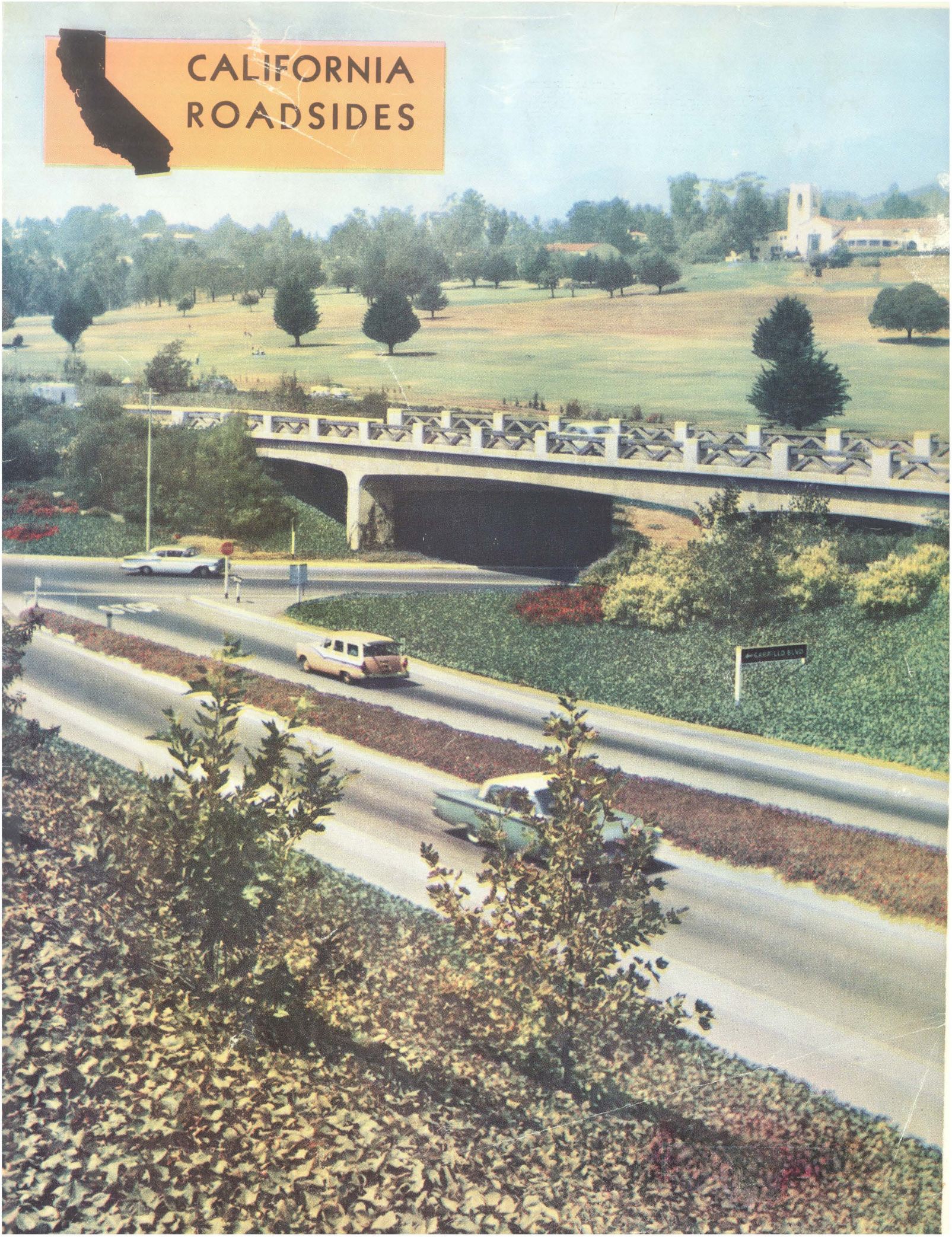
CALIFORNIA ROADSIDES



California Roadsides

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STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS
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California Roadsides—I

State's Highway Planting Policy Has Grown Out of Special Problems of Terrain, Climate, Changing Pattern of Traffic

THE ROADSIDE policy of any agency is bound to be strongly influenced by local conditions and attitudes. In the Middle Ages in England, there was a law requiring that all trees and shrubbery be removed for a distance of two hundred feet on either side of major travel routes, because they gave cover where highwaymen could lie in wait.

Conversely, many European countries have planted roadside trees for centuries, probably for delineation and dust control as much as shade. The frugal Europeans, mindful of their land shortage, often used fruit trees which were harvested by nearby inhabitants. Today, with the greatly increased motor traffic in Europe, this harvesting no doubt creates serious traffic hazards.

In parts of the United States where there is plentiful summer rainfall, highway landscaping is relatively simple. Shrubs and trees are usually already present. If not, they can be planted and grown with little maintenance except removal of weeds while the plants are small. Roadside grasses will stay green without watering, and can be kept mowed for a parklike appearance.

EDITOR'S NOTE

This booklet is a reprint of a series of articles on landscaping and other roadside problems on the California State Highway System which appeared in the January-February, March-April, May-June and July-August, 1961, issues of *California Highways and Public Works* magazine.

The series was prepared by John Robinson of the Public Information Section with the assistance of various staff members concerned with planning, planting and maintenance of roadsides.

California Climate Difficult

In California, and those other western states which have Winter-wet, Summer-dry climates, landscaping is much more complicated and expensive. In much of California there is no rainfall at all from about mid-May until mid-October—sometimes not until late November or even December. Few trees and shrubs can live through such a long drought, especially when that drought season is also the hot season. Yet California today has thousands of miles of clean, attractive roadsides with handsome planting and pleasant vistas.

It has not always been that way. In the 1880's and 1890's most roads in most states were morasses in wet weather, choking dust pits in dry.

The "good roads" movement began to gather momentum toward the turn of the century, but maintenance of such roads as existed all too often merely consisted of passing over the road with a grader once or twice yearly. Sometimes the sides were ditched. There was little road money and many taxpayers literally worked out their road tax.

With virtually no subgrade, vehicles would sink to their axles in mud in the rainy season, so it was desirable to dry the roads as quickly as possible in the spring. By mid-summer, of course, these same roads were impossibly dusty.

Photo at left, taken about 1905, shows "Winters-Davisville Oiled Earth Road" (Yolo County). Roadside trees are black walnuts planted some time in the last century. This section is no longer state highway but trees are still there as shown by recently taken photograph at right.

Early vintage Cadillac (note right-hand drive) plows through mud of US 101, El Camino Real, about 1912, in Ventura County. In summer this same section would be impossibly dusty. It was paved in 1915.

Sprinkling became popular, and as more money was available, most counties bought one or more sprinkling wagons. When California's first Highway Commission inspected all the county roads of the state, the members commented time after time, in the 1895-96 report, on this problem of keeping roads from getting neither too wet nor too dry.

Tree Planting Recommended

Speaking of Los Angeles County, they said, "The planting of trees of a deciduous nature along the sides of the highways should be inaugurated. Trees of this character should be planted so that their foliage may shade the roadway during the heat of summer, while during the wet winter months their barren limbs offer no obstruction to the rays of the sun, which remove all excess moistures. The further development of sprinkling should be carried on as rapidly as available funds will permit." (At

Below: This type of road, actually a wagon track following contours, was landscaped by Mother Nature.

In early days of road expansion, cuts were made steep to save money, but savings were lost when slides became serious problem in wet season. Above is ridge route about 1915.

that time it cost about $75 per application to sprinkle a mile of road, the cost varying with the availability of water.)

The Commissioners recommended roadside trees for virtually all the counties, and the comment on San Joaquin County is typical: ". . . rainfall renders the roads impassable during the rainy season on account of mud, while the unrestricted action of the sun during the summer months makes the grinding of the roads into dust a certainty." San Joaquin County, of course, was no better nor worse than the others.

This report bore fruit and many of our older roadside tree plantings date from about 1900. Some of the old curving rights-of-way may still be seen marked by double rows of trees in fields near present roads, a new alignment some time in the past having left them stranded like oxbow lakes of a river.

Road Oil and Trees

With the introduction of oil for road surfacing a few years later, roadside trees seemed less important. At that time, it appeared oil would control the dust problem. But this was a temporary attitude, for road oiling was expensive and there wasn't enough money to treat all the new roads being opened up after the invention of the automobile. Furthermore, many maintenance men insisted trees were helpful, oil or not. Actually, the Highway Commission continued an active roadside tree planting program for another thirty years—and might still be pursuing it had not traffic speeds made the roadside tree a hazard.

Even by the early 1900's the automobile, beginning to be seen occasionally on the highways, was creating new standards and needs. County road commissioners complained that their roads theretofore had been built to withstand the cutting action of iron tired wagons and animal hooves, but that the automobile tire sucked the surface off the roads, causing pockets and ridges rather than ruts. This sucking action, and the suction of the vacuum created in the wake of the faster

Below: With improved design and increased speed of the motor car, the old short radius curves and contour-following roads developed high accident records, and had to be realigned. This is a section of the Ridge Route on US 99 which was realigned in late 1920's. The old reversing-curve alignment shows clearly.

moving vehicles, made the dust problem worse.

After California's first Highway Bond election in 1910 provided funds for a network of state owned roads, the Commission began to think of planting from more than a maintenance point of view. Voices were beginning to be raised asking for road beautification and scenic highways. By this time, the automobile was the dominant factor in road planning although it was still essentially a novelty and luxury for most people rather than the everyday necessity it has since become.

A resurfacing job going forward on another stretch of US 99, near Wheeler Ridge south of Bakersfield, about 1922. Note young roadside trees, planted about 1920. Due to lack of experience of planters, many trees planted in those days were not adapted to climate and soils.

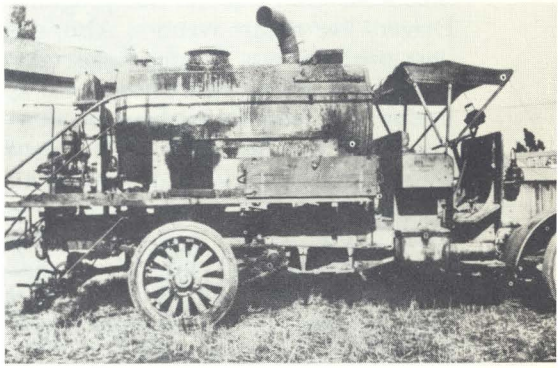
The Sunday Driver

There were taxis and buses and trucks, of course, but most people used their cars for pleasure. The "Sunday Driver" was king. He liked to make pleasant drives at 20 or 25 miles per hour along shaded roads, preferably those roads which had places to turn out and look at a view, or to stop and picnic. On any "nice" Sunday in those days picnic parties could be seen scattered through the rural areas at likely spots near the highway, their cars pulled up beneath a roadside tree.

All this "pleasure driving", this "going for a drive", precipitated another Gold Rush. Myriads of roadside businesses catering to the motorist began to develop. With a few dollars to buy wieners and rolls, any sort of primitive stove, and a day's work with scrap lumber and canvas, a man could go into business. Almost every farmer had a vegetable "stand". The cities were encircled at easy driving distances by "roadhouses".

This fierce competition for the motorist's dollar developed a roadside nightmare. An enthusiastic entrepreneur might place crudely made signs every hundred yards for a mile in either direction from his place of business, only to have a newly arrived competitor intersperse between the first signs a new series of bigger, uglier and more blatant ones. Many of the structures were worse than the signs. Gasoline service stations of wire and burlap were not uncommon. As early as 1912 the California Federation of Women's Clubs was working for signboard control and roadside cleanup.

Also in 1912, the Highway Commission adopted a resolution recommending the protection of timber growing near the roads in the forest districts "to enhance the scenic beauty and attractiveness through wooded portions of California". Landowners were urged to deed 100-foot wide strips of standing timber with right-of-way grants. (In the early 1920's, the Lagoon Lumber Company of Humboldt County actually gave the Highway Commission 25 miles of right-of-way 80 to 100 feet wide, with timber, for U. S. 101 between Trinidad and Orick.)



Two early types of road oilers. Horse drawn vehicle (below) used about 1913 was gravity flow, would only work in warm weather. Motorized model (above) had heater and pump. Both required a driver and an operator who rode seat in rear.

Roadside Problem Threefold

By the time of the U. S. entrance into World War I in 1917, it was apparent that there were three areas of action in dealing with the roadside problem.

The first and oldest part of the problem was the one of *roadside trees*. These were essentially part of the maintenance program.

The second part of the problem was *roadside clutter and signboards*.

The third part of the problem was *highway beautification*, a broad term which even today can mean either conservation, functional planting, or expensive landscaping.

For many years the only part of the three-sided roadside problem given

Early photograph (about 1930) of Mexican fan palm roadside tree planting in Riverside shows success of adapted variety.

much attention was the tree program. Drivers like shady avenues. Also, the dust problem was by no means conquered. A report from District IV as late as 1917, complains about the condition of the heavily traveled road through the Santa Cruz Mountains to the popular Santa Cruz beaches. "This route", the report says, "was constantly worked up into deep dust under the many wheels" so that a large portion of maintenance funds had to be spent on sprinkling.

In 1918, the Highway Commission accepted maintenance of all trees on the state highways, whether they had been planted by private individuals or not. Soon after this a working agreement was made between the Highway Commission, the State Board of Forestry, and the Department of Landscape Architecture at the University of California at Berkeley.

This group, known as the Tree Planting Committee, was to develop a plan for highway beautification over the entire state highway system, and advise the counties on their tree problems as well. One outgrowth of the plan was the establishment of a state nursery on a 30-acre tract near Davis, with the Division of Forestry administering it. At about this time, also, the Highway Commission hired arboriculturist W. E. Glendenning as its first full time employee in charge of roadside trees and road beautification.

Nursery Releases Trees

In 1921, the State Nursery released its first trees. A total of 7600 black walnut, European sycamore, Lombardy poplar, American elm, and black locust were turned over to civic groups for roadside planting.

Although civic groups were by then doing the major portion of the tree planting, it was no longer done in whatever fashion the owner of the abutting property wished. To plant roadside trees, a permit was required from the Tree Planting Committee. A planting plan was issued with the permit, and a highway survey party staked the area.

