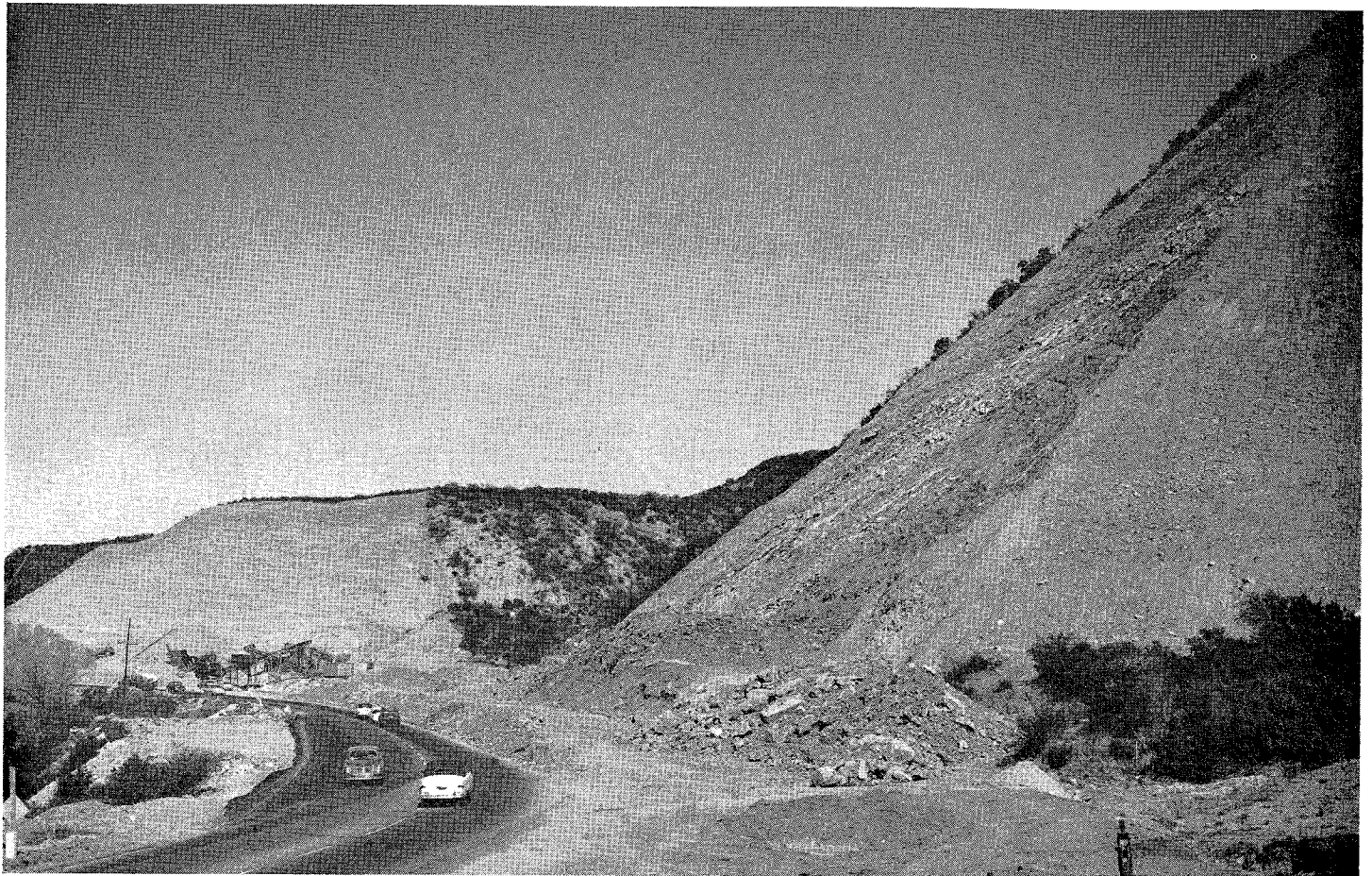
At about the time that the franchise on Brown's Turnpike expired and it became a county road, the railroads were engaged in a struggle to put

with the intention to extend its San Joaquin Valley Line to the east by way of Tehachapi, Cajon, and San Geronimo Passes, by-passing Los Angeles completely. Meanwhile, Santa Fe officials were informed of the lower pass through the East Cajon and under the name "California Southern Extension Railway," tracks were laid from San Bernardino to Barstow, causing the Southern Pacific to run its line to Los Angeles.

When descending the pass today in a matter of a few minutes seated in

at a cost in excess of \$2,100,000 is the southerly 9.3 miles of the pass between Devore and Gish Underpass about four miles south of the summit. About half of the old two lanes built in 1932 have been converted to use for one-way traffic, with two additional lanes constructed for traffic in the opposite direction. Four new lanes of pavement have been constructed for about five miles.

Resident Engineer J. B. MacDonald reports that the immense sand and



The contractor's aggregate production plant is shown in the left background. The entire bluff behind the plant is composed of millions of cubic yards of high quality gravel and sand.

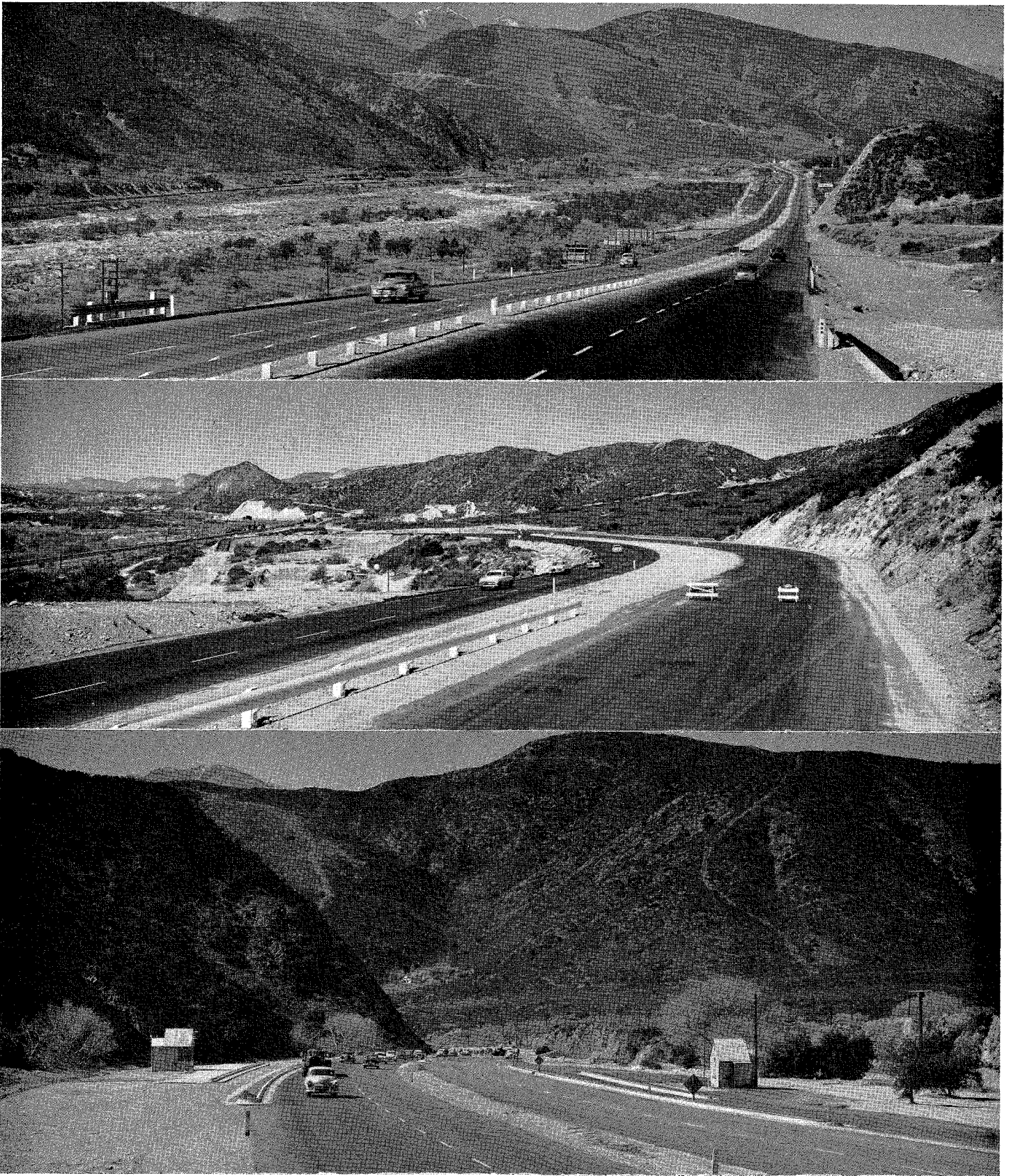
tracks through the pass. The Los Angeles and Independence Railroad fought off Southern Pacific forces with gun play on the West Cajon, thought at that time to be the only practical route over the pass. The Southern Pacific later bought the right to build through the Cajon when it took over the bankrupt Los Angeles and Independence Railroad,

comfort in automobile or train, it is difficult to realize the hardships of but a few years ago when it was necessary to dismantle wagons and lower them by ropes at the Narrows in the East Cajon.

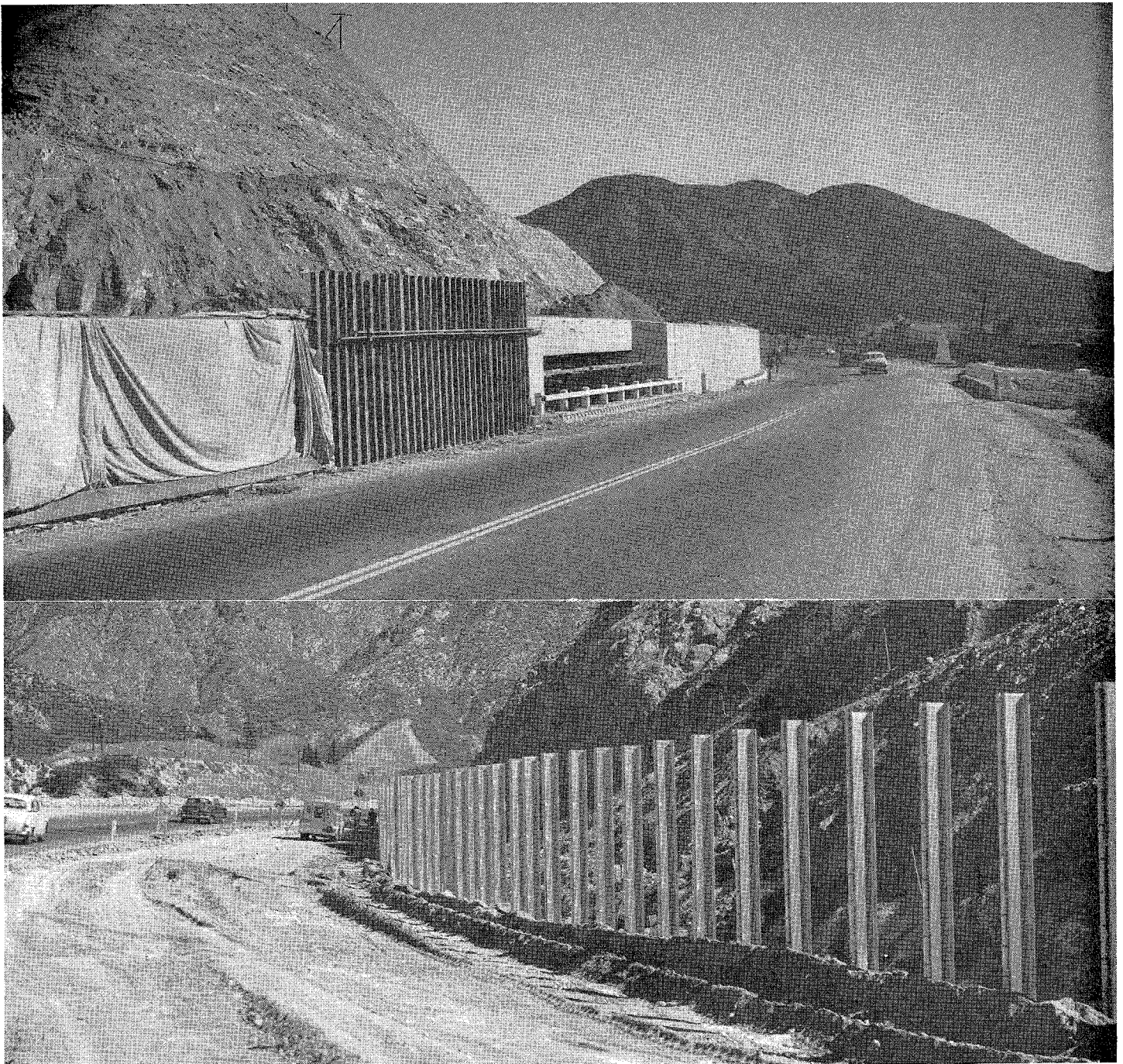
Two Million Dollar Contract

The highway contract now being completed by Fredericksen & Kasler

gravel deposit near Cleghorn Creek designated in the Special Provisions as the source for base material proved to be ideal not only for the base but for mineral aggregate in plant-mixed surfacing. R-values for the base material ranged from 76-81. No cement was used. Stability of the plant-mixed surfacing with 150-200 penetration paving asphalt was usually about 40.



UPPER—Typical view of completed construction, except for Class "C" seal coat. Iron Mountain and North Baldy silhouetted against sky line. CENTER—Looking uphill during construction one mile south of Cajon Station. Traffic has been diverted to the two new southbound lanes while the old road is being reconstructed to accommodate northbound traffic. Cajon Creek and the Santa Fe Railroad tracks on the left. LOWER—Truck scale installation adjacent to Blue Cut. Scale on right is the old 50-ton, 40-foot platform, while that on the left is of the new 15-ton, 10-foot single-axle platform type. This dual installation will permit weighing trucks without congesting through traffic.



UPPER—Looking south across East Fork of Cajon Creek (Horse Thief Canyon). In the right center can be seen the Mormon Trail Historical Monument. The existing road in foreground is to be used by southbound traffic. Northbound traffic will use the higher level road supported by the retaining wall shown under construction. A slide developed in the 120-foot high cut on the left during construction, and a bench had to be provided to stabilize the formation. LOWER—Construction scene at the well known Blue Cut approximately at the center of the contract. This marks the crossing of the main axis of the San Andreas Fault. H-columns in the foreground have been set in concrete foundations and together with chain link fencing to be fastened to them will serve as a debris fence to stop rocks from rolling onto pavement.

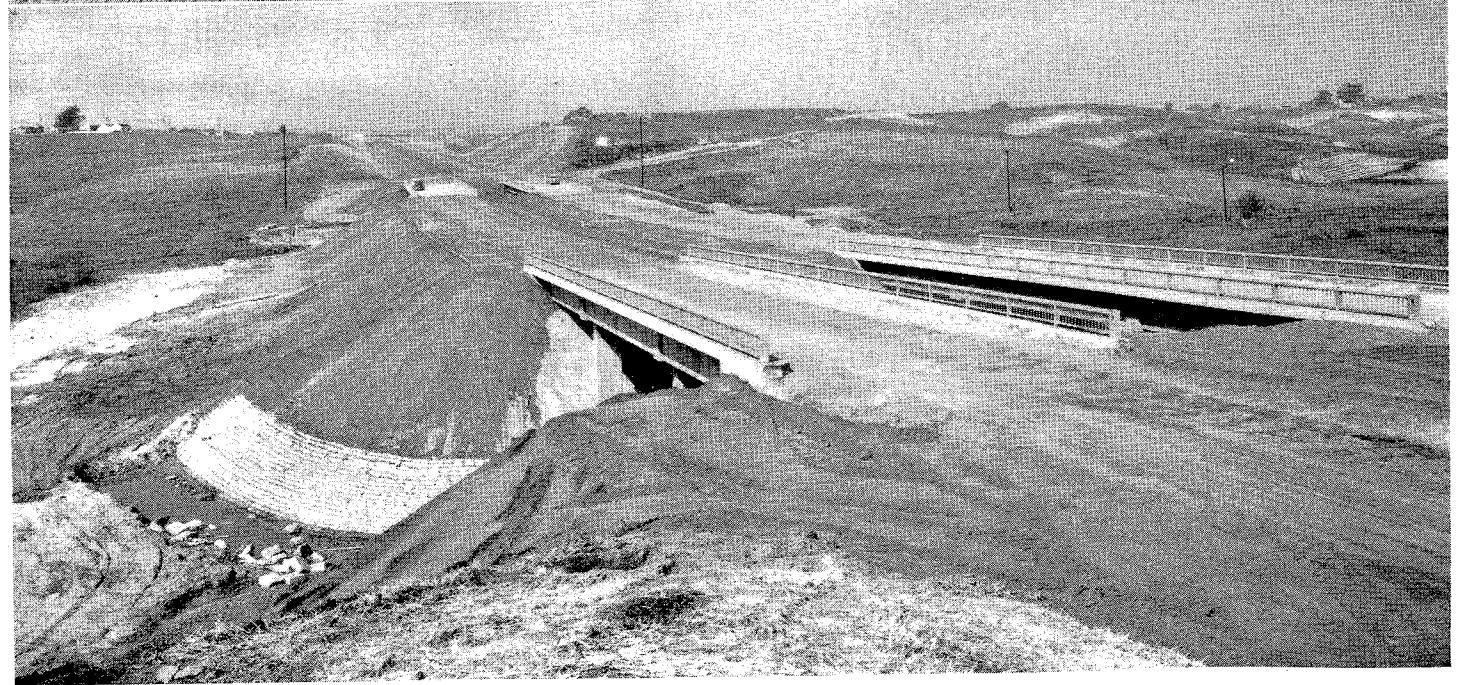
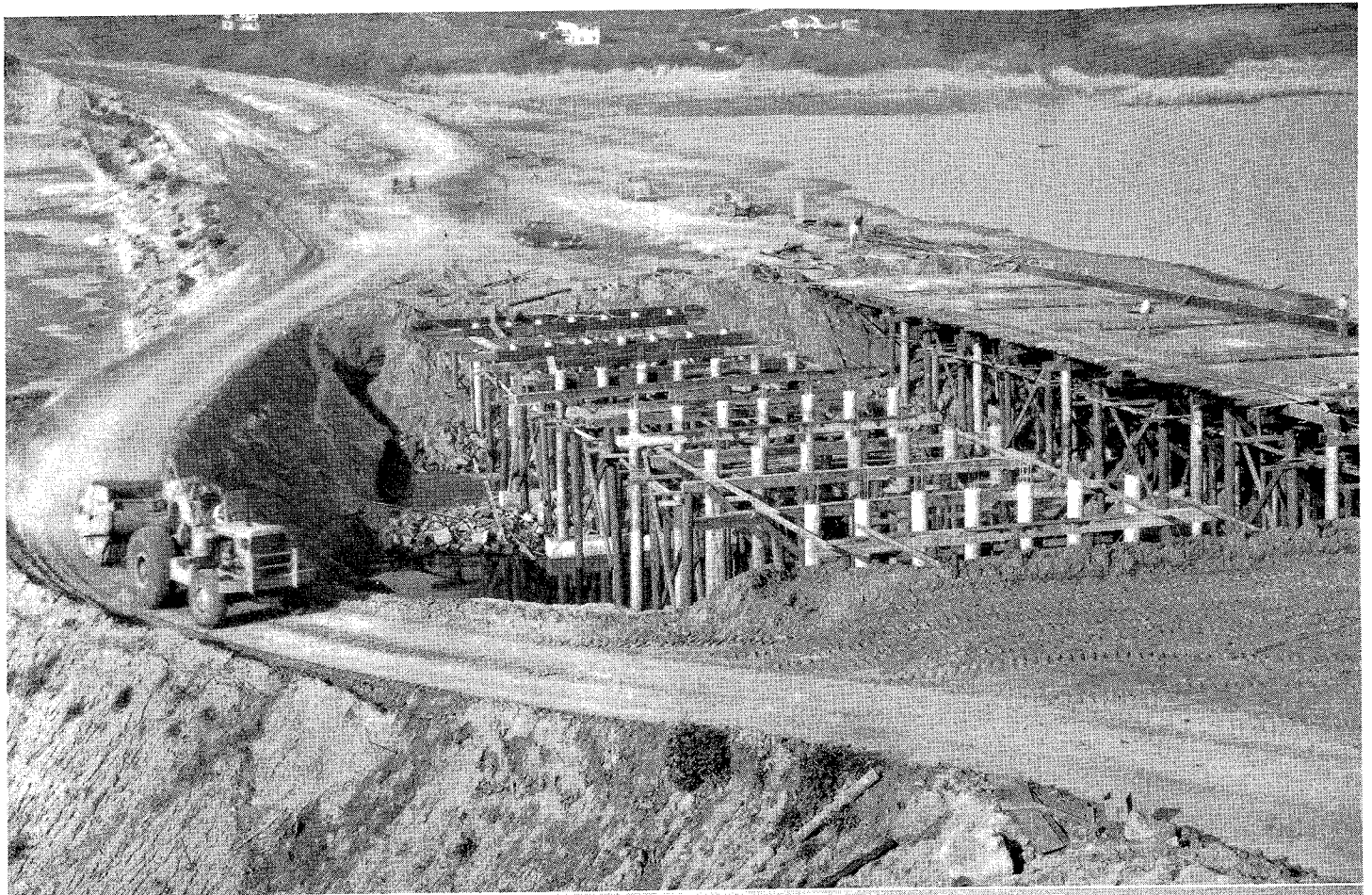
Slides Cause Trouble

Because of previous experience at the Blue Cut, present construction was around the critical area. It was years after the first big cut was made here before the slopes stabilized. Initial construction at this location in

1931-1932 was during a severe winter and an enormous slide occurred involving 100,000 cubic yards, completely blocking the new road, as well as the existing one. It became necessary to bridge Cajon Creek temporarily and route traffic over an old

trail through a cattlepass under the railroad on the opposite side of the canyon and on for two miles to Cajon Station to a connection with the existing road. About 1937, a rock wall was built to catch rolling boulders and

... Continued on page 60



UPPER—Bridges and fill at Agua Hedionda. LOWER—Bridges and fill at Loma Alta Creek.

of silt and mud from incoming streams. The area is covered with water approximately three feet deep for the

greater part of the year. At the freeway crossing, the depth of the unsuitable material varied from two feet

to seven feet and it overlaid a deposit of fine sand of undetermined depth.



UPPER—Storm drain construction. LOWER—Fill and structures at Buena Vista.

This fill contained about 191,000 cubic yards and was 1,100 feet in length and varied from 17 feet to 28 feet in height. A reinforced concrete slab bridge consists of two parallel structures, 150 feet from the south bank of the slough.

The unsuitable material was removed with draglines working from the fill as it progressed. The fill was maintained about five feet above the water level in order to support the equipment. Selected granular material was also required here to an elevation five feet above the existing ground line. After the fill was brought to rough grade, a surcharge five feet thick was placed on the portion of the fill between the south bank of the slough and the bridge. This was done in anticipation that the additional weight would accelerate the settling of this portion of the fill which was placed several months later than the northerly portion.

Loma Alta Slough

The slough at Loma Alta is considerably higher than the other two. The existing ground was dry enough to support heavy equipment and was being used as pasture land before the freeway was constructed. The 111,000-cubic-yard fill at this location was about 600 feet long and varied from 37 feet to 42 feet in height. The underlying material was composed of alternate layers of fine sand and clay, each layer being approximately two feet thick. The south end of the fill terminates in a bridge and the north end in a railroad overhead.

The contractor was able to remove the unsuitable material to an approximate depth of four feet with bulldozers. The resulting space was filled to five feet above the existing ground with a selected granular material, before constructing the embankment.

Variable Foundations

After considering the variable foundation conditions at the three sloughs, it was decided that control points should be placed to determine the amount of settlement. Metal plates with an area of approximately five square feet were installed at an elevation about two feet above the bottom of the fill. A three-quarter-inch coupling was welded to the plate to provide

means of attaching three-foot lengths of pipe to the plate as the fill progressed. The plates were placed in the center dividing strips at approximately 200-foot intervals. Levels were run each time it became necessary to add pipe and at regular intervals thereafter.

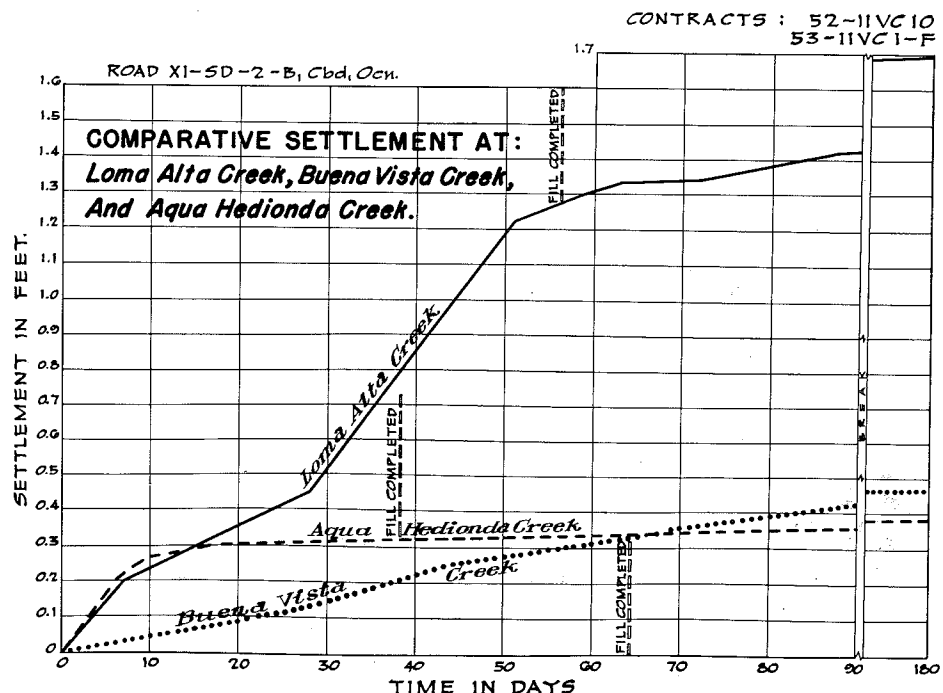
After plotting the amount of settlement against time, it was determined that very little settlement took place at Agua Hedionda or Buena Vista after the initial load was placed. At Loma Alta, settlement did continue for a longer period, reaching stability after about six months. This was probably due to movement of the underlying clay strata and to the greater fill height. All three fills have ceased to show measurable settlement in recent months.

It was anticipated that the driving of bridge piles and hauling heavy loads over the fill would accelerate settlement, but the tests run did not bear out this assumption. Due to the limited amount of surcharge work performed, results regarding acceleration of settlement were inconclusive. The accompanying chart shows the rate of settlement of a typical control point at each slough. The chart shows that the total subsidence since the start of embankment operations has been 0.4 foot for Agua Hedionda, 0.5 foot for Buena Vista and 1.7 feet for Loma Alta.

Subsurface Water

Another interesting problem was the subsurface water encountered at several locations in the Carlsbad area. As the freeway cuts were opened up, a water-bearing stratum was found from 5 to 15 feet below the surface of the original ground. The heaviest flow was found in the area just north of the Tamarack overcrossing. Here the water was evidently pocketed and under pressure, for when the excavation was first made, it flowed quite freely for several hours and from all directions, then gradually diminished to a steady flow from the northeast. The installation of perforated metal pipe backfilled with rock filter material effectively controlled the water at this location. However, when the trench for the storm drain, down the centerline of the freeway, was excavated in the same general area, additional seepage water was found coming from seams in the heavy sandy clay. As this elevation was approximately four feet below subgrade, the only remedial measure taken was to lay the reinforced concrete pipe with open joints and back fill with filter material where seepage was found. This arrangement functioned well and no indications of wet subgrade were found.

... Continued on page 42



EXAMPLE OF USE OF ANALYSIS OF VARIANCE IN INVESTIGATION OF SOME PROPERTIES OF PORTLAND CEMENT CONCRETE

By W. E. HASKELL, Associate Materials and Research Engineer

ONE OF THE fundamental problems in research on structural materials is that of measuring the effect of one or more variables factors on some physical property of the material under investigation. Theoretically the solution is very simple. It is only necessary to make a series of experiments in which some of the factors are held constant, while the others are varied over the range desired; and to measure the effect of the variables with apparatus which will detect the magnitude of the changes quantitatively and without ambiguity.

Unfortunately this theoretical ideal is never realized in actual practice. No human being can fabricate or test a specimen in identically the same manner at all times, no apparatus is completely reliable, and no factor can be held precisely constant. Since this is so, investigators must be reconciled to the hard fact that absolute precision and accuracy are both impossible of attainment. In consequence it is often observed that when the effects of variables are small, measurement data become confusing, inclusive, or uncertain, unless a method can be found by means of which the reliability of the results can be ascertained, and a valid interpretation made.

Analysis of Variance

There is a method, or statistical technique, which will do this. It is called the "analysis of variance" and was largely developed by R. A. Fisher and his colleagues at the Rothamsted Experiment Station in England. It is of comparatively recent origin, and has been extensively used in biological, agricultural and medical research. In some fields of research it has not been used as frequently as its usefulness warrants, and one of these fields is that of portland cement concrete investigation.

In this paper, an outline of the use of this valuable mathematical tool will

be given by means of an actual example.

In common with all other structural materials, portland cement concrete will exhibit volume changes under certain conditions. One of the factors which will produce volume change is the absorption or loss of water from the concrete specimen or structure. If water is driven off by heat or a low relative humidity, the concrete will shrink. If water is absorbed, the concrete will expand. The magnitude of these volume changes are small, but are of considerable practical importance; and ways and means of minimizing these changes are always being sought by concrete technologists and engineers.

A Good Example

A part of a recent study of the volume change of concrete as effected by the addition of varying percentages of hydrated lime, affords a good example of how the analysis of variance may be employed.

In this study, test bars of portland cement concrete were fabricated and the length changes were measured when the bars had been moist cured for three days and then dried for seven days. The second measurement was made when the bars had been immersed in water for seven days, and the drying, immersion, and measurements were then alternately repeated.

The first or initial drying shrinkage is an effect of one or more variables, as is also the average change in length between the wet and dry condition, over four full cycles of wetting and drying. This latter change is known

as the "moisture movement." Measurements of the initial water loss, and the corresponding water moisture movement were also made.

Series of Experiments

This series of experiments was also designed to observe the effects of two other variables in addition to the variable of added hydrated lime; namely, two types of portland cement, and three different cement contents of three, four and five sacks of cement per cubic yard of concrete. Hence there are seven possible factors which might or might not produce assignable causes of variation in the results. They are:

1. Differences between the three cement contents.
2. Differences between the two cement types.
3. Differences between the cement contents and cement types.
4. Differences between the amounts of added hydrated lime.
5. Differences between the hydrated lime content and the cement content.
6. Differences between the hydrated lime content and the cement type.
7. The residual or random test variability.

The investigator's problem is to decide upon the basis of the test measurements, which, if any of these factors are significant, and if possible, how significant.

Table No. 1 is a part of the measurement data obtained from the experiments and shows the initial drying shrinkage length changes of the test specimens, reported as a percent of their length at the three-day period.

TABLE No. 1

Type of cement	Amount of cement sacks per cubic yard	Percent of hydrated lime		
		0	5	10
I	3	-0.024	-0.020	-0.024
	4	-0.028	-0.022	-0.023
	5	-0.036	-0.031	-0.026
II	3	-0.019	-0.016	-0.016
	4	-0.022	-0.026	-0.027
	5	-0.030	-0.030	-0.034

TABLE No. 2
The Analysis of Variance of the Measurements Shown in Table No. 1

Item	Source of variance	Degrees of freedom	Sums of squares	Mean squares
1	Between cement contents	2	0.000388	0.000194
2	Between cement types	1	0.000011	0.000011
3	Cement contents x cement types	2	0.000038	0.000019
4	Between lime contents	2	0.000017	0.000009
5	Lime contents x cement contents	4	0.000007	0.000002
6	Lime contents x cement types	2	0.000040	0.000020
7	Residual variance	4	0.000048	0.000012
Totals		17	0.000549	

Systematic Procedure

It is at once apparent that all of the possible real differences in these measurement values can only be revealed by means of a systematic procedure, and that some sort of a criteria or test of their reliability is essential. Both the procedure and the criteria are provided by the analysis of variance.

In brief, the analysis of variance is a mathematical operation by which the original more or less cloudy and obscure test results are transformed into a new set of values, each of which is associated with one of the seven possible causes of variation. These new values are mean squares of residuals. It is not necessary for an understanding of the paper to describe how the mean squares are computed, but these values and some others, are then arranged into a table such as that in *Table No. 2* which is the transformation of the values in *Table No. 1* arranged with respect to all of the possible variations.

The column headed "mean squares" contains the new transformed values that are associated with the causes of variation listed in the column headed "source of variance."

New Values Tested

It is now necessary to test these new values for significance by comparing them with the criteria provided by the variance analysis method. This criteria is known as Fisher's Variance Ratio (F), and is obtained by dividing the mean squares of all of the items from 1 to 6 by the mean square of Item 7, the residual variance. Testing items 3, 5, and 6 in this manner results in variance ratios of 1.58, 0.58, and 1.67.

In developing his analysis of variance, Fisher was able to calculate the distribution of the variance ratios for

all degrees of freedom, at several levels of probability, and to collect these values in a table. In comparing a variance ratio obtained from experimental data, with the variance ratios in Fisher's table, the investigator first makes an assumption called a null hypothesis. Knowing that all experimental work is subject to random or unassignable causes of variation, the investigator now tentatively assumes that all of the observed variations are random ones, and that no real differences exist in his experimental results. The probability of the validity of this assumption can then be tested by reference to Fisher's tables.

Values in Fisher's Tables

The values in Fisher's tables corresponding to the degrees of freedom for Items No. 3, 4 and 5 are:

	5%	1%
For Item No. 3	6.94	18.00
For Item No. 5	6.39	15.99
For Item No. 6	6.94	18.00

The probabilities of 5 percent and 1 percent are termed "Levels of significance." In the case of Item No. 3 the specific meaning of the figures is that there is a probability of 5 in 100 or 1 in 20 that a variance ratio as high as 6.94 could be obtained if nothing but random or unassignable causes were responsible for the observed variations, and that there is a probability of 1 in 100 that a figure as high as

18.00 could occur as a result of random or chance causes. If the values of the variance ratios obtained are greater than those given in Fisher's table for the corresponding degrees of freedom, then the results would be more significant than the significance level in the table, and if lower, less significant.

Since in the above example, the calculated variance ratios are so much smaller than the ratios for the tabulated levels of significance, the investigator is justified in holding that his null hypothesis is valid, and that the three variables listed are of no significance. The mean squares for these items are therefor pooled with the residual mean squares, resulting in *Table No. 3* as shown below.

The calculated variance ratios (F) in *Table No. 3* for the remaining assignable causes of variation are obtained in the same way as heretofore, and are shown in column No. 5. Columns No. 6 and No. 7 show the corresponding ratios from Fisher's tables. From these results the investigator may now state with a very high degree of probability of being right, that the only assignable cause for the variations in the measurements of the initial drying shrinkage is due to the variable cement contents of the several concrete specimens. Neither the cement types nor the hydrated lime contents are significant so far as initial drying shrinkage is concerned.

It was stated in an earlier paragraph, that in addition to the initial length changes, other measurements were made. The variance ratios for these measurements were also computed and the results are shown in *Table No. 4*.

By means of the analysis of variance, the measurement data from *Table No. 1* and three more tables of equal size, have now been condensed in *Table No. 4*. Every figure in this table

TABLE No. 3
Analysis of Variance With Nonsignificant Interactions Pooled With the Residual Variance

Source of variance	Degrees of freedom	Sums of squares	Mean squares	Calculated F	F, from Fisher's tables	
					5%	1%
Between cement contents	2	0.000388	0.000194	17.64	3.88	6.93
Between cement types	1	0.000011	0.000011	1.00	4.75	9.33
Between lime contents	2	0.000017	0.000009	0.82	3.88	6.93
Residual	12	0.000133	0.000011			
Totals	17	0.000549				

TABLE No. 4
Variance Ratios of Several Properties of Portland Cement Concrete

Source of variance	Initial drying shrinkage	Variance ratios (F)				Fisheries (F)	
		Moisture movement	Initial water loss	Water moisture movement	5%	1%	
Between cement contents.....	17.64	2.50	15.73	37.47	3.88	6.93	
Between cement types.....	1.00	30.50	3.45	13.59	4.75	9.33	
Between lime contents.....	0.82	1.50	3.53	2.01	3.88	6.93	

is meaningful and without ambiguity. All of the information provided by the experimental work with respect to the effect of the variable factors has been removed from the zone of conjecture or opinion and placed in the category of a probability.

A "probability" expressed as a number, is essentially different from the best kind of guess or conjecture. It has a specific meaning. A calculated probability is actual knowledge, not a belief, an opinion, or a hypothesis. It is the relationship of a conclusion and the evidence upon which the conclusion is based.

Calculated Variance Ratio

In *Table No. 4* the figure of 17.64 is the calculated variance ratio between cement contents based on the experimental data. The figure 6.93 is the corresponding 1 percent level of significance figure from Fisher's tables. Referring to these figures it can be stated that there is only a probability of 1 percent or one chance in 100 that a variance ratio greater than 6.93 would be obtained in the experiments purely as a result of chance or unassignable causes. The calculated variance ratio of 17.64 is associated with the "between cement contents" of the experiment and is much larger than the tabulated variance ratio of 6.93.

Hence a null hypothesis stating that different cement contents produce *no* effect on drying shrinkage is invalidated by the calculated variance ratio.

The basic installation of the new high-frequency FM radio system has been completed in all 11 state highway districts as well as on the San Francisco-Oakland Bay Bridge, according to the California Division of Highways. There are now in operation throughout the State, 75 base stations, 27 control stations, 28 fixed relay stations and 550 radio-equipped cars and trucks.

This invalidation of the null hypothesis is equivalent to a statement of the converse hypothesis—that the different cement contents *do* produce an effect on drying shrinkage—and this assertion is confirmed by the large variance ratio. For all practical purposes this high probability might well be called a certainty. It is the final conclusion that can be drawn from the data.

When a variance ratio is either very high or very low, the conclusions are easily made. In the event of an inconclusive ratio, the investigator must repeat the experimental work or devise improvements in his experimental technique. In any case the analysis of variance is the most rational method that can be used in interpreting experimental data.