No trees were allowed within 100 feet of road intersections, within 200 feet of railroad crossings, or within 75 feet of inside curves. Trees were planted 100 feet apart on alternate sides of the roadway, which gave an apparent interval of 50 feet. Holes for planting had to be 3 feet deep and 3 feet in diameter, the tree supported by a stout stake and protected from animals by a wire guard.

Plantings cost about $1 per tree unless there was hardpan to be broken. Sometimes a contract was let for the plantings, sometimes they were done by public spirited individuals. In Orland 350 citizens once turned out and planted seven miles of trees in one day.

Part of the agreement was care of the trees for a year. Later this was changed to a cash deposit to cover one year's maintenance. After the first year the Highway Commission accepted responsibility for care and replacement. In general, about 80% to 90% of these plantings survived.

Trees Aid Maintenance

The tree program got further support in the early 1920's when the Highway Commission established a test road at Pittsburg, Contra Costa County. One part of the program showed the great deterioration hard surfaced roads suffered when exposed to the daily cycle of temperature extremes between noon and night. (The highway engineer's rule of thumb says that temperatures of 100° F. on a clear day mean as much as 140° F. at the pavement, depending on the type of surface, when the road surface is in the full sun.) Shade trees greatly reduce these surface temperatures.

Further evidence for the trees was developed through studies of a section of road in Imperial County which was planted to Long Beak Eucalyptus (*E. camaldulensis*). This section had required less maintenance and was in better condition than its adjacent treeless sections. The studies showed that not only had the trees shaded the surface and lessened the temperature extremes which often buckled the pavement in nearby unshaded areas, but also that the roots had sought the moisture beneath the roadbed and reduced sub-pavement water—the maintenance man's enemy.

In 1922, the State nursery released 60,000 young shade trees of various species, and the commission's planting plan proceeded on a systematic basis, adding about 100 miles of trees each year. In 1924, seven new water tank trucks were purchased for use in various districts, and the budget for maintenance of more than 100,000 trees was $41,000.

Nevertheless, constantly increasing traffic was already threatening the program. In February, 1924, the Commission said, "Until the requirements for widening state highways can be more definitely determined, tree planting is not being encouraged. It has been found almost impossible to protect young trees in many places where it has been necessary to lay new and wider pavements."

New Planting Policy

In 1927, a new tree planting policy was adopted, requiring that plantings allow for a much wider right-of-way. Great numbers of trees had already been and still were being planted, however, and the Division of Highways was now maintaining nearly 700 miles of them. New varieties were being tested, and there was consideration of the conflict between the trees and public utilities, such as telephone and power lines.

Despite this continued activity, the peak of roadside tree planting as a maintenance measure had passed.

Faster moving traffic and more of it required ever wider roads which either eliminated the trees or brought them dangerously close to the traffic. Wherever the trees were too close, motorists could not seem to avoid them, and "he hit a tree" became an all too common epitaph. Even today records of the Division of Highways traffic section show that such accidents include only about 1½% of the state total, but account for more than 4% of the fatalities!

Signboards Uncontrolled

Number two in the three parts of the early days roadside problem was dealing with signboards and roadside clutter.

As early as 1915 a signboard law was added to the statutes. It began "No sign, picture, transparency, advertisement or mechanical advertising device may be placed upon or over any state road or highway without a permit . . . and, if so erected shall be a public nuisance . . . " This law, however, only controlled signs on the right-of-way. There was no provision in the body of the law for control of a sign that was not on public property, such as a sign just inside a farmer's field, even though it was fully visible to the motorist and intended for his eyes.

Almost twenty years were to pass before an effective control could be established. Women's groups, conservationists, automobile clubs, newspapers, the Highway Commission, and many other groups called for action. The more farseeing of the signboard companies were also in the fight, for not only was the business getting a bad name, but an uncontrolled glut of signing would tend to defeat its own purpose.

In November 1928 the California Highway Commission adopted a resolution on the subject of signboards, in which civic organizations were encouraged to induce outdoor advertisers to discontinue certain objectionable practices. The resolution also pointed out that no law had yet been enacted in California which effectively controlled advertising signs on private property adjacent to public highways.

The first local zoning ordinance in California had been passed as far back as 1885 in Modesto, but it could not be enforced until it was fought through the State Supreme Court. The idea of any sort of control over private property was new and untried. Many other variations of the idea of zoning control were enacted in other communities throughout the country in the years ensuing, but it was not until 1926, in the case of the city of Euclid, Ohio, versus Ambler Realty Co. that a U.S. Supreme Court decision upheld the principle of comprehensive zoning.

Shortly after this the California Planning Act of 1929 stipulated "Any county, city, town, or township may make and enforce within its limits all such local, police, sanitary and other regulations as are not in conflict with general laws . . . to conserve and promote the public health, safety and general welfare." This act also said all counties must, and cities might, create a planning commission.

The judge in a Minnesota case said, "It is time the courts recognize the aesthetic as a factor in life. Beauty and fitness enhance values in public and private structures." A judge in a New York signboard control case said "Beauty may not be Queen, but she is not an outcast beyond the pale of protection or respect. She may at least shelter herself under the wing of safety, morality or decency."

Outdoor Advertising Act

In 1933, the Legislature passed the Outdoor Advertising Act which, with some changes and additions, is still in effect today. This law requires the licensing of all those engaged in the signboard business, and, exercising the state's police power, requires permits and conformance to certain standards, by all signboards visible from a public road outside city limits, whether located on private property or not. Minor exceptions are allowed, such as a sign located at a place of business, or a realtor's sign on a piece of property.

Signs cannot imitate official warning, stop, or danger signs, nor can they have red or blinking lights which might confuse drivers. No signs or structures may be placed within 300 feet of an intersection, within 500 feet of the inside of curves, nor in any position where they might divert or impede a drainage channel in time of flood. The law empowers the Director of Public Works, or his agent, to enter private property to remove or destroy illegal signboards if necessary.

Legal action prevented the Division of Highways from implementing the new law immediately. A company in Oakland obtained a restraining order pending court action and sued the Director of Public Works, attacking the

Below: Sylvan beauty marked this winding section of US 101 in Santa Barbara County, as seen in mid-1920's photo below, but it would be a nightmare to drive with today's cars and traffic.

Modern freeway section of State Sign Route 1 south of Santa Cruz. Simple roadside planting treatment here functions well for slope control, also blends roadside attractively into surrounding terrain.

act as unconstitutional on the ground it was double taxation and deprived persons of their property without due process of law.

On May 23, 1934, Superior Court Judge Fitzpatrick of San Francisco ruled for the Department on both counts, and there was no further contest of the act's legality. The decision had far-reaching effects, as a number of other states had such laws which had not been tested in court for constitutionality. Still other states were contemplating such laws.

Highway Beautification

The third part of the highway roadside problem—highway beautification—got little more than lip service for many years. When highway development in California began the roads were narrow, and built along the natural contours of the terrain. Such a road was a very minor, undisturbing element in the landscape.

Furthermore, although the need for roads was urgent, there was little money for construction, let alone beautification. In reading the 1896 report, it is obvious the commissioners were speaking of trees as maintenance tools, much as they might have discussed a road grader. (They did castigate the litter bugs of the 1890's who left dead horses and cows on or near the highways.)

It was not until 1912, two years after the State Highway System had come into being, that there was any discussion of road beautification. This was the year the Commission voted the resolution suggesting "landowners be encouraged to leave timber uncut for a considerable distance on both sides of the state highways. . . ."

Many landowners of the time did pledge that the timber on each side for a distance of 100 feet would not be cut. These agreements were voided later on, of course, when the state began buying right-of-way outright, rather than to continue to depend on the older easement sort of agreement in which the owner often made a number of stipulations.

When the route was selected for the Redwood Highway about 1915, the Commission wanted to buy 600 feet of right-of-way on each side of the route through the giant redwoods, but was unable to finance such a huge land purchase. When critics later complained because the huge trees were not protected, the Commission explained it had not been financially feasible and added, ". . . at that time the possibilities of the cutting off of the timber for many years, if ever, appeared very remote, but unexpectedly, with the opening of the state highway, a number of camps were installed for the cutting of the redwood trees into railroad ties and grapestakes. Some time intervened before friends of the redwoods awakened . . ." (and could take steps to save the remaining trees).

For the two decades after 1912, the attitude toward highway beautification was in this vein—primarily conservation of existing scenery through which the road traveled. Positive action was rarely advocated, except in the case of trees. Tree planting was constantly urged by garden and women's clubs, service groups, and other civic minded bodies. In many cases the groups actually did the work, and this program, with the roadside cleanup program, was the major roadside beautification effort for many years.

Trees and Traffic

About 1932, a number of things coincided to change this situation. As already stated, the tree program itself was faltering because of accidents involving trees, road widening, and realignment. In 1931, the State Assembly adopted a resolution requiring the Division of Highways and the Division of Beaches and Parks to report to the Assembly by January, 1933, progress being made on road beautification. The two divisions were to ". . . supply a definite leadership in the matter of roadside beautification . . ."

To a considerable extent, this resolution was a response to the new federal aid policy which was requiring that ½ of 1% of federal aid highway funds be spent on road beautification. This policy, (with the allowance later raised to 1%), remained in effect until approximately the beginning of World War II.

Another factor in the early 30's was the depression and the "make work" programs of those days. Drains, drinking fountains, guard walls and vista points were built of ornamental rock. Ground covers, shrubs, and

San Bernardino Freeway in the vicinity of Covina, with modern landscaping treatment.

trees, were planted on slopes and at grade separations to prevent erosion and improve appearance.

Also, by then the automobile had come a long way from the chugging, slow-moving vehicles of the 1900's. The new highways being built for faster moving traffic no longer meandered along the hillside contours. They traveled in wider, more sweeping curves for better sight distance, and with the straighter alignment, both vertically and horizontally, cuts and fills were much greater.

Slides Expensive

Not only were all these cut slopes unsightly, they were also difficult to maintain. Slides often dumped earth on the highways or undercut the fill sections, so that crews were kept busy clearing dirt away and restoring the roadway. Some districts found slope maintenance was getting the lion's share of their maintenance budgets.

Hence virtually all of the slope and cut plantings were for erosion control rather than job beautification; although the latter was usually a by-product. State Arboriculturist H. Dana Bowers (now Supervising Landscape Architect of the Division of Highways) wrote in 1932: "With few exceptions all roadside work done under the category of 'beautification' might well be called 'protection' or 'conservation', for aside from the fact that the roadsides are improved in appearance by such work, the important economic factor is not to be disregarded. Evergreen ground covers planted on slopes that tend to erode, and along roadsides to force out the natural weeds and grasses that constitute a fire hazard when dry, result in an enormous saving of labor and expense."

These words were written more than 30 years ago, but they remain the heart of State highway roadside planting policy today. Functional planting is still paramount, although even the simplest example of it contributes some beauty, and although reasonable expenditures for planting of the landscape-beautification type have been made for many years and are still being made.

How today's roadside planting policy is implemented, the initial and upkeep costs involved and the reasons for them will be discussed in forthcoming articles.

California Roadsides—2

A MAJOR problem in planting and maintaining planting on California Highways is the cost, which is mounting each year. In 1950-51 for instance, the Division of Highways spent $606,-127 for planting and erosion control, while the 1960-61 budget for roadside planting and landscaping was $4,609,-000. This increase is in line with the legislative intent expressed in Assembly Concurrent Resolution No. 132, adopted in June, 1957 and printed herewith.

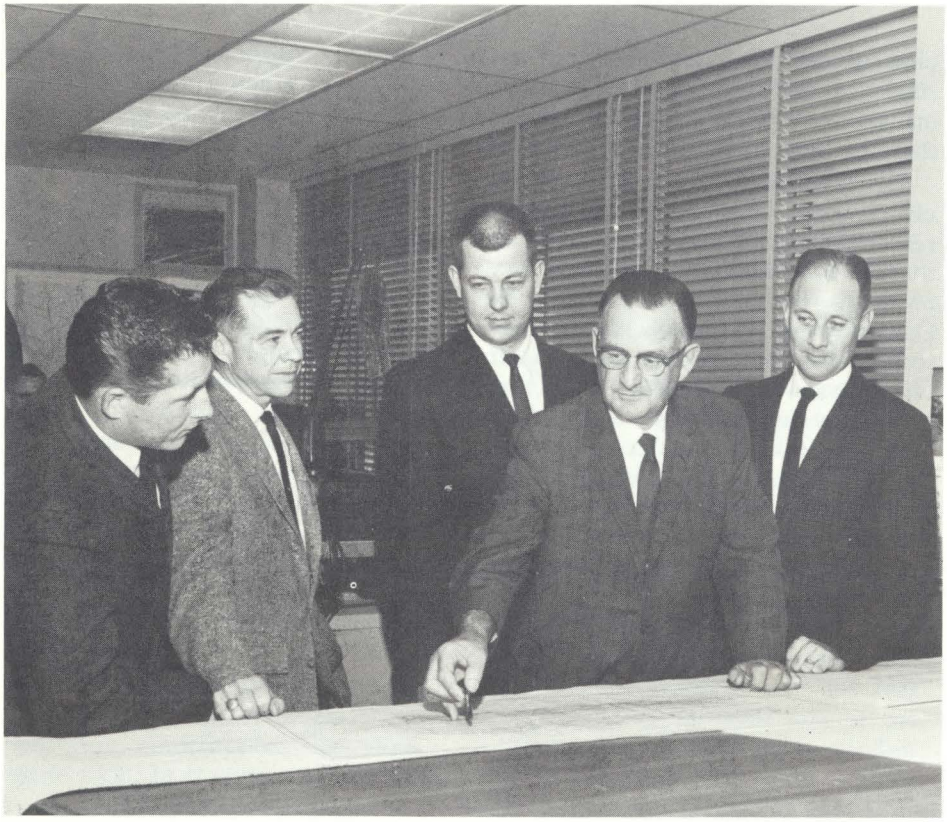
The much publicized California climate is another big problem, because "sunny California" also means "little rain California" for part of the year. This basic pattern of winter wet —summer dry is constant over the entire state, differing only in intensity. Even in areas of high annual precipitation there is always a long summer drought.

This long summer drought eliminates from consideration for highway landscaping in California more than 90% of the world's plants, as few can live very long without water. Some desirables might survive the drought, but can't stand the heavy winter rains, especially in the heavy poorly drained soils which are common in California. Thus, the plants we can use are few.

Terrain a Factor

Terrain is another limiting factor, with all the micro-climates and soil variation which are found in a state with several major mountain ranges and stretching through nearly 10° of latitude. In California, state highways cross several passes over the Sierra Nevada at more than 7,000 and some nearly at 10,000 feet altitude; in Death Valley and Imperial Valley they go far below sea level. Many mountain roads are literally blasted from solid granite, other highways travel mile after mile of endless desert through sagebrush, greasewood, and cacti. Still others are almost like tunnels through dense forests.

To cope with this tremendous variety of conditions, it has been necessary for the Division of Highways to develop its own experts. Starting with a single employee back in the 1920's, the landscaping section organized under the Design Department, consists today of 10 well trained landscape architects and draftsmen. H. Dana Bowers, who was the entire section in 1929, has continued in charge. Some of Bowers' work in slope erosion control has received international attentions, and his hard-earned knowledge is being passed on to the younger men.



Group of Division of Highways landscape architects discuss planting of interchange, including, left to right: Thomas R. O'Donnell, Kenneth S. Buchanan, John W. Pehrson, Supervising Landscape Architect H. Dana Bowers, Fred A. Inderkum.

Three Types of Planting

In the evolution of California's roadside policy, three types of planting have been developed — "functional planting," "landscaping," and "tree planting." In general, "functional planting" is utilitarian, as its name indicates, while "landscaping" goes beyond pure function and seeks aesthetic effects as well. "Tree planting," in the division's own policy statement, is "for the primary purpose of aesthetic improvement in undeveloped areas where a higher type planting is not justified, and to preserve the naturalistic appearance by replacement of trees removed by construction."

What Functional Planting Does

The modern uses of functional planting could be said to be an outgrowth of the early day roadside tree plantings for road surface protection from the sun, for these trees were actually functional. However, generally speaking, the use of plants to reduce maintenance costs, dates from about 1930 when maintenance forces began planting mesembryanthemum or "ice-

plant" to reduce erosion, eliminate weeds, and control fire.

Some of the things functional planting provides today are erosion control; delineation of route, of structures, of curves; center headlight screen; roadside screens to lessen noise, dust and headlight glare; ground cover for fire control and/or weed control; and screens for the benefit of adjacent development. Plants are used in great numbers on cut and fill slopes to control wind and water erosion. In many cases these functional plantings also beautify the road and blend it into the natural landscape.

In the 1920's, with the ever increasing number of automobiles, the important thing was to get the roads built. Because California's rugged terrain made thousands of cut and fill slopes necessary, these became a problem. Almost every Highway District had some sort of experimental program to control erosion. Fences, wattles, board baffles, rocks and asphalt were all tried.

One school of thought in the early days even advocated vertical cuts, claiming rain could not fall on such a cut. A few of these cuts were tried experimentally and actually were stable too, for a while, as long as the rainfall came down straight and did not continue too long. They failed quickly, however, in a driving rain or when erosion started from runoff water at the upper edge.

Slope Control Developed

Some of the techniques worked out by the U. S. Forest Service, the U. S. Soil Conservation Service, and the Bureau of Public Roads were incorporated into California's experiments, with encouraging results. Eventually a great deal was learned about slope control, and techniques developed in the 1930's are still used today.

In general, these techniques include carefully calculated and flatter angles, slope "benching", rounded crowns, and good drainage. The surfaces of the slopes are then held down with plantings of grasses, vines and shrubs. Sometimes binding agents such as straw or a wood grid are used to hold the slope until the plant roots grow.

These slopes, of course, may be either on cut or fill sections. They are a greater problem today because "cut and fill" construction is used more than ever to get the straighter alignment, both vertically and hori-

Assembly Concurrent Resolution No. 132—Relative to State Highways

[Filed with Secretary of State, June 13, 1957.]

WHEREAS, The Legislature of California finds:

(a) In the last 10 years more than seven million dollars ($7,000,000) have been spent in planting on state highways, but this amounts to only six-tenths of 1 percent of total state highway construction expenditures of the same period; however, maintenance of this planting has cost more than eight million dollars ($8,000,000) in 10 years, and the annual cost is now approaching one million five hundred thousand dollars ($1,500,000) a year;

(b) Past policy of the Highway Commission has been directed purposely toward channeling a maximum amount of available funds into the construction of highway mileage that will provide immediate benefits to the traveling public;

(c) The Division of Highways under present policy undertakes two classes of construction work generally under the classification of planting, as follows:

i. Roadside development and control, which is constructed for the purpose of traffic control, economies of maintenance, or other engineering requirements. Within this class is included that work which may be required for erosion control, traffic safety, fire control, or traffic noise abatement;

ii. Landscaping, which is for the purpose of enhancing or preserving the aesthetic values of the highway and its immediate environs;

(d) Under present policy functional planting for roadside development and control is being done on a minimum basis consistent with actual requirements. Planting for landscaping is being done on freeways on a minimum basis, and almost exclusively in built-up or highly developed areas;

(e) Expenditures for landscaping and for design that enhances the attractiveness of highways are legitimate highway purposes for which the motor traveling public may properly be expected to pay;

(f) The appearance of freeways and other highways, and their design and landscaping in keeping with the immediate surroundings, especially in metropolitan areas, are major factors in their acceptance by the public in the affected communities;

(g) California's freeway development program can be greatly accelerated in the years ahead, largely as a result of the Federal-aid Highway Act of 1956, but such acceleration will depend in great measure on increased public acceptance which will be encouraged by attractive design and appropriate landscaping of freeways; now, therefore, be it

Resolved by the Assembly of the State of California, the Senate thereof concurring, As follows:

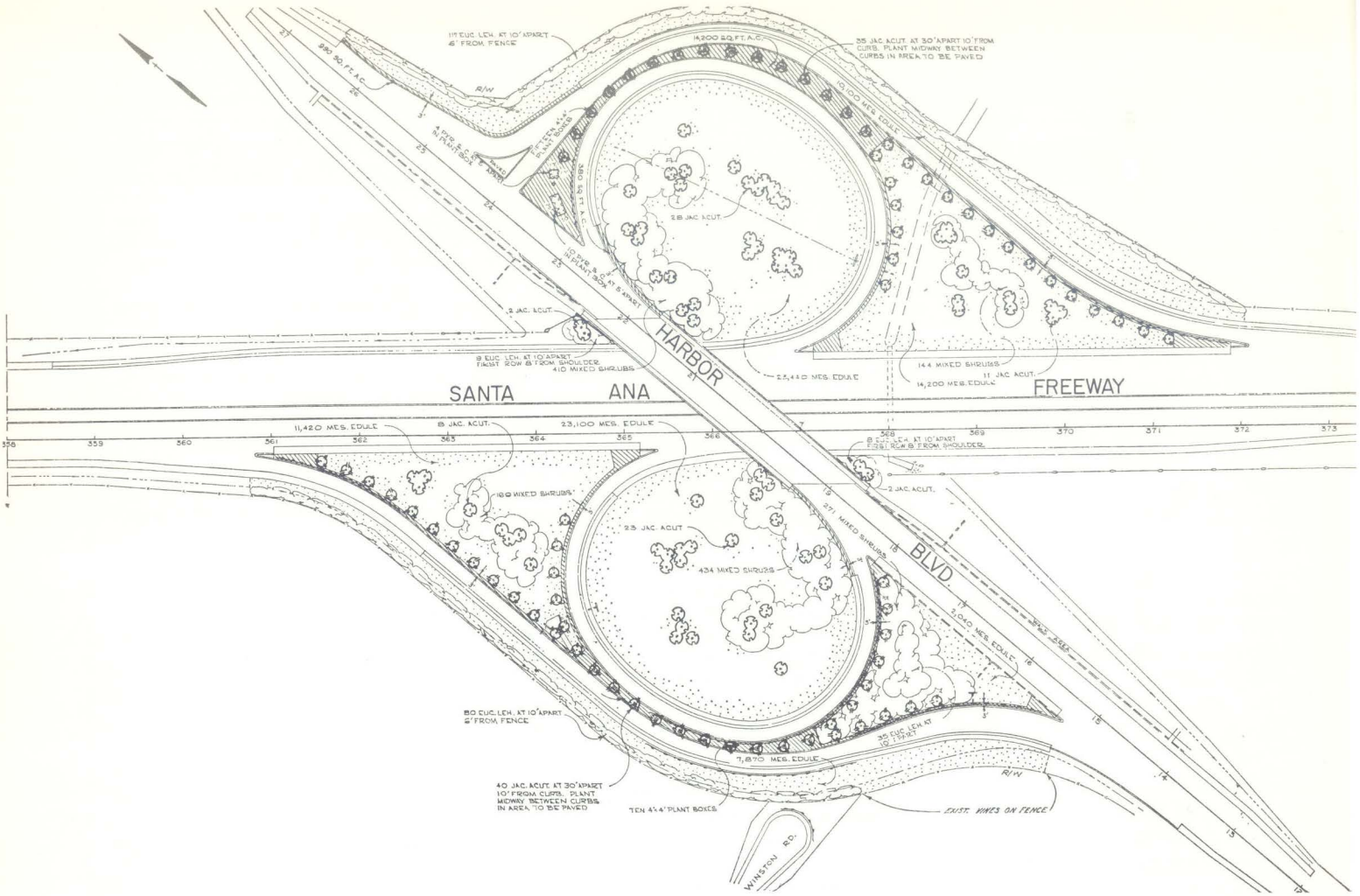
1. The California Highway Commission and the State Highway Engineer are commended for their past policies of economy in the matter of planting and landscaping;

2. In view of the expanded freeway development program now getting under way, the State Highway Commission is urged from this time on to give full consideration to functional planting and highway beautification in the formulation of its annual budgets for freeway construction and maintenance and local jurisdictions are encouraged to participate and cooperate in this program;

3. The State Highway Engineer is urged from this time on to give more attention to enhancement of the appearance of highways (particularly in metropolitan areas), not only by means of landscaping but also in the original design of structures and roadways. Wherever economically feasible under California's climatic conditions, consideration should be given to incorporation of parklike development in highway design;

4. The Department of Public Works is urged to portray at the earliest possible time in public hearings or on other appropriate occasions the nature of each proposed freeway design by means of artists' drawings or other visual aids in order to better inform the public as to the appearance of the freeway and its effect on the community;

5. It is the purpose of this resolution to inform the Highway Commission, the Department of Public Works, the State Highway Engineer, and the public generally, that the Legislature intends that a moderate increase in landscaping and other aspects of attractive design appropriate to conditions in this State be regarded as integral features of California's freeway program.



Typical planting plan for simple two-quadrant interchange on Santa Ana Freeway in Los Angeles. Plan calls for almost 75,000 iceplants, 250 jacaranda trees, 150 eucalyptus trees, and more than 1,500 shrubs.

zontally, which is needed to provide safety at today's higher speeds.

"Landscaping"

The second kind of planting—"landscaping"—is understood to mean something more than functional planting. It includes planting which is purely for aesthetic reasons. Landscaping is considered wherever it is necessary to blend the right of way into adjacent development.

While this type of planting goes beyond function and strives for pleasing effects, nevertheless virtually all of it is also highly functional. It is planted for aesthetic reasons, but it also provides fire and weed control; delineation; headlight, noise and dust screens.

Sprinkling systems are usually installed in landscaped areas, to give a wider choice of plant materials. With more water, the plants grow better, and the over-all effect is greener, more

Wherever possible, existing palms are used in planting plans. These were salvaged from right-of-way and transplanted.

lush. Because of the high cost of watering and maintenance, better landscaping can be accomplished when a cooperative agreement to cover these costs is made with the community. Such agreements allow much more latitude on design and choice of plants, and have resulted in some of the finest sections of landscaped freeway.

Tree Planting

This type of planting is generally awarded in small contracts. The trees planted are often in gallon-can size, to conform with the economy dicta of substituting trees when "a higher type planting is not justified." The trees planted are hardy varieties, but must still be watered for several years to insure a good start. Usually the trees selected are varieties which blend in well with the landscape, or may be species like pistache or liquid-ambar which give good fall color.

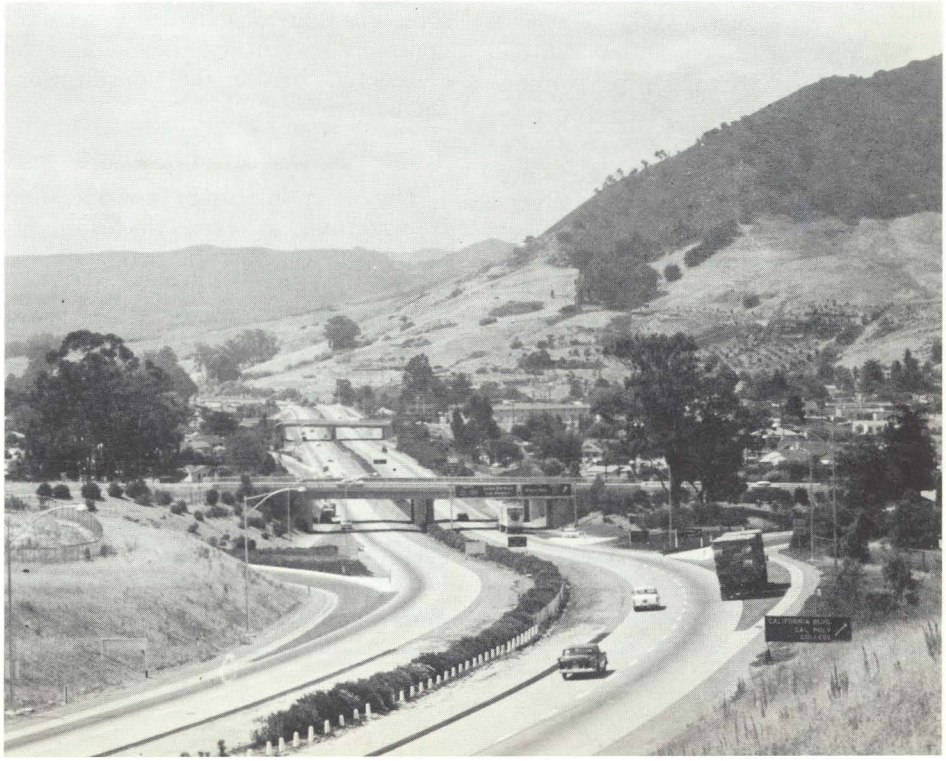
Occasionally tree-planting projects are combined with functional planting, to give the functional planting more character. In other cases an inexpensive tree planting is put in several years in advance of a more comprehensive landscaping project which may become desirable as the district is built up. This is termed "stage planting." Mainly, however, tree planting is intended to give some change and variety to the scene in those long stretches of rural freeways through country which has little natural vegetation to relieve the monotony.