The statistical approach is particularly satisfying to the engineer inasmuch as it permits the condensation of a great deal of measurement data into a few unequivocal indices, and eliminates the inherent uncertainties of experimental work insofar as they can be eliminated.

In recent years there has been a steady increase in the use of all kinds of statistical methodology in widely dissimilar fields. In the field of portland cement concrete studies, it would seem safe to predict that some of these techniques, including the analysis of variance will play an increasingly important role.

During the 1951-52 Fiscal Year the Pavement Section of the Materials and Research Department in the Division of Highways has performed a total of 88,000 individual tests on 9,700 samples of highway material. During the same period the Chemical Laboratory made some 20,000 tests on 25 different kinds of material including nearly 19,000,000 pounds of corrugated metal pipe.

Salute to Road Workers

"ROADWORK. Speed Limit 25 Miles." How often have motorists maligned the maintenance men who set out signs with that legend along the highways! And on some occasions it must be admitted their complaints are justified—the signs are placed an unnecessarily long distance from the work, or are left up while workers attend to other duties. There is reason for impatience in such cases.

Yet no better friends of those who drive are to be found anywhere than these same maintenance men.

Highways are never really finished. No sooner are they opened than the work of upkeep must begin. There are always wear and tear, wind and weather, plantings to be made and signs to be replaced.

The maintenance men are the ones who perform this unending task. They operate the snowplows, clear the debris-choked drains, remove the slides and set up the warnings. To them, as the records will show, hours mean little when a road must be kept clear of snow, or reopened after a blizzard.

Perhaps you've seen them out with flags and lanterns in the rain to caution you of a slide ahead, or floodwater on a road, a bridge out or a detour too new to be identified by a sign.

So next time you see a "road work" sign, even if it seems unnecessary, do not become impatient with the maintenance men. Round the clock and round the year, they do a lot to make the highways safer and more convenient for you and your family—*Motorland, May, 1953.*

A total of 30,703,245 vehicles crossed the San Francisco-Oakland Bay Bridge during the 1951-52 Fiscal Year to establish a new record for vehicular traffic over the bridge, the recent Annual Report of the State Division of Highways reveals. The new record represents a gain of nearly 3½ percent over the 29,672,520 of the preceding year. Average daily traffic for the year was 83,889.

Dunsmuir to

By F. E. BAXTER
Assistant District Engineer

*Work Goes Forward
After Winter Shutdown*

Big Canyon

THE SEPTEMBER-OCTOBER, 1951, issue of the *Highways and Public Works* magazine included an article entitled "Footpaths to Freeway" in which future plans for the improvement of U. S. 99 in Siskiyou County were discussed.

Since that time, the first unit of this work has been undertaken with the awarding to A. Teichert & Son, Sacramento, of a contract for the grading and paving of 4.3 miles of highway between Dunsmuir and Big Canyon (II-Sis-3-A), Contract 53-2TC2-F).

The early road builders in this area who, in 1860, first developed a stage road from Yreka in northern Siskiyou County to Upper Soda Springs,

which lies within the limits of the present project, undoubtedly encountered many of the same problems which are prevalent today in endeavoring to construct this modern freeway-type of roadway through this historic area wherein are found many springs and watering places which in earlier times helped to make this area function as a rendezvous for the Hudson Bay Company trappers and the Indians of the area.

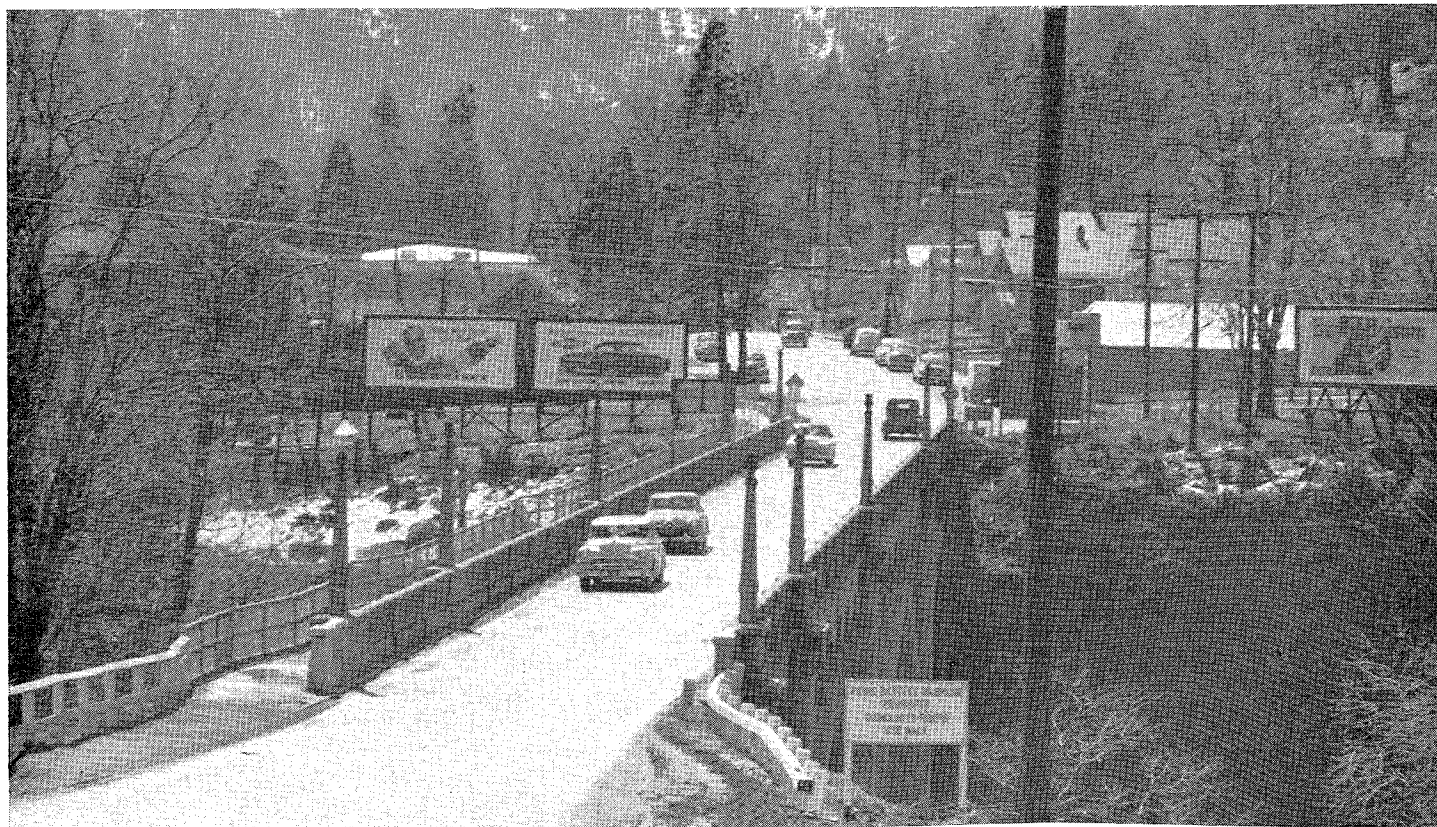
Winter Shutdown

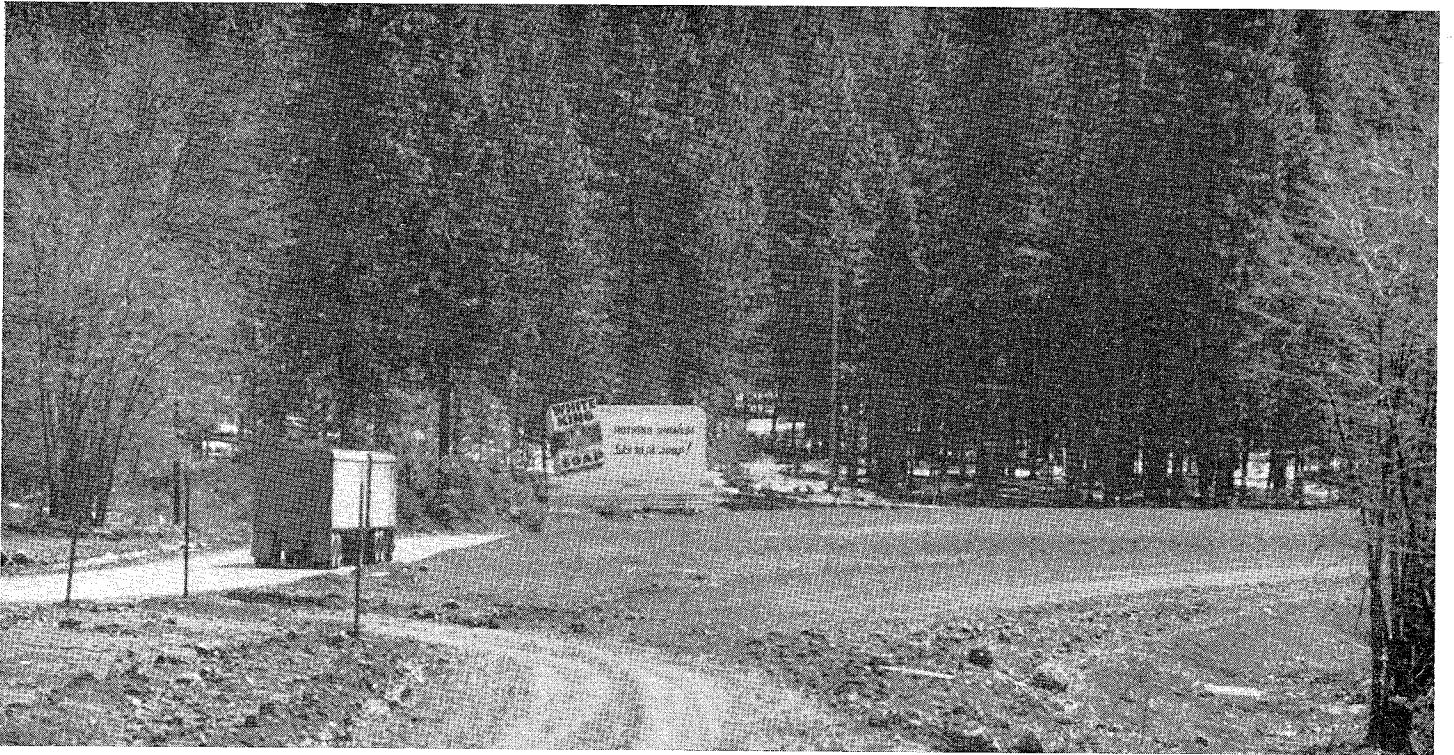
The contractor has diligently pursued the grading work on this project. The work started on May 13, 1952, and the bulldozers and scrapers and

shovels were hard at it until inclement winter weather forced a shutdown of all operations in the early part of December of 1952. The construction of drainage structures and the grading occupied the major effort during this period.

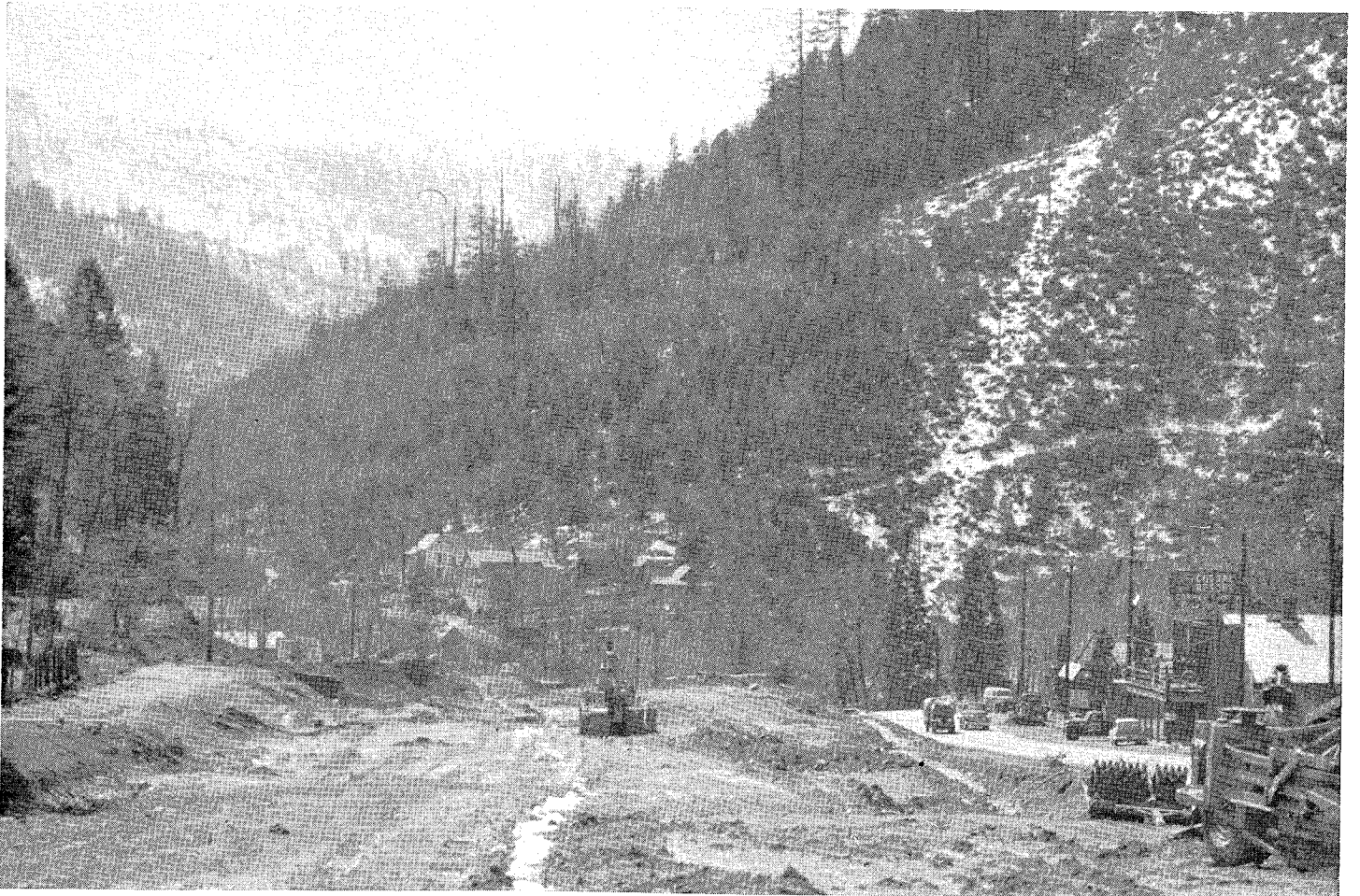
Many seepages and springs were uncovered as the work progressed. In several instances the design slopes of the cuts were found to be too steep to withstand the wet conditions which prevailed after the cuts had been opened and the springs were uncovered. Many feet of cut slopes had to be laid back to a flatter slope (a 1: 1 slope was flattened to 3: 1 in one instance) and hundreds of feet of addi-

View of present Sacramento River Bridge at north entrance to Dunsmuir





UPPER—Partially completed grade. New construction will eliminate present road at left. LOWER—Partially completed grade. Dunsmuir in background.



tional perforated metal pipe drains were used to drain the encountered water from fill and cut areas.

Slides Interfere

Slides resulting from springs and water saturation of soil have caused an approximate 25 percent increase in roadway quantities and an approximate 100 percent increase in the use of perforated metal pipe drains.

During the winter shutdown, on January 8th and 9th of 1953 a warm rain succeeded in melting a two-foot depth of snow pack on the surrounding area. The resultant concentrated runoff caused the flooding of the parallel existing highway in four different places and resulted in washing out many of the partially completed drainage facilities. However, the con-

tractor's forces, with the help of the state maintenance crews, succeeded in diverting this water before serious damage to the roadbed or adjacent residences could result.

Completion This Fall

Work was resumed on the project after the winter shutdown in the early part of April and it is expected the job will be completed in the fall. Surfacing will consist of a bituminous plant mix over a cement-treated base course.

A. H. Bauer is superintendent for the contractor and R. J. Wilson is the State's Resident Engineer under J. W. Trask, District Engineer.

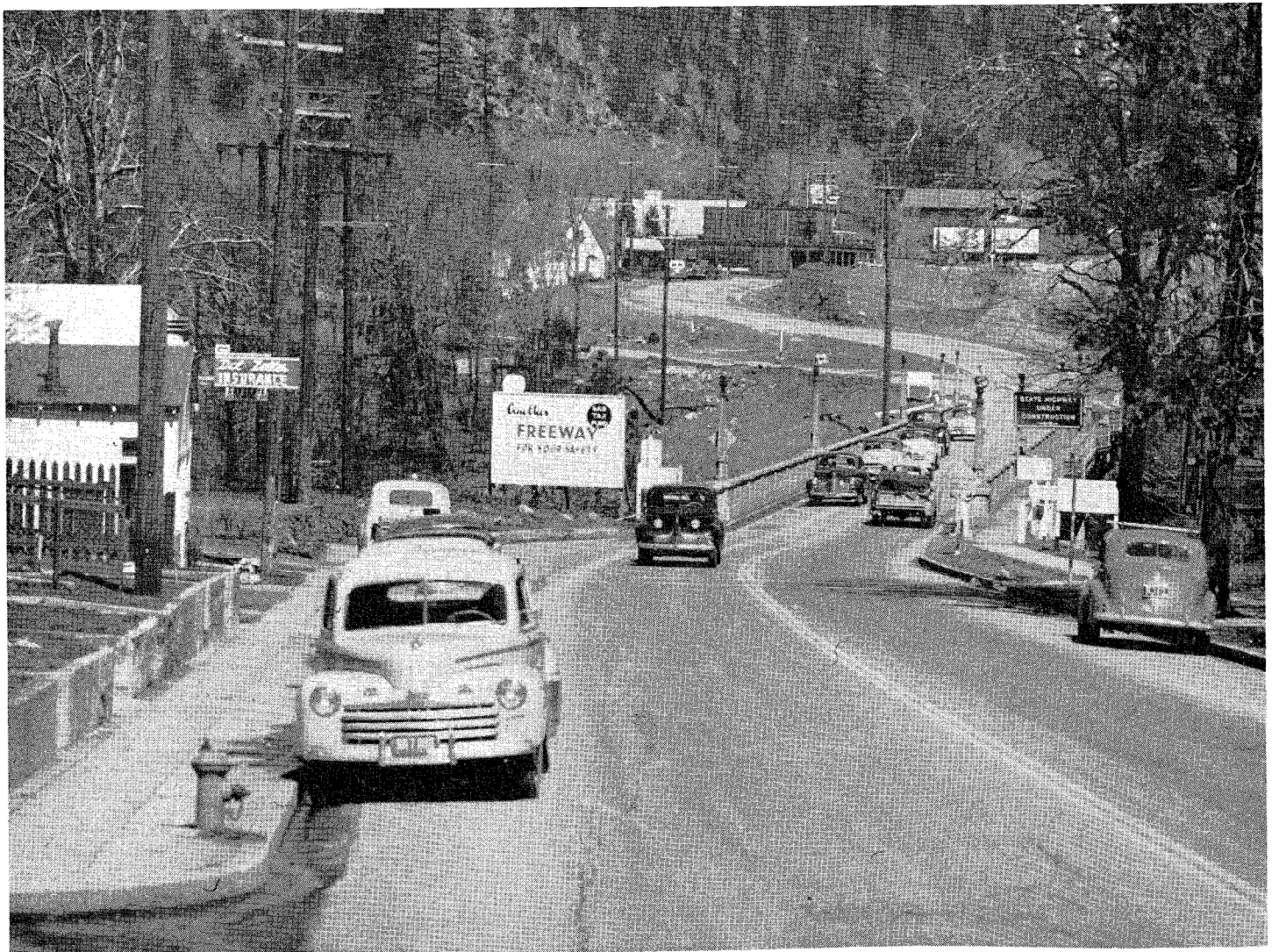
The next step in the development of this historic highway to present-day standards will be the widening of the Sacramento River Bridge at the south

limits of the present grading and surfacing contract and the construction of the south approach to the bridge from Spring Street in the City of Dunsmuir. The bridge is to be widened by the construction of a new span on the upstream side of the present bridge and the deck of the existing bridge will be double-decked to raise the grade approximately two feet to meet the grade of the new span and the new approaches, thus improving the grade rate for the whole project.

Plans for the new bridge and approach work are now complete and the work is to be advertised in the near future.

As can be observed from the accompanying photographs, the need for more roadway capacity at the north entrance to Dunsmuir is very obvious.

Congested condition at Sacramento River Bridge. New grade can be seen in the right background.



An Explanation

*Why Maintenance Work
Must Be Done in Summer*

THOSE state maintenance crews and their equipment which you encounter along the highways and which sometimes hold you up from getting to your favorite recreation spot on schedule are not placed there by the Division of Highways to make it tough for you.

They, like you, are the victims of circumstance, for the old saying that oil and water don't mix was never truer than in the case of maintaining the more than 14,000 miles of state highways in California.

It's a sad but inescapable fact that highway repairs cannot be accomplished during cold, wet weather.

And to California's 5,700,000 licensed drivers, this means that on many stretches of highway, the three- or four-month period when vacation travel is at its peak, is the only time when the state crews can repair last winter's damage and keep the highway in shape for use.

Summer Work Extensive

Each year, some 2,000 miles of road repair work must be done during the summer months.

Except for emergency situations, a road resurfaced during cold, damp weather is money down the drain. Without warm temperatures and drying sun, road materials will not fuse properly and will go to pieces in short order under heavy and fast moving traffic.

A large portion of the Division of Highways' woes occur in the northern part of the State, where an increasing number of heavy trucks must use highways designed and built for traffic of 20 years ago. Add to this heavy rainfall and snows, plus freezing and thawing action, and a situation develops that would be tough on even a modern road. To keep these roads from breaking up completely a lot of work must be done on them during the vacation season.

And where 10 years ago a 15-minute delay on a typical mountain highway might stop a dozen cars, it is not infrequent for such a delay now to hold

up many more. After all, California has nearly doubled its motor vehicle registration in the last decade.

Tough Job Last Year

The weather has not always been cooperative, either. During the 12 months between July 1, 1951, and June 30th of last year the division's Maintenance Department experienced one of the most difficult years in its history. This was partly due to the increasing traffic, but the main stress came from meeting the many emergencies caused by one of the longest and severest winter seasons on record.

ROADSIDE CLEANUP CAMPAIGN LAUNCHED

CALIFORNIA'S roadsides will be free of paper, bottles and cans this summer, provided the public will practice the same good housekeeping in its cars as it does at home, according to the Travel and Recreation Committee of the State Chamber of Commerce.

Meeting in San Francisco, representatives of the California Federation of Women's Clubs, Congress of Parents and Teachers, California Garden Clubs, California Roadside Council, Boy Scouts of America, and business interests whose containers are thrown from passing cars perfected plans to "Keep Our Roadsides Clean."

The plan, as summed up by Joseph R. Knowland, Chairman of the State-wide Travel and Recreation Committee, is simple. "We believe," said Mr. Knowland, "that the habit of tossing litter from the cars, which has been responsible for the unsightly condition of our roadsides, has been due mostly to thoughtlessness. We are asking the motoring public to join with us in practicing the same good housekeeping in its cars as it does at home. At home people use their grocery bags in which to deposit garbage and other refuse and then transfer them to the proper receptacle. Used grocery bags should also be carried in the car for

Snow removal alone in the 1951-52 winter season cost more than \$2,445,000, against less than a million for average years in the past. Resulting damage to roads was extensive, requiring a greater amount of work during last summer to get them back into shape.

All these factors have contributed to making the maintenance of California's state highways the huge project that it is, currently costing \$23,000,000 a year and requiring the services of nearly 2,500 people, including engineers, equipment operators, mechanics and many other workers.

depositing wrappers, tissue, lunch remains, bottles and cans, and finally should be disposed of in a proper trash receptacle along the highway, at one of the roadside services, or carried home."

Mrs. C. K. Schnabel, Secretary, California Federation of Women's Clubs, reported that resolutions backing up such a cleanup campaign had been passed by her organization. Mrs. John O. England, representing National and California State Garden Clubs, reported that a "Don't Be a Litterbug" campaign is part of their national program.

Mrs. Ralph Reynolds of the California Roadside Council said that members of her organization had been notified of official endorsement of the campaign by the group and would make plans to cooperate with local chambers of commerce in carrying it out.

Mrs. George Beanston, reporting for the California Congress of Parents and Teachers, advised that this organization is making the campaign a part of their program and that they will contact the schools in order to secure the cooperation of teachers and students.

Experience Report

On Sawing Weakened Plane
Contraction Joint in Pavement

BY D. G. EVANS, Construction Engineer

LATE IN 1952, the California Division of Highways began sawing the weakened plane joint in concrete pavement and to date nearly 260,000 lineal feet of these joints have been sawed on five paving projects. In this relatively new procedure the groove to form the weakened plane contraction joint is sawed by diamond rimmed blades after the concrete has hardened.

Projects constructed so far have been largely of an experimental nature and while some recommendations can be made at this time, no definite sawing procedure has been decided upon as yet. Joints constructed appear to be superior to the premolded paper strip type of weakened plane joint specified in the past. Several short sections of concrete pavements were placed in 1947 and 1948 in which the contraction joints were sawed; recent observation of these joints disclosed the excellent performance of this type of construction. The sawed joint is at present, however, a more expensive joint and under certain conditions numerous random cracks have appeared in the pavement as a result of its use.

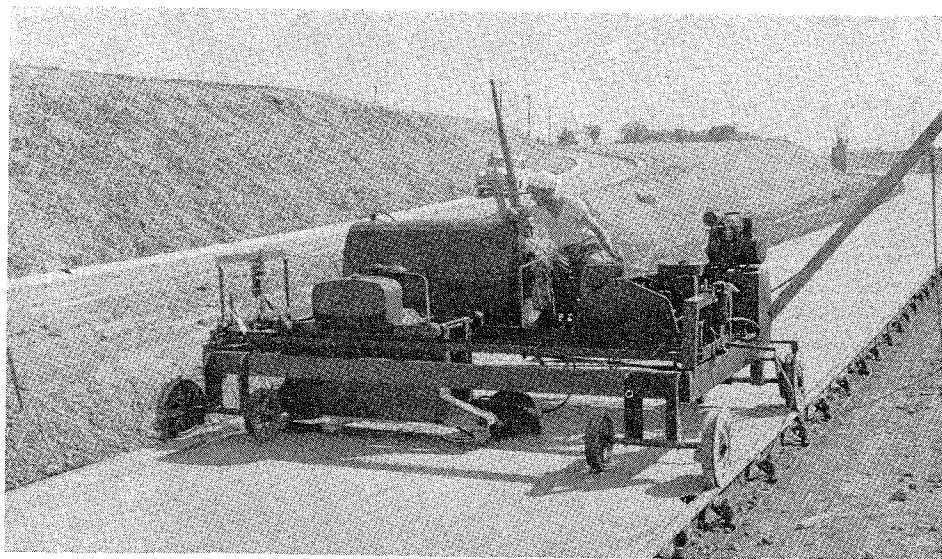
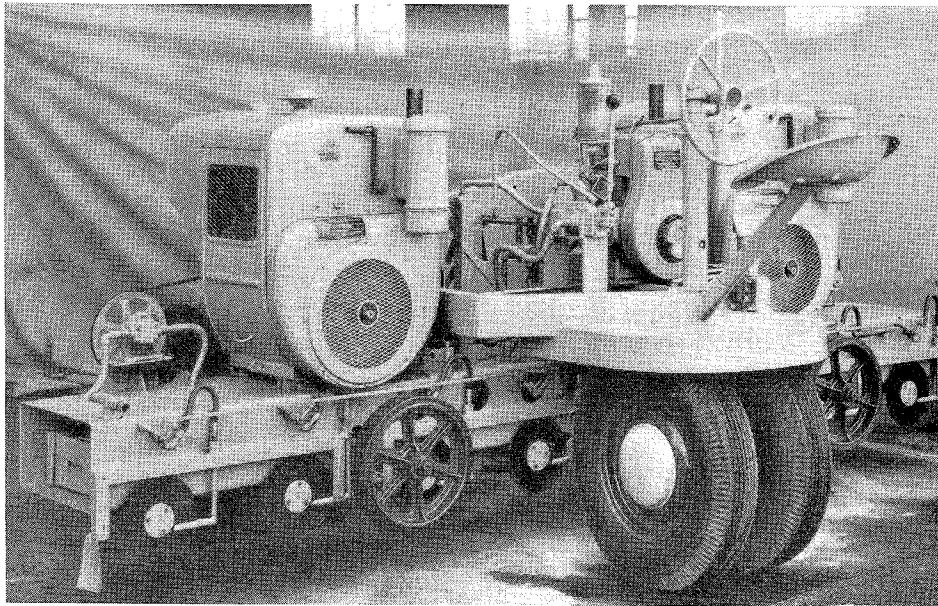
The high costs and many of the uncontrolled cracks may well be characteristic of any new operation with its untrained operators and inspectors as well as unproven equipment.

Equipment

Contractors have supplied two general types of equipment for use in sawing pavement concrete, the single-bladed machine and the multiple-bladed machine. Both types are capable of sawing an equal quality joint but the advantages of each are still somewhat controversial.

Single-bladed Machine

This type of concrete saw consists primarily of a compact gasoline engine mounted on a four-wheel carriage balanced so that it can be easily moved from one location to another. Generally the power unit is used to drive



Multiple-bladed machines used recently to saw joints in concrete pavements

the cutting spindle and the machine must be propelled by the operator. Originally designed for other types of concrete sawing, the single-bladed machines are adaptable to constructing pavement joints. This type of equipment is manually guided and requires a chalk line for proper joint

alignment. Speed of sawing varies from 1½ feet to 4 feet of 2-inch depth joint per minute, depending on the age and character of the concrete.

Multiple-bladed Machine

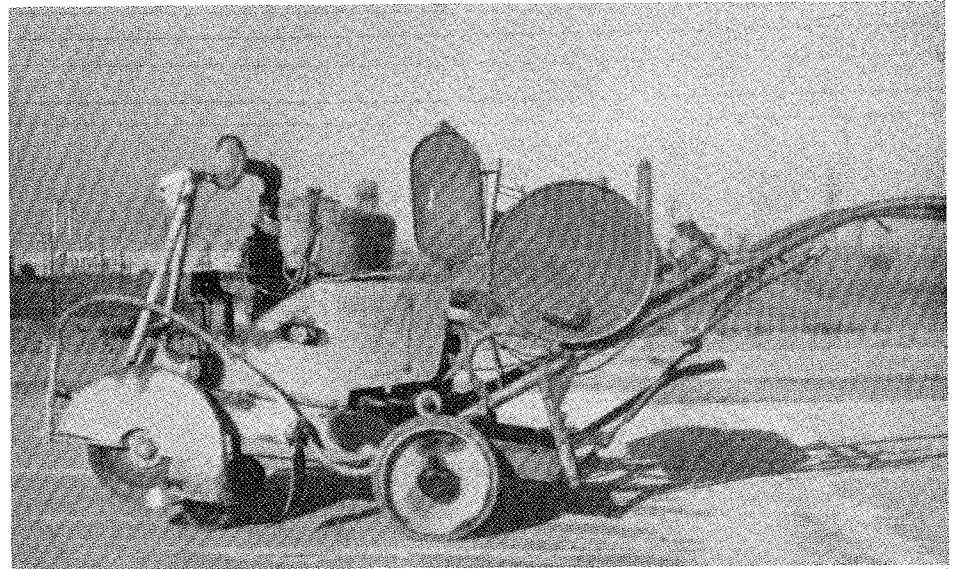
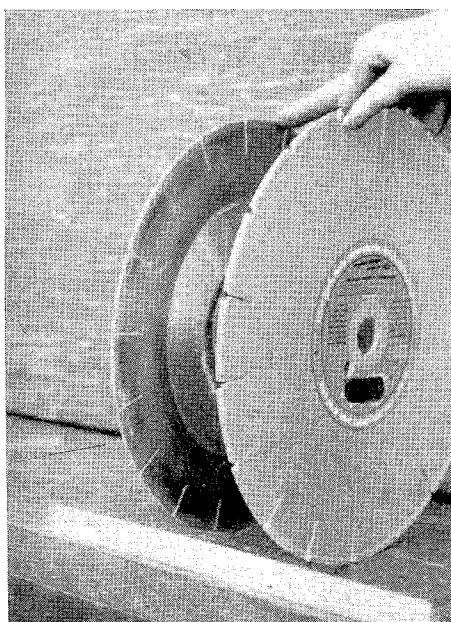
The multiple-bladed concrete saw has been especially developed to saw transverse joints in pavement concrete.

The machine is mechanically propelled along the pavement and the cutting carriage is power-driven transversely across the pavement at a constant rate on guide rails or wheels. Separate power units are provided for each of these operations. The cutting carriage is equipped with two or more blades placed in tandem.

The cutting cycle requires from three to five minutes per joint which in turn will require one to two shifts per day to keep abreast of an average day's run of the mixer.

Both types of machines feature a water-spray system for cooling the blade and lubricating the cutting. The saw blades revolve at approximately 3,300 r.p.m. and ample quantities of water are necessary to protect the expensive diamond set blades. For large scale sawing it is necessary to provide an auxiliary water truck to supply the large quantities of water needed. An inadequate water supply will result in lower blade footage and in the more extreme cases a warped blade. Normally, a crew of two men is necessary, one to operate the saw and the other to mark the joint alignment where necessary and to move the water truck.

Segmented diamond-rimmed saw blades used to saw concrete. These blades are good for about 800 feet of two-inch groove.



Single-bladed machines used recently to saw highway concrete

Saw Blade

The concrete saw blades now in use for joint sawing are 10- and 12-inch diameter segmented circular steel disks with diamond cutting edges. The saw blade is a high-grade steel and the cutting edge is set with commercial-grade diamonds.

The groove made in the concrete by the saw varies from around three thirty-seconds inch to three-sixteenths inch, the variation being due to the condition of the blade, and the age of the concrete. Ordinarily, new blades cutting green concrete produce the widest cuts, while cuts by worn blades in hardened concrete result in the narrow sharp-edge grooves.

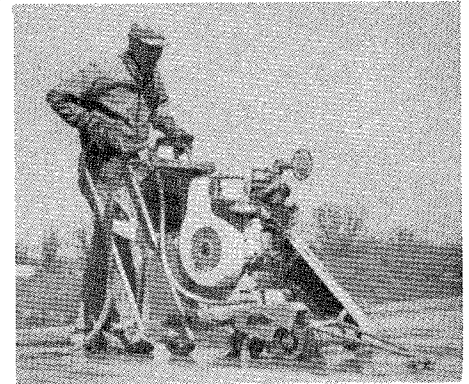
Prices currently being quoted for the concrete saw blade at the retail level are \$130 for the 10-inch size and \$150 for the 12-inch size.

Footages obtained from these blades have varied greatly. On one project an average of 450 lineal feet of 2-inch groove was obtained per blade; on another, the average was nearly 850 lineal feet. It now appears that 800 to 850 lineal feet may be reasonably expected from each blade with present equipment and sawing procedure.

Factors Influencing Blade Wear

(1) Age of concrete.

More footage will be obtained with blades cutting hardened concrete than green concrete.



Sand particles work loose when the concrete is green and the increased abrasion decreases the blade life.

(2) Type of aggregate.

Footage that can be obtained with each blade is in direct proportion to the hardness of the coarse aggregate used in the concrete. The State of Washington reports footages of 700 lineal feet per blade sawing aggregate of basaltic nature, while the midwestern states have cut 2,000 to 3,000 feet of concrete having limestone aggregate. However, with the various California aggregates not much difference in blade footage is anticipated on that account.

The contractors' men must become familiar with the specialized equipment used in sawing concrete. Failure of the water supply, for example, may ruin a blade or a set of blades in a

few seconds. An excessive rate of sawing also reduces blade life considerably.

Costs

The cost of sawing joints is directly related to the type of aggregate used, the time at which the concrete is sawed, the efficiency of the operation of the saw, and the rate of sawing.

The depth of cut is necessarily another item to be considered. To date, joints have been sawed to a depth of 2 inches, but in an effort to reduce costs several test sections of 1½-inch joints have been placed. From these sections, it appears that a 1½-inch groove is effective in producing a weakened plane and in several future contracts this depth cut will be specified. The blade life is not directly proportional to the depth of cut and only a 10 to 15 percent reduction in sawing costs is expected as a result of this shallower groove.

The unit costs, based on an assumed production of 800 cubic yards of paving concrete per day, 850 lineal feet of 2-inch joint per blade, an operating crew of two men per shift and two shifts per day, equipment rental of \$4 per hour for water truck and 2 cents per lineal foot of joint for the machine, would be approximately 75 cents per cubic yard of concrete or 27 cents per lineal foot of joint. Analyzing this cost further:

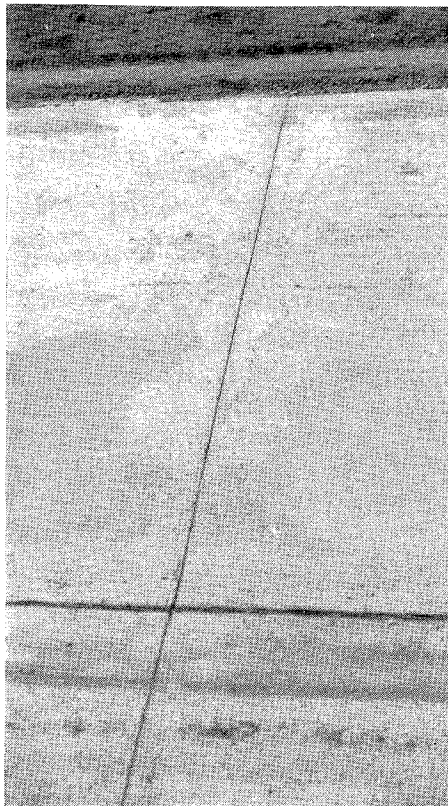
Items	Cost/L.F.	Percent
Blades	\$0.17	63
Labor	0.05	19
Equipment	0.05	18

It should be noted from this analysis that the bulk of the cost of sawing is in blade wear and any savings in this item will materially reduce the overall cost. Presumably a 1½-inch depth cut would average out at around 24 cents per lineal foot.

Basic Factors

When the concrete is first placed on the grade it begins to undergo several chemical and physical changes that result in a slight but important decrease in volume. This decrease in volume is due to:

- (1) Loss of mixing water. (Drying shrinkage.)
- (2) Temperature drop. (Due to atmospheric temperature changes and loss of heat of hydration.)



Typical random crack in companion lane. Random crack was present before groove was sawed.

- (3) Hardening of the cement paste. (Hardening shrinkage.)

The decrease in volume, if uncontrolled, will result in initial transverse random shrinkage cracks at intervals of 60 to 90 feet. If weakened planes are constructed in the pavement, the concrete will crack directly at these plane locations and form a regular transverse opening called a contraction joint. Whereas the random shrinkage crack will spall under the action of traffic due to its irregularity, the straight well-constructed contraction joint that occurs at a weakened plane is spall-free.

Weakened plane contraction joints had previously been formed by a 2-inch premolded paper strip placed in the fresh concrete. These joints, while economical, were difficult to maintain in the proper position during the finishing operation, which later often resulted in severe spalling. Nevertheless, this paper insert did have the advantage of being in position when the initial shrinkage began and this had the direct effect of controlling the first shrinkage cracks.

Construction Procedure

In making the initial transverse control cuts to prevent random cracking of the slab, it is necessary to wait until the concrete hardens sufficiently to permit sawing without tearing and yet saw the groove before uncontrolled random cracking occurs. It is only necessary to cut the 60-foot joints (or control joints) to control the early shrinkage and once these are cut the stress is relieved and no further cracking should be experienced within a reasonable length of time. The intermediate joints may then be cut 24 or 48 hours later when a better joint will be obtained at a lower cost.

The time at which the control joints should be cut varies greatly and in general is directly related to climatic conditions. Physical and chemical composition of cements and water-cement ratios are undoubtedly influencing factors of a secondary nature.

It has been found that the time at which the control cuts must be made will vary from seven hours on a hot day to 26 hours in cool, foggy weather. The sawing operation of these control joints might be compared to the concrete finishing operation, as there exists only a certain period in which the work can be done. Trained operators can usually determine the proper time for sawing after a few trial cuts. Generally, it has been found that some raveling must accompany the sawing of the control joints, for if a neat sharp-edged joint is obtained, the concrete has hardened to a point where shrinkage stresses probably have already resulted in random cracks, though they may be difficult to see. If a slight raveling and water rounding of the joint occurs, it indicates that the concrete has not yet hardened sufficiently to result in damaging shrinkage stresses.

Since loss of the excess mixing water (over that required for hydration of the cement) is one of the major sources of early shrinkage, delaying this water loss will also delay tensile stresses in the concrete and allow more time in which to cut the weakened plane. This is particularly true of the initial lane. Continued heavy fogging of the fresh concrete until the final curing operation gets under way will

aid in this respect. Of course, that portion of the volume change due to hardening and the temperature variation will be uncontrollable. Large variations in temperatures between day and night, together with low humidity and high winds, appear to be the most difficult in which to control random cracking. As for any individual day, the greatest number of random cracks have occurred in that part of the day's pour which had been completed before noon. It is this portion that hardens quickly and which must be watched closely. The afternoon's pour sets slowly and there appears to be considerable time in which to cut these control joints. In this respect, the State of Colorado reports similar experiences.

Any joint that has opened in the initial lane must be matched by a control joint in the companion lane. This is very important, since if it is not done a random crack across the second lane will invariably result. When pouring the second lane, it is necessary to mark all joints that have opened in the first lane so as to know which joints are critical. It has been found that the best system is to have a man paint in the morning each joint that has opened in the first lane. The opened joints are widest at this time and most easily detected.

The sawing of the control joints in the companion lane is more critical as to timing, and under certain conditions it will be impossible to cut the pavement before a random crack occurs.

The critical nature of the companion lane stems from the fact that in addition to the normal shrinkage stresses of the concrete, the initial lane transmits through the tie-bolt assemblies to the companion lane additional volume change stresses. At times, the initial lane will transmit enough stress to the second lane to result in a random crack before the concrete has set hard enough in the latter to permit sawing. When it is evident that this is happening, it will be necessary to start inserting premolded paper strips to form the control joints.

Diagonal and Normal Joint Construction

Contraction joints have been sawed both normal and diagonal to the cen-

ter line of the pavement. Under certain conditions, the diagonal joint has proven more difficult to saw and has resulted in a more serious random crack pattern. As a result, it is recommended that the diagonal joint not be specified until the sawing technique has been better perfected and construction personnel become better acquainted with the operation.



Typical intermediate sawed contraction joint. These joints will not be sealed.

General

Based on field observations of the experimental sections placed in 1947 and 1948, as well as of the more recently constructed projects, the following advantages are apparent at present in the sawed joint over the premolded paper weakened plane contraction joint:

- (1) The sawed joint insures a groove that is vertical and straight which is surrounded by a concrete that is of equal quality to that found elsewhere in the pavement. There is less spalling at the joints with the result that a better riding pavement is obtained.
- (2) The narrow groove of the sawed contraction joint is not noticeable at average driving

speeds and the pavement appears as a continuous white ribbon.

- (3) The sawed joint permits a better sequence of operation of the concrete finishing equipment train. The operation of the Johnson float is simplified since there are no paper strips to "roll" or "pull" and extra passes of the float are eliminated.

FROM INDIANA

STATE OF INDIANA
Director of Traffic Safety
Indianapolis 4, Indiana

California Highways and Public Works

GENTLEMEN: The State of Indiana has recently established a Department of Traffic Safety, which will be charged with the responsibility of developing and conducting a state-wide program designed to reduce traffic deaths and injuries.

To assist us in this endeavor, it would be appreciated if my office could be placed on your mailing list for *California Highways and Public Works*.

With thanks for your cooperation, I am

Sincerely yours,

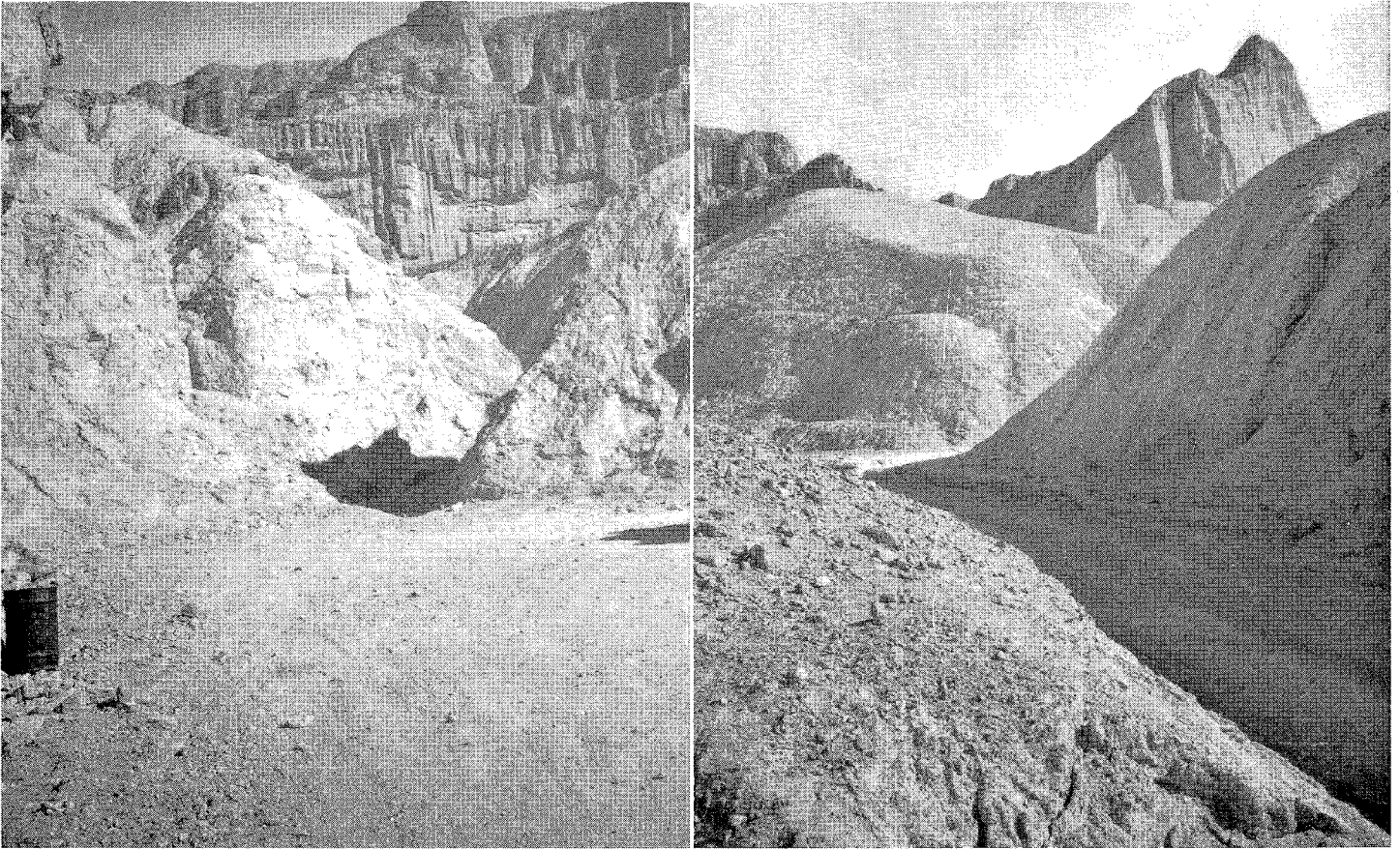
J. L. LINGO
Director of Traffic Safety

Merit Awards Are Given

MERIT AWARDS for employee suggestions granted by the Merit Award Board were presented to Lloyd B. Reynolds, Associate Highway Engineer, and to Sam Lunetta, Supervising Blueprinter in the Service and Supply Department, by Assistant State Highway Engineer Richard H. Wilson on May 22d.

Reynolds received a check for \$25 for his suggestion that data on contract statistics to be included in the annual report of the Division of Highways be recorded on individual sheets in loose form. Lunetta was given a check for \$10 for his idea of a roll-up device used in connection with the exposure of autopositive film.

DEATH VALLEY ATTRACTS CAMERA ENTHUSIASTS



TWO DIFFERENT VIEWS OF SCENES IN DEATH VALLEY

LEFT: A view of wind eroded rocks seen from Artist's Canyon. The wind eroded rocks, with different colored strata, is one of the scenic views from this canyon.

RIGHT: A cathedral like rock at the head of the canyon called Natural Bridge. This inspiring pile rises above all else at the end of this canyon.

U. C. Professors Offer a Revised Edition of Book

A REVISED EDITION of "Surveying Theory and Practice" by Raymond E. Davis, Professor of Civil Engineering, and Francis S. Foote, Professor of Railroad Engineering, University of California, is just off the press of McGraw-Hill Book Company, Inc., New York.

Divided essentially into three parts, the book covers fundamental relationships and techniques, operations common to all branches of surveying, such as measuring and plotting angles and distances, and the practice of survey-

ing as extended to entire surveys. The book's revision includes rewriting of many sections such as those on errors, field astronomy, photogrammetric surveying, barometric leveling, index error of the transit, strength of triangulation figure, geodetic leveling, planimeter, vertical curves, adjustment of compass traverses, state systems of plane coordinates, three-point problem, plotting details, and specifications for topographic maps. These changes afford greater clarity, simplicity, and intelligibility.

The authors have added new advances in the inclusion of discussions on recently developed sensitive barometers, new European types of transit and level. Further, summary tables of error in chaining and in leveling are given, and tabulation of systematic procedure for taking side shots with the plane table is presented. For clarification of adjustment of level and transit, line diagrams show desired relationships between principal lines of instruments. Applications of photogrammetry in route surveying are newly discussed. And there are many more noteworthy brief additions.

Gaviota Tunnel

*Last Section of Lining
Placed, Portals Finished*

By JOHN E. WITTE, Resident Engineer

WITH THE placing of the last section of reinforced concrete tunnel lining, completion of the pavement, and construction of the portal structures, Gaviota Gorge Tunnel on U. S. 101 all field work in connection with construction of the project was completed on May 13th. The tunnel, which is 435 feet long between portals, is a portion of the planned limited access freeway between Gaviota and one mile north of Najoqui Summit, in Santa Barbara County, a distance of approximately 8.3 miles. The work on the entire section was begun in May, 1950, and is scheduled for completion in the fall of 1953 at an estimated cost of \$3,300,000.

The history and geology of the area were discussed together with an account of the driving of the tunnel in the January-February, 1953, issue of the *California Highways and Public Works* magazine.

The completed tunnel will accommodate two traffic lanes 12 feet in width with combination sidewalks, curbs, and two-foot gutters. It is on a 1,200-foot radius curve and a plus 4.47 percent grade with the roadway section superelevated 10 percent to provide for the design speed of 60 miles per hour.

The Portland cement concrete tunnel lining is 18 inches thick in the cut and cover section of the tunnel, 24 inches thick in the steel supported section and 36 inches thick in the timber supported section.

Tunnel Lining Form

In order to secure the desired continuity in the surface of the tunnel lining the specifications limited the lining form to a length of 16 feet. With the over-all dimensions of the form specified by the plans, the dimensions of the structural members of the form were designed from a stress analysis which considered not only the total load of the wet con-

crete imposed on the form during the placing of the lining but also the rate of pour and the temperature of the concrete at the time of placing.

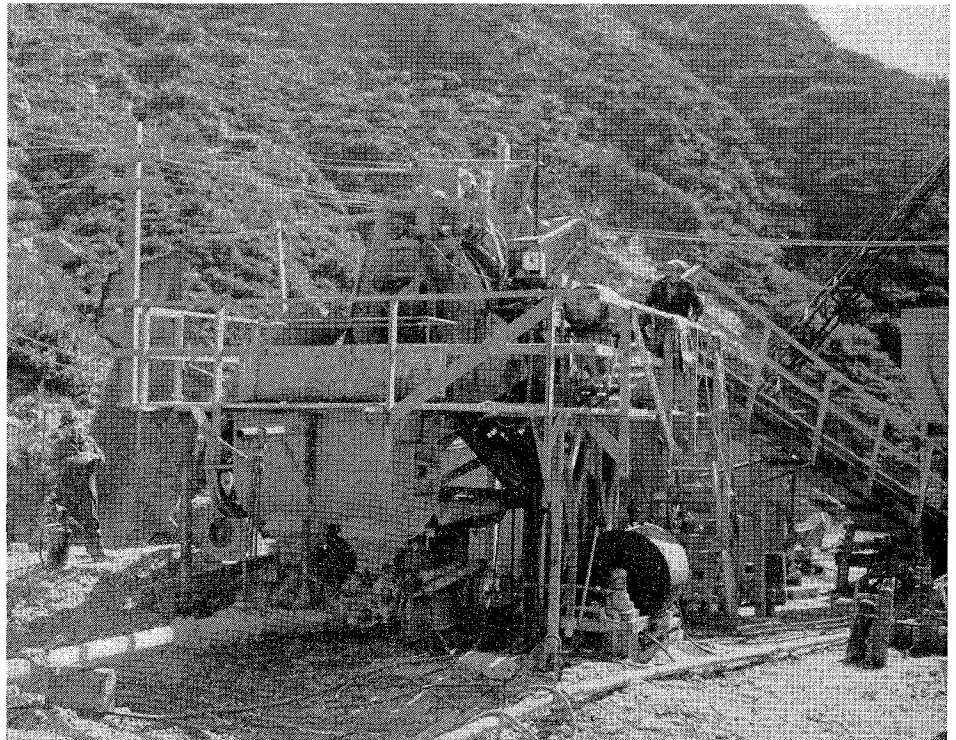
The steel lining form used was designed by William H. Schutte for the contractor, Rhoades-Shofner Construction Company of Los Angeles. The form consists of a crown section and two side panel sections mounted on a gantry frame and supported by gantry trucks composed of 12-inch rubber treaded wheels. The three-eighths-inch skin plate is welded to the steel ribs which constitute the upper members of the structural steel trusses which are hinged to the gantry frame. The crown section is moved vertically by means of four 20-ton hydraulic jacks mounted on telescoping gantry legs. The side panels are

moved laterally by means of jack screws. The crown and side panels are adjusted to line by use of steam-boat type ratchet jacks. The form is moved along the 4.47 percent grade by means of a pulley system using either an Ingersoll-Rand air tugger or a Caterpillar D-8 tractor as the prime mover.

On Line and Grade

Prior to moving the lining form into the tunnel the reinforced concrete curb, gutter and tunnel arch footing sections were placed to line and grade along each side of the tunnel to carry the form. The lining reinforcing steel, which was placed from scaffolds, consisted of two layers of five-eighths-inch bars at 24-inch centers along the arch line and two layers of three-quarter-inch bars at

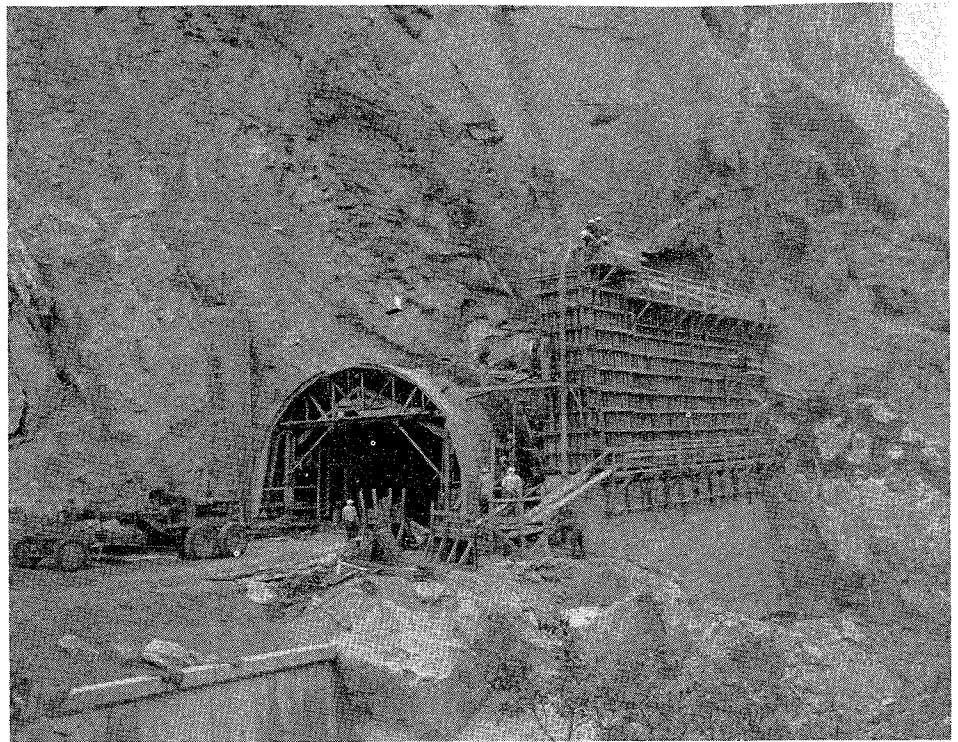
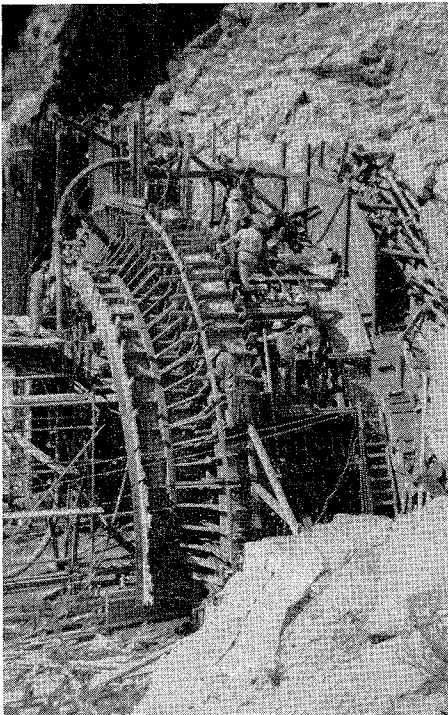
View of the concrete mixing and pumping unit. Conveyor is on the right, the concrete mixer upper center, and the pumpcrete machine is in the lower center. Remix hopper is above the pump, the "siamese" is shown in the lower left of the picture.



24-inch centers placed longitudinally. The inner layer of steel was three inches from the lining surface and the outer layer was imbedded 16 inches from the concrete surface.

After the form had been moved into position and adjusted to line and grade the form was secured in position by placing three-quarter-inch bolts through the bottom flange of the side panels into precast tie holes in the arch footing. The gantry trucks were secured by placing wedges between the wheels and the truck frame and by securing a cable tie from the gantry frame to steel dowels in the arch footings. Blocking was placed between the bottom flange of the side panels and the haunch line of the footings to transmit the loading imposed on the form by the wet concrete to the footings. The form was placed to line and grade with a tolerance of one-eighth of an inch. Electrical conduit, pull boxes, magnetic contactor and transformer vaults, grout pipes and tunnel weepers were bolted, in their prescribed positions, to the outer surface of the form in order that they be either completely encased or have their access

Pumping concrete to the top of the lining form at the south portal in the cut and cover section. The forms for the vaussoir appear left of center.



Lining form in position for placing of section of tunnel lining at north portal of the tunnel. Pipeline right of center is being used to pump concrete into the forms which constitute a part of the north portal structure.

covers flush with the surface of the lining as the case required.

A timber platform was placed on the lower members of the crown section truss for the purpose of providing a working area during the placing of the concrete in the side panels and for operating the form vibrators. Tubular steel scaffolds with timber decking were placed adjacent to the ends of the form to serve as working areas during the placing of the timber bulkheads and for handling the arch pipe and air tuggers during the placing of the concrete above the form.

Pumpcrete Machine

Because of its important role in the successful lining operations it is believed that a description of the mechanics of the Pumpcrete machine will be of interest. The Pumpcrete system has been defined as the method of transporting concrete through pipelines by means of direct acting pumps. The mixed concrete is discharged from the mixer into a remix hopper into a cylinder and expelled by a piston into the pipeline. Each charge forced into the line pushes all the concrete in the line

forward and, as the concrete is relatively incompressible, a nearly equivalent amount is ejected from the end of the line.

The Pumpcrete machine is a heavy duty, single acting horizontal pump much like a heavy duty, piston type water pump. The outlet connection is directly in line with the horizontal cylinder. The remix hopper, of the pug-mill type, is mounted above the cylinder head chamber and an inlet valve is located between the hopper and cylinder. The outlet valve is between the chamber and the pipe line. Both inlet and outlet valves are mechanically opened and closed in timed relation to the movements of the piston.

The valves are mechanically actuated from double acting cams on the crank shaft through oscillating arms or "banjos," thence by valve rods to the valves. Springs in the valve rods provide the necessary relief to prevent damage to the operating mechanism.

Cycle of Operation

The cycle of operation is as follows: On the suction stroke of the piston the inlet valve opens (outlet valve closed) and the charge of concrete is drawn

from the overhead hopper through the valve into the cylinder. On the pressure stroke the outlet valve is open (inlet valve closed) and the charge of concrete in the cylinder is pushed from the cylinder into the connecting pipe line with each revolution of the crank shaft.

The metal piston never comes into direct contact with the concrete nor with the metal cylinder walls. A replaceable rubber piston end pushes the concrete. The piston skirt and cylinder wall back of the rubber piston-end are continuously rinsed with washwater. The rubber piston-end keeps the washwater out of the concrete.

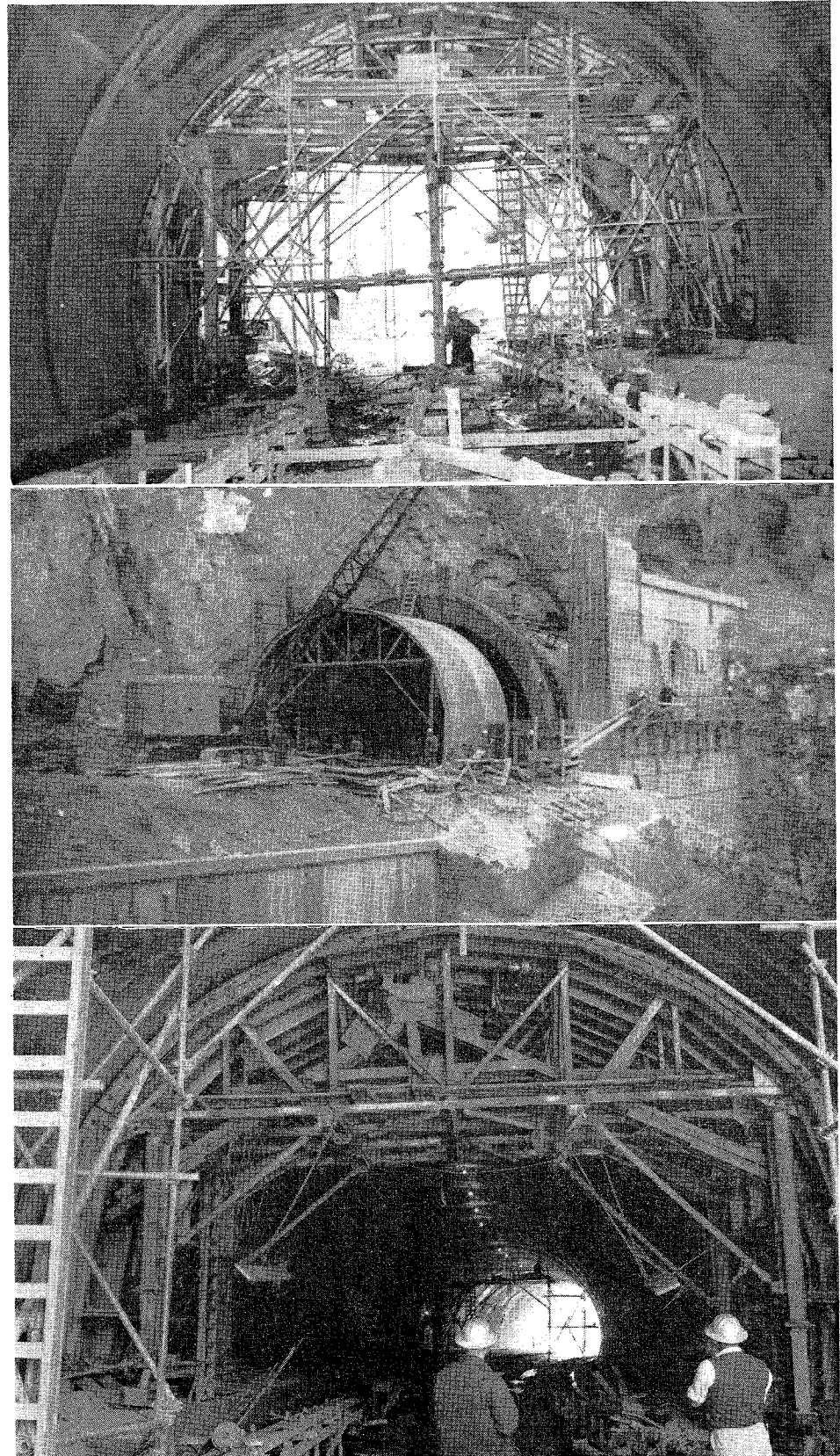
After the concrete leaves the pump it moves through the pipe in pulses but at all times the pipe is completely filled and there is no tendency to segregate or disarrange the structure of the concrete mixture. There is a tendency, due to the troweling action of the inside of the pipe, to bring a slight surplus of grout to the outside of the concrete stream which is helpful to pumping as the grout is the only part of the concrete that can act as a lubricant. Due to the remixing action of the pump itself and freedom from segregation in the pipe line, the concrete reaches the end of the line normally in better state of uniformity of mixture than it was at the hopper of the pump.

Combining the two streams of concrete from the double cylinder Pumpcrete involves the use of a "Siamese" pipe section with an enlargement at the junction of the two incoming pipes so that the area at the point where the streams are completely merged is one and one-half to two times the area of either of the incoming pipes. To reduce this to normal pipe size requires the use of a tapered section.

The pipe line from the pump was placed on cribbing along the invert of the tunnel to a location just beyond the forward end of the form where it was elevated, by means of a 180-degree segmented pipe section, to the elevation of the crown truss section of the form. From the elbow the arch pipe was suspended horizontally by chains secured to the tunnel supports.

Arch Lining

The first phase of the arch lining operation was to place the concrete be-



UPPER—Lining form in position for placing of concrete tunnel lining. Pumpcrete pipeline is shown rising from tunnel invert to the crown of the form. Operator is operating the air slugger. CENTER—Lining form as it emerged from the tunnel after the last section of the tunnel had been completed. LOWER—Steel form in place in foreground. Gantry for finishing tunnel lining in background.

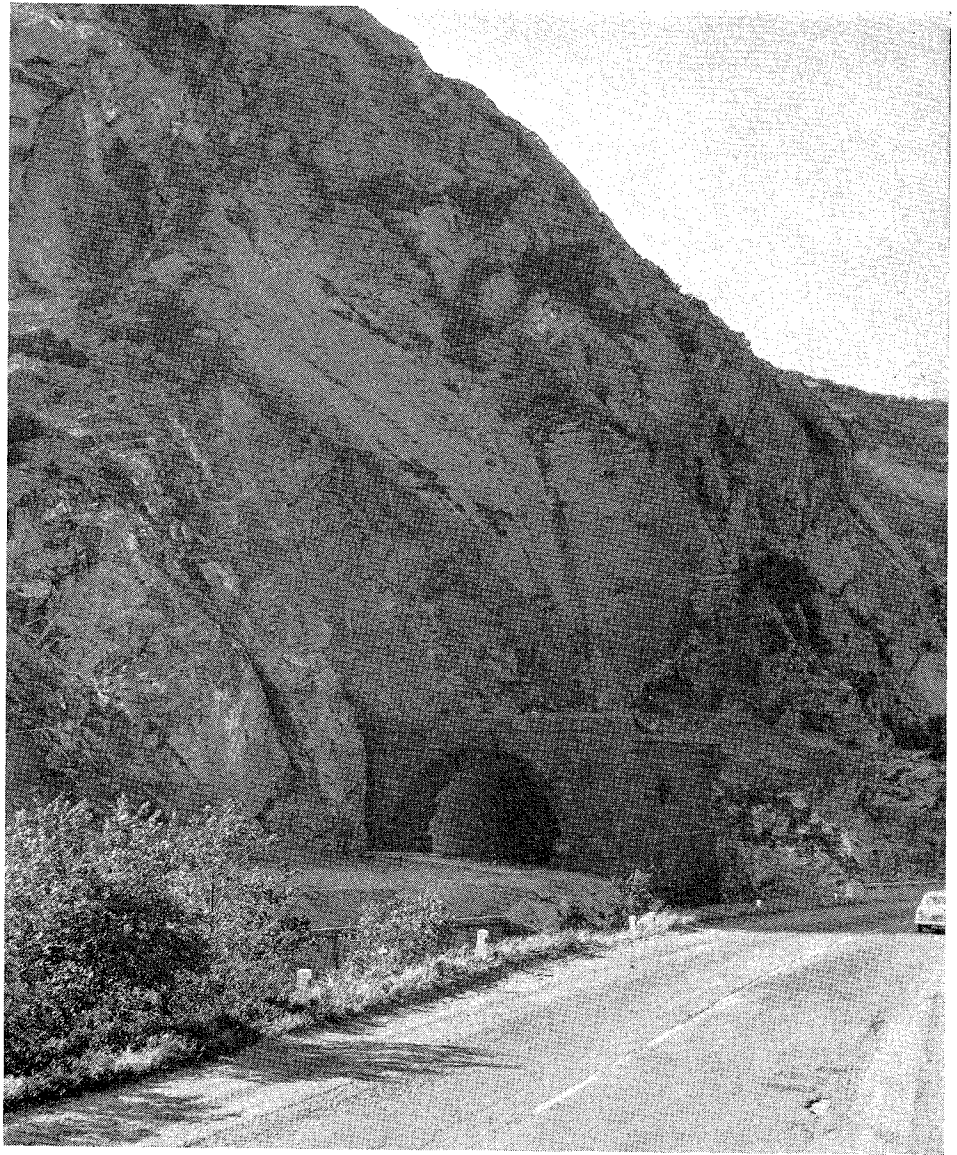
hind the side panels. The pipe line was erected to the elevation of the crown section truss where it discharged the concrete into metal lined telescopic chutes which in turn discharged the concrete through hinged access doors in the side panels. The concrete was vibrated by use of immersion type vibrators supplemented by periodic use of form vibrators. After the concrete had reached the elevation of the bottom of the access doors the chutes were withdrawn and the access doors closed and secured with metal wedges. The pipe line was then erected to the elevation of the top of the form where it was connected to the arch pipe.

In the timber supported section of the tunnel the arch pipe was connected to a section of light gauge pipe called a "slick." The slick line was placed through an opening in the timber bulkhead and along the top of the form to a point three feet from the opposite end of the form. In the steel supported section of the tunnel where the head room was restricted, the use of a Siamese slick line was necessary. The Siamese slick line was in the form of an elongated "Y" with the regular seven-inch line branching into two parallel flattened sections of six-inch light-gauge pipe at a point outside of the bulkhead.

Air Sluggers

The Siamese slick line was equipped with an air "slugger" two feet back of the junction, and an air slugger in either leg of the "Y." The air sluggers consisted of compressed air connections tapped into the line, and used to control the direction of the discharge, and to push the concrete away from the discharge end of the pipe in order to fill the furthest recesses of the form first. As the concrete progressed to the top of the form, the discharge end of the slick line became buried in the concrete, after which the slick was withdrawn at a rate which provided for the continued submergence of the outlet to insure complete packing of the arch. Both the single slick and the Siamese slick were withdrawn from the form by removing short segments of the regular arch line and pulling the slick back to the new connection.

Several sections of the lining were placed by pumping the concrete



This is a view of the north portal of Gaviota Tunnel

through the crown section of the form rather than through the bulkheads. To place the concrete by this method, it was necessary to cut a hole in the skin plate of the form, insert a short section of slick line through the sleeve of a special flat plate valve welded to the form, and then connect the slick to a vertical riser of the regular pipe line. The form was filled by straight pumping pressure supplemented by an air slugger placed at the bottom of the riser pipe.

Completing the Pour

When the pour had advanced to a point where the concrete in the hopper and the line was sufficient to complete

the pour, the remaining concrete in the hopper was pumped into the line, a shut-off pin type valve in the line near the pump was closed, and the Siamese connection and the tapered section were removed.

The Pumpcrete hopper was then cleaned out and converted to a high pressure water pump by the addition of inlet water valves above the inlet concrete valves and outlet water valves beyond the outlet concrete valves. The converted pump was connected to the pipe line by a Siamese washout assembly behind a section of pipe, which contained two "go-devils" with a wad of excelsior and burlap ahead and behind each go-devil, attached to the

rear end of the pipe line. A "go-devil" is a dumbbell-shaped unit with rubber cups at each end. The cups fit closely in the pipe and are turned towards the pump, the seal being the same as in a single plunger pump.

Operation of Go-devils

The hopper of the Pumpcrete was then filled with water, the pin valve opened and the pumping begun. The water pressure propelled the go-devils, which in turn pushed the concrete in the pipe. As the go-devils advanced, the concrete was forced out of the end of the line into the form and at the same time, the water back of the go-devils rinsed out the pipe. As the go-devil approached the form, the slick line was completely withdrawn and the pour "keyed-off." The riser pipe was then removed to the elevation of the tunnel invert where the go-devil and the water behind it were discharged.

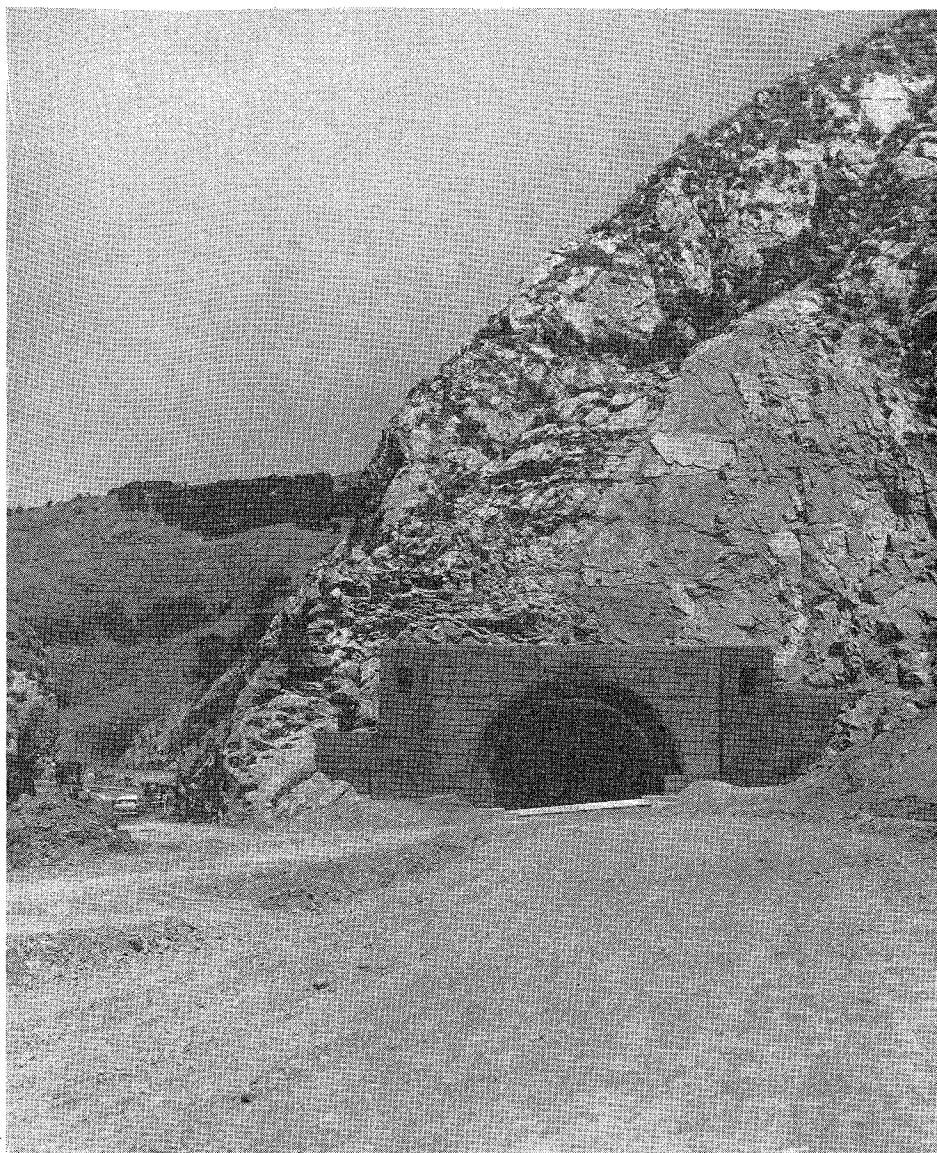
The crew assigned to the mixing and pumping of the concrete consisted of a master mechanic, a crane operator, an oiler, a batch plant operator, a mixer operator, and a Pumpcrete operator and oiler. The placing crew consisted of a foreman, two carpenters, who constructed and maintained the bulkheads, four internal vibrator operators, one form vibrator operator and two men who operated the air sluggers and helped handle the slick line.