Billboard Control

Early in the days of freeway landscaping—(landscaped freeways were then called "parkways")—the Division of Highways found it was virtually useless to landscape without adequate zoning controls against billboards. Obviously, the purpose of beautiful landscaping may be defeated by excessive advertising display.

The current policy of the Division of Highways is set forth in a resolution adopted by the California Highway Commission on April 19, 1951, which is implemented by an order of the Director of Public Works issued June 21, 1951. Basically this order and resolution provides that no highway funds will be expended for landscaping of any section of freeway until the local governing body having jurisdiction has adopted proper ordinances prohibiting advertising displays "within view" of the freeway which is to be landscaped. This policy applies only to *landscaped* freeways, and certain minimum requirements as to regulatory ordinances have been

"Before and After" photos of freeway section of US 101 through San Luis Obispo to show effects of planting. Elapsed time between the two photographs was five years. Oleanders in median at lower left are later planting.



High retaining wall was necessary here on San Diego Freeway in Westwood Village, Los Angeles County, to save right-of-way costs. Planting was put in at request of Village Church. Creeping ivy eventually will cover entire wall. (Freeway is out of sight beyond wall.)

worked out, which must be met before landscaping will be performed.

With the revision and adoption in 1953 of the Outdoor Advertising Act in its present form, the Director's order applies only to freeways within incorporated cities. The Outdoor Advertising Act controls the erection of advertising displays in unincorporated territory.

Advance Plan Study

All highway construction project plans are referred to the Supervising Landscape Architects office for recommendation concerning erosion control and planting before the plans are completed or the contract is advertised. This advance study often makes it possible to avoid maintenance problems which would be expensive.

For instance, these studies often recommend that construction contracts specify that the contractor must treat the slopes with straw. This is incorporated into the soil with a specially designed roller. It is essential the slopes get this straw treatment as soon as possible after completion and before rains occur, as one heavy rain can erode gulleys several feet deep in some soils.

After a highway construction job is completed, and the Highway Commission approves funds for a planting project, headquarters landscaping personnel study in minute detail the section to be planted. Several day's time is required on freeway sections, "field checking" every part of them, climbing slopes, studying local terrain, existing plant growth, exposures and soils. Planting jobs are let as separate contracts and many things must be considered before the specifications can be written.

Watering Most Important

The most important consideration is watering, as even the drought-hardy plants must be irrigated for several years before their root system is adequate to support them. Most urban landscaping jobs must be watered indefinitely. If for no other reason, the plants close to the traveled way must be washed off at least once each week to eliminate the greasy dust film generated by the fast moving traffic. Otherwise, the film would eventually kill the plants.

Therefore the location of water outlets and permanent sprinklers is of major concern. Not only must they be placed so they leave no planted area unwatered, but they also must not wet private grounds beyond the right-of-way. Although it might seem adjacent property owners would welcome the free water, actually it would be a great nuisance, and highway sprinklers are set so they do not encroach. Obviously, they must not wet the pavement, either.

Apparently unrelated factors, such as prevailing winds and the foibles of motorists, must be considered in planning sprinkler systems. Where possible, the service outlets themselves are best located just over the edge of the fill, off the shoulder, to prevent their being broken off by wheels of vehicles, and to make the maintenance man's job safer. In planning the sprinkler system, the arcs and throws of the sprinklers must be fitted into the odd angles and curves of the freeway right-of-way as it progresses from interchange to interchange.

Choice of Plants

Choosing the kind of plants brings up a new set of problems. Since broken or dramatic effects divert the motorist's attention, it is best to use only a few varieties and create a smooth effect. But this is only part of the job. Plans must be considered for their effect visually, for their adaptability to local growing conditions, and for their ability to thrive close to moving traffic.

Will they do well on a south slope in this latitude? What about drainage? Is the soil acid or alkaline? Are the plants deep rooted to penetrate and hold the soil, or will they slide when the earth becomes saturated? What will be the character of the plants in the local climate—compact and bushy, or straggly? Can they be obtained in quantities?

Sometimes a hundred thousand shrubs and trees, and a half million ground cover cuttings are needed all at one time if several jobs are starting —more than all the commercial nurseries can provide on short notice. Nor can these demands be staggered, for most plantings must be made in summer before the soil is too wet to work. The new plantings then have the wet

winter in which to get established. A system of advance ordering and buying has been worked out to help handle the tremendous demands.

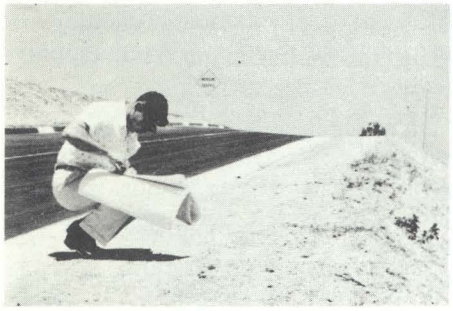
Plants Propagated Beforehand

The Division's Service and Supply Department is notified of the plant needs through a request form. A number of bids are obtained by the State Purchasing Division, and the plants are ordered in advance of delivery. The time between the date of the order and the date of delivery may be a few months or over a year, to give the supplying nursery a chance to propagate and/or collect the plants.

Delivery in such cases is normally made to one or the other of the two storage yards the Division of Highways maintains. One of these is located adjacent to the State Nursery at Davis, the other at the Clinton Street maintenance station located between the separated roadways of the Hollywood Freeway near Vermont Avenue in Los Angeles. Plants are cared for by Division of Highways landscape maintenance personnel during the time they are in the storage yards awaiting pick up by the various landscape contractors. The contractor gets these plants "state-furnished" and allows for these free plants in his bidding on the planting job. The contractor's effective date for beginning iceplant planting contracts is controlled by the specifications which do not permit planting until there has been sufficient rainfall to moisten the earth to a depth of at least one foot.

Ground Covers

Orders for ground covers, such as the ivy which has been very successful in the southern part of the state, are handled somewhat differently. These orders, which may run into as many as half a million plants for one job, specify holding the plants at the supplying nursery until needed, although the nursery is given a firm order well in advance. Often the contract specifies the contractor may, if he desires, take iceplant and vinca (periwinkle) plants from already well established plantings on state right of way, if he can do it without serious damage to the original planting.



Prior to writing specifications on contract preliminary to call for bids, new sections to be planted must be carefully checked against plans.

Fast growing acacias create lush effect in six years after planting on Santa Ana Freeway-Long Beach Freeway interchange, Los Angeles.

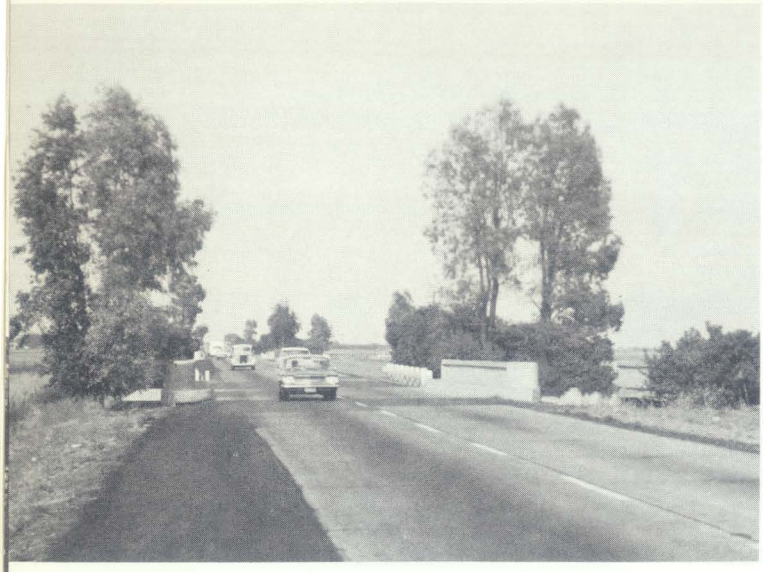
The contractor is bound by a number of rigid stipulations. The plants must thrive. This requires him to water and care for them about four months after the actual planting is completed. He must clean up the area before and after planting. Specifications covering the use of commercial fertilizer, manure, and other soil conditioners must be followed. In addition he is bound by all the general provisions for contractors working on Department of Public Works contracts.

The above are generalizations which pertain to all planting—both landscaping and functional. A number of other considerations enter into functional planting as such, although, as heretobefore stated, much of the so-called "landscape" planting is also essentially functional.

Median Screen Planting

Probably the functional planting most noted by the public is the planted median strip. The primary purpose of this center planting is to shield the driver's eyes at night from the tiring effect of the headlights of oncoming cars in the opposite lanes. Its secondary purpose is to diminish the speed of, or stop, cars crossing the median when out of control.

These cross-median accidents are relatively rare, but they may result in head-on collisions with fatalities if there is no barrier at all. A good



Eucalyptus and California Toyon used for delineation of series of short bridges on US 40 just south of Davis.

Example of Type A slope control in Cahuenga Pass section of Hollywood Freeway.

median planting absorbs the shock, slows or stops a car which is out of control, and does not throw it back into the path of others. Of course, planting for this purpose is not always practical, and the Division has spent many thousands of dollars on experiments developing other types of median barriers.

The shrub used for these median plantings must have many properties. It must grow densely to stop headlight glare, and retain its leaves the year round. It must grow in clumps, with many stems, be strong, neither brittle nor too willowy. It must not grow too high, nor change its character as it gets older—preferably it should grow in thick clumps between eight and ten feet high. It must be highly resistant to drought, and to the gases produced by automobiles. It must be able to survive in many kinds of soil, particularly in the heavy adobe soil found in many parts of California, through a wet, soggy winter. It should be ornamental, and it should be easily propagated so it can be obtained in great numbers cheaply.

Oleander Best for Purpose

No shrub has been found which will fit these requirements better than the oleander, (*Nerium oleander*), a member of the dogbane family, and native to the Mediterranean region. Although the oleander is widely used in home and park planting, occasional complaints are received because the Division of Highways is planting a "poisonous shrub." A few plantings are made inside freeway fences along frontage roads, but the greatest number by far are planted in the median. In any case, if either children or stock managed to get to the vicinity of the shrubs, they would be in much greater danger from traffic than from poisoning by the shrubs, the leaves of which are bitter and unpalatable.

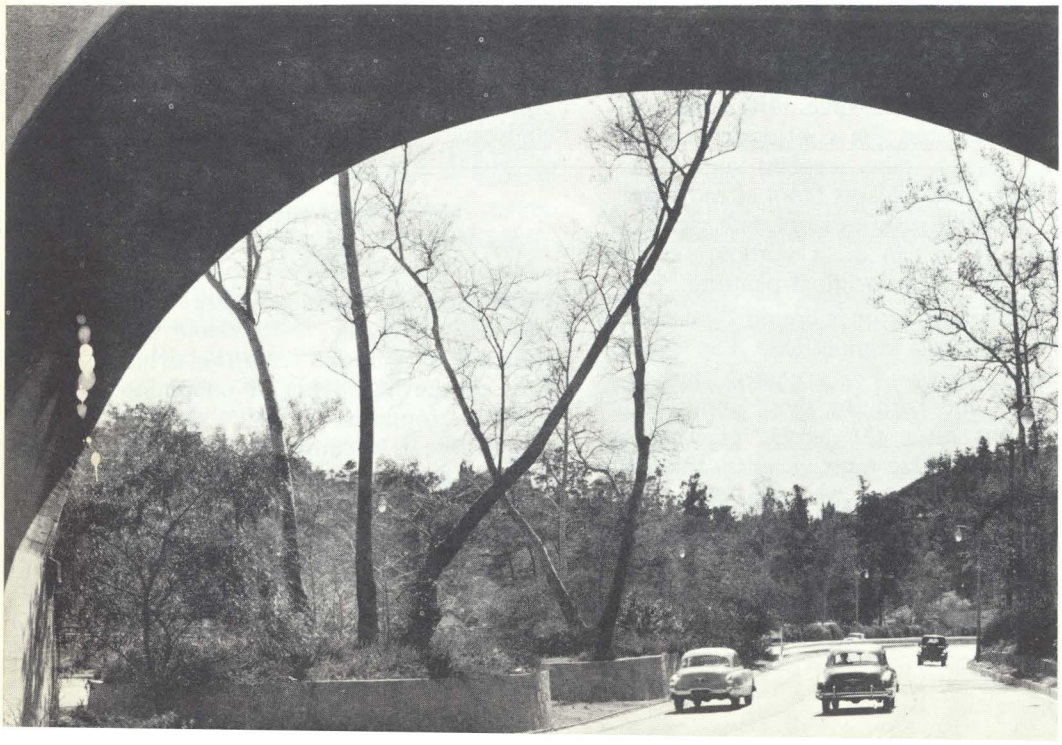
The Division of Highways has no record of either people or stock ever being poisoned by its oleanders. Balanced against a very meager possibility must be the number of lives the shrub certainly has saved from death in traffic accidents.

Slope control is another major job of functional planting. It not only can save maintenance funds, but sometimes saves millions in right-of-way cost where property values are very high. Engineers must in these cases resort to steeper slopes on cuts and fills and use functional planting to help control the slopes from slipping.