Approximately 2,800 cubic yards of concrete were placed in the tunnel lining with the individual pours ranging from 80 to 132 cubic yards depending upon the section being lined and the amount of overbreak. The concrete was placed at the average rate of 22 cubic yards per hour with the maximum of 26½ cubic yards per hour.

Three-inch diameter tunnel weepers and six-inch diameter footing weepers will drain the water from behind the lining into drain galleries on either side of the tunnel.

Removal of Lining Form

The contract specifications provided for the removal of the lining form as soon after placing the concrete as working conditions permitted, providing, however, that should there be any evidence of sagging, cracking or other damage to the concrete the form was to remain in place until removal was authorized by the Engineer. This pro-



This photograph show the south portal of Gaviota Tunnel

vision permitted the contractor to schedule his operations to provide for the placing of one section of the lining per day. The form was usually removed within 12 hours but on one occasion it was removed in eight hours without any indications of failure in the concrete arch.

The bulkheads were removed as soon as possible to provide for the removal of the keyway forms and the cleaning of the construction joint. Sixteen-gauge galvanized sheet metal water stops were installed between successive pours.

The form was removed by first retracting the form jack screws which brought the bottom flange of the side

panels clear of the arch footings. This clearance allowed the crown section to be lowered approximately six inches by releasing the pressure in the four 20-ton hydraulic jacks supporting the crown section on the gantry frame. The form was then removed to the next location.

Each section of lining was water cured for a period of seven days by a system of garden type sprays tapped into a 1½-inch water line suspended from the pull boxes which were cast in the crown of the lining arch.

Batch Plant and Mixer

The 100-ton capacity batch plant and two 250-barrel cement storage

silos were designed and built by the Pacific Coast Tank Company. The bulk cement was loaded into the silos by a screw conveyor which fed a vertical bucket elevator. The cement was conveyed to either silo and to the batch plant by screw conveyors. The batch plant was equipped with four compartments for the coarse and fine aggregates, a 2,000-pound capacity Hardy automatic scale for weighing the cement, and a 10,000-pound capacity scale for weighing the sand and coarse aggregates. The plant was designed so that when dismantled it can be transported by truck without requiring a special permit for over-size load.

The 1½-inch x ¾-inch aggregate and the sand were trucked from the Sisquoc plant of the Southern Pacific Milling Company. The 1-inch x No. 4 aggregate was obtained from the Consolidated Rock Company's plant at Irwindale and shipped in railroad gondolas to the siding at Gaviota and trucked to the jobsite. The aggregates were stockpiled in bulkheaded bins and loaded into the batch plant compartments by a Lorain 77 crane equipped with a 1¼-cubic-yard clamshell bucket. The cement was hauled by tank truck from the Tehachapi plant of the Monolith Cement Company.

The dry batch of coarse aggregates, sand and cement were transported from the batch plant to a Ransome 28S concrete mixer by a 24-inch belt conveyor. The conveyor is covered with a semicircular section of pipe to prevent the loss of cement and aggregate fines to the high velocity winds that blow almost constantly through the gorge. The water for mixing the concrete is obtained from a 600-foot deep artesian well located midway between the batch plant and the south portal of the tunnel, a distance of approximately 150 feet.

The concrete was discharged directly from the one-cubic-yard capacity mixer into the remix hopper of a Double 180 Rex Pumpcrete machine. The purpose of the remixer was to blend the incoming batch with the previous batch in order to provide uniformity and to prevent segregation in the concrete before it was delivered to the pump.

Design of Concrete

The design of the concrete used in the tunnel lining was based on three factors: workability, "pumpability" and strength. The concrete had to be workable in order that the tunnel supports and reinforcing steel would be completely encased with the concrete and to insure a minimum of voids between the lining and the rock surface of the tunnel bore. A high degree of pumpability was essential in order to obtain the maximum efficiency from the concrete pump and minimize the chance of a plugged line. The concrete was found to have maximum pumpability and workability when the slump was between four and five inches. A water cement ratio of 0.53 was used to secure the desired slump. Twenty-eight day tests on the concrete indicated an average compressive strength of 3,900 pounds per square inch.

Portal Structures

In excavating for the tunnel footing and the retaining wall footings of the north portal structure it was found that, at the elevations indicated on the plans, the footings would be founded on soil having a bearing value considerably less than that of the rock which had been anticipated at the planned elevations. This necessitated redesign of the footings.

A cost comparison between a combined spread footing of reinforced concrete and a footing based on steel piling indicated that the driving of steel piling was the most practical and economical method of obtaining a secure foundation.

The design of the pile foundation was based on the assumed ability of 10-inch by 10-inch 42-pound bearing piles to develop a bearing value of 30 tons per pile. A total of 32 piles having an average penetration of 20 feet were driven to refusal by a Lorain 77 crane equipped with a boom, a set of leads and a drop hammer weighing two tons. The piles were placed in five rows—one vertical and one batter row under the retaining wall, one vertical row under the center of the piling slab and one vertical and one battered row under the tunnel lining footing. The piles in each row were on four-foot centers.

Lagging Between Webs

Upon the completion of the driving operation, 2-inch by 4-inch lagging was placed between the webs of the outer row of piles to retain the soil during the excavation for a reinforced concrete cut-off wall that extended to an elevation eight feet below the streambed of the adjacent Gaviota Creek. The purposes of the cut-off wall was to prevent the erosion of the material through which the piles were driven. Large boulders were later placed along the face of the cut-off wall at the elevation of the stream channel to deflect the stream flow away from the footing.

A four-foot thick slab of reinforced concrete was placed over the piling to provide a piling cap and a combined footing for the retaining wall, the tunnel footing and the back-fill material. The bottom of the slab was two feet below the top of the piling.

The forms for the construction of the portal structures were constructed of five-eighths inch plywood on 2-inch by 6-inch studs and walers. Forms for the outside surfaces were faced with rough form lumber with the unfinished surface in contact with the concrete and with recess strips to present the appearance of sandstone blocks. The forms were held in position by Superior continuous threaded coil rods three-fourths inch in diameter acting as both ties and spreaders.

The concrete for the portal structures was batched, mixed and transported by the same method used for the tunnel lining. The concrete was deposited in the forms through 12-inch "elephant trunks" and vibrated by immersion type vibrators.

After the concrete had been cured and cleaned the exposed surfaces of the portal structures were treated with Rholoff Company "Kemico" acid stain to simulate the buff colored sandstone formation adjacent to the structures.

Concrete Pavement

The concrete used in the construction of the pavement was batched, mixed and transported by the same method employed in the construction of the tunnel lining and the portal structures. The pipe line discharged the

concrete into a swivel chute which allowed the concrete to be distributed over the full width of a 12-foot lane.

The placing of the pavement proceeded from the north end of the tunnel towards the south end near the location of the pump. This procedure allowed for the removal of the 10-foot sections of the pipe as the pour progressed.

The metal side forms for the pavement were the standard nine-inch "L" shaped forms with one-inch timber shims, connected to the base to provide the required 10-inch section. The normal method of securing the metal forms by means of steel stakes was not generally practical in this case as the base consisted of a layer of six inches of relatively loose rock under which was the solid rock of the tunnel invert. In order to obtain a foundation upon which to secure the forms, 24-inch by 12-inch by 4-inch concrete pads were cast in place at 25-foot centers along the centerline of the tunnel. The forms were fastened to bolts cast in the pads and adjusted to line and grade. Steel stakes were also placed, where possible, to minimize lateral movement of the forms.

Concrete Distribution

The concrete was distributed uniformly and vibrated with immersion type vibrators. The concrete was then brought to the required grade and shape by a hand operated strike-off float consisting of a 2-inch by 6-inch plank 13 feet long trussed to provide stiffness and prevent sag. Plow handles at either end were provided to facilitate handling and tamping. The float was moved longitudinally by two men pulling on ropes attached to eye bolts placed near the ends of the float.

Tamping of the concrete, to force the larger rock away from the surface and bring mortar to the surface to facilitate finishing, was performed by a bull float operated by two men working from bridges spanning the pavement. The bull float was raised and dropped so that the concrete was thoroughly compacted and rammed into place. The tamping action was followed by a transverse screeding action which brought the mortar to the surface. Utility floats were used to bring the mortar to a uniform surface.

After the tamping was completed and the mortar was still plastic a wooden float was operated from the side of the pavement and parallel to the center line of the pavement by means of a long handle. The edge of the float was used to cut down the high areas and float the excess material into depressions. The float was operated until a true surface was obtained. Each successive passage of the float lapped the previous path. The float was then brought back and used to smooth the overlap between the two passages. The final float was a steel-shod cutting float operated in the manner of the first float but at a time when the concrete had hardened sufficiently to avoid leaving a trowled finish. The finish floats were 16 feet long, one inch thick and four inches wide and rigidly ribbed with adjusting screws at 24-inch centers between the rib and the float to insure a true and flat surface.

Final Finish

The final finish was obtained by the use of a burlap drag pulled longitudinally along the pavement.

In order to drain the warm sulphur water that percolates through the rock invert of the tunnel a six-inch layer of crushed rock filter material was placed on the subgrade prior to placing the concrete pavement. Water drains through the pervious base into two-inch collector pipes placed at 16-foot centers and 16 inches below the profile grade and thence into the left longitudinal drain gallery through the curb and gutter section.

An analysis of the water in the tunnel indicated that the water contained 136 p.p.m. of hydrogen sulphide. In order to minimize the detrimental effect of the hydrogen sulphide gas on the concrete pavement an impervious membrane seal of grade 60-70 paving asphalt emulsion was placed over the pervious base material. To prevent the emulsion from being lost into the pervious base a continuous layer of Sisalcraft paper was placed over the pervious base after which the emulsion was applied at the rate of 0.35 gallons per square yard by a hand operated pressure spray from a distributor truck.

Painting

After the tunnel lining had been completed it was decided to paint the tunnel bore in order to provide utmost in visibility and safety to traffic. One coat of primer consisting of silicone crystal solution, which will retard the efflorescence on the tunnel lining, and waterproof the surface, was applied by spray gun and followed by a prime coat and a finish coat of a flat white cement base paint. The completed work provides additional visibility which will be most essential and desirable during the time the tunnel will have to be used for two-way traffic, prior to completion of the adjacent grading and paving contract.

Work Remaining

The installation of a lighting system, and development of the parking area adjacent to the historical monument to be re-established south of the tunnel will be done under separate contracts.

The construction of the Gaviota Gorge Tunnel is under contract to the Rhoades-Shofner Construction Company of Los Angeles, of which A. A. Mathews is Chief Engineer and W. A. Ripley is Superintendent. The contract is being administered by the Division of Highways, District V, E. J. L. Peterson, District Engineer, and C. I. Brown, Assistant District Engineer (Operations) and M. F. Masters, District Construction Engineer. The author is Resident Engineer.

During the course of experiments with alloy steel blades for road graders, the State Division of Highways evolved a method of controlling heat treatment and hardness for low-cost carbon steel blades which has increased the wear of the blades about 50 percent at no extra cost.

Inspection and testing forces of the State Division of Highways in Sacramento, Berkeley and Los Angeles performed approximately 18,000 individual tests during the 1951-52 Fiscal Year while sampling and inspecting 25,400,000 pounds of structural steel, 25,000,000 pounds of reinforcing steel, 22 miles of steel guard rail, and 55 miles of concrete and clay pipe.

Four Years After

All Business in Fairfield
Gains From Bypass Project

By JOHN F. KELLY, Headquarters Right of Way Agent

ON JULY 2, 1949, the freeway bypass of the City of Fairfield was opened to traffic and Fairfield was no longer the community strategically situated on the highway between San Francisco and Sacramento to receive a major portion of the through traffic business. In line with our policy of making economic studies of the effects of freeway construction on abutting and bypassed properties, a study was completed and published in the January-February, 1951, edition of the *California Highways and Public Works* magazine.

The facts in that study lead to a conclusion that businesses catering specifically to the highway traffic patronage had suffered from removal of this traffic by the freeway construction; however, the stores that were catering to the general needs of the community and which represented 73 percent of the retail outlets showed an increase of 14.1 percent above the county average.

Reason for Study

Since the publication of that study there has been considerable inquiry and conjecture about the continuing effect of through traffic removal on the retail business in Fairfield; the greatest amount of interest centering around the cafes, bars and service stations which had suffered business losses immediately after removal of the through traffic. It is the aim of this study to trace the economic effects up to the present time to ascertain whether the losses indicated by these businesses in the first year after traffic removal were a temporary setback, or whether these particular outlets are continuing to show decreased sales.

The utilization of the gross business returns reported to the State Board of Equalization for sales tax purposes has been used in this study in the same manner as employed in the original study. This makes a direct comparison in all business aspects possible without the use of undue interpretation or

adjustment. The major notable difference in the two reports is that the first study was a direct comparison of the conditions before the removal of through traffic with the conditions immediately following. In the present study, rather than being a direct comparison, interest centers on the progression through the adjustment period into a stabilized business era which reflects the local businessmen's ability to merchandise to a growing community.

Travis Air Force Base

This study covers a period of four years since the realignment of the highway, and with the extended period of time, should have a tendency to eliminate the minor deviations which sometimes over-emphasize reactions in a study of shorter duration.

Before stating the actual business analysis, consideration should be given to a condition which has had a tremendous influence on Fairfield's present status. Since the 1951 report, the Travis Air Force Base located nearby has become one of the largest air bases in the Nation. The latest official figures show a total of 10,850 military and civilian personnel. Housing facilities on the base provide living quarters for 1,301 families, in addition to quarters for unmarried personnel. The remaining 3,061 military and civilian family heads without housing accommodations on the air base, of necessity must seek housing in the general area. With this backlog of demand it is understandable that the residential building activity in Fairfield since July, 1949, has been phenomenal. No other city of comparable size in Northern California has experienced such an increase in the number of single and multiple family dwellings during the past four years. At the present time, 1,237 units have been completed and plans have been completed for the construction of many more in the immediate future. The accompanying map of Fairfield shows the location

of the 1,237 residential units completed since July, 1949. The majority of this new construction has been within the 22 residential tracts developed along the northerly side of the city.

Population Growth

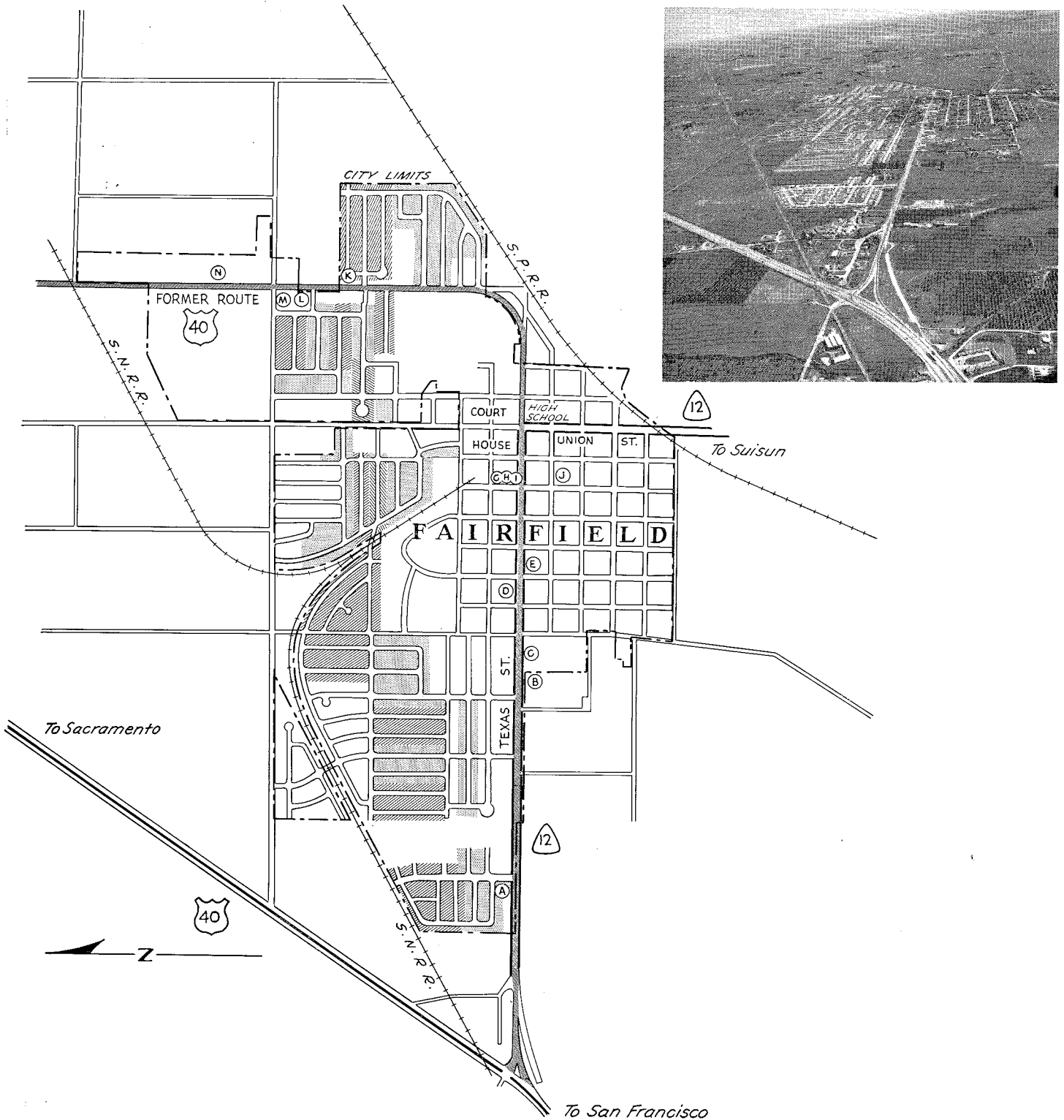
During the four-year period, 1949 through 1952, Fairfield enjoyed a population growth of 40 percent, whereas Solano County had an increase of 26 percent. However, the number of building permits for single family residences in Fairfield exceeded the total number of residence permits issued throughout Solano County by 40 percent. This comparison is an indication of the permanence of the current growth in this area and clearly indicates the magnitude of the residential building program.

In addition to housing, consideration should be given to the increase in the commercial possibilities of catering to this increased military and civilian personnel. The current average monthly pay roll for all personnel at Travis Air Force Base approaches \$3,000,000. In addition to this figure, there are an estimated 3,000 dependents of air force personnel living in the Fairfield area receiving monthly allotments ranging from \$75 to \$200 per month.

This large pay roll at Travis Air Force Base naturally influences the economy of Fairfield and neighboring towns. The commissary and post exchange at Travis do not adequately serve the needs of the personnel on the base, therefore, the neighboring towns have the opportunity of selling consumer goods to many of the people from Travis.

Commercial Development

Undoubtedly this influence has contributed to the commercial building activity in Fairfield which represents an expenditure of over three-quarters of a million dollars since 1949. The accompanying photos show



Shaded areas in this map of Fairfield show location of 22 residential tracts, where 1,237 residential units have been constructed since July, 1949. New alignment of U. S. Highway 40 is shown along lower left side of map. Heavy line along Texas Street identifies location of the old alignment through Fairfield. INSET—Aerial photo. View of Fairfield today. Highway 40 bypasses city. Old route went through central section of Fairfield.

some of the commercial structures recently constructed in the city. The interesting fact is that the majority of the commercial activity has taken

place on Texas Street, the superseded Highway Route 40 through Fairfield.

Conspicuous among the new commercial improvements constructed on

Texas Street are two motels. The accompanying photo shows one of the new motels which is situated within the main business district. There was

an older motel on this property, but the new structure was not built until after Highway 40 traffic was removed from Texas Street.

Other commercial improvements which have attracted considerable attention in the community are the two large supermarkets constructed on Texas Street, an attractive automobile sales agency and a furniture store. The largest and most expensive single unit being constructed in Fairfield is the new Pacific Telephone and Telegraph Company plant. This \$300,000 installation and the new Pacific Gas and Electric Company building represent utility company expenditures in Fairfield. It is not likely that the utility companies would make substantial investments in the community, unless they are confident that the growth is of a permanent nature. The third important factor that affects the general development of this community, much of which generates from the Travis Air Force Base activities, is the traffic volume.

Traffic

In order to make a fair analysis of the increased traffic before and after the realignment of Highway 40, consideration should be given to the increased number of vehicles which are on the highway today. Vehicle registration between 1948 and 1952 increased throughout California by 33 percent. Solano County has shown an increase of 39.8 percent vehicle registration during the same period of time.

The traffic volume on Texas Street in 1948 consisted of 15,000 vehicles on an average week day. It is estimated that 9,500 of these vehicles were Highway 40 through travelers. An additional 2,500 vehicles were through motorists using Texas Street as a portion of State Highway No. 12 toward Rio Vista. This highway intersects Texas Street west of Fairfield and leaves Texas Street at the intersection of Union Street to proceed southwest. The accompanying map of Fairfield indicates the location of this state highway route through Fairfield. Considering the total volume of through highway traffic on Texas Street in 1948, it is apparent that only one-sixth of the vehicles were local motorists;

that is, vehicles which either originated or whose destination was in Fairfield.

A new traffic survey has recently been completed on Texas Street and along the new alignment of Highway 40 north of Fairfield. Today there are a total of 10,000 vehicles using Texas Street on an average week day. The survey also shows that at the present time there are 13,000 vehicles on Highway 49 bypassing Fairfield. Theoretically, we can assume that if Highway 40 was still routed through Fairfield, there would be 23,000 vehicles on Texas Street today.

Analyzing the present traffic on Texas Street, we find that approximately 50 percent of the vehicles originated, or have their destination, in Fairfield. The remaining 50 percent of the 10,000 vehicles on Texas Street today are vehicles following State Highway Route 12 through the city.

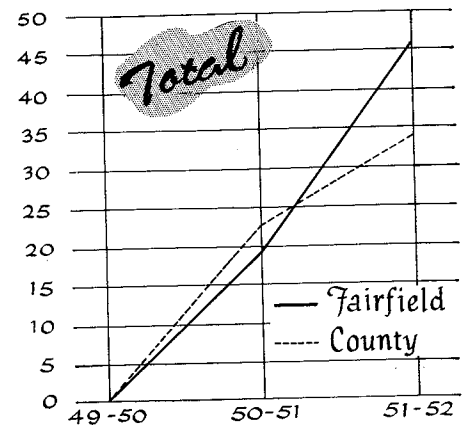
Retail Business

The following statistics cover a time period beginning July 1, 1949, and ending June 30, 1952. The retail outlets have been segregated so that a clear distinction can be made between those business formerly deriving a substantial part of their income from highway traffic, such as cafes, bars and service stations, and the retail outlets which served the needs of the community such as clothing, grocery and furniture. This type of retail outlet has been grouped together and referred to as "all other business."

Total Business Gains

The total gross sales of all retail outlets has increased 45.5 percent during this period. Tabulation of total volume of retail business in Solano County for the same period shows an increase of 34.4 percent. This indicates that Fairfield has enjoyed an 11.5 percent increase over and above that of the county, or over and above that which could be considered a normal expectancy.

In the year immediately following removal of through traffic, total volume of retail business in Fairfield increased 4.5 percent as compared to a 5.0 percent increase in Solano County. These figures clearly indicate that after the period of adjustment which occurred in the first year after



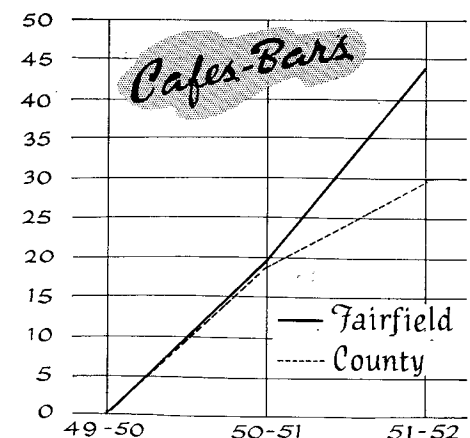
the freeway realignment, the community has progressed business-wise in proportion to the area's population growth and merchandising potential.

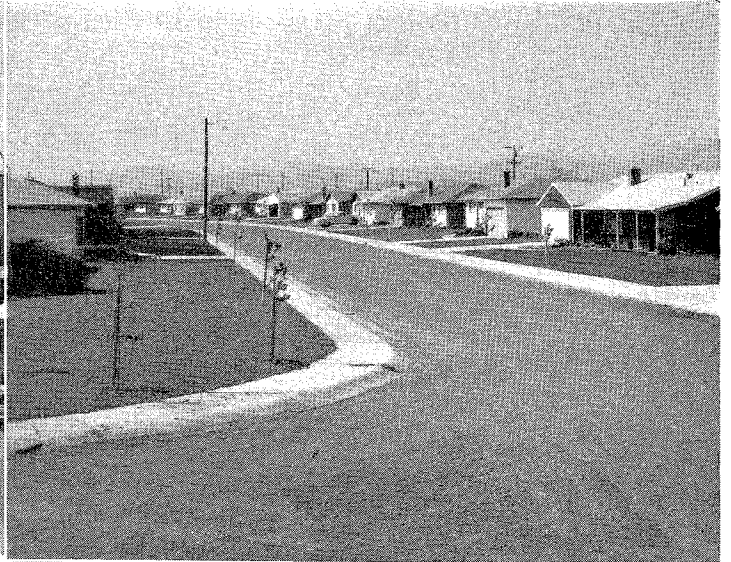
Cafes and Bars

The gross sales of cafes and bars since July, 1949, have increased 43.7 percent. The same class of business throughout Solano County increased 39.7 percent, or a net gain over and above that of the county of 14.0 percent.

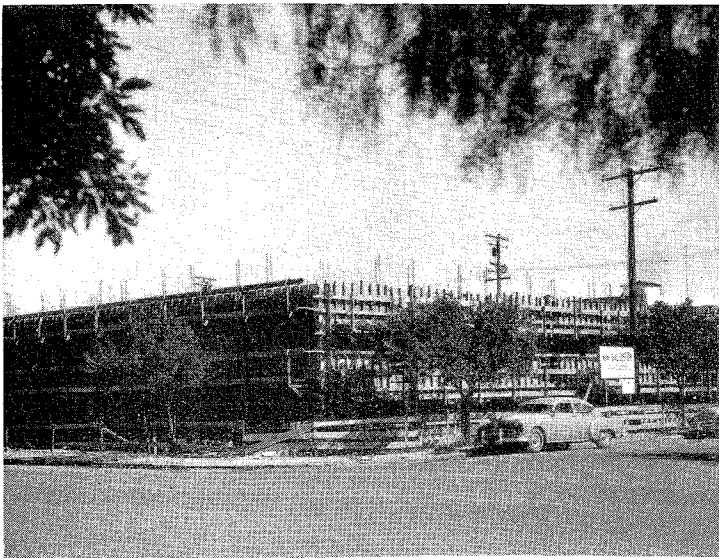
Cafes and bars formerly catering to highway traffic enjoyed a business volume in excess of the normal expectancy for a city the size of Fairfield. Therefore, it was not surprising that the facts in the first economic study revealed that cafes and bars decreased 30 percent during the year immediately after the realignment of Highway 40, while cafes and bars throughout Solano County decreased 5.6 percent.

The facts in the previous study indicated that cafes and bars lost their highway customers who were in the habit of stopping at Fairfield. The





Examples of the recent building activity in Fairfield are shown in these photographs. (1) The main business district on Texas Street, formerly U. S. Highway 40. (2) One of the new residential subdivisions being developed in the city. (3) New motel constructed on Texas Street after the realignment of U. S. Highway 40. (4) One of the new super markets recently constructed on Texas Street. (5) The new Pacific Telephone and Telegraph Company building being constructed in downtown Fairfield.



extent of the loss made it apparent that they would need to make adjustments whereby they no longer relied upon transient business.

The above figures indicate that these merchants have made this adjustment in a satisfactory manner.

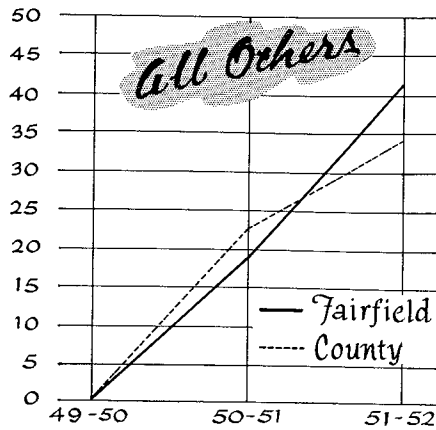
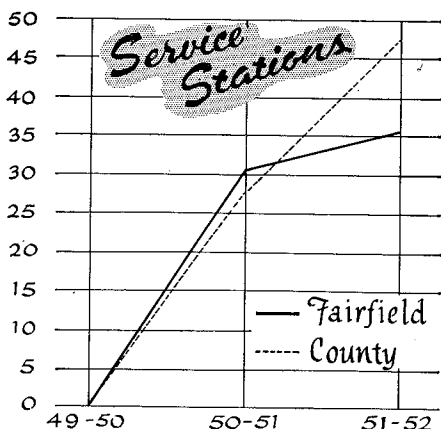
Service Stations

Gross sales since 1949 of service stations in Fairfield show an increase of 35.3 percent, while Solano County increased 47.4 percent during the same period, and as indicated on the accompanying line-graph. The number of stations throughout the county increased by 6 percent, while Fairfield remained constant.

This would indicate that the service stations in Fairfield have adjusted and are now catering to local patronage. It also appears that they have increased their business to a definite point and are reaching a constant which is probably the buying capacity of the community.

All Other Business

The majority of the business in the community is reflected in the gains or losses within this class of retail outlet. This survey reveals that the majority of retail outlets in Fairfield increased their gross sales by 41.5 percent since July, 1949. At the same time the majority of retail business in Solano County made gains amounting to 34 percent. Fairfield excelled the county by 11.5 percent, which is exactly the same difference which appeared for the total volume of business. In checking the tabulation of the figures, we find this percentage difference happened to be coincidental. However, it is not a strange coincidence because



the "All Other" class of business represents a large portion of the total volume.

Referring back to the previous economic study, we find that "All Other" business in Fairfield increased 22.6 percent, whereas Solano County increased 8.5 percent. The difference between the town and county was much greater during the year following the removal of through traffic from the business district of Fairfield. The highway travelers who stopped in Fairfield did not patronize the retail outlets which supplied the basic needs of the community. Their purchases were confined principally to cafes, bars and service stations. In fact, it is this group of retail outlets which comprise the majority of the community business, which benefits the most by the removal of through traffic.

The removal of the highway traffic showed an immediate benefit to the "All Other" class of retail outlet. This gain was reflected in the difference in gross sales between Fairfield and the county immediately after the by-pass went into effect.

Conclusion

A review of the facts in this study clearly indicate that:

1. Travis Air Force Base is to a large degree responsible for the majority of the growth and development which has taken place in Fairfield during recent years.
2. Those retail outlets which suffered business losses immediately after the realignment of U. S. Highway 40 have made a successful readjustment and are now enjoying higher business returns from the increased patronage of local customers without the congestion of through traffic.

3. Removal of the heavy volume of through traffic from the business district in Fairfield aided in providing an uncongested and easily accessible shopping center ready to serve the new residential growth.

4. It is reasonable to assume the desirability of the existing business district without traffic congestion in Fairfield discouraged the development of a new competitive shopping area.

5. The construction of new motels in the Fairfield area is indicative that proper approaches to the area from the by-pass and the accessibility of related services are equally as important as the volume of the traffic.

OUT-OF-STATE CAR ENTERS CALIFORNIA EVERY 25 SECONDS

An out-of-state automobile entered California every 25 seconds during the first three months of this year, the Touring Bureau of the Automobile Club of Southern California reports.

An all-time high of 319,847 cars, carrying 837,297 passengers, checked into border stations during the three-month period. This is an increase of more than 15 percent over the 277,240 "foreign" cars which entered the State during the first quarter of 1952. The passenger count during the same period last year was 704,828.

More than 61 percent of the automobiles checked into the State through the five Southern California border stations. The count was 197,876. During the first quarter last year, 185,087 cars entered through the five stations.

Since the San Francisco-Oakland Bay Bridge was opened to traffic in 1936, nearly 64,000 vehicles have run out of gas on the bridge; another 65,000 have had to be towed off because of engine trouble, accidents or because they were not carrying spare tires; and 38,000 had to have their tires changed, bringing the total breakdowns to date to nearly 167,000. This is an average of more than 28 vehicles each day or, to put it another way, one car out of every 2,050 crossing the bridge has had some sort of breakdown before it got to the other end.

Cost Index

California Highway Construction Costs
Dip 3.5 Percent in First Quarter of 1953

By RICHARD H. WILSON, Assistant State Highway Engineer
H. C. McCARTY, Office Engineer
J. D. GALLAGHER, Assistant Office Engineer

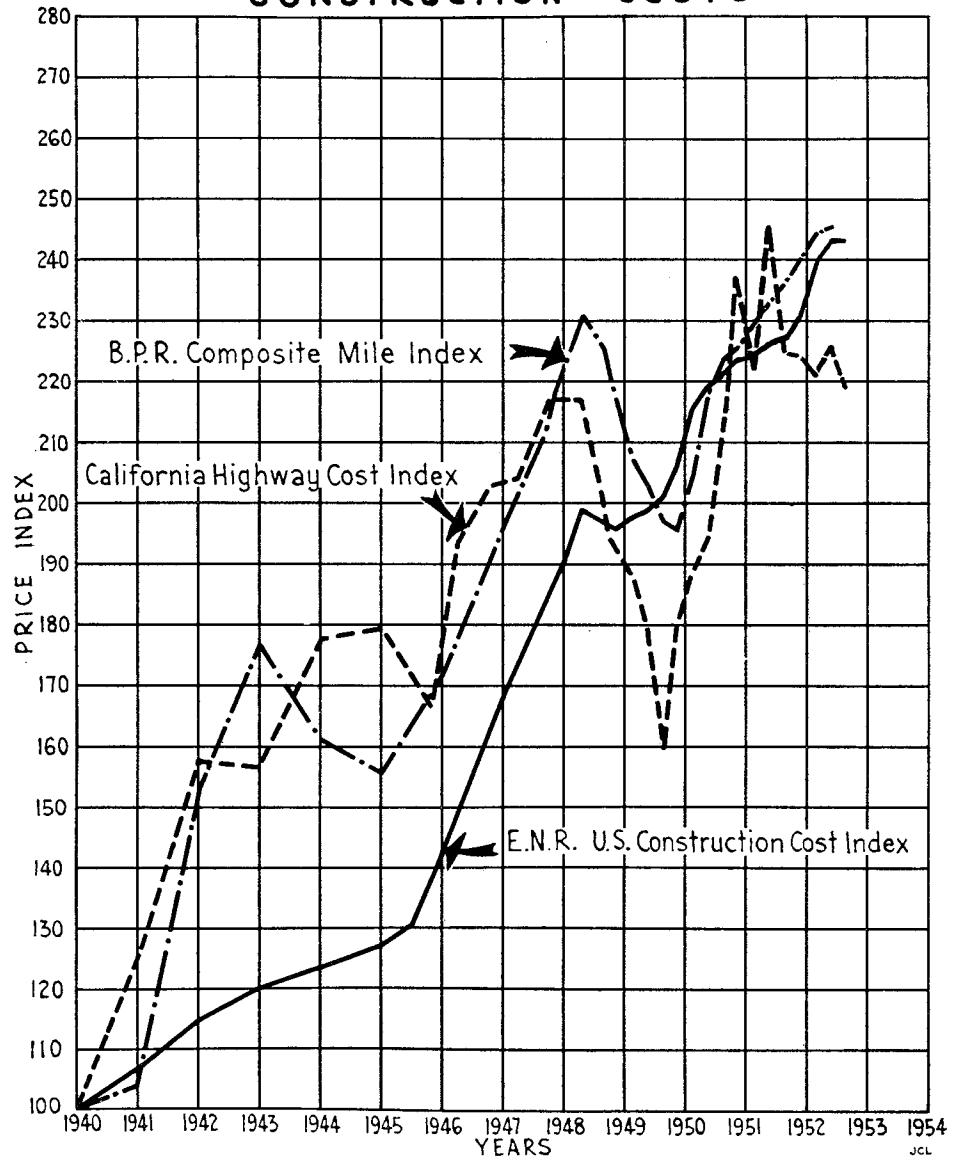
CONSTRUCTION COSTS on state highway projects on which bids were opened during the first quarter of 1953 were 3.5 percent lower than those of the fourth quarter of 1952 as reflected by the California Highway Construction Cost Index.

The index, which is computed on the base of 1940 = 100, stood at 218.3 for the first three months of the year. This is 7.9 points below the 226.2 of the last quarter of 1952. The first quarter of 1953 index of 218.3 is 27.1 index points or 11.0 percent below the 245.4 of the fourth quarter of 1951, which was the quarter of highest costs as indicated by the index, and is 58.3 index points or 36.4 percent over the 160.0 of the third quarter of 1950, which was the low point dip in prices prior to the beginning of the Korean War.

The following is a tabulation of the California Highway Construction Cost Index by years and quarters since 1940:

Year	Cost Index
1940	100.0
1941	125.0
1942	157.5
1943	156.4
1944	177.8
1945	179.5
1946	179.7
1947	203.3
1948	216.6
1949	190.7
1950 (1st quarter)	160.0
1950 (2d quarter)	180.0
1950 (3d quarter)	189.2
1950 (4th quarter)	194.8
1951 (1st quarter)	215.4
1951 (2d quarter)	238.3
1951 (3d quarter)	221.9
1951 (4th quarter)	245.4
1952 (1st quarter)	224.8
1952 (2d quarter)	224.4
1952 (3d quarter)	221.2
1952 (4th quarter)	226.2
1953 (1st quarter)	218.3

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS
**PRICE INDEX
CONSTRUCTION COSTS**



The 3.5 percent drop in the index during the first quarter of 1953 is almost entirely due to a 32 percent decline in the average price of road-

way excavation (from \$0.66 to \$0.45). While crushed rock and Portland cement concrete pavement were also down slightly, the average prices for

Number of Bidders Prequalified to Bid On State Highways

The following data shows number of contractors qualified to bid State highway projects as of January 29, 1953. Based on their maximum ratings, these 611 contractors are grouped as follows:

\$10,000,000 and over	— 29
5,000,000 to 10,000,000	— 63
2,500,000 to 5,000,000	— 103
1,500,000 to 2,500,000	— 162
1,000,000 to 1,500,000	— 222
500,000 to 1,000,000	— 319
250,000 to 500,000	— 437
100,000 to 250,000	— 522
50,000 to 100,000	— 549
up to 50,000	— 611

The combined bidding capacity February 1, 1953, of these 611 contractors was \$1,263,819,000 or in round figures \$1,265,000,000.

In arriving at this combined bidding capacity figure all ratings in excess of \$20,000,000 are entered at the \$20,000,000 figure.

AVERAGE CONTRACT PRICES

	Roadway excavation, per cu. yd.	Crusher run base, per ton	Plant-mix surfacing, per ton	Asphalt concrete pavement, per ton	PCC pavement, per cu. yd.	PCC structures, per cu. yd.	Bar reinforcing steel, per lb.	Structural steel, per lb.
1940	\$0.22	\$1.54	\$2.19	\$2.97	\$7.68	\$18.33	\$0.040	\$0.083
1941	0.26	2.31	2.84	3.18	7.54	23.31	0.053	0.107
1942	0.35	2.81	4.02	4.16	9.62	29.48	0.073	0.103
1943	0.42	2.26	3.71	4.76	11.48	31.76	0.059	0.080
1944	0.50	2.45	4.10	4.50	10.46	31.99	0.054	0.132
1945	0.51	2.42	4.20	4.88	10.90	37.20	0.059	0.102
1946	0.41	2.45	4.00	4.68	9.48	37.38	0.060	0.099
1947	0.46	2.42	4.32	5.38	12.38	48.44	0.080	0.138
1948	0.55	2.43	4.30	5.38	13.04	49.86	0.092	0.126
1949	0.49	2.67	4.67	4.64	12.28	48.67	0.096	0.117
1st quarter 1950	0.34	2.22	3.65	3.74	—	40.15	0.077	0.081
2d quarter 1950	0.40	2.13	4.48	3.74	10.86	43.03	0.080	0.105
3d quarter 1950	0.41	2.32	4.25	5.50	10.91	44.34	0.093	0.131
4th quarter 1950	0.42	2.81	4.64	4.61	12.55	43.18	0.098	0.120
1st quarter 1951	0.45	3.07	4.06	5.22	11.71	46.38	0.103	0.206
2d quarter 1951	0.63	3.88	4.56	4.63	12.93	51.50	0.105	0.166
3d quarter 1951	0.56	2.88	4.59	3.90	12.41	46.14	0.107	0.165
4th quarter 1951	0.66	2.91	5.66	4.89	12.71	49.38	0.105	0.169
1st quarter 1952	0.56	3.25	4.88	4.77	14.25	47.46	0.094	0.152
2d quarter 1952	0.53	3.19	5.29	4.13	14.20	49.12	0.091	0.143
3d quarter 1952	0.55	2.61	5.49	4.60	12.80	48.21	0.094	0.132
4th quarter 1952	0.66	2.68	4.97	—	12.53	48.45	0.094	0.128
1st quarter 1953	0.45	2.48*	5.27	4.46	12.47	53.19	0.098	0.150

* Untreated rock base substituted for crusher run base at this point.

NUMBER AND SIZE OF PROJECTS, TOTAL BID VALUES AND AVERAGE NUMBER OF BIDDERS

(July 1, 1952, to December 31, 1952)

Project volume	Up to \$50,000	\$50,000 to \$100,000	\$100,000 to \$250,000	\$250,000 to \$500,000	\$500,000 to \$1,000,000	Over \$1,000,000	All projects
		\$100,000	\$250,000	\$500,000	\$1,000,000		
Road projects:							
Number of projects	75	26	28	14	7	1	151
Total value (bid items)	\$1,658,528	\$1,800,875	\$4,469,587	\$4,568,889	\$4,811,328	\$1,919,792	\$19,228,999
Ave. number bidders	3.9	4.5	6.0	5.1	6.4	5.0	4.6
Structure projects:							
Number of projects	16	11	4	4	2	2	39
Total value (bid items)	\$378,558	\$782,590	\$726,929	\$1,467,222	\$1,233,486	\$4,101,836	\$8,690,621
Ave. number bidders	4.1	5.7	7.3	9.0	9.5	6.0	5.8
Combination:							
Number of projects	—	—	—	—	2	4	6
Total value (bid items)	—	—	—	—	\$1,917,715	\$9,012,508	\$10,930,223
Ave. number bidders	—	—	—	—	3.0	8.1	6.5
Summary:							
Number of projects	91	37	32	18	11	7	196
Total value (bid items)	\$2,037,086	\$2,583,465	\$5,196,516	\$6,036,111	\$7,962,529	\$15,034,136	\$38,849,843
Ave. number bidders	3.9	4.8	6.2	5.9	6.4	7.1	4.9

Total Average Bidders by Months

	July	Aug.	Sept.	Oct.	Nov.	Dec.
1952	4.3	4.3	5.9	5.1	5.9	4.8
1951	4.3	4.0	4.6	4.4	8.0	7.3

... Continued on page 55

other items used in compilation of the index registered increases.

Plant-mixed surfacing average prices rose from \$4.97 to \$5.27 per ton; structure concrete increased from \$48.45 to \$53.19 per cubic yard; bar reinforcing steel rose from \$0.094 to \$0.098 per pound and structural steel increased from \$0.128 to \$0.150 per pound.

These facts would indicate that in spite of the 3.5 percent over-all decline in the index, costs of some major items are still on the rise. However, both the Engineering News-Record Construction Cost Index and the U. S. Bureau of Public Roads Composite Mile Index, as shown on the accompanying chart, indicate their first leveling-off in the last four years.

It is thought that the drop in roadway excavation merely reflects the seasonal effort of bidders who have completed work in the fall and early winter to insure their obtaining jobs

Roadside Trash

Santa Barbara County Boy Scouts Perform Good Deed

AT THE SUMMIT of San Marcos Pass, north of Santa Barbara on State Sign Route 150, there was on display for an entire week in March a pile of rubbish five feet high, covering an area 12 feet wide and 30 feet long.

The pile—composed of tin cans, bottles, boxes, tires, junk metal, cartons, and even old Christmas cards—was the “harvest” from a one-day Boy Scout roadside cleanup campaign which covered 14 miles of scenic highway crossing the Santa Ynez Mountains.

The Boy Scout project provided another dramatic illustration of the problem created by the insistence of some motorists on using highways and roadsides as a public dump. In addition to its obvious detraction from the scenic attractiveness of the California countryside, the indiscriminate tossing or depositing of rubbish along the highway by motorists is costly in terms of hard cash as well.

Costs Run High

It costs the State Division of Highways about \$450,000 a year to remove and dispose of roadside rubbish along the 14,000 miles of state highway in California, an average of \$35 a mile.

Actually, the annual cost can run from almost nothing on some lightly traveled remote mountain routes to \$1,600 a mile on some sections of heavily traveled freeway. Some stretches of highway yield as much as a large truckload of refuse every week.

State highway crews are equipped and trained to maintain the roads in safe condition for travel. For economy, the operations are highly mechanized. It is costly and contrary to public interest to divert the equipment operators and other maintenance men from their main tasks in order to pick up the roadside litter left by thoughtless motorists.

Boy Scouts Do Good Deed

The Boy Scouts’ “good deed” on Sign Route 150 was a mass effort,



Boy Scouts of Santa Barbara County staged a one-day roadside cleanup campaign along 14 miles of State Sign Route 150, the San Marcos Pass Highway, in connection with National Conservation Week. This pile of assorted rubbish is the result. It was collected and left on display at the summit of the pass for several days, to dramatize the end result of careless depositing of trash along State highways.

sponsored by the scout organization in Santa Barbara County. A total of 169 boys and 24 adult leaders took part, including groups from Santa Maria and Lompoc as well as Santa Barbara.

One group started at the intersection of U. S. 101 and the San Marcos Pass route just west of Santa Barbara; the other started at the San Lucas Bridge in the Santa Ynez Valley. Both worked toward the summit, the boys gathering up the rubbish and placing it in trailers and pickup trucks which patrolled the route.

AUTO ACCIDENT TOLL IS WORST IN NATION'S HISTORY

More than 2,000,000 casualties, the worst automobile accident toll in the Nation's history, were recorded in 1952, according to figures released by the Traveler's Insurance Companies.

Last year's traffic deaths totaled 37,600, an increase of 500 over the 1951 mark. The injury count soared

The Division of Highways, through the Maintenance Department in District V, made red flags and hand stop signs available to the scouts for use in warning traffic that the cleanup drive was in progress.

After the pile of accumulated roadside litter had remained on view at the summit of the route for several days, it was hauled away for disposal by Division of Highways trucks.

State highway maintenance workers pointed out that the San Marcos Pass Highway has always been regarded as one of the brighter spots in the roadside rubbish picture.

to 2,090,000, more than 127,000 over 1951.

The death and injury totals are highlight statistics from “Who, Me?” nineteenth in an annual series of traffic accident data booklets published by the Travelers. Company statisticians collect and analyze accident facts from each state.

The most dangerous mistake in driving last year was excessive speed.

Assembly Honors The Memory of A. Teichert, Jr.

THE ASSEMBLY of the California Legislature, when it adjourned on May 12th, did so out of respect for the memory of Adolph A. Teichert, Jr., nationally known construction contractor, after adopting the following resolution:

WHEREAS, The Members of the Assembly have received with deepest regret news of the passing in Sacramento on May 6, 1953, of Adolph A. Teichert, Jr., prominent California community leader and construction contractor; and

WHEREAS, Adolph A. Teichert, Jr., was born in San Francisco, April 24, 1885, graduated from the University of California at Berkeley with a Bachelor of Science degree in 1908, and through his personal skill, resourcefulness, and ingenuity rose to become President and General Manager of the well-known construction firm of A. Teichert & Son., Inc.; and

WHEREAS, As recognition of his abilities and achievements he was Past President of the Associated Contractors of America, and also of its Northern California Chapter; and was Vice President of the Sacramento Guarantee Building and Loan Association, Buffalo Brewing Company, Fidelity Title Insurance Company, and the El Dorado Limestone Company; and

WHEREAS, He assumed a foremost role in state service and civic affairs as former President of the Sacramento Chamber of Commerce, The Community Chest, Young Men's Christian Association, and Exchange Club, as a charter and life member of the Ben Ali Temple of the Shrine, as a life member of the Shriners Crippled Children Hospital organization, as a Thirty-second Degree Mason in the Sacramento Scottish Rite Bodies, and as a member of the State Chamber of Commerce, the Consulting Engineers of America, Inc., Rotary Club, Del Paso Country Club and Sutter Club; now, therefore, be it

Resolved by the Assembly of the State of California, That when the Assembly adjourns today it does so out of respect to the memory of Adolph A. Teichert, Jr.; and be it further

Resolved, That the Chief Clerk of the Assembly is hereby directed to transmit suitably prepared copies of this resolution to Mrs. Alma Teichert, widow; Miss Nancy Teichert, daughter; Henry Teichert and Adolph H. Teichert, sons; Mrs. Caroline Skinner, sister; and Frederick Teichert, Rosalind Teichert, and Jonathan Teichert, grandchildren.

To lessen the chances of roadway slipouts and slides, 12,000 lineal feet of horizontal drains were installed at various locations by the State Division of Highways during the 1951-52 Fiscal Year.

By combining 50 percent palmyra and 50 percent hickory fiber on power brooms, the State Division of Highways has increased the wearability of the brooms on its equipment by 50 percent at no additional cost.

New Sign Routes Added to State Road Map

TWO NEW highway sign route numbers will appear on future revisions of road maps made available to California motorists.

The California Division of Highways announces the completion of its latest master map of the State showing U. S. and state sign routes. This master map, which the division brings up to date each year, is made available to tourist bureaus, auto clubs, map printing firms, oil companies and other public or private agencies who produce maps for the convenience of the motoring public.

Major Changes

The major changes over the 1952 version of the sign route map are:

Highway 30—A newly-numbered route between the Los Angeles area and the Big Bear Lake resort country.

Highway 28—Along the north shore of Lake Tahoe.

Highway 128—A new number, assigned to the former Highway 28, between the Mendocino Coast and Winters, in Yolo County.

U. S. 395—Follows a new section of highway between Temecula and Perris, in Riverside County, instead of via Elsinore.

Highway 30, located in San Bernardino County, follows Highland Avenue and City Creek Road, with its temporary western terminus in Upland at the junction of Euclid Avenue and Foothill Boulevard (U. S. 66). The eastern end of Highway 30 is at Running Springs on Highway 18 west of Big Bear Lake.

City Creek Road Traffic Increases

Eventually, Highway 30 will follow Highland Avenue all the way from its western terminus near Glendora, in Los Angeles County. This permanent route designation will not be made, however, until the portion of Highland Avenue between Glendora and Upland has been improved.

Since the improvement of City Creek Road two years ago, more and more cars from the Los Angeles area

are using this route as an alternate way of getting to Lake Arrowhead and Big Bear Lake.

The hitherto unnumbered highway along the north shore of Lake Tahoe between Tahoe City and the California-Nevada boundary has been designated as new State Sign Route 28, joining Nevada Sign Route 28 at the state line.

New Number for Sign Route 28

The former State Sign Route 28, which extended from State Sign Route 1 at the mouth of the Navarro River to Winters, in Yolo County, has been redesignated as State Sign Route 128. This change made possible the assigning of number 28 to the Lake Tahoe north shore route.

The newly-constructed stretch of highway between Perris and Temecula, in Riverside County, has been officially designated as U. S. 395, replacing the old portion through the City of Elsinore. This procedure is routine in the case of major relocations. State Route 71 still goes through Elsinore.

The division has been issuing a revised edition of its master map each year since 1934.

Fill Construction

Continued from page 14 . . .

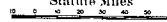
Elm Street Overcrossing

The freeway is carried over Elm Street by an overcrossing and the grade of the existing street was lowered about two and one-half feet to obtain clearance and drainage. Here, ground water level is close to subgrade elevation and three lines of perforated metal pipe backfilled with rock filter material will be installed in Elm Street. The grade lines will descend to the west, following the general slope of the underlying impervious stratum, to an area clear of the work where porosity of subsurface material will permit absorption of the underground flow.

STATE OF CALIFORNIA
 DEPARTMENT OF PUBLIC WORKS
 DIVISION OF HIGHWAYS
 MAP OF
CALIFORNIA
 SHOWING
 UNITED STATES AND STATE
 NUMBERED HIGHWAYS

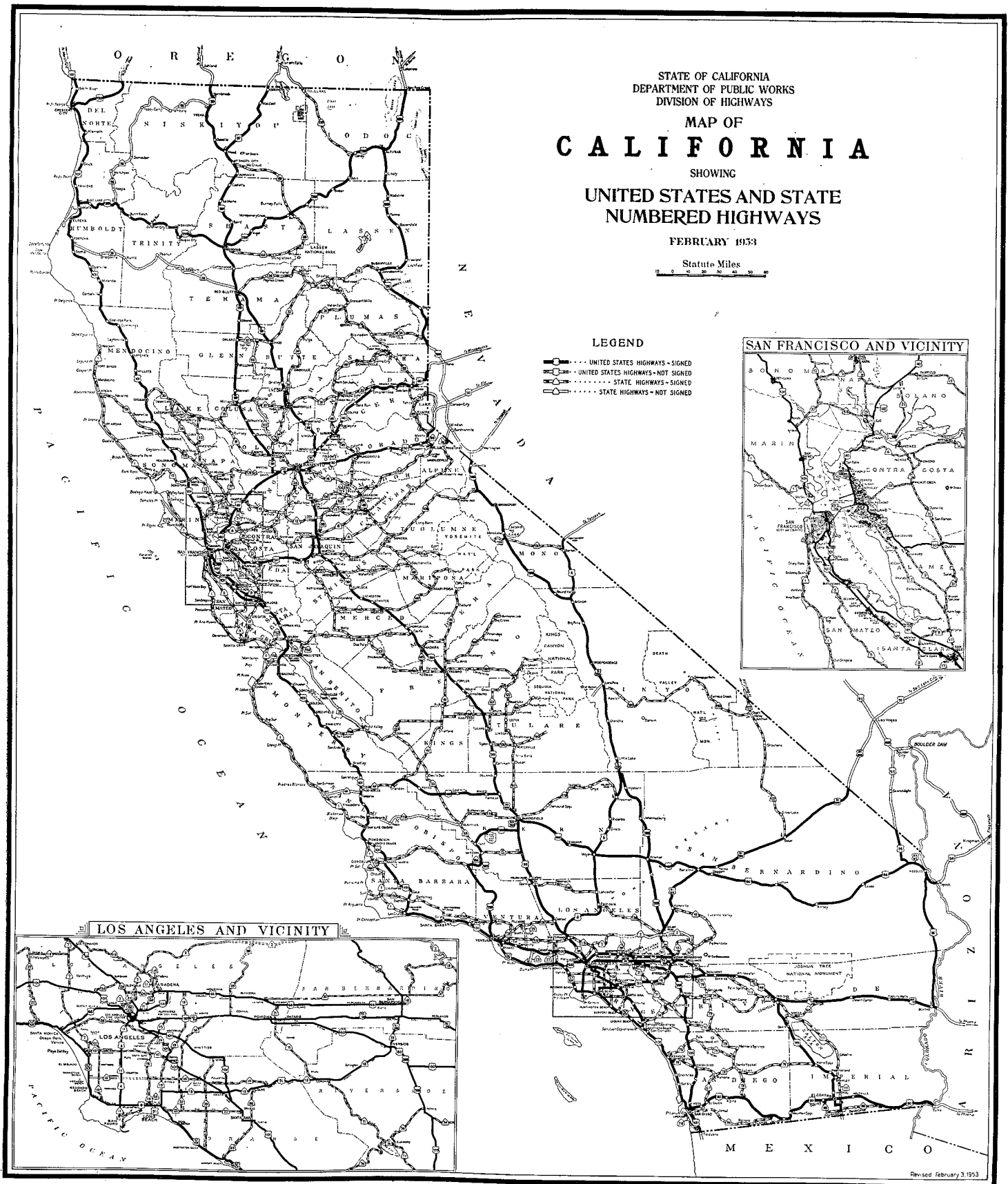
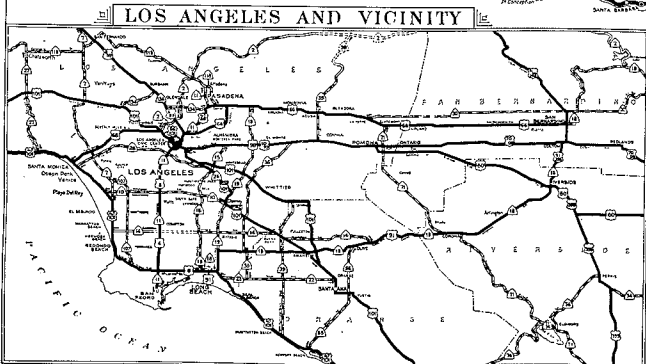
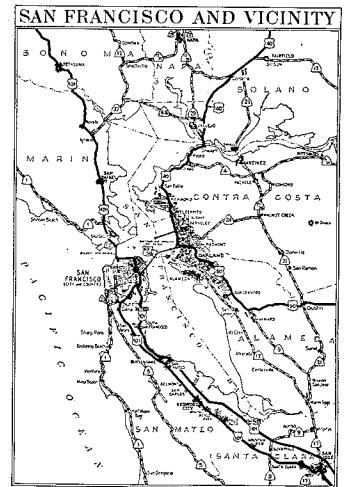
FEBRUARY 1933

Statute Miles



LEGEND

- UNITED STATES HIGHWAYS - SIGNED
- UNITED STATES HIGHWAYS - NOT SIGNED
- STATE HIGHWAYS - SIGNED
- STATE HIGHWAYS - NOT SIGNED



Revised February 3, 1933

Early Days

Minutes of First Highway Commission
In 1916-19 Make Interesting Reading

By R. C. (CASS) KENNEDY, Secretary, California Highway Commission

Continued from last issue

THIS STARTS the notes on the 1916 minutes of the California Highway Commission. Nothing much of interest happened during January and February, except on February 11th Commissioner Darlington suggested that the commission take steps to cause to be introduced a bill in Congress providing for governmental aid in the construction of a highway from Merced to El Portal. This evidently was the beginning of our Yosemite All-Year Highway which is now in existence. Later on, in February, the commissioners authorized the highway engineer to have prepared suitable motion picture films illustrating his state highway activities. The cost of these films was not to be more than \$2,000, and were to be supplied, rent-free, to moving picture houses throughout the State.

Bridge in Humboldt

In March, the commission wrote a letter to the Board of Supervisors of Humboldt County in reference to a bridge to be built up there. The original estimate for the bridge was \$40,000, which sum the commission agreed should be paid by the State. It was understood that Humboldt County would pay the entire cost of the structure in excess of the sum of \$40,000.

The plans for the bridge had been prepared by the engineers and the estimate showed that the structure would cost more than \$100,000. This cost was much in excess of any amount heretofore discussed with the board of supervisors, and the additional estimated cost was largely due to the extraordinary rise in the price of steel due to war conditions. It also appeared that because of the war the mills were so busy that steel deliveries were not promised earlier than the following October, with a chance of a much later delivery date.

Sold Steer Hides

In several places, I have noticed in going through these files that the commissioners were crediting money that they had received from the sale of hides, and I had no idea where the hides came from until the minutes of March 7th disclosed that the State Board of Control granted the necessary authority to the commission to sell hides at the best price obtainable. It seems that the commissioners were buying beef on the hoof for road construction crews. Naturally, as the steers were killed, hides accumulated, and the idea was that the commission would be allowed to sell them and credit the money to the Highway Fund.

There is a note in the May 13, 1916, minutes to the effect that the commission voted its sincere appreciation to the Causeway Celebration Committee. This was in connection with the ceremonies commemorating the completion of the Yolo By-pass Trestle, which work was completed on March 24, 1916, and the structure became known as the Yolo Causeway.

Speed of Autos Controlled

In May of 1916, the commission received a letter from the County Clerk of Marin County, requesting its cooperation in the matter of enforcing regulations controlling the speed of automobiles on state highways, this speed to be controlled particularly in the neighborhood of schools. There are further notes in the minutes of this same day suggesting that the commission call upon the proper authorities of the several counties to prosecute to the fullest extent the conspicuous violations of the state speed law incident to the various reported record auto runs between Los Angeles and San Francisco. The letter to the several district attorneys called attention to the Motor Vehicle Act, Section 22(a), prohibiting automobile road racing

upon state highways except by specified permission of the state authorities. Also, that a provision of the act, Section 22(b), established a maximum speed limit of 30 miles per hour. The letter continued that it was a matter of press report that various road records had been made between Los Angeles and San Francisco over state highways since the passage of this resolution.

Just for the information of the younger generation, let me say that it was quite a feat in those days to drive from Los Angeles and San Francisco without having quite a lot of trouble. Different motor car dealers would pick out one of their better drivers, either a salesman or a mechanic, and work over a car until they got it in pretty nearly perfect condition. Then they would make arrangements for refueling it at different spots; then, would start out either from San Francisco or Los Angeles to find out how fast they could make it to the other city. Naturally, as soon as they did that, they had advertisements prepared and placed them in newspapers crowding about the speed and stamina of their car. This is what the California Highway Commission was taking exception to.

Early Road Signs

On June 7th, the commission voted that the B. F. Goodrich Company be notified that the precedent established by the commission demanding the removal of all advertising signs from the right of way of the California state highways had been, and would be, enforced without exception. And it further stated that the Goodrich road markers could not be given a special permit but that in recognition of the public service rendered by the Goodrich road markers, this company would be granted until December 1st to remove its signs. I don't know how many of my readers remember the signs of

the B. F. Goodrich Rubber Company. They were established along our highways and gave mileages to different towns, and of course, carried the advertising of the Goodrich Rubber Company. The thought of the Goodrich people at the time was that they were going to sign the entire United States with these signs, but they ran up against the same idea in several other states as they did in California, and finally gave it up.

County Contributions

There is one thing that I noticed in the minutes of June 26, 1916. There was a job to be done in Division IV in San Mateo County, and the commission was opening bids. The list of contractors and the amounts bid are listed in the minutes. One of these bidders was Eaton & Smith, of San Francisco. This same firm was allotted a contract in Plumas and Lassen Counties for some \$400,000 the first part of April, 1952. Eaton & Smith still bid on state highway jobs.

In the minutes of June 27, 1916, I ran across this. It was voted that the various counties, obligated to contribute money to the State Highway Fund, for the construction of state highways or bridges, be requested to forward their contributions to the State Highway Fund as soon as possible.

In August of 1916, the Pacific Coast manager of the B. F. Goodrich Company appeared before the commission, requesting permission to repaint all of the company's signs on state highways. This would cover up the name of the Goodrich Company and all advertising features, and the signs would be donated to the State without cost. The commission advised the gentleman that its plans for a uniform system of signs on the state highways were determined upon and that it could not consistently consider the proposition.

Sign Order Modified

And then, in October, 1916, a notation appears in the minutes that the commission would not be in a position for some months to install upon the state highways the State's distance and directional signs. The commission decided, in order that the traveling public might not be inconvenienced by such

delay, its previous order for removal of the Goodrich markers by December 1st be modified and that the markers might remain upon the state highways until further orders were received from the commission. At the same time, it denied the application of a Dr. Paul Bauer of Newhall, California, who owned White Sulphur Mineral Springs and wanted to erect certain road signs on portions of the state highway in Los Angeles County. But the commission said "No."

Now, in the old days, gasoline pumps were set out near the curb. We did not have what we now know as "Service Stations." So the commission passed a rule that in no case would pumps be permitted to be installed at any point nearer than 20 feet from the center of the state highway.

During the meeting of December 19, 1916, it was voted that Mr. Darlington be elected chairman of the commission. It was evidently the thought of the commission, being made up of only three men, that the chairmanship would rotate.

New Districts

By the time 1917 began, the commissioners evidently were surfeited with work and they thought it well to divide the State into three districts. These districts were for the commissioners alone. District I comprised the whole of Divisions I, IV, and V, with the exception of Santa Barbara County. This district was to be under the charge of Mr. Blaney, and Mr. Blaney was to make his headquarters and office in the Rialto Building in San Francisco. District II comprised the whole of Divisions II, III, and VI, with the exception of Kern, Mono, and Inyo Counties, and that was to be under the charge of Mr. Stern, with his headquarters and office in the Forum Building at Sacramento; and District III would comprise the whole of Division VII, together with Santa Barbara, Kern, Mono, and Inyo Counties, and was to be under the charge of Mr. Darlington, who was to make his headquarters and office in Los Angeles. It is further stated in the minutes that all transactions arising in any district, other than such as are purely routine, no matter by whom received or to whom presented, should be referred

forthwith through the proper channels to the commissioner in charge of such district.

Commission Meetings Rotated

The commission also decided that there would be a stated meeting of the commission on Tuesday of each week—such meetings to be held in rotation in Sacramento, Los Angeles, and San Francisco. But it further stated that on the third Tuesday of each month the meeting should be held in Sacramento.

The minutes also state that each commissioner should remain in his district, to such extent as was necessary, and center his energies upon the work of his district, except that at all of the weekly meetings all questions, no matter where they originated, should be presented at the meeting for discussion and action. The weekly meeting was to be, in effect, the clearing house for all actions by the commission. The next day, on January 24, 1917, the commission voted that Commissioner Stern be designated to act as an auditing committee of one for and on behalf of the commission.

It would seem that the commission had ordered all electric power companies to take their lines off the state highway right of way. On January 24, 1917, there is record of a meeting with representatives of all the large power companies in the State together with the secretary of the Light and Power Association of California. These gentlemen asked that an opinion of the Attorney General of the State be obtained in the matter before the order would take effect. The gentlemen appearing had an opinion that there were good grounds for believing that the commission was exceeding its legal authority and arbitrarily determining what was a dangerous high-tension voltage. It was finally decided that Mr. Carleton, the attorney for the commission, and the Attorney General, would get together and decide on the legality of the question, later upheld by the Attorney General. This was the beginning of clearing the rights of way of the state highways of all poles and other pieces of equipment of public utilities.

New Commissioner

On March 6, 1917, the commission met in Sacramento, and there is a note

that a new commissioner, Henry J. Widenmann of Vallejo, appointed by Governor Johnson on March 1st to Commissioner Blaney, would be seated as a member of the commission. This was done.

In April, 1917, the commission discovered that it needed a steam shovel. Mendocino County had had a number of slides. A second-hand steam shovel was bought for \$3,500.

Also, on April 3d, it shows that a J. W. Vickrey was employed as a transitman in Division I at \$90 a month, with allowance for board and lodging. This same J. W. Vickrey is now Assistant State Highway Engineer in charge of planning, and his headquarters is in Sacramento.

In 1917, the first World War was on. At that time, the commission voted that deductions could be made from the salaries of various employees of the commission who had authorized it to make deductions to cover their subscriptions for Liberty Bonds on the employer's plan.

The commission had received a letter from Division Engineer Patch, recommending the installation of cast iron discs 12 inches in diameter and 6 inches high, painted white, at the center of the intersection of certain streets in Southern California. These were to serve the purpose of automatic flagmen. The commission approved this suggestion, but amended it to say the discs should not be over three inches high and of a diameter and design satisfactory to the Highway Engineer.

Feather River Highway

In July, 1917, the North Fork of the Feather River appears in the minutes. It seems that a joint committee of the supervisors of Butte and Plumas Counties was heard concerning a detailed examination for a state highway route in the canyon of the North Fork of the Feather River. The commission decided that the Highway Engineer should appoint one of the engineers of the commission to act with the engineers selected by the two counties, and that the dates of the examination were to be arranged by the three engineers so appointed. I hope my readers realize that the North Fork of the Feather River is where our present Feather River Highway is located.

At the meeting of July 26, 1917, the secretary read a letter from the Cotati Chamber of Commerce urging the early construction of the highway between Petaluma and Santa Rosa. The reason this question is brought up is that the people in that neighborhood are right now urging the commission to build a freeway between Petaluma and Santa Rosa as quickly as possible.

In September, 1917, the commission received a letter from the District Attorney of Napa County, concerning the necessity for a reduction in speed of vehicles on the state highway in the vicinity of the main entrance of the Napa State Hospital. So, the commission voted that the speed limit be reduced to 15 miles per hour.

In October, 1917, the Highway Engineer submitted forms of proposed warning road signs. The commission authorized him to order 100 of these signs. The signs were to be enameled on metal—white letters on a green background. This was probably the beginning of our road signs.

Wartime Shipments

During the meeting of November 1, 1917, the commissioners went into executive session with the Highway Engineer and the seven Division Engineers, the Purchasing Agent, and the Chief Geologist. They had the matter under consideration regarding the government's threatened injunction against the shipment of road-building materials by railroad freight cars. Spread on the minutes is a copy of the telegram sent to the State Council of Defense in San Francisco, and also to Robert S. Lovett of the War Industries Board in Washington, D. C., protesting against the idea of stopping shipment of highway and roadbuilding materials by railroad. A copy of both communications was forwarded to Governor Stephens, and his aid was solicited in trying to get the matter straightened out.

At the December meeting, the commission requested the attorney, Mr. Carleton, to prepare a digest of the Motor Vehicle Act and lay out the duties of the commission as defined by that act.

Also, at the December meeting, there was a letter received from the North-of-Bay Counties Press Asso-

ciation—in fact, there were two letters. These letters asked that the commission interest itself in removing signs from the state highway in Sonoma, Mendocino, and Humboldt Counties. This gets us pretty well through 1917; in fact, that is one of the last entries in the book for the year 1916.

Intersection Buttons

Starting the year 1918, the commission minutes are mostly devoted to routine business. The County of Orange had asked permission to set buttons at the centers of intersections of the principal paved county highways with the state highways. Where the county highways crossed the state highways the county wanted to set buttons of cast iron in the middle of the intersection. There is a drawing in pen and ink in the minutes of a cross-section of one of these buttons. They were to be 18 inches in diameter and 3 inches high and set on a one-inch bar of steel which was cast into the disc. This bar was to fit into the hole in the middle of the pavement and the button was to be in the center of the intersection. The buttons were to be painted white. A permit was issued for the installations of the buttons.

With World War I going on, there was trouble down at Camp Fremont on the San Francisco Peninsula. There is a letter from P. J. Tehaney, who was Acting Superintendent of the Motor Vehicle Department at the time. He forwarded a letter from B. H. Pope, the Provost Marshal of Camp Fremont, concerning the revoking of certain automobile and motorcycle licenses. It also asked for advice in the matter of placing signs at certain railroad crossings at the camp.

The secretary was instructed to refer Mr. Tehaney's letter and the enclosure to Attorney Carleton, and Mr. Carleton was instructed to consult with Mr. Tehaney directly and to arrive at an understanding with that official concerning all matters pertaining to the commission's functions under the Motor Vehicle Act.

It would seem that some soldiers stationed at Camp Fremont and some civilians were driving a little bit fast; the camp authorities wanted to slow them down when going by Camp Fremont.

Careless Drivers Cited

At the January 30, 1918, meeting, the commission received from the official reporter of the coroner's office in San Francisco a copy of a verdict in the case of a certain person who came to his death through an accident caused by the careless driving of an automobile by another person. This letter recommended that the driver's license be revoked by the proper authorities, and there were two letters again from the Motor Vehicle Department regarding two other infractions of the law. It was decided that all similar letters be referred to the attorney with the recommendation that the attorney prepare a report and the necessary blanks to govern the procedure of the commission in trying all cases of this character.

In February, another letter from Mr. Tehaney, Acting Superintendent of the Motor Vehicle Department, was read and his letter enclosed copies of letters from two people complaining against a driver of an automobile with a certain license number. It would seem that this person was accused of reckless driving. The letter was referred to the attorney with the request that a form letter be prepared in reply to this and similar complaints.

Prison Labor Camps

In the minutes of March 5, 1918, a couple of pages are used to report on a conference at San Quentin Prison. Two of the commissioners and the Highway Engineer representing the commission, and the Prison Board and Warden Johnston, sat down around a table and decided how they were going to run convict labor camps. It was agreed that thereafter the supervision and administration of the work in the prison camps would rest entirely in the hands of the Highway Commission and its representatives, and that prison representatives would no longer act as subforemen or in any other executive capacity with reference to the work of road-building. The prison representatives were to have exclusive control of the discipline of the prisoners, but were to limit their activities solely to this. It was also agreed that the commission's representatives should have the right to ask the return of any men to the prison for any reason that

to them seemed sufficient. This request was to be made to the head guard and by him carried out. It was also agreed that the prison representatives would have the same right to return men for any cause that to them seemed sufficient; and it was also agreed that Mr. Fletcher, the Highway Engineer, and Warden Johnston, would keep each other closely informed of all administrative measures adopted by either.

Pasadena Bridge Speed Limit

The commission had received a letter from the City Attorney of Eagle Rock, California, which talked about the speed on the concrete bridge located on the main road between Eagle Rock and Pasadena. This concrete bridge was the old bridge that is still in use but is being replaced by a new bridge just east of it at the present time. Evidently, some motorists in Southern California were using the bridge as a speedway. The commission voted that the speed limit should be 15 miles per hour on the bridge.

At the May meeting, the Board of Supervisors of Santa Clara County requested and received permission to erect signs on the state highways at the various entrances into Santa Clara County. These signs and the locations were to be satisfactory to the Division Engineer. The wording was to be "*Welcome. Please help us keep our highways and byways clean of picnic refuse,*" and was to be signed by the Board of Supervisors of Santa Clara County.

Improvement clubs, women's clubs, and other civic-minded organizations continually are writing in to the commission, even today, or to the State Highway Engineer, complaining of the rubbish-littered condition of highways in different parts of the State. The Division of Highways has tried in every way possible to alleviate this trouble and to do something about keeping our highways clean.

Pacific Highway

In July of 1918, a letter was received from Samuel Hill, of Seattle. He requested that the commission designate the Western Sacramento Valley Line as the Pacific Highway, and the commission proceeded to vote approval, and gave permission to the Pacific

Highway Association of North America to sign the route, provided that such signs be in form and location satisfactory to the commission.

The minutes of July 17, 1918, also show that the commission had received an agreement with the United States Department of Agriculture regarding Project No. 7, the road between the city limits of Redding and Power House. This is a distance of 15.94 miles, known locally as the Weaver-ville Road in Shasta County. It is quite interesting. It was signed by A. B. Fletcher, Highway Engineer, and by Carl Vrooman, who was Acting Secretary of Agriculture.

In July, 1918, the offices in the Forum Building, Sacramento, were once more expanded for the Headquarters Office. It would seem from the minutes that the State Fish and Game Commission had three rooms on the fifth floor and the Highway Commission wished to expand on the fifth floor. There being no more rooms available, except the three held by the Fish and Game Commission, it was agreed that this agency would move down a floor and the Highway Commission would spend about \$250 installing certain fixtures and floor covering to be the equivalent of what Fish and Game had up on the fifth floor.

At the October 30th meeting, there was spread upon the minutes a resolution regarding the death of Commissioner Widenmann. Mr. Widenmann had passed away on October 6th.

Commissioner Whitmore Seated

At the December 10, 1918, meeting, Charles A. Whitmore, of Visalia, presented his credentials as an appointee of the Governor to succeed Mr. Widenmann on the commission. Also, on December 10th, Assistant Secretary Helen J. Erway resigned, whereupon the commission appointed a new Assistant Secretary in the person of Mrs. Helen M. Davidson (nee Hawkins).

In December, Charles S. Stern decided he didn't have the time to give to the commission, so he resigned, and on December 30th Emmett Phillips, of Sacramento, presented his credentials to the commission as the new appointee by the Governor.

... Continued on page 60

Retirements *from* Service

ON THE OCCASION of his retirement from state service after 33 years with the Division of Highways, L. V. (Pat) Campbell was honored by associates and friends at a dinner at Hotel Senator on April 30th. For the past 20 years, Campbell has been Engineer of City and Cooperative Projects of the Division of Highways.



L. V. CAMPBELL—1953

Pat was born in Louisville, Kentucky, and attended local elementary and preparatory schools in that city. He got his engineering education at Rensselaer Polytechnic Institute where he was a member of the Theta Nu Epsilon and the honor society of Tau Beta Pi.