Slope Stabilization

The landscaping section has three types of slope stabilization and in cases such as this "Type A" is justified. This type is for steep slopes, and is relatively expensive—$2 to $3 per square yard. Its basis is a grid of wood —2 x 4's vertically, 1 x 4's horizontally, with openings approximately a yard square. The framework is held in

Existing native sycamores on Pasadena Freeway were saved by building retaining walls to preserve natural grade around them.



place with stakes. The openings are filled with compacted top soil, then covered with six inches of straw. Finally wire mesh is laid over the whole and fastened to the grid. Ground cover is then planted in the soil beneath the mesh and straw.

Type A slope stabilization was first used on the Arroyo Seco Parkway (now the Pasadena Freeway) in the Los Angeles area. Although these slopes are quite steep (one-to-one), there have been no serious failures in more than 20 years. Much of the wooden part of the slope control has rotted out by now, but the plant roots have spread and matted so that the structural support is no longer needed.

Type B stabilization, commonly used on 1½ to 1 slopes, is similar to Type A, without the wooden grid. It costs about two-thirds as much as Type A, and is used wherever there is danger that the toe of slopes might slump and intrude on adjacent property or facilities.

Type C is used on 1½:1 or flatter slopes and consists of straw rolled into a cultivated surface and planted. If seed is used instead of plants the seeding is done before the straw is placed.

ABOVE. Young lady making iceplant cuttings on piecework basis for contractor who is planting freeway median nearby. (See below.)

Ground Covers Useful

Ivy and iceplant are used in great quantities for these different slope and controls, and for control of weeds also. They are often used in both urban and rural areas as fire control cover, too, because they stay green and are not flammable. This is a far cry from the 1920's when maintenance crews burned the roadsides each year as the grass got dry and became a menace.

A number of hardy shrubs have been used for sound, dust, and headlight screens on the sides of urban freeways—several of the acacias, eucalypti, and California natives are used for these purposes with excellent results. The eucalypti also have proven to be one of the most useful trees for use in the arid sections, delineation of overcrossings, curves, bridges, and general screen planting.

These are all specific values obtained from planting. In addition there are the intangible values obtained, the softening and increased interest given the roadside area—both functional and beautifying. With between 25,000 and 50,000 trees planted each year, and between 100,000 and 200,000 shrubs, the Division of Highways more than compensates for those which must be removed for straightening or realigning the routes. This fact is often overlooked when critics complain of tree destruction. It also is important to remember there are practical financial ceilings on landscaping which can be raised only by added taxation or by reducing expenditures for highway modernization.

(The next article on California Roadsides will discuss the problems of maintenance.)

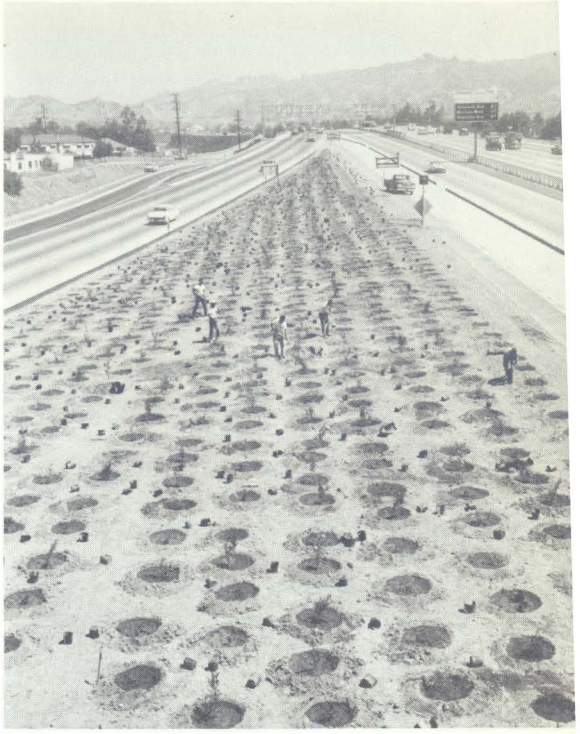


Photo of contractor's crew planting interchange on Hollywood Freeway Extension in North Hollywood gives good idea of scope of planting jobs. Small circles are wetted planting holes with newly planted shrubs. Dots are empty gallon cans.

BELOW. Contractor's crew and equipment planting iceplant cuttings in median, Santa Ana Freeway, near Tustin.

California Roadsides—3

EDITOR'S NOTE

This, the third in a series of articles on landscaping and related roadside problems on the California State Highway System, covers the maintenance of landscaping and roadsides under today's policy and practices. The next and final article will cover the plants used today by the Division of Highways Landscaping Section, and why these choices have been made. The four articles are available to interested persons as a reprint booklet under single cover.

It has been shown how the earliest road maintenance problems were those of mud and dust, and that the roadside tree was helpful in controlling these problems. Later, with straighter roads and modern design, slope control also became a problem. With the gradual refinement of the automobile as our main means of transportation, many new maintenance problems have developed. Here are some of these modern developments which have complicated roadside maintenance.

Today's cars are faster, longer and lower. This kind of automobile requires a different kind of highway from the one used by the famous Model-A Ford with its high clearance, good visibility, and short wheelbase. A driver of today's car is unable to see over slight rolls in the terrain, and his speed demands more sight distance on curves for safety. Nor can he easily negotiate sharp curves even if he can see around them, because of his car's speed, weight, and long wheelbase.

To a great degree, therefore, today's highways are dictated by automotive design engineers in Detroit. To be safe for today's vehicles, highways must be broad, with gentle, wide-sweeping curves. Rises must be cut down, and dips brought up, to grade, so today's low seated driver can see far ahead. This kind of highway goes *through* the terrain instead of following land contours as the stagecoach roads did. Obviously, there must be more cuts and fills than ever. These countless new slopes create new problems of settlement, slippage, and disturbance of esthetic values. It is necessary, too, that obstructions such as bridges and interchanges on these new high speed highways be clearly delineated.

Smokers are another problem. Highways today must be considered a fire menace to every dry field and forest they border, for although it is against both common sense and the law, every day thousands of smokers carelessly throw lighted cigarettes and matches from cars. This is a more difficult problem than the spark problem of the early day railroads, which was solved by screens over the stacks of the locomotives.

Another relatively new maintenance job is the care of headlight screen planting in the median. With today's high speed vehicles bright headlights are needed, which in turn blind the drivers of oncoming vehicles. The best solution to this problem so far devised is the erection of some obstruction between the opposing lanes of traffic. On most highways in California the cheapest and most decorative solution is a living barrier of shrubs.

Then there is litterbugging—not exactly a new problem, but today many times magnified over what it was a generation ago, primarily because our technology has developed marvelous packaging of our foods, tobacco products, and beverages. Unfortunately, this packaging is usually partly or entirely of paper (except in the cases of beverages, when it is tin, glass, or waxed cardboard). Furthermore, everybody is constantly deluged with newspapers, magazines, direct mail advertising, and dozens of other kinds of printed matter. Most of these things are of temporary value, and are too frequently disposed of on the highway, although this too is illegal.

As previously pointed out, the judicious use of plants and landscaping techniques can assist the highway engineer in solving, or at least alleviating, these and other problem conditions. But the planting itself is only the first step. When the landscape contractor has finished his job, the maintenance man starts in. And as with many other expenditures, both public and personal, "it isn't the initial cost, it's the upkeep".

"ROADSIDE MAINTENANCE IN STANISLAUS COUNTY IN 1895"

"It is the custom to cover the roads in the summer season with refuse straw, which is abundant. This is the most temporary makeshift. The cost of this strawing varies from $40 to $45 per mile, and in many instances must be repeated two or three times a season. Nor is this all. It frequently happens that a lighted match or cigar is dropped on a freshly strawed road, and the whole roadway vanishes in smoke. It is a well-authenticated fact that, on one occasion on the day after a road had been strawed, a band of hungry cattle came along and actually ate the road up."—From the 1895-96 Report of the California Bureau of Highways.

These are some of the activities and considerations involved in roadside planting maintenance:

● **Median plantings:** As previously stated, the Division of Highways landscape architects are in unanimous agreement that the most practical shrub for median planting for headlight screening is the oleander. But despite its hardiness, it must be watered for several years after planting;

it must be pruned in locations where it affects sight distances; litter must be cleaned from around it; and it occasionally must be replaced after an accident.

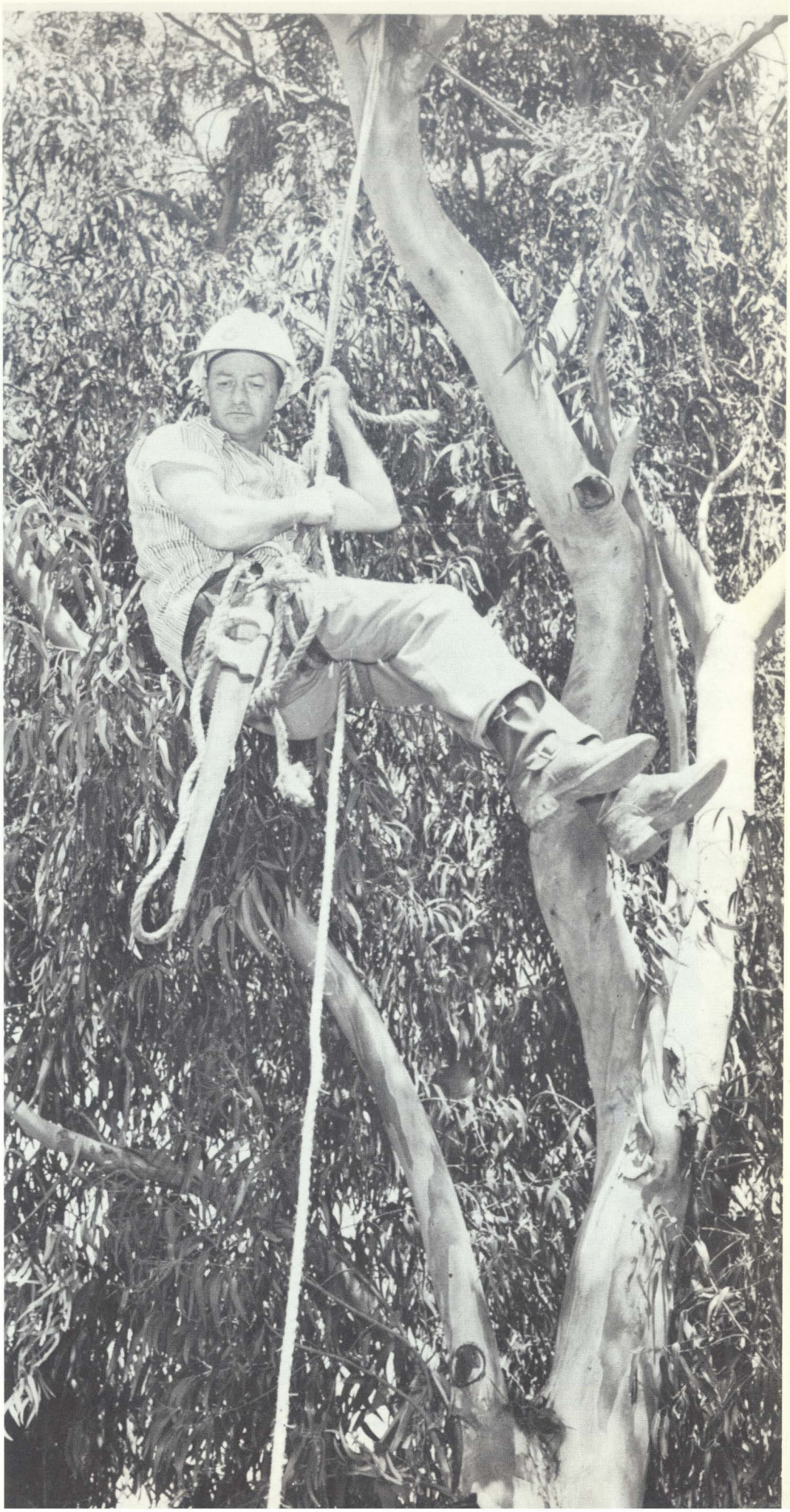
● **Delineation:** Trees are planted to mark structures which might not otherwise be noted by a fast moving motorist. Shrubs or trees accentuate a curve, and a ground cover emphasizes a traffic island or "gore" between the main route and the off ramp. All these plantings mean additional maintenance.

● **Erosion control:** Wherever any of the slope stabilization methods are used, the plants must be fed, watered, and weeded for several years until they are established. Some must be watered indefinitely. The contractor's responsibility for plant establishment on landscaping contracts usually ends after 90 working days.

● **Fire control:** Because of careless smokers, "fire control" is necessary on thousands of miles of state highway, to protect such flammable areas as forest, grassland, and grainfields. This is another problem which does not trouble states with adequate year-around rainfall.

In most of California's rural areas today, fire control simply means removal of all vegetation from a four-foot strip outside the shoulder on either side of the road. Sometimes this is accomplished by discing or grading, but it is most likely to be done by chemical weed killers and sterilants. The sterilants are faster, neater, and leave no blackened roadside. Thirty years ago fire control was accomplished by spraying diesel oil on the roadsides; then, a week or two later, burning a ten-foot strip beyond the shoulder. Today's four-foot strip has proved adequate, and presents little bare area for soil erosion to start.

Where they can be used, evergreen ground covers are excellent fire controls. Unfortunately, because of the summer drought, it is impracticable to attempt to grow ground covers along highways throughout most of the state, since there are no satisfactory



RUFUS J. W. COX demonstrates safety line technique taught Division of Highways tree maintenance crews.

Section of U.S. 40 (Interstate 80) in the Sierra Nevada showing dike and cleared area outside it. Dike is essentially for control of runoff water, but also catches many cigarette butts.

Neatly trimmed section of U.S. 40 near Roseville blends into surrounding landscape.

Dense growth of drought resistant plants on U.S. 101 in San Luis Obispo serves to delineate turnoffs, to lessen fire hazard, to keep down weeds, to screen and to beautify.

ground covers which can survive any length of time without water. The mesembryanthemums, or ice plants, have proved practical in certain cool coastal sections where fog is common. Where conditions are good for them, they are almost ideal plants for slope control, fire control, and pleasant effect. Certain ivies are also effective, but they must have sprinkler systems installed for their survival.