After graduation in 1910, Pat returned to his native city and engaged in electrical power production. In 1912 he came to California and located in San Diego where he was employed on relocation and construc-

tion by the San Diego and Arizona Railway, and by local private firms. In 1915 he went to work for the California Highway Commission in the old Division III office in Sacramento.

Veteran of World War I

During the first World War he was a second lieutenant in the Engineer



L. V. CAMPBELL—1915

Corps. After receiving his discharge he was employed by the Sacramento County Highway Commission for two years as resident engineer during the construction of county highways by bond issue. Following completion of that work, he was employed by the Nevada State Highway Commission as office engineer for a year and one-half and by the Montana State Highway Commission as office engineer for one year. Returning to California in 1922 he was employed by the Cali-

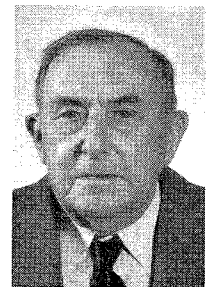
... Continued on page 49

O. B. Brinkerhoff

O. B. Brinkerhoff, Assistant Highway Engineer with the Division of Highways District VIII Office at San Bernardino for 25 years, retired on February 28th.

Brinkerhoff served as resident and location engineer on many highway projects in District VIII, which includes most of San Bernardino and western Riverside Counties.

Brinkerhoff came to work for the California Highway Commission in 1922 as instrument man, and later assistant resident engineer, on various construction projects throughout the State. He resigned in 1926 to take a job with the Southern California Edison Company, but returned to the Division of Highways the following year, accepting employment with the San Bernardino Office where he remained until his retirement.



O. B. BRINKERHOFF

Brinkerhoff was born at Fort Scott, Kansas, in 1883. He attended public schools at Fort Scott and Compton, California, and continued his education at the University of Southern California Law School, graduating in 1904.

He began his engineering career in 1909 when he became a rodman on a survey party with Southern California Edison. He left the Edison Company in 1918 to work for the Sonoma County Surveyor's Office at Santa Rosa, remaining there until his appointment by the California Highway Commission four years later.

Brinkerhoff estimates that during his career he has supervised more than 300 miles of highway construction, most of it in District VIII.

L. H. Williams

L. H. "BILL" WILLIAMS, engineer in charge of the District XI Right of Way Engineering Department at San Diego, was honored at a surprise party in the district office on April 30th in recognition of his impending retirement after 38 years with the Division of Highways.

Williams came to work for the State as a chainman and rodman in District II at Dunsuir on April 23, 1915, beginning a career that was to see service under four State Highway Engineers and was to take him on various highway assignments throughout the State from Tulelake to Calexico.

Williams' first field job with the State was as a concrete inspector under the late Spencer W. Lowden on the Shasta River Canyon Highway. In those days, Williams recalls, inspectors were required to walk to their jobs, and as this particular project was eight miles long his fondness for hiking was often put to the test. Williams further recalls that Mr. Lowden, as resident engineer, rated the only means of locomotion, outside of walking, that the camp could boast—a horse.

Under Jim Standley

In 1916, Williams returned to the district office as chief clerk, a post he held until 1921 when he became a squad leader under James G. Standley, who was then Chief Draftsman for the District.

In 1925, when the district headquarters moved to Redding, Williams was made inventory clerk, and came to be one of the first men in the State to put into effect the California Highway Commission numbering system for all equipment so familiar to division personnel today.

Two years later, Williams took over the right of way work for District II. At that time it was a one man department. It was up to him to figure descriptions, make his own calculations, write deeds, and then contact his prospective customers and get them to sign the deeds.

He returned to the field in 1930 to become resident engineer in charge of one of the early honor camps using

prison labor, at Ingot east of Redding. After this he served as resident engineer on various jobs throughout the district, including highway construction projects at Alturas, Tulelake and Redding.

Transfers to San Diego

In 1937, Williams transferred to District XI at San Diego, and during the next 13 years supervised many major construction jobs in the southern part of the State, including the highway between Oceanside and Las Flores Creek, the La Mesa By-pass, the new highway at Fort Rosecrans, and the northern section of the Cabrillo Freeway.

He took charge of the District XI Right of Way Engineering Department in 1950.

Williams, who is married and has a son, was born in 1888 at Alhambra. He began his engineering career as a young man of 17 when he took a job as rodman and chainman doing subdivision work in Southern California, and it is from this period in his life that Williams has garnered one of his most valued memories. In 1906, he and another young surveyor were sent to the Palo Verde Valley to establish the boundaries of a 45,000 acre ranch and Williams can still tell you about sleeping on the ground around a campfire, of eating three meals a day which unvaryingly consisted of boiled beans, bread, syrup and coffee, and of killing anywhere from two to six rattlesnakes a day. But the thing that pleases him most is the fact that, as part of this job, they were to stake out 160 acres of sand and sagebrush along the Colorado River for a townsite. Those 160 acres, Williams adds, have since become the City of Blythe.

L. V. Campbell

Continued from page 48 . . .

California Highway Commission in the Headquarters Office at Sacramento where he was soon appointed office engineer. He was in this position 11 years.

When the Legislature in 1933 allocated gas tax revenue for expenditure in cities, he was assigned the duty of organizing and conducting the De-

Harrison Smitherum

Starting with the old State Water Commission as a member of a hydrographic survey crew in June, 1920, Harrison Smitherum, Supervising Hydraulic Engineer of the Division of Water Resources, retired on May 1st after 33 years of continuous state service.

Smitherum was born in Johnsville, Plumas County, March 29, 1888. He moved to San Jose in 1895 and attended grammar and high school



HARRISON SMITHERUM

in that city. He graduated from Stanford University in May, 1911, with an A.B. in civil engineering. His first employment was on the construction of earth and oil storage reservoirs for the Associated Oil Company at Coalinga and Bakersfield. His next employment was with the Pacific Gas and Electric Company in charge of hydrographic work in connection with the hydroelectric system of that company. At the time of his retirement he was Supervising Hydraulic Engineer in Charge of Water Right Applications and Adjudication of Water Rights.

Smitherum is a life member of the Lake McArthur Water Master Conference, a coterie of ardent fishermen which calls its shack at Lake McArthur "The County Club." Smitherum intends to spend a great deal of his time at the club and on trout streams in the Sierras.

partment of City and Cooperative Projects and has been in that position for nearly 20 years.

Worked for Retirement System

Pat was a member of a small coterie that worked hard and diligently towards securing a retirement system for state employees and was one of the group that obtained an appropriation from the Legislature of \$5,000 to conduct a study and report for a

. . . Continued on page 55

George M. Webb in Post of Highway Traffic Engineer

STATE HIGHWAY ENGINEER GEORGE T. MCCOY on May 1st appointed George M. Webb as Traffic Engineer for the State Division of Highways. He succeeds E. T. Telford, recently transferred to Los Angeles as District Highway Engineer.



GEORGE M. WEBB

Webb, who has specialized in traffic engineering and highway planning work for the Division of Highways since January, 1942, had previously served as acting traffic engineer for a one-year period. Since March of last year he has been assistant planning engineer.

His latest promotion came on the eve of this twenty-fifth anniversary of service with the Division of Highways. He joined the division as an instrumentman in the summer of 1928 after nine years of highway experience in his native State of Oregon. His initial California assignment was on the Feather River Highway project, and he supervised heavy grading and tunnel work on that route in the course of the next several years.

His subsequent experience included work in the Bridge Department Office

Fred Bagshaw Is New Assistant to Director Durkee

APPOINTMENT of T. Fred Bagshaw, Mill Valley, to be special assistant to the director, was announced on May 1st by Director of Public Works Frank B. Durkee.

Bagshaw fills a vacancy which had existed since September 28, 1951, when



T. FRED BAGSHAW

Robert M. Shillito resigned. He has been well known in public life in California for many years. He was chairman of the Marin County Board of Supervisors for 14 years prior to his retirement on January 5th, last. He is a former Mayor of Mill Valley, a Director of the Golden Gate Bridge and Highway District, and has been active in the Redwood Empire Association, the State Supervisors Association, and the California State Chamber of Commerce. He formerly owned and published the *Marin Journal* in San Rafael.

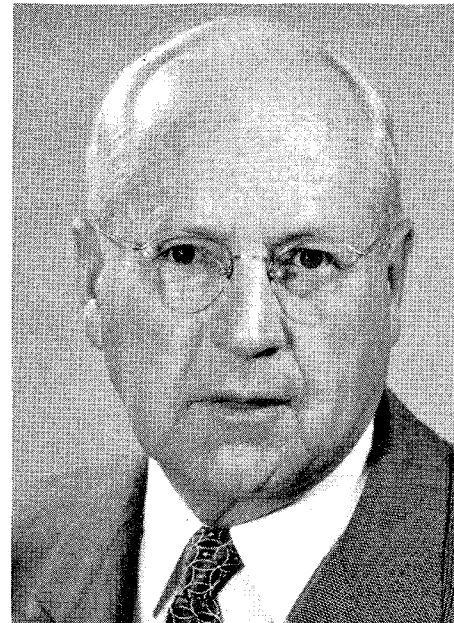
at Sacramento and in District I, northwestern California, where he was engineer in charge of city and cooperative projects.

Webb's 11 years of work in the Traffic and Planning Departments at

... Continued on page 55

C. E. Bovey Named To Post Vacated By L. V. Campbell

STATE HIGHWAY ENGINEER GEORGE T. MCCOY on April 30th announced the appointment of Clarence E. Bovey as City and Cooperative Projects Engineer of the Division of Highways to succeed L. V. Campbell, who retired on the same date.



C. E. BOVEY

Bovey was Assistant District Engineer in charge of administration for District X at Stockton, which includes a number of central California counties. His new headquarters will be at Sacramento.

Bovey has been with the Division of Highways for 39 years, having gone to work in March, 1914, as an engineering draftsman in the Sacramento office.

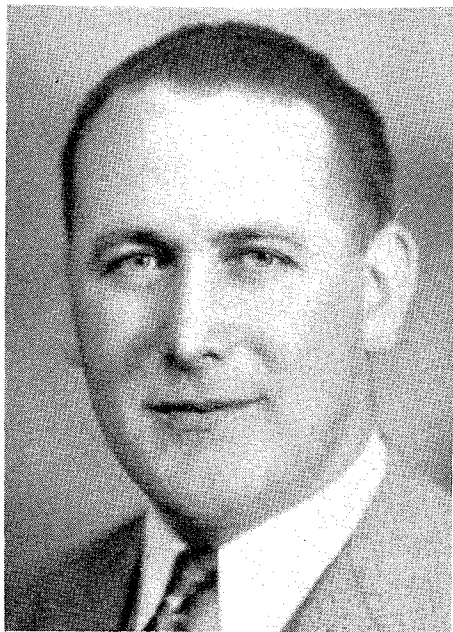
During the succeeding four years he served as transitman on surveys and as assistant resident engineer on highway projects in central California. From 1918 to 1924 he was resident engineer in charge of numerous grading and paving projects, including ones in Yolo, Stanislaus and Yuba Counties. In 1926 he became Maintenance Engineer for District X with headquarters in Sacramento, and moved

... Continued on page 60

Safety Council Program Stresses Highway Needs

ADEQUATE HIGHWAYS, to relieve congestion and keep pace with increasing motor vehicles, rank first on the 1953 program of California Safety Council, declares George Hoberg, president.

California cannot afford inadequate



GEORGE HOBERG

highways or inadequate highway financing, Hoberg says, pointing out that:

(1) Seventy percent of California's annual 3,650 traffic fatalities and \$300,000,000 economic loss due to traffic accidents occur outside incorporated city limits.

(2) All major industries in the State's \$20,000,000,000 economy are dependent on highway transportation—manufacturing, agriculture, mining and oil, forestry and fishing, and the tourist industry.

Hoberg has been one of California's most active citizens in promoting highway improvements since the 1930's. Engaged in the resort business in Lake County, he was President of Lake County Chamber of Commerce 1931-1935, Director of Redwood Em-

... Continued on page 57

State Works Chief Addresses Safety Awards Conference

REPRESENTATIVES of 40 cities and counties, mostly from Northern California, gathered Thursday noon, May 14th, at the Palace Hotel, San Francisco, for the Nineteenth Annual Awards Conference of California Safety Council.

Principal speaker on the program was Frank B. Durkee, State Director of Public Works, who discussed "Building Safety into California Highways."

Oakland and San Francisco head the list of Safe Cities Awards, presented by George Hoberg, president of California Safety Council, who acted as chairman.

Oakland is winner of the annual Safe Cities Sweepstakes Trophy for the best record among all cities in reducing motor vehicle accident fatalities with a saving of 29 lives during the previous year, while San Francisco has the best record among cities over 500,000 population with 21 lives saved.

Orange County is the winner of the Safe Counties President's Trophy for the best record of reducing motor vehicle accident fatalities outside city limits with 26 lives saved.

Alameda County was awarded first place among counties over 500,000 population with eight fewer fatalities during the year, while Santa Clara, Contra Costa, San Joaquin, San Mateo, Tulare and Marin won recognition among counties in other population groups. Additional awards were made to Ventura, Humboldt, Mendocino, Inyo, Mono, Placer, Siskiyou, Colusa, and Modoc Counties.

Perfect records of no traffic fatalities for the year won Safe Cities Awards for the following cities: Whittier, Ventura, Maywood, San Bruno, Chico, Watsonville, Hermosa Beach, Santa Paula, Madera, Santa Maria, Redding, Orange, Hanford, Pacific Grove, Woodland, San Anselmo, El Monte, Sierra Madre, Mill Valley, Porterville, Concord, Claremont, Mountain View, Escondido, Sanger, Calexico, Turlock, Ukiah, Chino, Wasco, Coalinga, Oro-

Veteran Employees Given Awards for 25 Years of Service

UPON the occasion of the spring dance of the California State Employees' Association at the Hollywood Palladium on the evening of May 7th, certificates and pins were presented to 19 employees of District VII, Division of Highways, in recognition of 25 years of service with the State of California as of December 31, 1952. A gathering of about 1,000 state employees and their friends was presided over by James H. Anderson, Regional Director, Region XI, of the C. S. E. A. Anderson introduced P. O. Harding, Assistant State Highway Engineer in charge of District VII, who made the awards. Harding was assisted in the presentation by Mr. Fred L. Everett, District VII Office Engineer.

The awards were made to the following: Emmett Bush, Mark E. Cessna, Elvira Cochran, Roy M. Cooley, Frank B. Cressy, Mary C. Dougherty, Charles C. French, Basil N. Frykland, Charles L. Gildersleeve, James E. Hefferon, Charles J. McCullough, Howard F. Meinke, William E. Melcher, John O'Malley, Ernest R. Scott, Eugene Sorin, Ruby B. Trenholm, Hugh Truesdale, Harry H. Wildy.

It is interesting to note that the service record of these 19 employees totals 494 years, 9 months, and 4 days, of which 323 years was in the service of District VII of the State Division of Highways.

ville, Grass Valley, Los Gatos, Red Bluff, Auburn, Livermore, Carmel, La Verne, Reedley, Blythe, Exeter, Fairfax, Oakdale, Needles, Glendora, Covina, Taft, Arcata, Davis, Seal Beach, Hillsborough, Hemet, Yreka, Brea, Vacaville, Rialto, Fairfield, Gridley, Willows, Port Hueneme, Atwater, Bishop, Emeryville, Alturas, Clovis, Sebastopol, and Woodlake.

Other Northern California cities to receive awards include: Stockton, Richmond, Burlingame, El Cerrito, Eureka, Hayward, Pittsburg, Millbrae, North Sacramento, and Manteca.

BASIC PHOTOGRAMMETRY FOR HIGHWAY ENGINEERS

By REX H. FULTON, Senior Highway Engineer

THE POPULAR conception of a highway engineer is a rugged individual dramatically posed on a cliff peering through a transit while holding a blueprint. We know that the transit and blueprint are important engineering tools but they are only incidental to the over-all objective.

Likewise, aerial photographs are immediately apparent or spectacular and, although essential, they are somewhat incidental to the over-all objective. *The most important use of photogrammetry in highway work is for production of large-scale contour and planimetric maps for expediting highway location and design.*

Aerial photogrammetry has been successfully used for reconnaissance, location and design of highway improvements; ascertaining drainage areas, location of structure sites, preparation of right of way maps, soil investigations, traffic studies, and in conjunction with project reports and public hearings. Perhaps no other engineering field can be benefited more by aerial photogrammetry than highway engineering.

At the present time, practically all photogrammetric work for the California Division of Highways is let to contract with private concerns. Highway photogrammetry usually takes the form of a strip along a proposed highway route. The component part of photogrammetric work as employed by the California Division of Highways is discussed under the following topics:

Aerial Photographs

Vertical aerial photography may be classified in general as follows: (1) stereo-plotting, used in devices for plotting topography and (2) geographic, used in making mosaics. Both are taken with a forward overlap of about 60 percent and can be used in a stereoscope. These two types of photography differ in their special purpose requiring different

focal length cameras and usually different flight scales.

Cameras with focal length of 6" and 8 1/4" are usually used for stereo-plotting work on contour maps and are flown at scales of from 1" = 200' to 1" = 800'. For mosaic work the focal length is usually 12" and 24" with flight scales of from 1" = 400' to 1" = 1,600'. The reasons for this are apparent from the following illustration:

length cameras will not lay down accurately in assembling mosaics.

Photo Scale

From the simple formula $A = fs$, representing altitude, focal length, and photo scale, it is apparent that photo scale is directly proportional to differences in ground elevation. In *Figure 1*, a difference of 24 feet in mean ground elevation results in a 1 percent difference in photo scale, and a difference

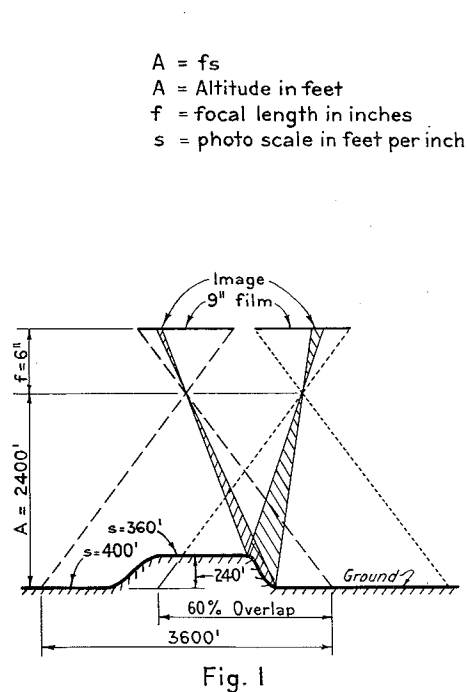
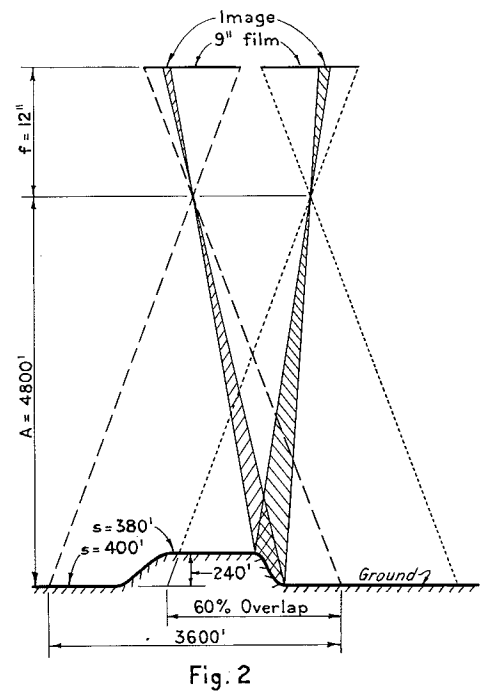


Figure 1, above illustrates that a 6" focal length lens results in wide angle photography and has a tendency to get a side view of ground objects which brings out depth in a stereoscope. The flight altitude is one-half of that required for a 12-inch lens to produce the same photo scale. Please note the hillside in the left image will occupy a narrow band on the photograph, while the same hillside in the right image will occupy a wide band on the photograph (known as parallax). This is the main reason that photographs taken with short focal



of 240 feet elevation (rolling terrain) results in a 10 percent difference in photo scale. This is another prime reason why short focal length pictures are not suitable for assembling into mosaics. In stereo-plotting work, however, it is parallax and vertical displacement in scale that makes vertical measurement possible.

Figure 2, the 12" lens camera indicates relatively narrow angle photography resulting in only 50 percent of the parallax and distortion obtained in 6" lens camera. A 24" lens camera results in a corresponding reduction

to 25 percent of the parallax and distortion of the 6" lens camera.

It naturally follows that the higher the altitude at which pictures are taken, the less distortion in scale. This again is dependent on the type of camera, the purpose of the photography, and keeping the scale within practical limits.

When used as a map for horizontal measurement, vertical photography is subject to inaccuracies due to tilt, lens distortion, film and paper distortion and shrinkage, displacement due to difference in elevation, parallax, and variation in scale. The principal source of such inaccuracies is tilt of the plane or camera at the time of film exposure. Tilt can be rectified after film exposure with special equipment and ground control.

It should be borne in mind that certain inaccuracies which are apparent when the photograph is used as a map, are an indispensable necessity for stereo-plotting.

Contact Prints

Contact prints are made by direct contact with the original flight negatives which are usually taken with 60 percent forward overlap. Contact prints result in a minimum loss of detail, however, inaccuracies due to tilt and variation in scale are uncorrected.

Enlargements

Enlargements are made by projecting the negatives on sensitized paper or film and may be enlarged to four diameters without appreciable loss of detail. Maximum enlargement is about six diameters, although eight diameters has been successfully used. Nonratioed enlargements increase the print size without much regard to exact scale. Ratioed enlargements are made to a fixed scale determined from ground measurements. Such enlargements are subject to the inaccuracies outline under aerial photographs. A minimum error of 1 percent for any sizable portion of the photographic enlargement is costly and difficult to obtain.

Photo-Index

Photo-index is a simple type of mosaic used as an index reference and is made by stapling contact prints laid down in correct position like shingles.

It is then photocopied and reduced in scale about three diameters.

Mosaic

A mosaic is an assembly of aerial photographs into a composite picture. Accuracy ranges from a simple lay-down of enlargements to a highly controlled mosaic, depending on the accuracy required. Do not expect too much accuracy from mosaics. Such accuracy is at its best in flat terrain and at its worst in rough terrain. Photography taken with a focal length camera of less than 12 inches adds greatly to the mismatch of mosaics.

Mosaics have found considerable use as displays at public hearings and for reconnaissance. A simple lay-down mosaic will usually suffice for these purposes. Good controlled mosaics cost about \$500 per strip mile and still require conventional ground surveys for right of way and design data. Where accuracy is required, a better solution is a controlled contour map or a planimetric map, supplementing enlargements or a simple mosaic.

Because of the many variables involved, it is difficult to write specifications for mosaics and obtain a product within practical price consideration. In order to simplify results and cut costs, it is sometimes preferable to photograph the entire width of strip in one flight line using small-scale photography and obtain enlargements by projection; that is pass the light through the negative. A 4 to 6 diameter enlargement will result in a picture from 36" to 54" square which can be used in lieu of a mosaic, or by joining two alternate (every other) enlargements, with 60 percent overlap between adjacent exposures, a satisfactory mosaic 64" to 97" long can be obtained.

Enlargement by projection loses a minimum of detail, whereas enlargement by photocopying, as required in preparation of regular mosaics, results in a loss of considerable detail. For this reason photocopying is usually restricted to a three diameter "blow-up."

A simple mosaic using photo enlargements will suffice for displays and reconnaissance. Whenever a better map is required for location or design purposes, consideration should be given to a planimetric or contour map.

Contours and Planimetric Maps

Contours and other topographic features are plotted from aerial photographs by means of stereo-plotting instruments onto a skeleton map or grid. The skeleton map is controlled by second-order triangulation survey at an accuracy of 1 in 10,000 and is tied into the California Coordinate System. This accuracy is desirable for two reasons:

1. When each photographic model is picture pointed and plotted on the skeleton grid, it will fit precisely and independently in true position.

2. The entire finished map may be utilized as a preliminary survey whereby survey lines may be calculated and quantities estimated therefrom.

In aerial contour work, approximate costs may be broken down as follows:

Aerial photographs	7-15%	say 10%
Ground control		say 50%
Plotting, compiling and drafting		say 40%
Total		100%

An aerial planimetric map is made in the same manner as a contour map, except that the contours and spot elevations are omitted. Such maps are used as an adjunct to the contour map for right of way work, for detailing portions of the plans where contours only clutter up the work, or in flat valley areas where contours are so far apart as to be meaningless.

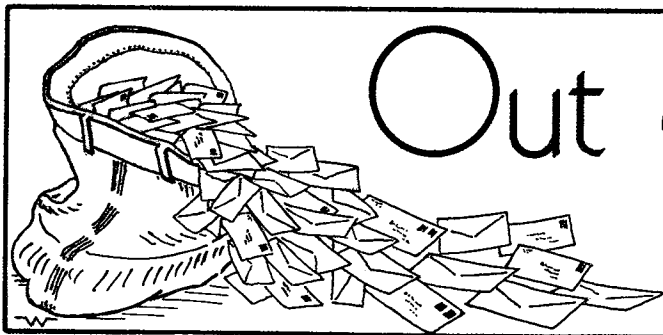
The Kelsh Plotter

Plotting of planimetric or contour maps is accomplished by means of instruments such as the Kelsh Plotter. One set of two pictures with about 60 percent overlap is called a model. Each model requires a minimum of two horizontal points to establish its position on the map and three vertical points to establish it as a plane, although more points are desirable. Such points are often chosen in common with more than one model.

Contour maps should be in scale relative to the contour interval. Although "C" factors* (relation of flight altitude to contour interval) usually control the contour interval, it is often the scale of the map that becomes the controlling factor rather than the contour interval.

* "C" factor of 1,000 means that if flight altitude is 5,000 feet, the contour interval cannot be less than 5,000/1,000, or 5 feet.

... Continued on page 59



Out of the Mail Bag

MANY THANKS

2321 Ward St., Berkeley

MR. KENNETH ADAMS, *Editor*

DEAR MR. ADAMS: I receive much pleasure and valuable information from your magazine. Since I have in the past edited small publications myself, I know that you are probably quite eager to receive comments from your readers. Let me tell you therefore that I can find nothing to complain about in the contents or presentation of the material. I have yet to find another publication which can compete in your field.

Once more, many thanks for bringing such a fine magazine to the engineering profession and to the State of California.

Sincerely yours,

WOLFGANG S. HOMBURGER
Construction Engineer
U. S. Army, Corps of Engineers

FROM WISCONSIN

THE UNIVERSITY OF WISCONSIN
University Extension Division

May 7, 1953

California Highways and Public Works

GENTLEMEN: You have been kind enough to send us *California Highways and Public Works* regularly for some time now. We want you to know that we greatly appreciate this courtesy and that we make very good use of the publication. Please continue to send it to us as long as you find it possible to do so.

Very sincerely,

(Mrs.) GLADYS TRAYSER
Administrative Assistant

MAGAZINE USED IN CLASSROOMS

LOS ANGELES CITY HIGH SCHOOL DISTRICT
Manual Arts High School

Los Angeles 37, California

MR. K. C. ADAMS, *Editor*

MY DEAR MR. ADAMS: After 32 years teaching history and government at Manual Arts, I am retiring this June. I want you to know my high regard for your able editing of the highway magazine and that the copies sent to the school have been used by the students in understanding our highway problems. I have been on the mailing list since 1932 when my good friend and neighbor, Jack Howe, started me out.

Will you please continue our school on the mailing list and send copies to Mrs. Genevieve McDermott. Thank you very much.

Sincerely yours,

ROBERT S. MAILE

FROM SAFETY COUNCIL

EASTBAY CHAPTER NATIONAL SAFETY COUNCIL
Oakland 12, California

May 12, 1953

MR. KENNETH C. ADAMS, *Editor*

DEAR MR. ADAMS: We would appreciate receiving a copy of your publication as issued. I had occasion recently to see it for the first time and realized its value to us in our work.

My congratulations to you on its excellence.

Sincerely,

CLINTON W. DREYER
Managing Director

Traffic stripes were painted on 11,500 miles of state roads by the California Division of Highways during the last fiscal year.

OF VALUE TO UNIVERSITY

UNIVERSITY OF SOUTHERN CALIFORNIA
Los Angeles 7

March 14, 1953

MR. G. T. MCCOY, *State Highway Engineer*

*Department of Public Works
Sacramento 7, California*

DEAR MR. MCCOY: This will acknowledge with sincerest appreciation the receipt this date of a copy of the "Anderson Study," by John F. Kelly, Headquarters Right of Way Agent. As a great admirer of the excellent work you are doing, I want you and your associates to know how much I appreciate the sincere cooperation which I have always received from your staff.

The Anderson Study—an economic study of the effects of freeway construction, including frontage road, through the town of Anderson in Shasta County, California, is an excellent piece of work. It is most informative and should prove a most valuable teaching aid in highway transportation courses offered by the Department of Transportation, University of Southern California.

Again, do I wish to thank you, Mr. McCoy.

Sincerely yours,

SAMUEL RUBIN
Head, Department of Transportation

The recent Annual Report of the California Division of Highways reveals that on November 23, 1951 (the day after Thanksgiving), a total of 102,613 vehicles crossed the San Francisco-Oakland Bay Bridge to establish a record for a single day's traffic which still remains unbroken.

TURKISH CORRESPONDENT

ZIYA GARMAR
BRIDGE DESIGN DEPARTMENT
GENERAL DIRECTORATE OF HIGHWAYS
Ankara, Turkey

March 30, 1953

MR. KENNETH C. ADAMS, *Editor*

DEAR SIR: After returning to my country, almost three months ago, I recently received a copy of *California Highways and Public Works*. It will be an expression of my feelings to say that your magazine is a pleasure to read and absorb, its widespread distribution makes a valuable contribution to better world relations.

During my visit to the U. S. A. for nine months all American people whom I met have shown a sincere interest in me and my work. Because of my position as a bridge engineer with the Turkish Highway Department, Bridge Section, the purpose of my visit to the United States was to observe and bring to Turkey the American advanced methods of bridge design and construction. At the same time, I had the time to observe America and become acquainted with American people and their way of living.

The reality of your progress in highways and all kinds of public works is very stimulating. I can say that *California Highways and Public Works* is one of the most most profusely illustrated highway magazines I have ever seen and has so many articles on advanced methods of bridge and highway constructions which are already in actual practice.

I spent five months in California, I was very much interested in seeing the improvements and advances which are being made over there.

As I understand it, you Americans have been kind enough to place my name on your mailing list for *California Highways and Public Works*.

I would like to express my appreciation for your kindness in mailing us the January-February issue of your useful magazine. I have always found it extremely helpful and I would be pleased to continue receiving future copies. Thank you very, very much.

Yours very truly,

F. CAHMAH

Ford at Fifty in Words and Pictures

FORD AT FIFTY, a picture story of the automobile industry, an industry that directly or indirectly provides Americans with one out of every seven jobs in the Country, published by Simon and Schuster, as part of the Ford Company's fiftieth anniversary observance is of interest to Sacramentans. It is an intimate portrait of the automobile industry, the people who make it work, and its effect on America, told in terms of one company.

"The growth and achievement of Ford Motor Company have been made possible by the kind of America in which we live," says Henry Ford II. "While this is a portrait of an American industrial enterprise taken in its fiftieth year, it is also a look at America and people at work."

The story opens with an informal camera-and-text study of the changes the automobile has brought since 1903 to a typical American town, Sacramento, California. There, "an American revolution" has resulted in one automobile for every 1.6 residents, created curb service at restaurants, banks, libraries, and the post office, and has broadened trade areas for local merchants.

The book then turns to Henry Ford, "a man and an idea." The origin and fabulous growth of Mr. Ford's automobile manufacturing system is told through anecdotes and pictures, including a painting by Norman Rockwell.

George M. Webb

Continued from page 50 . . .

division headquarters in Sacramento was interrupted for two and one-half years during World War II when he served in the Army Transportation Corps with the rank of captain.

Webb is a member of the American Society of Civil Engineers and of the Institute of Traffic Engineers.

He is married and lives at 778 Perkins Way, Sacramento.

Cost Index

Continued from page 40 . . .

during the coming construction season.

The Engineering News-Record Index is 242.7 (1940 = 100) for the first quarter of 1953 and the Bureau of Public Roads Composite Mile Index was 245.8 (1940 = 100) for the fourth quarter of 1952. Many economic pointers are indicating a slight drop or at least a leveling-off in prices at the present time; however, with increases in the average prices in California of such major items as plant-mixed bituminous surfaces, structure concrete, and steel during the first quarter of 1953, it is thought that the 3.5 percent drop in the California Highway Construction Cost Index is not a firm indication of a general drop in construction costs.

In addition to the accompanying chart showing the Engineering News-Record Construction Cost Index, the U. S. Bureau of Public Roads Composite Mile Index and the California Highway Construction Cost Index there is shown a tabulation of the average unit prices by years and quarters for the eight basic items on which California index is based and a tabulation of the average number of bidders on various sized contracts for the last six months of 1952.

L. V. Campbell

Continued from page 49 . . .

State Employees' Retirement System. Upon receiving a favorable report, the Legislature submitted the question to the people by referendum. Pat was a member of the campaign committee on the referendum and was instrumental in persuading Tom Stanton to accept the chairmanship of the committee which he guided so ably to a successful conclusion. After completion of the election campaign, he was active in the organization of the California State Employees Association, being a delegate to the first meeting of the general council.

Campbell has two children, a daughter, Mrs. Eugene M. Gray, who resides in Sacramento, and a son, Lawrence P. Campbell, who is in the export-import business in Germany.

HIGHWAY PIONEERS INDULGE IN REMINISCENCES

RECENTLY, three gentlemen in Los Angeles were reminiscing about early highway construction in Southern California. They are: Spencer Cortelyou, who started to work for the Division of Highways on February 1, 1912, and retired on October 1, 1949, as Assistant State Highway Engineer; C. P. Montgomery, who entered state service with the Division of Highways on February 12, 1912, and retired on March 1, 1952; L. L. Rogers, who was with Rogers Brothers Company, General Contractors, in 1912.

Rogers and Cortelyou had some old-time pictures. The accompanying photo shows the three men gathered around a table and all talking at once about some of the pictures. Their tales of the trials and tribulations of building highways back in 1912 took up most of the afternoon.

Rogers Gets First Contract in South

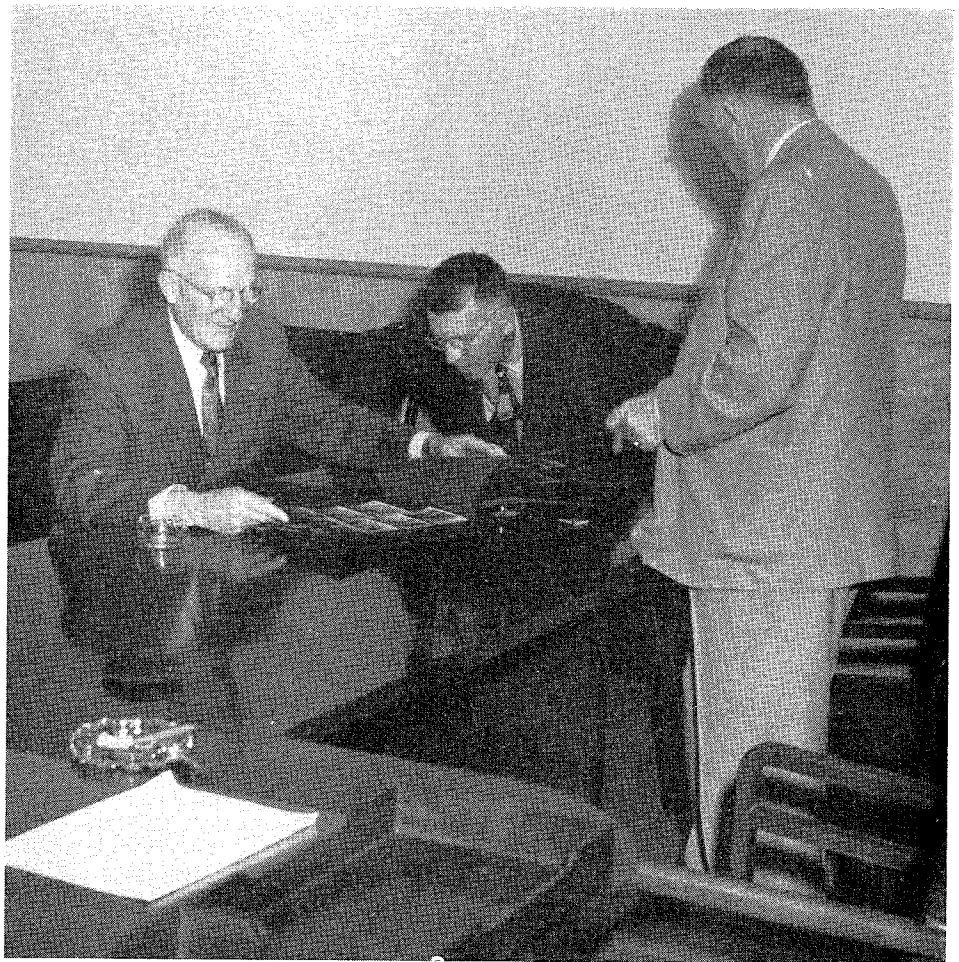
Rogers Brothers Company received the first contract let in Southern California by the original Highway Commission in the early part of 1912. The contract called for building a state highway from the northern city limits of San Diego to Cardiff. And, according to Rogers, it cost in the neighborhood of \$5,800 per mile. Any highway contract that was anywhere near \$10,000 per mile was not let. New specifications were written and new bids asked for—and received.

There were five of the Rogers brothers in the original company: H. H., Geo. A., Bob, Tom, and L. L. All of them have died with the exception of L. L.

The second contract in Southern California was from the then northern city limits of Los Angeles on Ventura Boulevard to about where Studio City is now located. Montgomery was Assistant Resident Engineer on that project. As Cortelyou was Assistant District Engineer at the time he remembers both of the jobs.

Fifteen-foot Roads

"In those days," said Cortelyou, "we were building concrete roads 15



Pioneer highway builders look at old photographs. Left to right, Spencer Cortelyou, C. P. Montgomery, L. L. Rogers.

feet wide and 4 inches thick. Our mix was one part of cement, two and a half of sand and five parts gravel with enough water to mix it. Rather haphazard when you think of the specifications of the present-day roads.