All ground covers need some maintenance. The ice plant needs the least, but occasionally should be fertilized, and must be weeded assiduously until it is established (as must all plantings).

● **Roadside growth:** In recognition of the farmer's troubles with noxious weeds, the State Department of Agriculture has long been empowered to organize control methods to keep these expensive pests in check. There are several dozen species of weeds on the state's list which are potentially dangerous. By decision of the County Agricultural Commissioner, any of them can be declared a noxious weed in any county.

The Division of Highways cooperates on county programs, for noxious weed control. In most cases, where the infestation is serious, payment is made from highway funds to the county, to pay the expense of using specialists to control the pest on State highways. These payments amount to about $100,000 per year statewide. Where infestation is light, Division of Highways maintenance crews do routine weed control, most of it by mowing.

Whenever possible, weeds on the roadside are mowed early, before they go to seed, which gradually tends to reduce roadside growth to grasses only. Several more mowings are made during the season as necessary. Mowing reduces fire danger, and also makes a neater roadside. Roadside mowing costs have been significantly reduced in recent years, by the adoption of the modern rotary type mower.

Roadside brush, which would otherwise gradually encroach on the roadway, particularly in foothill and mountain areas, must be kept in check. Brushcutters which cut a swath from the roadside and chippers, ingesting

Where medians are wide and midday traffic is not too heavy, power equipment can be used for maintenance. John Musitelli trims median on Junipero Serra south of San Francisco.

the cuttings and returning them to the roadside as finely chopped twigs and leaves, are very effective, but somewhat slow and expensive to operate. Chemicals are widely used today for brush control.

● **Roadside tree maintenance:** The California Division of Highways has tree maintenance crews throughout the state. These men are in a special group which includes such job classifications as Tree Maintenance Foreman, Tree Surgeon, and Tree Trimmer.

The thousands of miles of roadside in the state highway system have many old plantings of trees which must be maintained. Modern planting practice also calls for generous use of trees for delineation at ramps and bridges.

Dead limbs and unstable trees that are a hazard must be removed; so must low branches which obstruct vision and roadway clearances. Trees which are too high must be topped lest they blow over in a high wind. When the scope of any of these jobs is too great for routine maintenance, they can be let out to contract by professional tree care companies.

● **General planting maintenance:** Modern highway practice in California calls for roadside beautification wherever possible in densely settled areas. This may be accomplished to a limited extent with functional planting, or where suitable billboard control laws have been passed, by a full landscaping project. In either case, the planting will not only be roadside beautification, but will also function to absorb highway noises, gases and dust, prevent fire, delineate traffic changes and control erosion.

Landscaped roadsides must be maintained indefinitely. This kind of maintenance includes pruning, weed and pest control, fertilizing, and irrigating. Pruning is relatively light, usually necessary only when a change in conditions requires it, such as disease, dieback, or occasional unexpected growth to a size where foliage interferes with sight distances.

Weed control is very difficult on new jobs, but gradually lessens as the planted shrubs and ground covers take over. Weed killer sprays and oil sprays are used considerably to protect young shrubs and young trees. Because of the weed problem, highway landscape architects today especially favor shrubs which branch out right at the ground and grow in a dense globular shape, such as Lehman eucalyptus, *Acacia longifolia*, and oleander. This kind of plant is ideal

for screens, but unfortunately plants of this habit are not available for all of California's soils and climates.

Watering from a tank truck is expensive. This kind of watering is only done when sprinkler systems are impracticable. Usually, the tank truck is used only to water drought-hardy plants the first couple of years they are in the ground, to give them a good start.

This kind of watering is also dangerous; several of the tank trucks have been badly damaged by out-of-control vehicles, but luckily none of the operators was injured seriously. (Landscape maintenance is a dangerous occupation. Workers are hit by flung beer cans and flying hub caps, catch poison oak, get bugs in eyes, are stung by bees, bitten by snakes and spiders, sometimes even by small rodents such as squirrels and muskrats. They also have their share of the more common industrial accidents.)

Where economically feasible, and generally on major freeway landscaping jobs, permanent sprinkling systems are installed. These not only irrigate, but also wash the foliage. The water costs are high, however, and limit this type of installation.

No way has yet been devised to eliminate hand labor in performing most of these chores of freeway landscaping maintenance. The many cuts and fills, with their steep slopes, the odd shaped pieces of land around interchanges, the difficulty of working close to heavy, fast-moving streams of traffic, all tend to limit the use of mechanized equipment for this work. Some of the new back-pack power units with cutter attachments are being looked at hopefully. However, over the years the most fruitful channels explored to help this problem have been experiment and search among the plants themselves.

In the course of regular operations, maintenance workers Johnnie Shephard, Robert Spencer, and Jack Warman, District IV, replace a plant which has died.

The Division of Highways landscape architects have learned that except where communities are willing to absorb part of the maintenance cost, landscaping today must be more and more restricted to certain tried and true "workhorse" shrubs, trees and ground covers, and that the thousands of varieties of beautiful but delicate ornamentals which quickly succumb at the slightest rough treatment must be avoided.

These "workhorse" plants are the ones which can exist with little or no water, ordinarily do not require fertilization, and are virtually pest-free, hardy, and adaptable. The list of such plants is short, but each year, out of the many tried, a few new ones for the list are proved.

Such limited plant choices have occasionally caused the Division of Highways to be criticized for "lack of imagination" in its use of plant materials, but the fact is the lack of variety springs from practical economic considerations, rather than lack of esthetic sensitivity.

The restriction of planting to these easily maintained plants, plus an energetic and conscientious educational program given the landscape workers by their supervisors, has paid off handsomely. Ten years ago, the table of organization called for one landscape laborer to maintain three acres of highway landscaping. Today he maintains seven acres.

● **The litterbug:** In urban areas, where there is a landscaped freeway, landscape maintenance men do considerable litter removal. Disposal cans are obviously impracticable on these highspeed, heavily traveled routes, although the heavy traffic generates tremendous amounts of litter. The difficulties of enforcing the anti-litterbug law are obvious. The litter cans the state now provides in rural areas are serviced by maintenance forces, and they are collecting great amounts of litter, but many motorists still refuse to use them. Conversely, where cans

While the watering basin around young plant is filling, Clyde Francis, Groundsman, District VII, cleans up weeds.

are close to communities, local people often use them for disposing of household garbage!

An intensive public education campaign, backed up by firm enforcement when possible, has been going on for some time. It must be assumed that those who continue to strew our highways with litter are an irresponsible minority whom no campaign will reach. Better clean-up equipment may be invented, but because of the nature of the work, this seems unlikely in the near future. It begins to appear that we must resign ourselves either to a heavy annual bill for litter removal, or be willing to accept dirty, unkempt roadsides.

All these things, from the median screen to litter, are over and above the job and the costs of removing snow, of repairing pavements, of replacing guard rails and signs, and those other tasks normally associated with highway maintenance. Aside from these unavoidable costs, maintenance of just the roadsides and of the trees, shrubbery, and ground covers on the right-of-way, whether it is functional planting or landscaping, increases in cost each year and is now about $5,000,000 annually. The bill for State highway litter cleanup in California is now approaching $2,000,000 annually.

There seems to be no hope these costs will ever be less. In fact, we must expect them to be much more, as our present traffic loads will be doubled in about 20 to 25 years. Nor can we even expect that these costs will increase in simple ratio to traffic increase. Roadside maintenance costs on multilane divided highways are much higher than older-type two-lane roads because of medians, the large areas required for interchanges, larger cuts and fills, more structures, heavier traffic use, and wider right-of-way.

Expenditures for maintenance and administration of the State Highway System are limited to the revenue derived from one cent per gallon of the tax on gasoline and diesel fuel. A recent change in the statutes sets the ceiling on maintenance of landscaping and functional planting at $7,500,000 annually. Although this is a fixed figure, it is an appreciable share of the total maintenance budget. These increasing maintenance costs require strict control be exercised on planting projects involving continued or costly maintenance.

(The next and final roadsides article will be concerned with the plants and trees used by the California Division of Highways, and why they have been chosen.)

Above: Newly landscaped interchange on the Golden State Freeway in Los Angeles showing redwood planting boxes surrounded by gravel over sterilized soil. Original cost is less, and maintenance is minimized on large areas by this type of planting. Below: Older planting of same type on San Bernardino Freeway illustrates how this kind of landscaping delineates and beautifies.

California Roadsides—4

EDITOR'S NOTE

This, the fourth and last, in a series of articles on landscaping and related roadside problems on the California State Highway System, covers the choice of plants used for planting on California roadsides, and the reasons why. The four articles in this series, plus a list of most used trees, shrubs, and ground covers, are available to interested persons as a reprint booklet under a single cover.

As has been pointed out in the preceding articles of this series, the cost of creating artificial environments for plants is too high to be warranted except in special cases, so their ability to survive the environmental conditions on California roadsides must be the major factor in choosing them. The working list of plants and trees used by the Division of Highways Landscaping Section today represents an accumulation of more than 30 years experience in choice of trees and plants for growth under difficult and varying conditions.

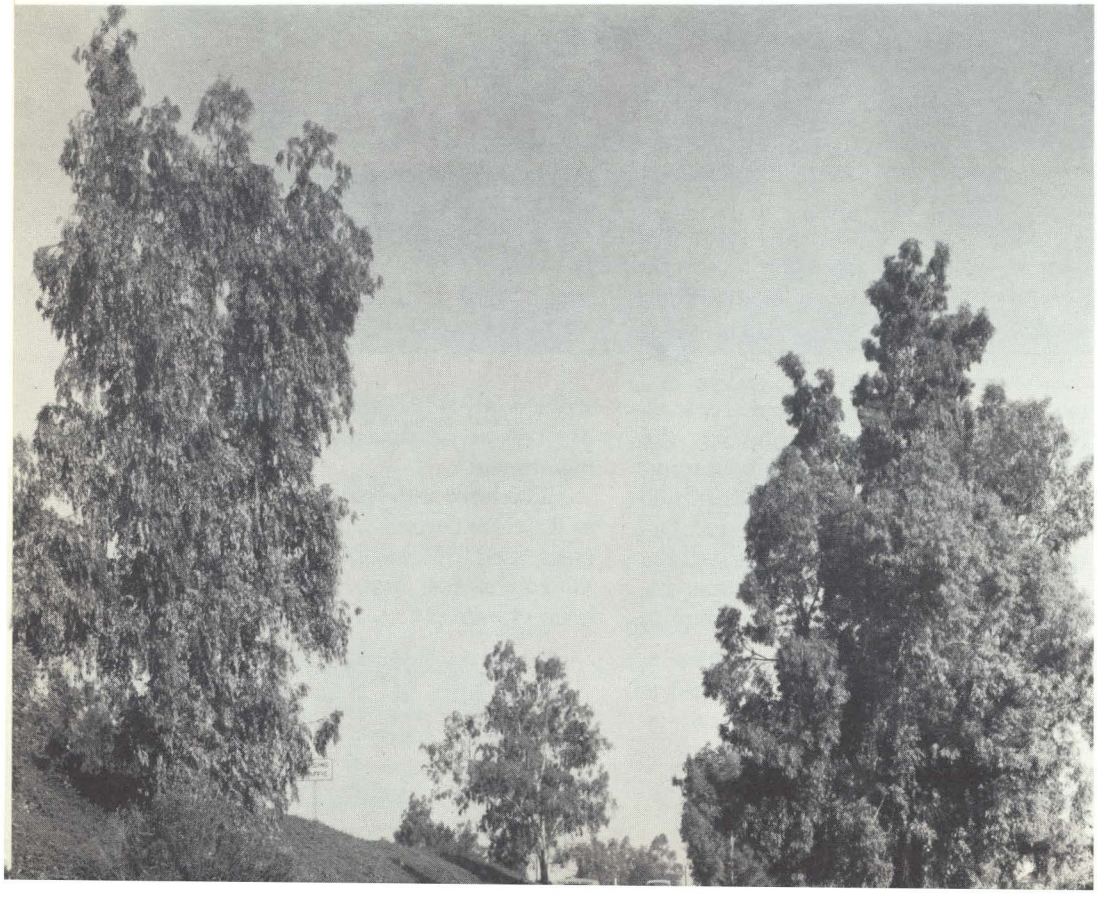
Actually, this experience started more than 60 years ago when the first extensive plantings of roadside trees in California began, but many organizations did the planting and records are sparse. We know little about the plantings that failed, but some of these early plantings are magnificent trees today. Fragmentary sections of these old plantings can be seen where they have survived the rigors of the years.

In the Central Valley huge blue gum eucalyptus, native black walnuts, sycamores, and a few oaks and elms still remain of these old plantings. In the Mother Lode country ancient black locusts, Chinese tree of heaven, and Lombardy poplars are accepted as part of the "gold country" scene. In southern California there are fine old peppers, black acacia, cottonwoods, silk oaks, palms, and of course the omnipresent blue gum. Very old plantings of olives may be seen occasionally in the vicinity of old missions and homesteads. Today most of these species have been superseded for highway purposes because they have some defect in their habit such as slow growth, brittleness, or they require excessive maintenance.

A second surge of roadside planting began in California in the period within the few years on either side of 1915. These plantings in most cases were spontaneous local community efforts, with choice of species too often made by some individual with a fond memory of a romanticized home town location like Fairmount Park in Philadelphia or Mount Vernon in Virginia. The concept of the highway right-of-way at this time also was a vague and tenuous thing which allowed adjacent property owners considerable say on road side matters. In the old type agreements a property owner might have a clause stipulating the variety of tree to be planted!

Even of these later plantings, no one today can say with any certainty how many were wasted, but in 1918, when the Highway Commission took over all the trees along state highways, many unsuccessful plantings had to be replaced. For instance, young trees had been planted in the few inches of topsoil over hardpan without breaking the hardpan. Some of these trees were growing only an inch or two a year. In many places virtually the entire planting had died because the species chosen could not survive through the

BELOW—U.S. 99 on-ramp in Kern County has lawn, oleander, vinca and honeysuckle on slopes. Trees are eucalyptus camaldulensis (rostrata), one of the most useful eucalypts.



arid California summers. Still other plantings had to be removed because they were too close to the roadways.