"Practically all our roads cost less than \$6,000 per mile. But I still think that A. B. Fletcher, the first Highway Engineer, had the nucleus of the right idea regarding roads. In those days the Highway Commission had very limited funds and Mr. Fletcher was trying to inform the people of California what good roads would mean to them. As a consequence, miles of narrow roads were built. They were not particularly narrow for that day, as our speed limit was

30 miles per hour for automobiles and 15 miles per hour for trucks. And, incidentally, all trucks had solid rubber tires in those days.

"Even then we were testing the concrete for its breaking strength," continued Cortelyou. "After we had built a road we would dig a hole under it and set up levels and transits and then drive loads over the small section to measure the deflection. In order to really cause the concrete to fail we finally had to concentrate the load on a two-inch by four-inch piece of wood in order to get a sudden failure."

Contractors Had Troubles

"Yes, and all the time you engineers were specifying concrete high-

ways we contractors were having our trouble," said Rogers. "The new concrete mixers we had didn't have any mechanical means of loading the darn thing. We had to do it with wheelbarrows. We built a runway to our first mixer and then found that we had to have two men to help the wheelbarrow man get up the incline with a load. It wasn't long before we managed to get some ship's timbers of decent length and make a runway that was more gradual.

"And another difficulty we had was trying to save our cement sacks. The water inlet for the mixer was directly over the mouth of the mixer. Try as we would we could never dump a sack of cement into the mixer without getting the sack wet. And wet sacks could not be turned back for credit to the cement company."

According to Rogers, he accepted a position with the Lakewood Engineering Co. after World War I. He traveled over most of the United States for them. At one meeting in New Jersey, Rogers remembers a statement made by one prominent engineer to the effect that people in that room would live to see the day when our highways would cost \$100,000 per mile.

No Superelevation on Curves

About this time Montgomery told of the strictness of Fletcher, our first Highway Engineer. It seems that Fletcher specified that there would be no superelevation on any curve. None of the men in the field could figure out why this rule had been made and all tried, in one way or another, to give a little superelevation on the curves. On the Ventura job that "Monty" was on he was sticking in a slight elevation on the outside of curves. Fletcher came by making an inspection trip and noticed it. "Monty" says that Fletcher didn't say a word to him but went right to the Resident Engineer and read the riot act.

Spencer Cortelyou told of some of the experiences of building the Ridge Route. According to Cortelyou, there was one camp on one of the jobs that had a cook who was quite a trapper. Seems that the cook got so intrigued

Commissioners
Chas. D. Blaney, Chairman
Charles F. Stern
N. D. Darlington

Highway Engineer
Austin B. Fletcher
Secretary
Wilson R. Ellis

State of California
DEPARTMENT OF ENGINEERING
CALIFORNIA HIGHWAY COMMISSION
Forum Building, Sacramento

January 12, 1917.

MR. A. B. FLETCHER, *Highway Engineer*
Sacramento, California

DEAR MR. FLETCHER: I herewith submit statements of moneys collected and disbursed, account of the fur coat presented to Governor Johnson by the officers and employees of this commission:

Contributions Received	
Mr. Blaney	\$10.00
Mr. Darlington	10.00
Mr. Stern	10.00
Mr. Fletcher	15.00
Mr. Ellis	10.00
Mr. Winslow for Headquarters.....	57.00
Mr. Somner for Division No. I.....	30.00
Mr. Bedford for Division No. II.....	25.00
Mr. Caruthers for Division No. III.....	53.00
Mr. Clark for Division No. IV.....	35.00
Mr. Howe for Division No. V.....	35.00
Mr. Woodson for Division No. VI.....	20.00
Mr. Patch for Division No. VII.....	30.00
	\$340.00
Disbursed	
Paid Williams & Berg's bill.....	\$65.00
Paid E. J. Evans for furs and making.....	100.00
Paid for Castaic furs.....	175.00
	\$340.00

Respectfully,

W. R. ELLIS, *Secretary*

with the trapping country that he put out a line of traps and caught fox. This was done in his spare time. Cortelyou then said he remembered that some of the furs were sold to make a fur-lined

coat for Governor Hiram Johnson. A reproduction of a letter regarding this coat is shown and reveals that \$175 was paid for Castaic furs.

R. C. KENNEDY

Safety Council

Continued from page 51 . . .

pire Association since 1935 and President 1943-1946, and Director of California State Chamber of Commerce 1939-1944. In addition, he was President of California Resort Association 1936-1942, Director of California State Hotel Association since 1942, member of the California Centennials Committee, and formerly a Vice President of California Safety Council. In 1944 he was appointed by Governor Warren to the State Water Resources Board.

Working with Redwood Empire Association, he has supported projects for elimination of hazardous conditions on highways. These have included safety lighting, traffic signals at hazardous rural highway intersections, passing zones for trucks on mountainous roads, channelized and divided highways, and elimination of curves.

Vice presidents of California Safety Council for 1953 include: Paul Dietrich, Los Angeles; O. L. Gray, San Francisco; George A. Scott, San Diego; Judge Daniel R. Shoemaker, San Francisco; and Dr. Robert Gordon Sproul, Berkeley.

Gas Tax to Cities

Review of Laws and Rulings
Governing These Allocations

By L. V. CAMPBELL, Engineer of City and Cooperative Projects *

This is the third and concluding installment of Mr. Campbell's article.

A traffic lane 11 feet wide is recommended for traffic densities less than 200 vehicles per hour, but I doubt if there are many city streets with such low traffic densities. In highly developed districts, where an additional width of four feet for the traveled way would run into exorbitant amounts for right of way, traffic lanes 11 feet wide would provide an acceptable compromise. For two-lane streets 12 feet should be the absolute minimum for a traffic lane as with the above clearances the left side of the moving car is 18 feet from the curb. This leaves only 2 feet clearance to the center of the street which provides very little latitude for maneuvering or eccentric driving. The expediency of reducing the width of parking lanes to seven feet does not result in any additional width for moving traffic. A parked car takes up so much space and it will take the same amount of space whether the parking lane is painted seven feet wide or eight feet wide. Drivers just will not drive too close to a line of parked cars. So when the parking lanes are designated seven feet wide in order to show 11 feet or 12 feet for the traffic lane nobody is being kidded as to how much width the moving traffic is going to have.

In an article published in *Western City* a number of years ago, I compared the clearance between passing cars centered in lanes 10 feet wide with the clearance provided on railroads. This comparison was to the disadvantage of the highway although railroad trains cannot deviate from a fixed course while automobiles are free to wander from one side of the road to the other.

Maintenance and Construction

With the allocation of gas tax funds specifically for maintenance of city

* Mr. Campbell retired on April 30th of this year.

streets separately from the funds allocated for construction of major city streets, it became necessary to recognize the distinction between construction and maintenance. Maintenance is defined in Section 27 of the code. A copy of this section is contained in the Manual of Instructions. The definition seems to be clear enough and generally we find no misunderstanding on whether any particular work should be classed as maintenance or construction, except in a case of pavement surfacing. Resurfacing may vary from extremely thin blankets which are clearly a repair operation to the placing of heavy one- or two-course construction over the existing pavement so as to withstand a heavier load than the original pavement was capable of carrying. The department had sometime previously found it necessary to define a line of demarcation between maintenance and construction when resurfacing was involved. The policy adopted by the State Highway Engineer is that resurfacing 1 inch or less in thickness will be classed as maintenance. Resurfacing 1½ inches or more in thickness will be classed as construction. There is a hiatus between 1 inch and 1½ inches, the determination being made in headquarters. I might interpose here that there is not complete agreement in headquarters as to the proper thickness for the line of demarcation between maintenance and construction.

Resurfacing Ruling

With the passing of the Collier-Burns Act, cities became concerned as to what thickness of resurfacing would be considered maintenance and what thickness construction. The department ruled that a thickness of 1½ inches or less would be considered maintenance. I do not recall any objection to the 1½ inch thickness being raised by any of the cities. In fact there were recommendations that thicknesses of two inches and more be allowed as maintenance so as to permit resurfac-

ing secondary streets with gas tax funds. It was finally agreed that the State policy was flexible enough to permit thicknesses of 1½ inches as maintenance and that the policy would apply to the expenditure of the gas tax allocation to cities. Obviously the same work cannot be both maintenance and construction at the same time and since the department has no veto authority over maintenance work, the cities may proceed with resurfacing 1½ inches thick as maintenance without securing approval of the department. Since resurfacing 1½ inches thick is classed as maintenance any resurfacing to be classed as construction would have to be greater than that thickness, that is two inches or more.

Along these same lines I might mention the demarcation between maintenance and construction for various types of oil treatment. The general principle is that any operation which raises the standard of surfacing to a higher type constitutes construction payable from construction funds while any operation which restores the surface to the condition to which it was originally constructed and does not provide a higher type of surface is classed as maintenance and is payable from maintenance funds. For example, a seal coat placed in conjunction with the construction of a plant mix or other type of bituminous surfacing or pavement would be a construction operation payable from construction funds. While a seal coat placed a year or so later to prevent raveling or prevent penetration of moisture would be classed as maintenance and be payable from maintenance funds. That is, the first application of an oil treatment to an unsealed surface would constitute construction while subsequent retreatment would be classed as maintenance.

We are willing to be broad minded in the application of these principles and, where both types of work are in-

... Continued on page 59

Basic Photogrammetry

Continued from page 53 . . .

A photographic model which will produce a map at $1'' = 50'$ is capable of producing 2-foot contours at slight additional cost over 5-foot contours. Or, 2-foot contours can be produced at $1'' = 50'$ for approximately the same cost as at $1'' = 100'$. With this in mind, a good balance between scale and contour interval is as follows:

$1'' = 50'$	.....	2'	contours
$1'' = 100'$	.....	2'-5'	contours
$1'' = 200'$	.....	10'	contours
$1'' = 400'$	.....	10'-20'	contours

The area of a map (and therefore the area of each photographic model) varies as the *square* of the map scale; that is a map at $1'' = 50'$ requires four times the map area as a map at $1'' = 100'$ and also requires 4 times as many photographic models. However, for usual highway strip maps of one model width (1000-2000 feet) only twice as many models would be required for $1'' = 50'$ as for $1'' = 100'$.

Determination of Requirements

In preparing photogrammetry work for contract, a common fallacy is to order a strip in some rounded figure, such as one mile wide which may have little bearing on actual requirements. Another version is to order a strip to full width of film negative, such as nine inches at 800 feet per inch = 7,200 feet width of strip.

Standard aerial film is 9" x 9" which multiplied by the flight scale equals the width of strip flown; that is at $1'' = 400'$ the maximum width of flight strip is $9 \times 400 = 3600$ feet. However, the outer inch on each side of the negative is often not too clear or precise, which reduces the width to 7 inches. Furthermore, a full width strip means that the flight line must be flown perfectly with no allowance for deviation, crabbing or tilt. It is therefore common practice to use 70 percent of the film coverage for computing flight lines. This factor applies when one, two or more flight lines are required for a given width; that is at $1'' = 400'$ one flight line will produce 70% of $3600' = 2520'$, say 2500; two lines 5000'; three lines 7500', etc.

One-flight Line

There is no object in specifying a width requiring two or more flight lines when one will suffice.

The preferred method of specifying a one-flight line strip is to simply draw a single line on a map as the center line of the strip and specify that this center line shall fall within the center two inches of the photograph. In this case, no outside limits of flight are required as the specified contact scale roughly establishes the width.

For contour or planimetric maps it is highly important to keep the width of the mapped area to a minimum. If at all possible keep the strip to the width of one model which is also the width of one practical flight line. As outlined above for picture work, the practical width of a flight line at $1'' = 400'$ is 70 percent of 3,600' or 2,500', however for contour work it is safer to use 60 percent or 2,160' (say 2,000' as the practical working width of such a model).

Whenever possible the width of contour or planimetric strips should be reduced to 1,000' or even less. It is true that ground control, picture points, and model set-up costs are approximately the same for a 1,000' as for a 2,000' strip in the above case. The actual cost of the additional 1,000 feet is merely the added plotting cost (not including model set-up) which in this case would add 25 percent to the total cost of the work. However, contractors sometimes add up to 60 percent for such additional width because our projects are not as clean cut as above outlined. Additional 1,000' widths often require additional models and ground control because of serpentine alignment, improper flight lines, and unforeseen difficulties.

Costs

In planning photogrammetry work, consideration should be given to the following criteria:

1. Separate flights are usually required for mosaics and contour work.
2. Simple mosaics or enlargements will usually suffice for preliminary work which can be supplemented with contour or planimetric maps for detail design work.
3. Generally in loss of detail, a 6-diameter enlargement by projection is comparable to a 3-diameter enlargement by photocopy.
4. Mosaics made from large scale photography require piecing numerous prints together and photocopying. The process is costly and leads to numerous errors.
5. Whenever possible, mosaic photography should be kept to one flight line.

It is also desirable to use small scale photography covering the width of strip in one photograph, obtain 4- to 6-diameter enlargements and use as mosaics; or join two or more enlargements together as mosaics.

6. Contour and planimetric maps should be kept to one model width, if possible.

7. Increasing the photo scale has same effect as increasing the mapped area. The square footage of map varies as the square of map scale.

8. On contour maps, keep the map scale compatible with the contour interval. For instance, 2' contours are in scale at $1'' = 50'$ and costs approximately the same as 2' contours at $1'' = 100'$.

9. A mapping project of such magnitude as will provide continuity of operations, will cut down the contractor's overhead and absorb "move in and out costs." For this reason, unit costs for a \$5,000 project may be 50 percent higher than for a \$50,000 project.

Following are a few approximate cost factors:

Contour Maps

$1'' = 50'$	.....	2'	contours	.....	\$10-\$25	per acre
$1'' = 100'$	.....	5'	contours	.....	\$5-\$12	per acre
$1'' = 400'$	.....	10'-20'	contours	.....	\$1.50-\$3	per acre

Enlargements, Typical Example

At $1'' = 200'$ from flight scale of $1'' = 800'$
5,000' wide one flight strip
\$80 per mile, including two sets enlargements, contact prints and index map.

Mosaics, Typical Example

At $1'' = 200'$ from flight scale of $1'' = 800'$
Limit to 4-diameter enlargement and preferably 2½ or 3-diameter
\$100 to \$350 per mile.

Gas Tax to Cities

Continued from page 58 . . .

involved in the same job, are willing to call the entire job construction. For example, where a street is being widened and it is necessary or desirable to resurface the old pavement so the entire surface will be of uniform appearance even though the resurfacing is only one inch thick, or in the case of resurfacing two inches thick, should more or less patching of the old base be necessary, the entire operation will be classed as construction. That is, it is not necessary to segregate the maintenance operation from the construction operation and finance the two operations from separate funds. We must not, however, let the tail wag the dog by making one block construction and the next block maintenance and then classifying the whole job as construction. In such case each section would have to be classified on its merits.

In Memoriam

ALAN L. ROBBINS

Alan L. Robbins, 30, junior civil engineer with the Division of Highways in District XI, San Diego, was struck and fatally injured on February 25th by a passing car while he was surveying near Indio.

Robbins had been with the division since June, 1950, when he was appointed senior engineering aid with the design department of District XI. He was advanced to junior civil engineer in June of 1951.

Robbins was born in Long Beach on November 13, 1922, and attended Hoover High School in San Diego. During World War II he served with the U. S. armed forces, after which he resumed his studies, graduating from San Diego State College in 1950 with a B.S. degree in engineering.

He is survived by his mother, Mrs. Marie Robbins, and two sisters.

C. E. Bovey

Continued from page 50 . . .

to Stockton when the district office was transferred there in 1933. He was appointed Assistant District Engineer in 1947.

Bovey was born in Grass Valley and attended grade school in Nevada City and high school in Sacramento.

His first job was with the Southern Pacific Company on surveying and inspection work on the construction of the railroad between Sacramento and Walnut Grove. Later he worked as chief of a survey party on the reconstruction of the levees on the Sacramento and American Rivers near Sacramento, and as chief draftsman at the Southern Pacific division office in Sacramento.

Bovey is married and has two children, Mrs. Joyce G. Keehner of Sacramento, and Robert Bovey of Stockton.

He is a thirty-second degree Mason and has been active in Y. M. C. A. and church work during the many years he has lived in Stockton. He also served as alternate chief of engineering services for District 4 of the Office of Civil Defense, located at Stockton.

Early Days

Continued from page 47 . . .

To start out the year 1919, Mr. Darlington, chairman of the commission, stated that it was agreeable with him to pass the honor and responsibilities of his position to another member, and he offered his resignation to the other two members. Commissioner Whitmore immediately nominated Mr. Darlington to succeed himself, and the motion was seconded by Commissioner Phillips. The re-election of Commissioner Darlington to the chairmanship was declared in effect.

At the meeting of January 22d, Commissioner Whitmore made a motion, and it was voted that the secretary be instructed to begin the preparation of copy and data for the publication of the next number of the *California Highway Bulletin*, to be issued on or before June 1, 1919.

Also, on this date, the minutes use up five pages for an agreement with the Department of Agriculture on Project 9. This called for building a road between the Tecate Divide and a point easterly on the San Diego-Imperial County boundary line, a distance of 15.2 miles, which was known locally as the San Diego-El Centro Road.

At the meeting of February 26th, a delegation consisting of Mr. Frank B. Durkee and Dr. Copeland, representing the Chico Chamber of Commerce, appeared and urged the commission to begin early construction of that section of the state highway between Nelson and Biggs in Butte County.

Chairman Darlington explained that the commission was not in a position to make any promises on account of the shortage of funds, but stated that it would take the matter under advisement and improve or complete the road as soon as funds were made available. This is the same Frank Durkee who is now Director of Public Works, and as such is ex officio member and Chairman of the California Highway Commission.

(To Be Concluded)

Cajon Pass

Continued from page 10 . . .

minor slides off the Blue Cut. Intermittently, it was necessary to remove the accumulation behind the wall to provide storage for the continuing fall of debris from the unstable slide material.

Eventually, the slopes stabilized and the rock wall was removed to provide room for the four-lane section being constructed under this contract. The cut itself was not disturbed, but to provide safety from possible rolling material from the high bank of unpredictable gouge material, a wire mesh fence fastened to 10-inch wide flange 25-pound steel columns was constructed at the toe of the slope.

Three Transcontinental Highways

Three transcontinental highways use the historic gateway serving the ever increasing traffic to and from Southern California. U. S. 395 leads from San Diego through the Cajon Pass to the Canadian border by way of Reno, Nevada, and Spokane, Washington. U. S. 91 utilizes the pass in carrying traffic from Long Beach to Las Vegas, Nevada, Salt Lake City, Utah, and Pocatello, Idaho. U. S. 66 also traverses the Cajon on its way to Chicago through Needles and Oklahoma City.

With steep grades and limited sight distance existing on most of the highway through the pass, the improvement is a great boon to the 7,500 vehicles using the road each day. About 10 percent of the traffic consists of trucks, most of which are of the multiple-axle long-haul type.

Plans are complete for the next project to extend from Gish Underpass to 1.4 miles north of Cajon Summit, a length of 5.8 miles. Plans are rapidly being developed to extend the four-lane expressway from the summit to Victorville on the Mojave Desert. Construction dates are as yet indefinite and will depend on available financing.

The assistance of the *San Bernardino Sun* and its Historical Editor, L. Burr Belden, is gratefully acknowledged in the preparation of this article.

HIGHWAY BIDS AND AWARDS

March, 1953—Continued

CONTRA COSTA COUNTY—Between Danville and Concord (portions), and at Avon intersection, a net length of about 3.0 miles; existing roadbeds to be widened and new roadbeds to be constructed, and plantmixed surfacing to be placed over new cement treated base and existing pavement. District IV, Route 107, 75, 106, Section A, Wlc, B, Cnd, C. Lee J. Immel, San Pablo, \$291,753.50; James R. Armstrong, El Cerrito, \$300,518.36; J. Henry Harris, Berkeley, \$313,304.90; Louis Biasotti & Son, Stockton, \$332,945.50; Clements & Co., Hayward, \$345,583.20. Contract awarded to Gallagher & Burk, Inc., Oakland, \$291,482.70.

GLENN COUNTY—At Big Butte Creek overflow about 6 miles east of Butte City, a reinforced concrete slab bridge on concrete pile bents to be constructed, and about 0.3 mile of approaches to be graded and surfaced with untreated rock surfacing and bituminous surface treatment applied. District III, Route 45, Section C. Friant Construction Co., Fresno, \$57,915.50; Anson-Smith Construction Co., Marysville, \$58,884.48; B. S. McElderry, Berkeley, \$59,773; R. E. Hertel, Sacramento, \$62,378.50; G. M. Carr Co. & Bati Rocca, Santa Rosa, \$64,911.90; Fredrickson Bros., Emeryville, \$66,209.50; Al Erickson & Co., Napa, \$67,484.50; O'Connor Bros., Red Bluff, \$68,230.14; Tricon Construction Corp., San Rafael, \$68,345.50; R. G. Clifford & C. O. Bodenhamer, Berkeley, \$69,649.10; J. Henry Harris, Berkeley, \$72,801.05; Paul E. McCullum, Richmond, \$73,857; Wheeler Construction Co., Oakland, \$80,520. Contract awarded to A. A. Edmondson, San Fernando, \$57,743.50.

LOS ANGELES COUNTY—In the Cities of Los Angeles and South Pasadena at various locations on Hollywood, Santa Ana, Ramona, and Arroyo Seco Freeways, reconstruct storm damaged slopes. District VII, Route 2, 26, 205. Henry C. Soto Corp., Los Angeles, \$27,730.75. Contract awarded to Justice-Dunn Co., Oakland, \$26,122.25.

LOS ANGELES COUNTY—On Garvey Avenue, between Holt Avenue and Bellevue Avenue about 0.5 mile in length, 48" chain link fence to be constructed. District VII, Route 26. Los Angeles Fencing Co., Inc., Los Angeles, \$2,950; Crown Fence & Supply Co., Ltd., Pasadena, \$2,950; Cyclone Fence Department, American Steel and Wire Division United States Steel Corp., Glendale, \$2,992.50; Pacific Fence Co., Los Angeles, \$2,997; Alcorn Fence Co., Los Angeles, \$3,050; Frank O. Query D.B.A. American Chain Link Machine Co., Los Angeles, \$3,075; Burkett Fence Co., Los Angeles, \$3,150; The California Wire Cloth Corporation, Los Angeles, \$3,225; Southern California Fence Co., Compton, \$3,890. Contract awarded to Mills Fencing Co., Bell Gardens, \$2,875.

MENDOCINO COUNTY—Across Noyo River, about 1 mile south of Fort Bragg, an existing steel bridge to be cleaned and painted. District I, Route 56, Section E. D. Zelinsky & Sons, San Francisco, \$78,626; Klaas Bros., Los Angeles, \$79,320; R. W. Reade & Co., Berkeley, \$84,205; J. S. Morris Co., Berkeley, \$91,880. Contract awarded to Acme Maintenance Engineering Co., Montebello, \$72,865.

MONTEREY COUNTY—Across Salinas River at San Ardo, an existing bridge to be cleaned and painted. District V, Route 2, Section H. John P. McGuire, San Jose, \$19,782; Klaas Brothers, Los Angeles, \$22,354; J. S. Morris Co., Berkeley, \$22,752; Allied Painters and Decorators Inc., Oakland, \$24,686; Acme Maintenance Engineering Co., Montebello, \$25,939; R. W. Reade & Co., Berkeley, \$27,630; J. P. Carroll Co., Los Angeles, \$32,736; Eric Lundeen Inc., Los Angeles, \$38,350. Contract awarded to D. Zelinsky & Sons, San Francisco, \$16,184.

SANTA CLARA COUNTY—At the intersection of Bayshore Highway with Embarcadero Road, traffic signal system and highway lighting to be furnished and installed and channelization to be constructed. District IV, Route 68, Sections A, PA. Joe W. Douglass, San Jose, \$35,211.25; J. Henry

Harris, Berkeley, \$38,348; Edward Keeble, San Jose, \$38,579; A. J. Raisch Paving Co., San Jose, \$39,094.80. Contract awarded to L. C. Smith Co., San Mateo, \$34,959.25.

SAN DIEGO COUNTY—In the City of Ocean-side, between ¼ mile south of Mission Avenue and San Luis Rey River, about 1 mile of roadside areas to be prepared and planted. District XI, Route 2. Justice-Dunn Co., Oakland, \$26,234.44; Jannoch Nurseries, Altadena, \$28,217.28. Contract awarded to Castro and Fisher, Glendale, \$24,378.09.

SAN MATEO COUNTY—Over Bayshore Freeway at Peninsular Avenue, in the City of San Mateo, an existing steel bridge to be cleaned and painted. District IV, Route 68. D. Zalinsky & Sons, San Francisco, \$19,681; J. P. Carroll Co., Los Angeles, \$19,700; John P. McGuire, San Jose, \$19,928; J. S. Morris Co., Berkeley, \$21,440; Acme Maintenance Engineering Co., Montebello, \$24,930; R. W. Reade and Co., Berkeley, \$32,513. Contract awarded to Allied Painters & Decorators, Inc., Oakland, \$18,842.

SAN MATEO COUNTY—City of San Mateo between Lindbergh Street and 0.1 mile east of South Norfolk Street, full traffic actuated signal system and highway lighting to be furnished and installed and channelization to be constructed. District IV, Route 105. The Lowrie Paving Co., Inc., San Francisco, \$29,187.60; J. Henry Harris, Berkeley, \$29,903.90; Piombo Construction Co., San Francisco, \$29,922. Contract awarded to L. C. Smith Co., San Mateo, \$28,513.50.

F. A. S. County Route

SANTA CRUZ COUNTY—On San Andreas Road, between Monterey Bay Academy and Monresna Beach, about 2.3 miles in length to be surfaced with plantmixing surfacing. District IV, Route 1147. Edward Keeble, San Jose, \$18,812.50; Leo F. Piazzi Paving Co., San Jose, \$20,272.26. Contract awarded to Granite Construction Co., Watsonville, \$17,704.75.

April, 1953

BUTTE COUNTY—At junction of Routes 21 and 87 about 0.5 mile south of Oroville, about 0.4 mile in length to be graded and surfaced with plant-mixed surfacing on untreated rock base. District III, Route 21, 87, Section A. A. O'Connor Bros., Red Bluff, \$43,137.65; J. Henry Harris, Berkeley, \$43,288.75. Contract awarded to Rice Bros., Inc., Marysville, \$39,375.05.

CONTRA COSTA COUNTY—Between Muir Station and Route 75 about 3.6 miles in length, to be surfaced with plant-mixed surface on cement treated base and existing pavement. District IV, Route 106, Section C. J. R. Armstrong, Oakland, \$206,042.95; Lee J. Immel, San Pablo, \$222,855; Frederickson & Watson Construction Co., Oakland, \$226,874.80; J. Henry Harris, Berkeley, \$239,103.70. Contract awarded to Gallagher & Burk, Inc., Oakland, \$196,987.30.

FRESNO COUNTY—Between 0.4 mile north of city limits of Kingsburg and south city limits of Selma, about 3.3 miles to be resurfaced with plant-mixed surfacing. District VI, Route 4, Section A. Baun Construction Co., Fresno, \$74,417.50; Volpa Bros., Fresno, \$77,350; Gene Richards, Inc., Fresno, \$79,196; Thomas Construction Co., Fresno, \$79,490; Valley Paving Co., Pismo Beach, \$81,812.50. Contract awarded to Rex B. Sawyer, Wm. S. & Bruce F. Rogers Co., Madera, \$65,560.

FRESNO COUNTY—On Ventura Avenue between Orange Avenue and Maple Avenue, in and adjacent to the City of Fresno, about 1.0 mile in length to be resurfaced with plant-mixed surfacing and drainage sumps to be constructed. District VI, Route 41. Volpa Bros., Fresno, \$32,771.80; Baun Construction Co., Fresno, \$33,008; Thomas Construction Co., Fresno, \$34,474. Contract awarded to Gene Richards, Inc., Fresno, \$30,554.50.

FRESNO COUNTY—Across Wahtoke Creek, about 22 miles east of Fresno, a reinforced concrete slab bridge to be repaired. District VI, Route 41, Section S. Friant Construction Co., Fresno, \$9,882.60; Volpa Bros., Fresno, \$11,433; Trewitt, Shields, and Fisher, Fresno, \$12,178.30. Contract awarded to Kaweah Construction Co., Visalia, \$9,162.35.

HUMBOLDT COUNTY—In Humboldt County, about 6 miles south of Eureka (I-Hum-1-G), a reinforced concrete catwalk to be constructed. District I, Route 1, Section G. Reed and Tuttle, Redwood Valley, \$11,694; Humboldt Constructors, Inc., Eureka, \$12,534; Beverly S. McElderry, Berkeley, \$15,902. Contract awarded to Mercer Fraser Co. & Mercer Fraser Gas Co., Inc., Eureka, \$11,225.

IMPERIAL COUNTY—At Sand Hills Maintenance Station, a cottage to be constructed, District XI, Route 27, Section B. Cotton Construction Co., Chula Vista, \$18,881. Contract awarded to Sooy and Jackson Builders & Contractors, Redlands, \$15,465.

IMPERIAL COUNTY—Between 2 miles northwest of Frink and the Riverside County Line, about 11.3 miles in length to be widened with imported base material and road-mixed surfacing. District XI, Route 187, Section G. R. R. Hensler, Sun Valley, \$66,970; James E. Roberts, San Bernardino, \$67,831; E. C. Young, San Fernando, \$71,745.70; Norman I. Fadel, North Hollywood, \$72,460; Marks Bros. Construction Co., El Centro, \$74,962; Dimmitt & Taylor, Monrovia, \$75,160; Arthur H. Famularo & Roland T. Reynolds, Anaheim, \$83,485; Basich Bros. Construction Co. (Corporation), R. L. Basich (Individual), H. L. Basich (Individual), South San Gabriel, \$83,774; Robert E. L. Parker Co., Claremont, \$90,838; Flickinger-Welker, Inc., Los Angeles, \$107,825. Contract awarded to Geiser Construction Co., Buena Park, \$65,286.80.

INYO COUNTY—Between 1½ and 12½ miles northwest of Bishop, four reinforced concrete bridges to be widened. District IX, Route 23, Sections E, F. Norman I. Fadel, North Hollywood, \$20,667; B. S. McElderry, Berkeley, \$21,493.50; Bishop Engineering and Construction Co., Bishop, \$27,427.60. Contract awarded to Charles H. Major, Ojai, \$15,671.50.

INYO COUNTY—Portions between Rilling Hills and Darwin Junction, about 4.4 miles in net length, to be graded and surfaced with road-mixed surfacing on imported base material. District IX, Route 127, Section D, E. E. C. Young, San Fernando, \$113,543; Chas. J. Rounds Co., Los Angeles, \$115,284.48; Roland T. Reynolds, Anaheim, \$123,694.35; Eaton & Smith, San Francisco, \$129,987.90; Flickinger & Walker, Inc., Los Angeles, \$133,960.90; James E. Roberts, San Bernardino, \$134,487.90; The Roger Co., Santa Barbara, \$157,528.49. Contract awarded to Hess Construction Co., Inc., Long Beach, \$111,535.85.

INYO COUNTY—Across Ash Creek and Cottonwood Creek, about 42 and 44 miles north of Kern County Line, two reinforced concrete bridges to be constructed. District IX, Route 23, Section J. Wonderly Construction Co., Long Beach, \$31,348; E. S. & N. S. Johnson, Fullerton, \$33,313; Norman I. Fadel, North Hollywood, \$35,051; Monterey Construction Co., El Monte, \$35,540; Joseph E. Bonadiman, El Monte, \$36,560.50; Chas. J. Rounds Co., Los Angeles, \$37,707; Oilfields Trucking Co., Bakersfield, \$39,035. Contract awarded to Friant Construction Co., Fresno, \$25,973.50.

LAKE COUNTY—Across Putah Creek about 4 miles northeast of Middletown, a reinforced concrete bridge approaches and a detour to be constructed. District I, Route 49, Section 4. Oliver de Silva & Minton Co., Oakland, \$169,414.50; S & Q Construction Co., San Francisco, \$173,583.10; R. G. Clifford & C. O. Badenhamer, Berkeley, \$177,666; Chaney Construction Co., Los Angeles, \$190,846.50; G. M. Carr Co. & Bati Rocca, Santa Rosa, \$192,009.50; Bishop, Younger, Bradley Co., San Francisco, \$194,942.50; Barton Construction Co., & Underground Construction Co., Oakland, \$199,

564.50; Charles MacClosky Co., San Francisco, \$204,864.50; Bos Construction Co., Berkeley, \$214,701.50; Baldwin Contracting Co., Inc., San Rafael, \$219,276.25; Anson-Smith Construction Co., Marysville, \$227,579; O'Connor Bros., Red Bluff, \$230,994.50; Paul E. McCollum, Richmond, \$235,998. Contract awarded to Victor Weidmer, Penryn, \$159,778.50.

LOS ANGELES COUNTY—City of Whittier at the intersection of Whittier Boulevard with Laurel Avenue, traffic signal system to be furnished and installed. District VII, Route 2. Westates Electrical Construction Co., Los Angeles, \$4,787; Fischbach and Moore, Inc., Los Angeles, \$5,065. Contract awarded to Electric and Machinery Service Inc., South Gate, \$4,567.

LOS ANGELES COUNTY—On Foothill Blvd. between Alta Canyada Rd. and La Canada-Verdugo Rd., about 2.0 miles in length, to be paved with plant-mixed surfacing on cement treated base and existing pavement. District VII, Route 9, Sections A, B, J. E. Haddock, Ltd., Pasadena, \$134,890.50; Schroeder & Company, Sun Valley, \$135,677.70; Jesse S. Smith, Glendale, \$141,802.50; Griffith Company, Los Angeles, \$144,297.50; J. A. Thompson & Son, Contractors, Inglewood, \$174,657.50. Contract awarded to Osborn Company, Pasadena, \$132,688.25.

LOS ANGELES COUNTY—At the intersections of Fifth Avenue with Hansen Avenue and with Buena Vista Avenue in the city of Pomona, traffic signal systems and highway lighting to be furnished and installed. District VII, Route 19. Westates Electrical Construction Co., Los Angeles, \$10,619; Electric and Machinery Service, Inc., South Gate, \$10,884; C. D. Draucker, Inc., Los Angeles, \$11,233. Contract awarded to Ed Seymour, Long Beach, \$10,492.

LOS ANGELES COUNTY—On Santa Ana Freeway between Pioneer Boulevard and Rosecrans Avenue, highway lighting and illuminated sign system to be furnished and installed and traffic signal and highway lighting equipment to be removed and salvaged. District VII, Route 166, Section A. C. D. Draucker, Inc., Los Angeles, \$113,791; Ets-Hokin and Galvan, Wilmington, \$115,813; Westates Electrical Construction Co., Los Angeles, \$116,565; Electric and Machinery Service, Inc., South Gate, \$118,845. Contract awarded to A. S. Schulman Electric Co., Los Angeles, \$112,490.

LOS ANGELES COUNTY—In and adjacent to the cities of Redondo Beach and Manhattan Beach, on Redondo Beach Blvd. between Pier Ave. and Inglewood Ave., traffic signal systems and highway lighting to be furnished and installed. District VII, Route 175, Sections Rdo, B, Man., B, A. Westates Electrical Construction Co., Los Angeles, \$38,087; Electric and Machinery Service, Inc., South Gate, \$38,278. Contract awarded to C. D. Draucker, Inc., Los Angeles, \$37,592.

MADERA COUNTY—At Cottonwood Creek, about 3.4 miles south of Madera, a reinforced concrete slab bridge to be constructed and about 0.5 mile of approaches to be graded and surfaced with plant-mixed surfacing on cement treated base. District VI, Route 126, Section A. Gene Richards, Fresno, \$77,618.50; Volpa Brothers, Fresno, \$83,454.50; Baun Construction Co., Fresno, \$84,019; Trewhitt-Shields & Fisher, Fresno, \$87,211.10; J. Henry Harris, Berkeley, \$93,516.55; W. F. Maxwell, Los Angeles, \$97,921; Tumblyn Co., Bakersfield, \$104,139. Contract awarded to Thomas Construction Co., Fresno, \$65,642.

MADERA COUNTY—Between Route 32 and south city limits of Chowchilla, about 2.5 miles in length, to be resurfaced with plant-mixed surfacing. District VI, Route 124, Section A. Volpa Brothers, Fresno, \$39,868.50; Baun Construction Co., Fresno, \$42,425; Thomas Construction Co., Fresno, \$44,448.75; Gene Richards, Fresno, \$52,011.25; J. Henry Harris, Berkeley, \$56,069.50; Browne & Krull, Hayward, \$56,700. Contract awarded to Fredrickson & Watson Construction Co., Oakland, \$37,931.50.

MENDOCINO COUNTY—Across the north fork of the Navarro River, about 17 miles northwest of Booneville, a reinforced concrete bridge to be constructed and approaches to be graded and surfaced. District I, Route 48, Section C. G. M. Carr Co., and Bati Rocca, Santa Rosa, \$145,888.50; Chaney Construction Co., Los Angeles, \$147,

405.50; Tricon Construction Corp., San Rafael, \$148,916.25; Barton & Scheyer, El Cerrito, \$157,469; R. E. Hertel, Sacramento, \$168,852.50; Bishop, Younger, Bradley Co., San Francisco, \$171,268; R. G. Clifford & C. O. Bodenhamer, Berkeley, \$171,818. Contract awarded to Transocean Engineering Corp., Hayward, \$145,547.50.

MENDOCINO COUNTY—At Ten Mile River, about 7.8 miles south of Fort Bragg, a bridge to be constructed and approaches, about 1.4 miles in length, to be graded and surfaced with road-mixed surfacing on cement treated base. District I, Route 56, Section F. Charles MacClosky Co., San Francisco, \$749,738.40; Erickson, Phillips & Weisberg, Concord, \$752,058; Fredrickson Bros., Le-Boeuf-Dougherty Construction Co., & Erickson & Pierson, Emeryville, \$759,998.30; J. H. Pomeroy & Co., Inc., San Francisco, \$791,999; Tumblyn Co., Bakersfield, \$847,296; Trewhitt, Shields & Fischer, Fresno, \$814,498. Contract awarded to Bishop, Younger, Bradley Co., San Francisco, \$715,573.10.