A state nursery at Davis was established so that adequate supplies of young trees would be available. In 1921 a total of 7,600 black walnut, European sycamore, Lombardy poplar, American elm, and black locust were made available. Increasingly large numbers were released each year and by 1927 the Highway Commission could say it had taken over or planted 60,000 trees on state highways.

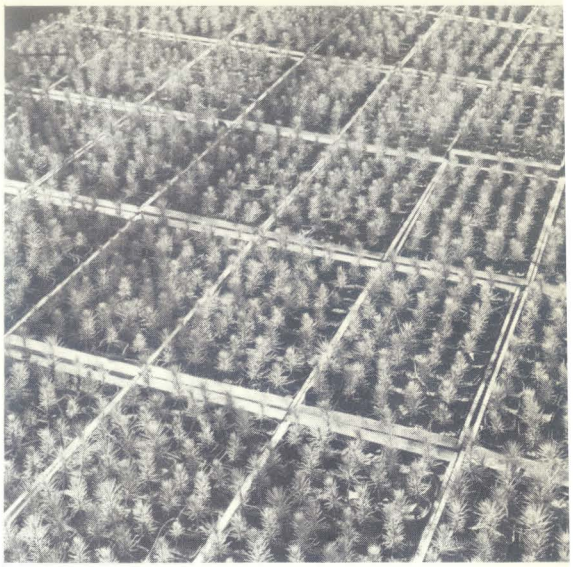
In addition to the above varieties, trees being planted in the valleys included blue gum, red gum, olive, Carolina poplar, silver maple, Arizona ash, and valley live oak. Redwoods, live oaks, maples, walnuts, gums and sycamores were being planted along the coast. In the deserts the trees being used were black locust, Arizona ash, blue gum, red gum, black acacia, and athel (tamarix articulata).

Little work was done with shrubs until the middle of the 1920's, when a movement for beautification of entrances to cities gathered impetus. Tree and shrub groupings were planted at the outskirts of cities, both on county roads and state highways. Plantings also were made near and on the slopes of the many railroad underpasses which were being built at this time.

As the highways became ever wider and straighter, the search for methods of stabilization of the growing number of cuts was intensified. One of the first laboratories for this work was the scenic highway in the Angeles Crest and Crest Drive area above Los Angeles and San Bernardino.

This was a new section of road, built on the side of steep mountain slopes, and necessarily the construction left a number of scars on the mountainsides to be covered. Many of the new cuts and fills were unstable in wet weather, with resultant maintenance problems.

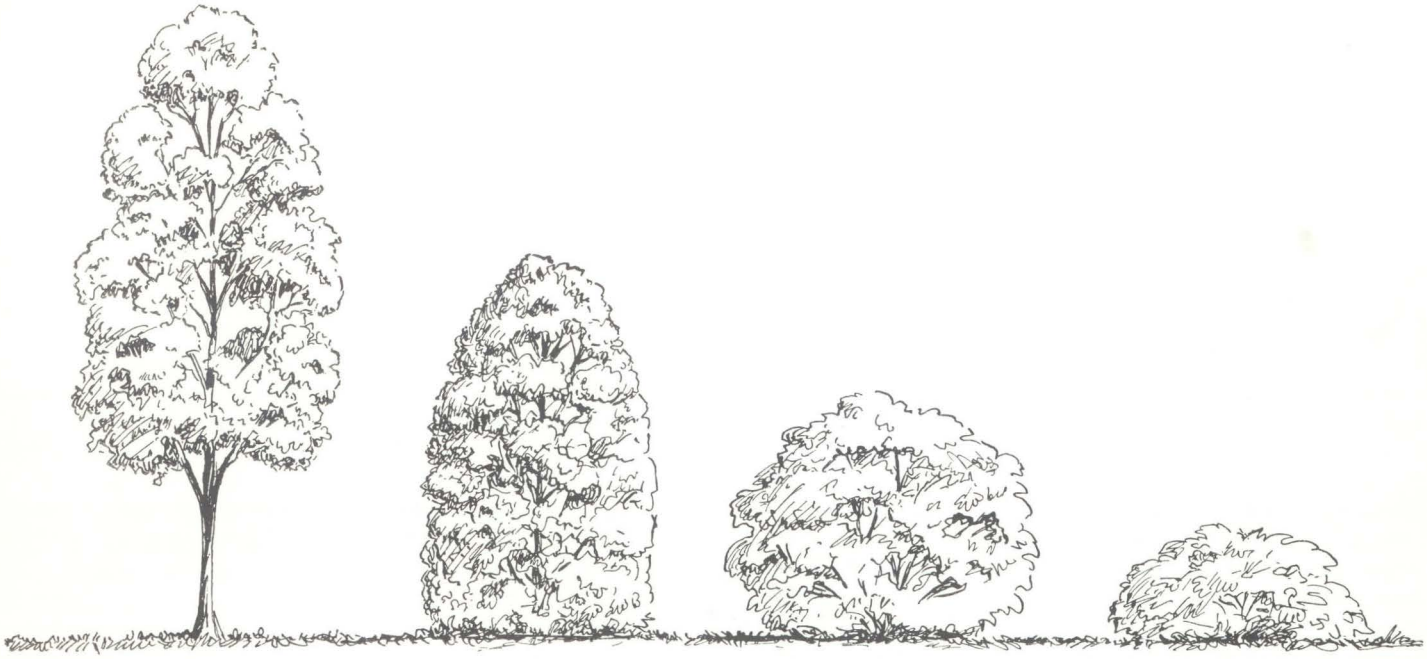
Although many agencies were experimenting with plants to hold cut and fill slopes, there was no way to hold the soil long enough to get growth started. All sorts of elaborate arrangements of brush, wire, wattles, and wooden frameworks were tried. H. Dana Bowers, who was then the entire landscaping section, personally visited some of these new slopes when rain was falling. He noticed that where old grass stems were mixed in disturbed soil, and where the surface was compacted, erosion did not easily begin. The grass kept the water from forming into streams and gullying.



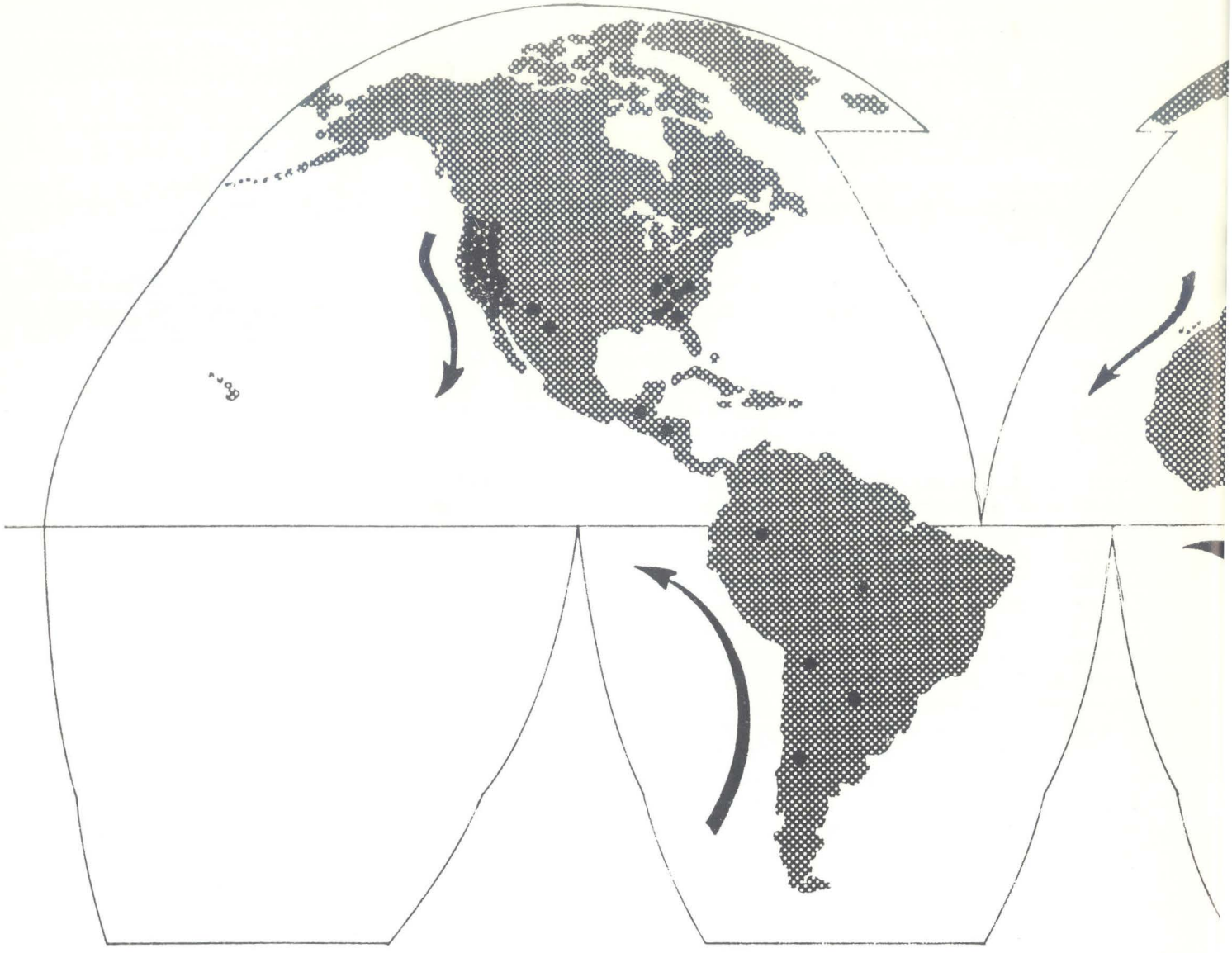
Seedling scotch pines in flats in state nursery.

From this study grew the present practice of working straw into all new fill slopes to hold the soil preparatory to planting or for natural revegetation. The steeper slopes, however, still must be held by some mechanical means until the plants are thoroughly rooted.

At first these were day labor jobs, and the straw was worked into the soil with shovels. Later as the scope of the work increased, the erosion control work was handled by contractors, and a sheepsfoot roller was used to force it into the soil. This type roller was not very satisfactory, as the broadened tips on the sheepsfoot



Sketch shows idealized versions of most useful types of trees and shrubs for roadsides planting. Trees should be upright in habit, fairly light in form, without branches which spread out and obscure vision. High and medium screen shrubs, as well as lower ones used for ground cover, should all hug ground outward from trunk to keep weed growth down.



Black dots indicate place of origin of approximately one hundred trees, shrubs and vines commonly used for planting on roadsides in various parts of California. Much the largest number of plants comes from Mediterranean type climates, or steppe climate areas close by. Note that great sections of the earth are

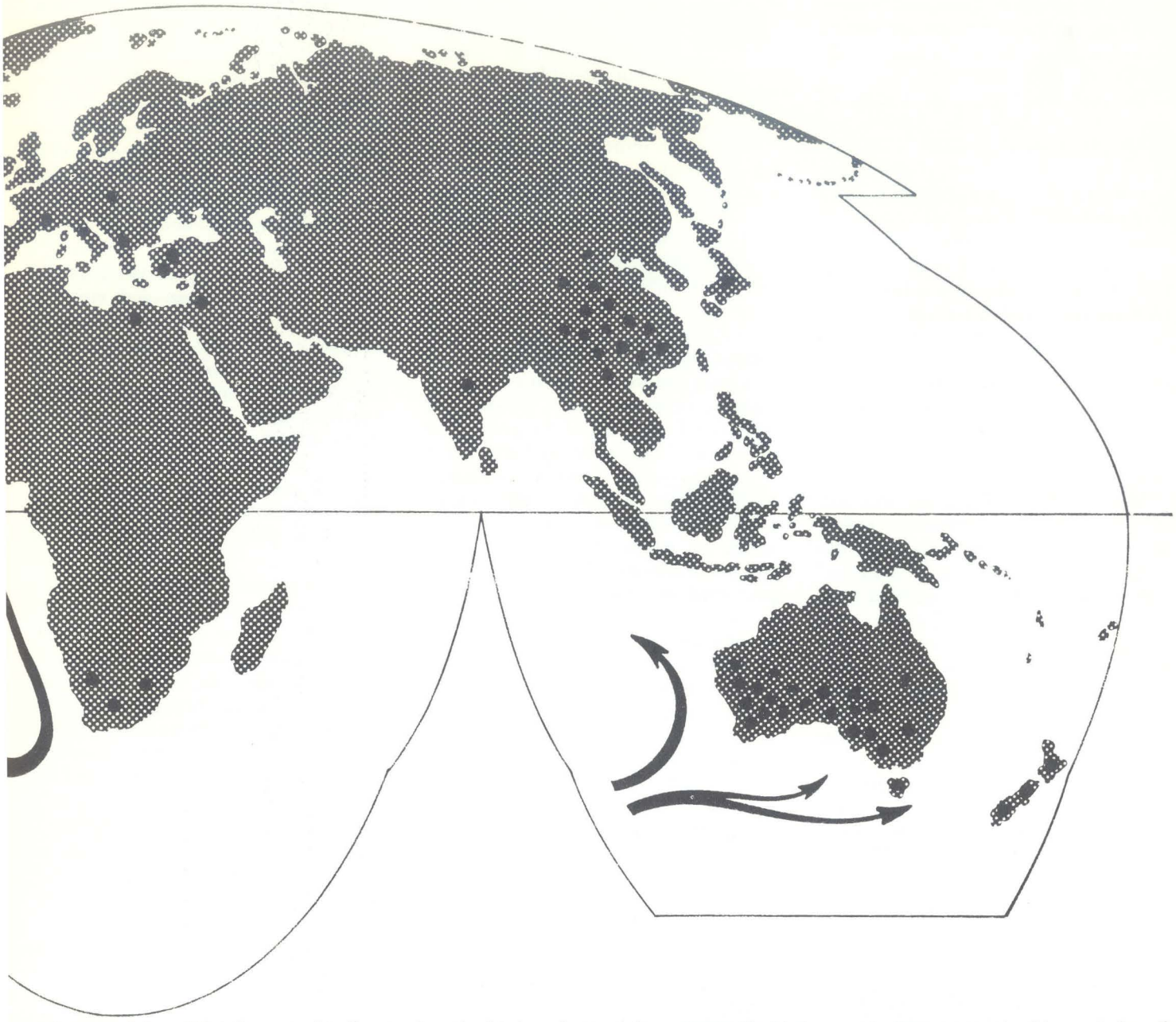
pulled much of the material out again. A modified form with smaller points was tried, but this left pits in which water collected. Eventually the special roller used today was evolved from a design by Landscape Contractor Bailey Justice. This is a roller similar to a sheepsfoot, but with what are essentially thick disks extending from it parallel to its direction of movement, instead of the peg shaped extrusions of the sheepsfoot.