MERCED COUNTY—Between north end of Livingston Underpass and south of Delhi, about 3.4 miles in length to be graded and surfaced with portland cement concrete on cement treated subgrade and with plant-mixed surfacing on untreated rock base to provide a four lane divided highway. District X, Route 4, Section D. Fredrickson Bros., Emeryville, \$398,562.10; Fredrickson & Watson Construction Co., Oakland, \$407,503.90; M. J. B. Construction Co., Stockton, \$414,587.15; Guy F. Atkinson Co., South San Francisco, \$417,299; Chas. L. Harney, San Francisco, \$476,659.50; Ball & Simpson, Berkeley, \$486,664.30. Contract awarded to Ukropine-Polich-Kral, San Gabriel, \$396,436.10.

MONO COUNTY—Between 2.4 miles south of Mammoth Road and 1.7 miles south of Mammoth Road, about 38 miles north of Bishop, about 0.6 mile in length to be graded and surfaced with road-mixed surfacing. District IX, Route 23, Section D. The Roger Co., Santa Barbara, \$27,879.20; Eaton & Smith, San Francisco, \$35,750.70; Friant Construction Co., Fresno, \$36,695; Bishop Engineering & Construction Co., Bishop, \$363,996. Contract awarded to Chas. J. Rounds Co., Los Angeles, \$21,846.50.

MONO COUNTY—Between Inyo County Line and Conway Summit, producing and stockpiling screenings. District IX, Routes 23, 112. Oilfields Trucking Co., Bakersfield, \$50,691.50; Clements Construction Co., Hayward, \$65,860; Floyd O. Bailey, Madera, \$84,035; John M. Ferry, Glendale, \$91,416.80. Contract awarded to Baker-Mitchell-Thwing Co., San Bernardino, \$44,309.70.

MONTEREY COUNTY—Between San Lucas and 2.5 miles north, about 2.4 miles in length, to be graded and surfaced with plant-mixed surfacing on cement treated base. District V, Route 2, Section F. Valley Paving Co., Pismo Beach, \$158,326; Hemreck & Easter, Santa Maria, \$161,901; Munn and Perkins, Modesto, \$191,715. Contract awarded to Granite Construction Co., Watsonville, \$153,287.

MONTEREY COUNTY—Between John Street and Market Street in Salinas, two reinforced concrete bridges and approaches about 0.6 mile in net length, to be constructed. District V, Route 2, Section K, Sal. W. A. Thompson & Son and N. F. Maxwell, Inglewood, \$535,198.95; Charles MacClosky Co., San Francisco, \$538,944.35; Gordon H. Ball & San Ramon Valley Land Co., Berkeley, \$554,310.13; Trewhitt-Shields & Fisher, Fresno, \$558,739.42; Frederickson & Kasler, Sacramento, \$565,481.80; Granite Construction Co., Watsonville, \$567,964.25; M. J. B. Construction Co., Stockton, \$573,222.40; Carl N. Swenson Co., Inc., San Jose, \$587,263.58; Transocean Engineering Corp., Hayward, \$598,972.10; Bishop, Younger, Bradley Co., San Francisco, \$611,894.15; Stolte Inc., Monterey, \$626,318.07. Contract awarded to Dan Caputo & Edward Keeble, San Jose, \$514,392.55.

MONTEREY COUNTY—Between 10 miles and 55 miles south of Monterey, 4 cattle passes to be replaced with corrugated metal pipes, culverts and bridge across Buck Creek to be redecked. District V, Route 56, Section C, D, F, H. Chaney Construction Co., Los Angeles, \$39,897; Minton Co., Oakland, \$43,922.20; R. G. Clifford & C. O. Bodenhamer, Berkeley, \$45,720; E. G. Perham, Los Angeles, \$48,024; Friant Construction Co., Fresno, \$48,720; William Radtke & Son, Gilroy, \$52,208; S. & Q. Construction Co., San Francisco, \$59,180; James B. Allen, San Carlos, \$63,993; Stolte Inc.,

Monterey, \$66,315. Contract awarded to H. H. Anderson, Hayward, \$35,634.

MONTEREY COUNTY—Across Little Sur River, about 20 miles south of Monterey, a reinforced concrete bridge and road approaches to be constructed. District V, Route 56, Sections F, G. Granite Construction Co., Watsonville, \$191,854; Thomas Construction Co., Fresno, \$193,934; Transocean Engineering Corp., Hayward, \$202,412.75; R. G. Clifford & C. O. Bodenhamer, Berkeley, \$202,494.50; Chaney Construction Co., Los Angeles, \$202,913; The Lowrie Paving Co., San Francisco, \$207,795.50; G. M. Carr Co. & Bati Rocca, Santa Rosa, \$210,853.20; Dan Caputo, San Jose, \$212,462; Gordon H. Ball-San Ramon Valley Land Co., Berkeley, \$213,176; Trewhitt-Shields & Fisher, Fresno, \$215,022.80; Tumblyn Co., Bakersfield, \$226,140; E. G. Perham, Los Angeles, \$226,545.50; Stolte Inc., Monterey, \$229,467.65; Wm. Radtke & Son, Gilroy, \$273,829.10; Chas. McClosky Co., San Francisco, \$311,803. Contract awarded to Condict Co., Berkeley, \$165,662.25.

NAPA COUNTY—Between Oakville and Rutherford, a distance of about 1.8 miles to be widened with plant-mixed surfacing on untreated rock base and existing portland cement concrete pavement to be resurfaced with plant-mixed surfacing. District IV, Route 49, Section B. O. C. Jones & Sons, Berkeley, \$136,058.30; Munn & Perkins, Modesto, \$140,802; Brown-Ely Co. Contractors, Corte Madera, \$156,906.90; E. A. Forde, San Anselmo, \$161,169; A. G. Raisch Co., San Rafael, \$174,581.65. Contract awarded to Arthur B. Siri Inc., Santa Rosa, \$136,589.50.

NEVADA COUNTY—Across Truckee River and over the Southern Pacific tracks at Hinton, about 9 miles east of Truckee, railing to be constructed on two bridges. District III, Route 38, Section B. Norman I. Fadel, North Hollywood, \$22,140; Friant Construction Co., Fresno, \$23,601.20; Bos Construction Co., Berkeley, \$29,569.40; H. H. Anderson, Hayward, \$30,478; B. S. McElderry, Berkeley, \$33,391. Contract awarded to Minton Co. Contractors, Oakland, \$18,858.

ORANGE COUNTY—On Newport Blvd. between Route 60 in Newport Beach and 20th Street in Costa Mesa, traffic signal systems and highway lighting at five intersections and highway lighting at four intersections to be furnished and installed. District VII, Route 43, Sections Npt, B, A. Electric & Machinery Service, Inc., South Gate, \$51,662; Fischbach & Moore Inc., Los Angeles, \$52,868; C. D. Draucker Inc., Los Angeles, \$54,483. Contract awarded to Westates Electrical Construction Co., Los Angeles, \$50,168.

ORANGE COUNTY—At Coyote Creek, about one mile north of Buena Park, the existing concrete slab bridge to be widened and about 0.08 mile of approaches to be resurfaced with plant-mixed surfacing and widened with plant-mixed surfacing on untreated rock base. District VII, Route 171, Section B. Oberg and Cook, Gardena, \$49,394; Norman I. Fadel, North Hollywood, \$49,520; Byerts & Sons and George K. Thatcher, J. V., Los Angeles, \$54,257; Charles MacClosky Co., San Francisco, \$54,610; Monterey Construction Co., El Monte, \$55,543.40; W. F. Maxwell, Los Angeles, \$56,468.80; A. H. Famularo, Santa Ana, \$57,793.50; E. S. & N. S. Johnson, Fullerton, \$59,085; Chaney Construction Co., Los Angeles, \$59,253; Gerstenberger & Pierson, Los Angeles, \$59,551; E. G. Perham, Los Angeles, \$59,798; A. A. Edmondson, San Fernando, \$59,905; N. M. Saliba Co., Los Angeles, \$62,446; Lars Oberg, Los Angeles, \$63,080; Concrete Construction Service Inc., Gardena, \$64,682.95. Contract awarded to Owl Truck & Construction Co., Compton, \$46,222.

RIVERSIDE COUNTY—Between Nuevo Road and March Air Force Base, about 4.8 miles in length, additional roadbed to be graded and surfaced with plant-mixed surfacing on cement treated base and existing pavement to be resurfaced with plant-mixed surfacing to provide a four lane divided highway. District VIII, Route 78, Section D. E. L. Yeager Co., Riverside, \$386,640.50; R. A. Erwin, Colton, \$400,701.50; Dimmitt & Taylor, Monrovia, \$419,081.65; Cox Bros. Construction Co., Stanton, \$450,536.50. Contract awarded to Robert E. L. Parker Co., Claremont, \$385,146.50.

RIVERSIDE COUNTY—In Riverside County at Colt Creek, about 34 miles east of Hemet. District VIII, Route 64, Section H. Installing 96" field as-

sembled plate culvert and removing existing timber bridge. E. L. Yeager Co., Riverside, \$9,760; E. G. Perham, Los Angeles, \$9,883; Norman I. Fadel, North Hollywood, \$10,240; Weardco Construction Corp., San Bernardino, \$12,285; Geo. Herz & Co., San Bernardino, \$13,964. Contract awarded to D. E. Higday, Temple City, \$9,385.50.

RIVERSIDE COUNTY—At two locations between 0.3 mile east of Cathedral City and 1.0 mile west of Route 64, about 1.3 miles in net length, to be graded and surfaced with road-mixed surfacing. District VIII, Route 187, Section C. James E. Roberts, San Bernardino, \$104,505.50; E. L. Yeager Co., Riverside, \$109,723; Hubbs Equipment Co., Colton, \$112,018; Basich Bros. Construction Co. (Corporation), R. L. Basich (Individual), N. L. Basich (Individual), \$113,169.65; Dimmit & Taylor, Monrovia, \$124,195.50; Lester S. Hawley, Montebello, \$135,696; George Herz & Co., San Bernardino, \$157,150.40; E. C. Young, San Fernando, \$163,622. Contract awarded to Match Brothers & Match Brothers Paving Co., Colton, \$101,472.

SANTA BARBARA COUNTY—Between Winchester Creek and Las Varas Creek, about 3.9 miles in length, to be surfaced with plant-mixed surface and seal coat to be applied. District V, Route 2, Section G. Valley Paving Co., Pismo Beach, \$168,370.70; Munn and Perkins, Modesto, \$181,925; Clyde W. Wood and Son, North Hollywood, \$184,164.20; Hermreck and Easter, Santa Maria, \$191,880; Granite Construction Co., Watsonville, \$196,670. Contract awarded to Baker and Pollock, Ventura, \$168,202.

SANTA BARBARA COUNTY—Between 1 mile east of Carpinteria and 0.5 mile east of Arroyo Parida and between Ortega Hill and Sheffield Drive, about 3.6 miles in length, roadways, ramps and frontage roads to be graded, seven reinforced concrete bridges to be constructed and ramps, and frontage roads to be surfaced with plant-mixed surface on untreated rock base. District V, Route 2, Sections H, J. Granite Construction Co., Watsonville, \$1,109,095; Clyde W. Wood & Sons, Inc., and Charles MacClosky Co., North Hollywood, \$1,111,159.35; J. A. Thompson & Son and W. F. Maxwell, Inglewood, \$1,114,645.90; Gordon H. Ball & San Ramon Valley Land Co., Berkeley, \$1,129,415.67. Contract awarded to Fredrickson & Watson Construction Co., Oakland, \$1,085,489.

SAN BERNARDINO COUNTY—Between Los Angeles County Line and Archibald Avenue about 7.2 miles in length, to be graded and paved with portland cement concrete pavement on cement treated subgrade to provide a four-lane divided highway. District VIII, Route 26, Sections C, Upl, Ont, D. Fredrickson & Watson Construction Co., Oakland, \$2,402,682.40; Guy F. Atkinson Co., Long Beach, \$2,441,734; Webb & White, Los Angeles, \$2,497,999.50; Griffith Co., Los Angeles, \$2,563,455.20; B. J. Ukropina, T. P. Polich, Steve Kral, John R. Ukropina, San Gabriel, \$2,585,961; J. E. Haddock, Ltd., Pasadena, \$2,588,897.55; Gordon H. Ball and San Ramon Valley Land Co., and Ball & Simpson, Berkeley, \$2,634,386.60; R. R. Hensler, Sun Valley, \$2,960,779. Contract awarded to J. A. Payton, George Herz & Co., and Clyde W. Wood & Sons, Inc., Riverside, \$2,308,178.22.

SAN BERNARDINO COUNTY—Between 3 miles west of Halloran Springs and Nevada State Line, about 38.8 miles in length, to be widened with plant-mixed surface, a portion to be resurfaced and seal coat to be applied. District VIII, Route 31, Sections L, M, N, P. Basich Bros. Construction Co. (Corporation), R. L. Basich (Individual), N. L. Basich (Individual), South San Gabriel, \$313,135. Contract awarded to G. W. Ellis Construction Co., North Hollywood, \$309,917.50.

SAN BERNARDINO COUNTY—Between Los Angeles County line, approximately 3.3 miles south-east of Palmdale, and Route 61, about 6.7 miles in net length, to be graded, base material to be placed and bituminous surface treatment to be applied. District VIII, Route 59, Section A. Clyde W. Wood & Sons, North Hollywood, \$78,121; Robert E. L. Parker Co., Claremont, \$78,442; Osborn Company, Pasadena, \$82,825.50; Jesse S. Smith, Glendale, \$89,516; R. A. Erwin, Colton, \$91,653; E. C. Young, San Fernando, \$93,204.40; Match Bros., Colton, \$95,245; Norman I. Fadel, North Hollywood, \$95,614; Dimmit & Taylor, Monrovia, \$104,182.40;

Flickinger-Welker, Inc., Los Angeles, \$135,431.70. Contract awarded to George Herz & Co., San Bernardino, \$68,002.30.

SAN BERNARDINO COUNTY—Between Route 59 and Daly Canyon Road, installing guard railing and guide posts. District VIII, Route 43, Section B. F. H. Harris, San Bernardino, \$8,653.80; Rodney B. Braswell, La Canada, \$9,122; E. L. Yeager Co., Riverside, \$9,470.20; Norman I. Fadel, North Hollywood, \$10,208. Contract awarded to George Herz & Co., San Bernardino, \$7,911.65.

SANTA CRUZ COUNTY—Between 1.5 miles north of Watsonville and Rob Roy Junction, about 5.7 miles in length to be surfaced with plant-mixed surfacing over existing pavement and existing shoulders to be reconstructed. District IV, Route 56, Section D. Edward Keeble, San Jose, \$142,365; Leo F. Piazza Paving Co., San Jose, \$143,209.80; Granite Construction Co., Watsonville, \$143,742.85; Munn & Perkins, Modesto, \$145,787. Contract awarded to Baun Construction Co., Fresno, \$139,503.30.

SAN LUIS OBISPO COUNTY—In the city of Arroyo Grande about 1.4 miles in length, to be graded and surfaced with plant-mixed surfacing on cement treated base. District V, Route 2, Section Ar. Gd. Hermreck & Easter, Santa Maria, \$99,691.65; Oilfields Trucking Co., Bakersfield, \$110,556.40; Baun Construction Co., Fresno, \$117,469; Madonna Construction Co., San Luis Obispo, \$125,348.50. Contract awarded to Valley Paving Co., Pismo Beach, \$96,945.40.

SANTA BARBARA COUNTY—At Gaviota Gorge Tunnel, furnishing and installing highway tunnel lighting system. District V, Route 2, Section E. John A. Rodriguez, Carpinteria, \$6,994.71; Santa Barbara Electric Co., Santa Barbara, \$7,785. Contract awarded to Ed. H. Anderson Electrical Co., Santa Maria, \$6,467.

SHASTA COUNTY—Between Boulder Creek and Project City, about 4 miles in length a 4 lane divided highway to be graded and a bridge across Churn Creek to be constructed. District II, Route 3, Section B. Fredrickson Bros., Emeryville, \$568,437.05; A. Teichert & Son, Inc., Sacramento, \$637,466.25; Harms Bros., Sacramento, \$643,379.05; M. W. Brown & R. E. Hertel, Redding, \$645,222.86; M. J. B. Construction Co., Stockton, \$667,599.90; Eaton & Smith, San Francisco, \$668,542.05; Transocean Engineering Corp., Hayward, \$668,566.70; Charles MacClosky Co., & L. A. & R. S. Crow, San Francisco, \$678,911.45; Claude C. Wood Co., Lodi, \$845,128.93. Contract awarded to Fredrickson & Watson Construction Co., Oakland, \$555,555.55.

SHASTA COUNTY—At Shingle Creek about 25 miles east of Redding about 0.2 mile in length, to be graded and surfaced with plant-mixed surfacing and a quintuplicate 48" corrugated metal pipe culvert to be installed. District II, Route 20, Section D. Morgan Construction Co., Redding, \$16,925; O'Connor Bros., Red Bluff, \$17,745; B. S. McElderry, Berkeley, \$18,475; Fredrickson & Watson Construction, Oakland, \$19,393; Reed & Tuttle, Redwood Valley, \$19,739. Contract awarded to M. W. Brown, Redding, \$15,932.

SISKIYOU COUNTY—Between one mile west and one mile east of Forest Mountain Summit, about 1.6 miles in length, to be graded and surfaced with road-mixed surfacing and cement treated base. District II, Route 82, Section D. Fredrickson & Watson Construction Co., Oakland, \$355,381; Fredrickson Bros., Emeryville, \$365,602; Harms Bros., Sacramento, \$377,342.15; Paul E. McCollum, Richmond, \$378,167.10; Huntington Bros., Napa, \$388,704; M. W. Brown, Redding, \$392,324.09; Natt McDougall Co., Portland, Oregon, \$436,833.30. Contract awarded to Eaton & Smith, San Francisco, \$335,605.60.

SOLANO COUNTY—Across Napa River near the west city limits of Vallejo, portions of an existing bridge to be redecked. District X, Route 208, Section A. O. C. Jones & Sons, Berkeley, \$41,272; Minton Co., Contractor, Oakland, \$41,778; R. G. Clifford & C. O. Bodenhamer, Berkeley, \$42,813.50; Payne Construction Co., Oakland, \$44,132.72; Kevry Construction, Inc., San Leandro, \$45,702; Bos Construction Co., Berkeley, \$47,318; Healy Tibbitts Construction Co., San Francisco, \$48,785; Wheeler Construction Co., Oakland, \$52,799; Stanley H. Koller Construction, Crockett, \$59,800.50. Contract awarded to Al Erickson & Co., Napa, \$40,265.

SONOMA COUNTY—Between 1.1 miles west of Gossage Creek and Gossage Creek, about 1.1 miles in length, to be graded and surfaced with plant mixed surfacing on imported base material. District IV, Route 104, Section C. O. C. Jones & Sons, Berkeley, \$140,626.30; Fredrickson Bros., Emeryville, \$144,242.65; J. Henry Harris, Berkeley, \$147,950.25; Brown-Ely Co., Contractor, Corte Madera, \$149,892.15; Huntington Bros., Napa, \$170,714.50; Ace Excavators, Oakland, \$221,643.75. Contract awarded to Arthur B. Siri, Inc., Santa Rosa, \$128,169.15.

SONOMA COUNTY—Across Petaluma Creek in the City of Petaluma, a steel bascule bridge to be redecked. District IV, Route 104. S & Q Construction Co., San Francisco, \$20,669; Condict Co., Berkeley, \$22,735; E. A. Forde Co., San Anselmo, \$22,846; R. G. Clifford & C. O. Bodenhamer, Berkeley, \$24,080; B. S. McElderry, Berkeley, \$24,180; Bos Construction Co., Berkeley, \$24,363; Al Erickson, Napa, \$24,495; Barton Construction Co., Oakland, \$25,522.60; Minton Co., Contractor, Oakland, \$28,664. Contract awarded to Payne Construction Co., Oakland, \$18,443.

SONOMA COUNTY—Sonoma State Home at Eldridge, roads and parking areas are to be graded and surfaced with plant mixed surfacing over untreated rock base or salvaged surfacing. District IV. Helwig Construction Co., Sebastopol, \$27,908; O. C. Jones & Sons, Berkeley, \$29,206; Arthur B. Siri, Inc., Santa Rosa, \$29,828.50; J. Henry Harris, Berkeley, \$30,523.25; Browne & Krull, Hayward, \$34,785.75. Contract awarded to I. J. Ely Co., Larkspur, \$24,929.90.

SONOMA COUNTY—Between 0.4 mile north of Petaluma Creek and Petaluma Creek about 0.3 mile of State highway to be graded and imported borrow placed. District IV. Route 1, Section F. Guy F. Atkinson Co., South San Francisco, \$391,320; Fredrickson & Watson Construction Co., & M & K Corp., Oakland, \$399,970; Ukropina-Polich-Karl, San Gabriel, \$455,200; M. Malfitano & Son, Inc. and Vega Engineering and Grading Co., Pittsburg, \$473,660; Harms Bros., Sacramento, \$475,050; Piombo Construction Co., San Francisco, \$479,430; Fredrickson Bros., Emeryville, \$492,090; Chas. J. Rounds Co., Los Angeles, \$496,090; McCammon-Wunderlich Co., Palo Alto, \$559,900; H. Earl Parker, Inc., Marysville, \$590,480; Claude C. Wood Co., Lodi, \$699,250. Contract awarded to Ball and Simpson, Berkeley, \$361,820.

SONOMA COUNTY—Between 0.6 mile south of Venezia and 0.2 mile south of Lytton Overhead and between Stony Point Road and 0.1 mile west of Northwestern Pacific Railroad about 2.6 miles in net length to be widened and resurfaced with plant mixed surfacing and a reinforced concrete bridge over the Northwestern Pacific Railroad to be repaired. District IV, Routes I, 51, Sections A, C. A. G. Raisch Co., San Rafael, \$123,162.25. Contract awarded to Arthur B. Siri, Inc., Santa Rosa, \$123,002.80.

TEHAMA, PLUMAS, LASSEN COUNTY—Between Mineral and about 5 miles east of Westwood, screenings to be furnished and stockpiled. District II, Routes 83, 29. H. Earl Parker, Inc., Marysville, \$34,897.50; Allen & Reddy, Red Bluff, \$35,100; Howard B. Folsom, Westwood, \$38,812.50; Harms Bros., Sacramento, \$44,550. Contract awarded to Clements Construction Co., Hayward, \$33,750.

VENTURA COUNTY—Between Calleguas Road and 0.4 mile west of Central Avenue, about 5.7 miles to be graded and surfaced with plant mixed surfacing on cement treated base and three reinforced concrete bridges to be constructed, to provide a four-lane divided highway. District VII, Route 2, Sections B, C. Webb & White, Los Angeles, \$1,248,187; Basich Bros. Construction Co., R. L. Basich, N. L. Basich, O. B. Pierson & Bert C. Altflisch, South San Gabriel, \$1,251,759.65; Fredrickson & Kasler, Sacramento, \$1,259,707.97; Gordon H. Ball and San Ramon Valley Land Co., Berkeley, \$1,262,398.80; J. A. Thompson & Son and W. F. Maxwell, Inglewood, \$1,266,241.39; Clyde W. Wood & Sons, Inc., and Charles MacClosky Co., North Hollywood, \$1,269,815; Ukropina-Polich-Kral, San Gabriel, \$1,293,232.50; Guy F. Atkinson Co., Long Beach, \$1,328,500; J. E. Haddock, Ltd., Pasadena, \$1,331,850.70; R. R. Hensler, Sun Valley, \$1,416,514.64. Contract awarded to Griffith Co., Los Angeles, \$1,170,026.25.

SECOND ANNUAL BONNEROO STAG

VENTURA COUNTY—On Telegraph Road, between Route 2 and Route 154, a net distance of about 3.4 miles to be surfaced with plant mixed surfacing, District VII, Route 79, Section Ven, A. Griffith Co., Los Angeles, \$46,561; Valley Paving Co., Pismo Beach, \$51,470; Jesse S. Smith, Glendale, \$52,782; Schroeder & Co., Sun Valley, \$53,875. Contract awarded to Baker and Pollock, Ventura, \$45,873.

YOLO COUNTY—Across Knights Landing Ridge Cut, about ½ mile southwest of Knights Landing, the existing reinforced concrete girder bridge to be widened by replacing the existing concrete railing with new metal curb and railing, District III, Route 87, Section A. Bos Construction Co., Berkeley, \$30,799.75; R. E. Hertel, Sacramento, \$31,245.75; Friant Construction Co., Fresno, \$33,089.50; W. C. Railing, Woodland, \$33,282.10; B. S. McElderry, Berkeley, \$38,847.50; Wheeler Construction Co., Oakland, \$42,055.31. Contract awarded to James W. Hill, Walnut Creek, \$24,669.

YOLO COUNTY—Between Yolo Causeway and Tower bridge about 4.0 miles in length to be graded and paved with Portland cement concrete and a reinforced concrete bridge to be constructed, District III, Route 6, Sections B, C. A. Teichert & Sons, Inc., Sacramento, \$1,227,940.50; Harms Bros, Sacramento, \$1,256,948; Brighton Sand & Gravel Co. and Parish Bros., Sacramento, \$1,334,770.47; Fredrickson & Watson Construction Co. and M and K Corp., Oakland, \$1,341,547.25; Guy F. Atkinson Co., South San Francisco, \$1,353,303.70; Peter Kiewit Sons' Co., San Francisco, \$1,386,988; Fredrickson Bros., Emeryville, \$1,394,612.90. Contract awarded to Ukropina-Polich-Kral & John R. Ukropina, San Gabriel, \$1,215,180.70.

F. A. S. County Routes

RIVERSIDE COUNTY—Between Bloomington Blvd. and Crestmore Bridge about 1.1 miles in length to be graded and surfaced with plant mixed surfacing on cement treated base, District VIII, Route 1177, J. A. Thompson & Son, Contractors, Inglewood, \$102,512.30; R. A. Erwin, Colton, \$108,381; L. A. & R. S. Crow, El Monte, \$109,981.95; Matich Brothers and Matich Brothers Paving Co., Colton, \$116,421.50; James E. Roberts, San Bernardino, \$131,568.20. Contract awarded to E. L. Yeoger Co. and J. A. Payton, Riverside, \$98,932.76.

SAN JOAQUIN COUNTY—On Pacific Avenue between 500 feet north of Hammer Lane and Calaveras River Bridge about 3.1 miles in length to be graded and surfaced with plant mixed surfacing on untreated rock base, District X, Route 543, 641, S. M. McGaw Co., Inc., Stockton, \$276,670.50; Clements & Co., Hayward, \$283,079.60; Antioch Paving Co., Antioch, \$286,587.70; Nomellini Construction Co., Stockton, \$289,874.90; Stephens Trucking Co., French Camp, \$297,911; Fredrickson Bros., Emeryville, \$299,024.60; J. Henry Harris, Berkeley, \$300,212.50; M.J.B. Construction Co., Stockton, \$328,640.80. Contract awarded to A. Teichert & Son, Inc., Sacramento, \$261,441.80.

SAN MATEO COUNTY—Whiskey Hill Road and Portola Road near Woodside about 2.4 miles in length to be graded and surfaced with plant mixed surfacing on untreated rock base, District IV, Route 1048, Douglass & Woodhouse, Redwood City, \$189,224; Peter Sorensen, Redwood City, \$196,921; Granito Construction Co., Watsonville, \$199,887.80; Piombo Construction Co., San Francisco, \$207,126.60; McCammon-Wunderlich Co., Palo Alto, \$207,911.80; Cecil L. Moore, San Leandro, \$215,781.50; S. A. E. Co., Redwood City, \$225,261.50. Contract awarded to L. C. Smith Co., San Mateo, \$179,756.35.

STANISLAUS COUNTY—On Scenic Drive-Old Oakdale Road, between east city limits of Modesto and State Highway Route 13, about 6.8 miles in length to be surfaced with plant mixed surfacing on untreated rock base and existing surfacing, District X, Route 1191, M. J. Ruddy & Son, Modesto, \$131,881.10; Standard Materials Inc., Modesto, \$136,938; Ukropina-Polich-Kral, San Gabriel, \$149,069; J. Henry Harris, Berkeley, \$164,667. Contract awarded to Munn & Perkins, Modesto, \$128,680.



CONTRACTORS and engineers of District VII assembled on Friday evening, April 17th, to celebrate the occasion of awarding trophies to the contractor and the resident engineer who completed the best district highway contract during the year 1952, as reported in the March-April issue of this magazine.

Earle Withycombe, Assistant State Highway Engineer, and Don G. Evans, Construction Engineer, presented the awards to Adolph Bauer, Superintendent of A. Teichert & Son, Inc., and Alden Carr, Resident Engineer, on Contract 51-7VC37-F, on the Santa Ana Canyon Road between Peralta School and Riverside County Line, the number one contract in District VII. The photograph shows the above-mentioned donors and recipients of awards: Left to right: Carr, Withycombe, Evans, and Bauer.

May, 1953

BUTTE COUNTY—Between junction Route 87 and Chico Avenue, about 9.0 miles to be surfaced with plant-mixed surfacing on untreated rock base, District III, Route 3, Section C. Clements Construction Co. & Clements & Co., Hayward, \$394,065; Peter Kiewit Sons' Co., San Francisco, \$406,421; A. G. Raisch Co., San Rafael, \$408,330; Fredrickson & Watson Construction Co., Oakland, \$418,415.20; Granite Construction Co., Watsonville, \$429,155; Fredrickson Bros., Emeryville, \$436,271; McGilivray Construction Co., Sacramento, \$448,220.70; Harms Bros., Sacramento, \$473,705. Contract awarded to Rice Bros., Inc., Marysville, \$384,424.50.

BUTTE AND GLENN COUNTIES—Across Sacramento River at Gianelli, about 8.5 miles west of Chico, a bridge to be redecked, District III, Route 47, Sections A.A. Judson Pacific-Murphy Corp., Emeryville, \$148,711.61; Payne Construction Co., Oakland, \$150,565.08; W. B. Willett Co., Sacramento, \$151,033.50; James P. Morton, Placerville, \$157,705.78; R. G. Clifford and C. O. Bodenhamer, Berkeley, \$169,747; Bos Construction Co., Berkeley, \$171,125.60. Contract awarded to Barton Construction Co. and B & B Steel Erectors, Richmond, \$139,667.

IMPERIAL COUNTY—Between Coyote Wells Underpass and Plaster City (portions), about 4.6

miles in length, road-mixed surfacing to be placed over existing surfacing and seal coat applied, District XI, Route 12, Sections A,B. Marks Bros. Construction Co., El Centro, \$41,208; L. A. Rankin & Arthur G. Booth, Playa Del Rey, \$43,981. Contract awarded to E. S. & N. S. Johnson, Fullerton, \$38,245.

MODOC COUNTY—Across the track of the Southern Pacific Co., about 21.4 miles southeast of Tulelake, portions of an existing overhead to be removed, existing structural steel girders to be strengthened and raised, and new reinforced concrete abutments, deck slab and approach spans to be constructed and approaches and detour to be graded and surfaced, District II, Route 210, Section B. R. E. Hertel, Sacramento, \$44,277; Stanley H. Koller Constructor, Crockett, \$47,620; Gibbons & Zick, Alturas, \$48,000; Bos Construction Co., Berkeley, \$57,785.50; Chaney Construction Co., Los Angeles, \$58,762.50. Contract awarded to B. S. McElderry, Berkeley, \$42,869.90.

SAN BERNARDINO COUNTY—In and adjacent to the City of Ontario, at the intersection of Route 26 with Vineyard Avenue, traffic signal system, highway lighting and channelization, District VIII, Route 26, Ed Seymour, Long Beach, \$11,299; Fischbach & Moore, Inc., Los Angeles, \$11,390; Electric & Machinery Service, Inc., South Gate, \$11,729; Drury Electric Co., San Bernardino, \$17,402. Contract awarded to Paul R. Gardner, Ontario, \$10,335.10.

EARL WARREN
Governor of California

FRANK B. DURKEE
Director of Public Works

HIGHWAY COMMISSION

HARRISON R. BAKER Pasadena
H. STEPHEN CHASE Sacramento
JAMES A. GUTHRIE San Bernardino
F. WALTER SANDELIN Ukiah
CHESTER H. WARLOW Fresno
CHARLES T. LEIGH San Diego
R. C. KENNEDY, Secretary Sacramento

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R. M. GILLIS Deputy State Highway Engineer
CHAS. E. WAITE Assistant State Highway Engineer
EARL WITHTYCOMBE Assistant State Highway Engineer
F. W. PANHORST Assistant State Highway Engineer
J. W. VICKREY Assistant State Highway Engineer
R. H. WILSON Assistant State Highway Engineer
F. N. HVEEM Materials and Research Engineer
GEORGE F. HELLESOE Maintenance Engineer
J. C. YOUNG Engineer of Design
G. M. WEBB Traffic Engineer
DON G. EVANS Construction Engineer
H. B. LA FORGE Engineer of Federal Secondary Roads
C. E. BOVEY Engineer of City and Cooperative Projects
EARL E. SORENSON Equipment Engineer
H. C. McCARTY Office Engineer
J. C. WOMACK Planning Engineer
J. P. MURPHY Principal Highway Engineer
F. M. REYNOLDS Principal Highway Engineer
E. J. SALDINE Principal Highway Engineer
I. O. JAHLSTROM Principal Bridge Engineer
STEWART MITCHELL Principal Bridge Engineer
E. R. HIGGINS Comptroller

Right of Way Department

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E. F. WAGNER Deputy Chief Right of Way Agent
GEORGE S. PINGRY Assistant Chief
R. S. J. PIANEZZI Assistant Chief
E. M. MacDONALD Assistant Chief

District IV

B. W. BOOKER Assistant State Highway Engineer

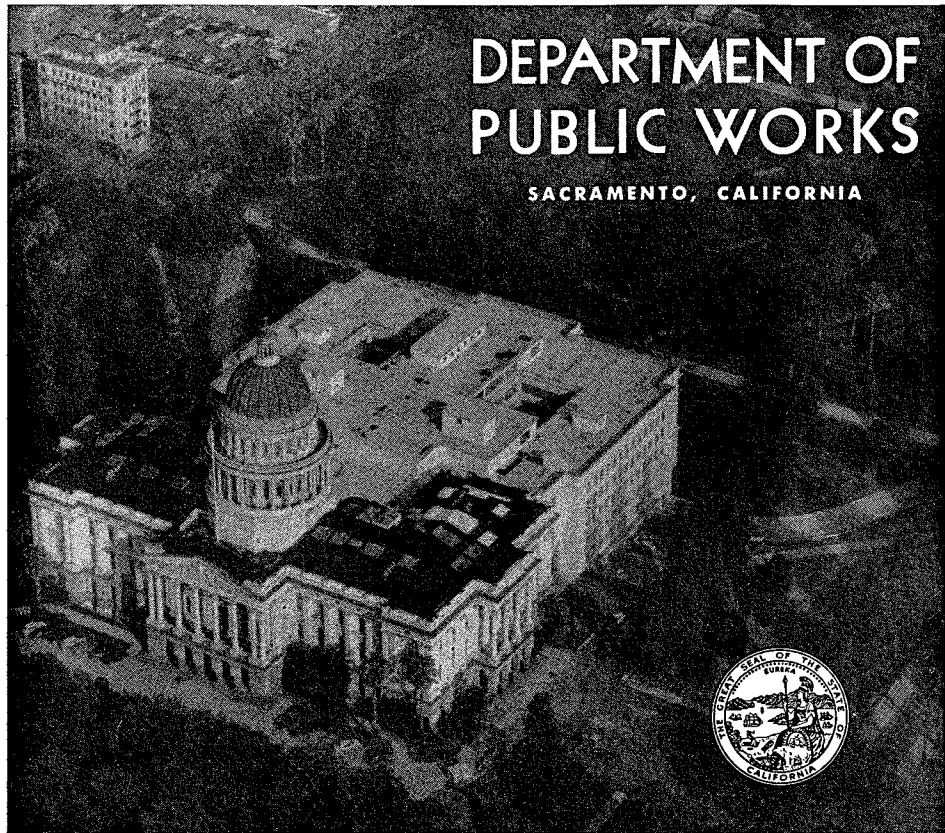
District VII

P. O. HARDING Assistant State Highway Engineer

DIVISION OF HIGHWAYS

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J. W. TRASK District II, Redding
A. M. NASH District III, Marysville
J. P. SINCLAIR District IV, San Francisco
L. A. WEYMOUTH District IV, San Francisco
E. J. L. PETERSON District V, San Luis Obispo
E. T. SCOTT District VI, Fresno
W. L. FAHEY District VII, Los Angeles
E. T. TELFORD District VII, Los Angeles
C. V. KANE District VIII, San Bernardino
MILTON HARRIS District IX, Bishop
JOHN G. MEYER District X, Stockton
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**DEPARTMENT OF
PUBLIC WORKS**

SACRAMENTO, CALIFORNIA



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J. WILLIAM COOK Area II, Sacramento
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**DIVISION OF SAN FRANCISCO
BAY TOLL CROSSINGS**

NORMAN C. RAAB Projects Engineer

DIVISION OF WATER RESOURCES

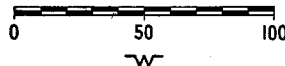
A. D. EDMONSTON State Engineer, Chief of Division
G. H. JONES Assistant State Engineer, Sacramento
River Flood Control Project, Supervision of Safety
of Dams, Sacramento-San Joaquin Water Supervision
T. B. WADDELL
Assistant State Engineer, Water Resources Investi-
gations, Central Valley Project, Irrigation Districts
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Supervising Hydraulic Engineer, Los Angeles Office
HENRY HOLSINGER Principal Attorney
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DIVISION OF ARCHITECTURE

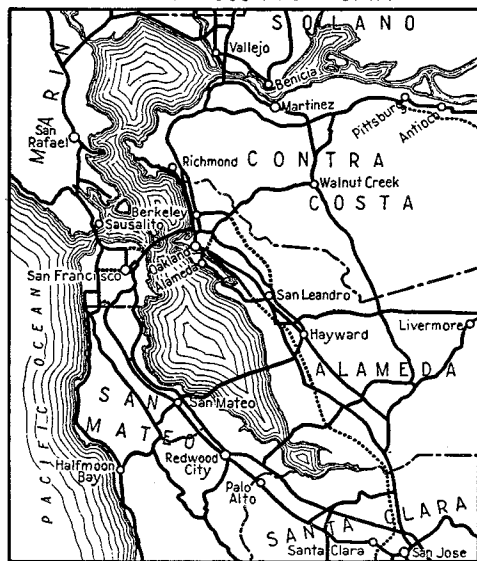
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CALIFORNIA STATE HIGHWAY SYSTEM

SCALE IN MILES



SAN FRANCISCO AND VICINITY



LOS ANGELES AND VICINITY