The Division of Highways began to acquire real experience with shrubs with the onset of the depression of the 1930's. Much highway beautification sprang from depression "make work" programs, and Federal highway money grants during this period specified a certain small percentage was to be spent on landscaping.

By the early 1930's also, plants were being used for functional planting. The virtues of ice plant as a bank cover had been discovered, and studies of ground covers for fire control and weed control were well along.

Experiments with true xerophytic plants—that is, plants which are highly drought resistant—proved disappointing. Although they survived under very dry conditions, they became dormant during the summer and dried out to such an extent they became a fire hazard.

At that time, even as today, there was considerable public pressure to plant "natives" along the highways. This is not always practicable. Most of California's native plants have adapted themselves to one particular climate or condition and are unhappy under other conditions. Dozens of species of ceanothus, for instance, grow in the state, each species adapted



not represented, and that there are virtually none from the interiors of any of the continents. The black arrows in the oceans mark cold currents from the poles, which are generally associated with Mediterranean type climates.

to one locality. But of these many species of ceanothus, only three or four are useable. The same thing is true of the manzanitas, which have almost as wide a variation of types in the state as do the ceanothus.

As an example of the problems of using "natives," the Federal Government's experience in 1957 with the slopes in the vicinity of the new Air Force Academy in Colorado may be cited. About a thousand ponderosa pine seedlings, native to the area, were planted on a south-facing slope which got the full effect of the sun's rays. Because of the southern exposure, watering through the summer was contracted to give the baby pines a fair chance. In supplement to this watering, 1957 turned out to be the heaviest rainfall year on record, yet fewer than 3% of these seedlings survived the first year.

At the time these were planted, several thousand other ponderosa seedlings were planted on nearby north-facing slopes, but received no care. Survival among these trees was better than 90%.

Residents of California and other semi-arid states will see this effect of north and south exposure demonstrated many times where the land is hilly. Northern slopes will often be covered with dense growth, while southern ones will have only thin carpets of dried grasses and a few, scattered, wizened shrubs.

Obviously, the simple term "native" is misleading. The state has many local climates, resulting not only from exposure, but also from latitude, from nearness to or distance from the ocean, and from altitude, to list a few of the

determining factors. Comparable combinations of these factors are apt to occur in only limited areas of the earth's surface.

To test the value of California natives for roadside use, experimental native plantings were made a number of places on the southern part of State Sign Route No. 1, which travels along or close to the ocean, and enjoys the climate modifying effect of moist ocean winds. Gaviota Canyon, Carmel Hill before the freeway was built (and recently replanted to natives), and the expressway just south of Santa Cruz are three of these sections where natives were used successfully. An inland area in the vicinity of the Devil's Gate Dam, in the San Gabriel Mountains, was also successfully planted to natives.

Many of these plantings still survive, and are very attractive today. Some of the shrubs have died out, but have been replaced by "volunteer" plants from windblown and birdborne seeds. On the other hand, results with California natives in the median of today's divided highways have been often indifferently successful, occasionally dismal failures, since the surplus of run-off water in any median is a drainage problem.

A constantly recurring request to the Division of Highways is for the planting of California Poppies, lupine, and other wild flowers. These flowers are still being planted on new construction whenever conditions are right, but they normally do not survive long. The first year they make a brave show, but quickly disappear after that, as the coarser grasses crowd them out.

One of the more difficult jobs from which valuable experience was gained was the planting of the San Francisco Bay Bridge approaches. On the Oakland end the fill was sand dredged from the bottom of the bay, and many truckloads of topsoil and manure had to be imported to make it suitable for planting. Before planting, young shrubs and trees had to be acclimated in a semi-exposed location for several months, otherwise they would have been rapidly burned to the ground by the force of the salt-spray laden wind.

Some non-coastal trees were planted such as incense cedar, Atlas cedar, and coast redwood which, despite its name, is rarely found in exposed coastal locations. These survived if protected by more hardy varieties. Lawson cypress from the Northwest failed completely. In the most exposed locations the shrubs and trees that survived were three of the hardiest California natives — Monterey cypress, western elderberry, and baccharis. Two melaleucas, (nesophila and armillaris), pittosporum crassifolium and the Australia tea tree also proved very resistant to drenching with salt spray. Ice plant ground covers stood the difficult conditions well, seemingly completely indifferent to the salt.

When the Pasadena Freeway (then called the Arroyo Seco Parkway) was built in Los Angeles the depressed sections were in cuts with steep slopes in order to save right-of-way costs. This freeway became a test section for ground covers, of which every available variety was planted to determine its suitability.

Few proved suitable. Wild strawberry, rosa wichuriana, and vitis capensis were not vigorous enough to compete with the rampant weed growth. Bougainvillea and climbing roses did well but did not smother out the weeds. Virginia creeper was also a vigorous grower, but deciduous in winter. Honeysuckle developed beneath its green surface masses of dead, woody stems which would catch fire in the afternoon even if watered that morning!

Morning glory was inconsistent. In some places it would grow poorly, in others rampantly climb upon itself until it was grown up into great humps and mounds, with much dead wood underneath. Ivy geraniums did not live long enough to be worth the trouble of planting. Hypericum required too much water. Nepeta hederacea failed miserably in the southern California climate.

Surprisingly, a small planting of mesembryanthemum croceum did well on unfertilized, decomposed granite. Vinca (periwinkle) was not satisfactory on slopes, although in other locations it has proved very valuable. The best cover was the common English ivy, which was used extensively for several years. Recently it has been supplanted by the Algerian ivy, which grows faster and has a more glossy leaf surface. Another very successful ground cover on this freeway was lantana sellowiana.

A study of the California Division of Highways preferred plant list will show that more than 90% of the plants used in roadside planting are native to Mediterranean or steppe climates. This is not a planned result, but is an empirical one learned during 30 years of trial and error. It is no accident these Mediterranean plants have come to the fore, because they are adapted to Cali-

Palo Verde trees growing on U.S. 99 in the Imperial Valley. These are native trees adapted to this true desert climate and soil.

fornia almost as well as the truly indigenous ones. Conversely, many California natives are planted in these other Mediterranean areas of the world.

California is called by geographers a "coldwater coast," or "Mediterranean," climate, which gradually shifts into a "sub-tropical steppe" climate inland and to the south. Only about 2% of the earth's surface enjoys a Mediterranean type climate, and these areas are found where prevailing westerly winds blow across cool ocean currents onto the land—in other words, always on the western side of continents, and near the middle latitudes. Mediterranean type climates are found in California, Chile, on the west and south coast of Australia, and at the southern tip of Africa, as well as in a deep penetration into the Afro-Eurasian land mass around the sea which gives the climate its name. Mediterranean climates are characterized by dry summers and even temperatures the year round.

Mediterranean climates are inevitably accompanied in the interior and on the equator side by the sub-tropical steppe climates. These climates are dryer, with hot, dry summers. Winter rainfall may vary greatly from year to year, but it is never heavy. Such climates are found in the southern Central Valley of California, Lower California peninsula, and north Africa.

Naturally, over the years, botanists and plant scientists have imported the best plants from all over the world which are adapted to these climates. The hardiest of these, after years of study and testing, have been adopted for use on California roadsides. The plant list used today by the Landscaping Section is a mixture of American and foreign plants, often used in cosmopolitan combinations.

Despite occasional public criticism that an insufficient number of California shrubs and trees are used, the Landscaping Section has more than 30 California natives on its list, as well as a few more from adjacent Southwest areas, such as the Mexican fan palm, and the Arizona cypress. Actually, California is the heaviest represented area on the list. Furthermore, in a survey of several Division of Highways landscape architects and landscape maintenance supervisors, four California natives were unanimously chosen to be included in the twelve plants voted most useful for highway planting in this state. These were California toyon, coast redwood, California sumac, and the palo verde.

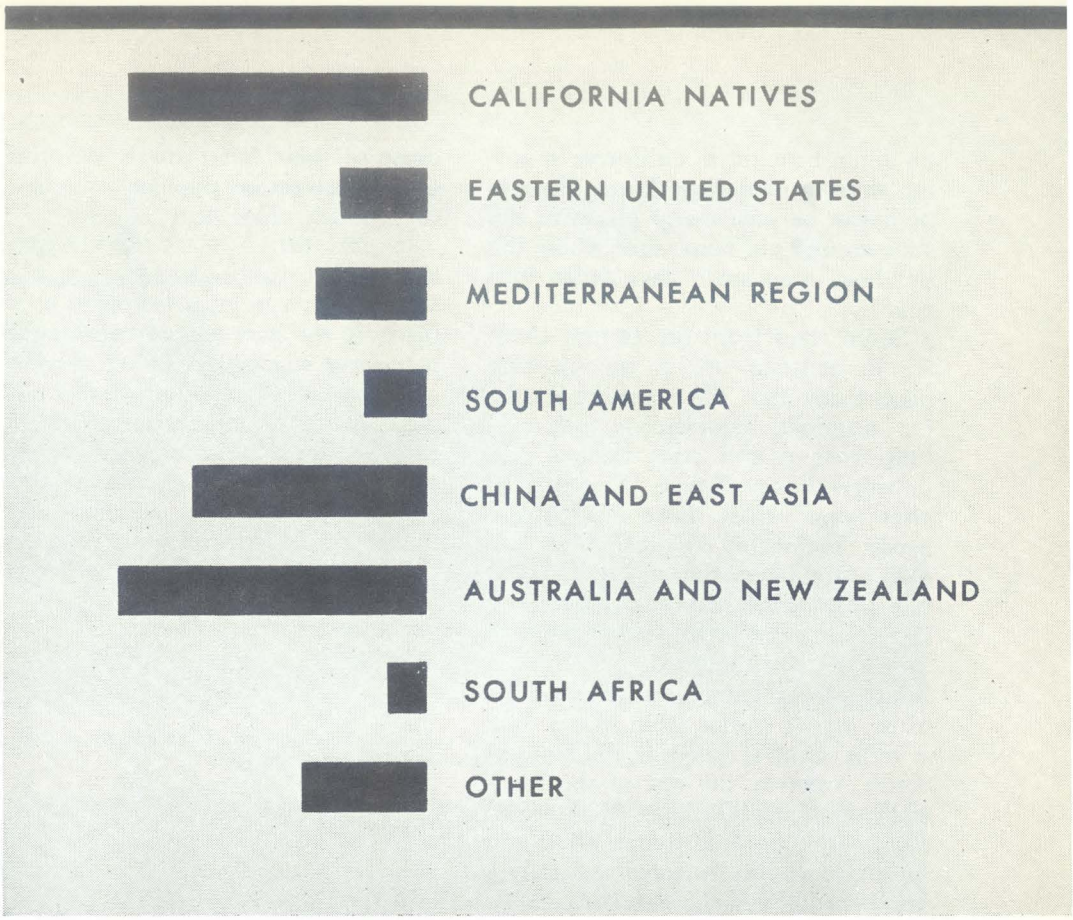


Chart shows relative number of trees, shrubs, and vines used in California roadside plantings from various parts of the world.

The second largest group of plants and trees, totaling about 25 in all, comes from Australia and New Zealand—mainly the former. These are the bottlebrushes, the pittosporums, the tea trees, but most important, the acacias and the eucalypts. Fast-growing, drought resistant, frost hardy over much of the State, generally insect free, evergreen and graceful, these exotics from the Antipodes have taken to California conditions as though they were native.

Another group of plants on the preferred list, almost a score, in fact, comes from eastern China and Japan. Some of these plants are steppe-born, some are developed from centuries of oriental gardening. Perhaps the greatest gift from this area is the pyracantha, which, like the Australian plants, also takes to California like a native. (One common pyracantha, coccinea, comes from southern Europe, but this is not generally used on roadside plantings). Two very useful vines, the Japanese creeper and Halls Japanese honeysuckle are native to east Asia. This area also gives us the camphor tree, the ginkho, forsythia, crapemyrtle, and the Pfitzer juniper.

A smaller group of plants, about 10 altogether, comes from the shores of the Mediterranean. This region's most important contribution can unreservedly be said to be the oleander, which the Division of Highways has planted by the hundreds of thousands. Other good imports from this region are the carob, pomegranate, Algerian ivy, and the Aleppo pine.

A few old favorites from non-Mediterranean Europe have proven able to exist in the California climate without excessive care. One of these that has proven very useful as a ground cover, particularly at interchanges, is the vinca, or periwinkle, which made such a poor showing on the Arroyo Seco plantings. This is a very hardy ground cover. Its first plants were

no doubt brought to California in sailing ships around Cape Horn. Patches of it can be seen many places in the state around old home sites where the buildings long since have fallen into rubble.

Seven trees from the eastern U. S. are in constant use in the planting plans today also. These are the Southern magnolia, liquidambar, pin oak, tulip tree, scarlet oak, catalpa, and thornless honey locust. Tested year after year, these have all proven hardy, reasonably fast growing, and ornamental. Because they are native to a year-round rainfall climate, they all require considerable watering until they are well established.

Except for these few trees and a scattering of shrubs from places such as India, Central America and tropical South America, the rest of the list is made up of miscellaneous Mediterranean or sub-tropical steppe trees and shrubs. It should be noted that only a single shrub from the eastern U. S. has proved satisfactory on roadsides in California, the Carolina cherry.

Of all the imports from the various continents, and excepting the oleander, those from the New Zealand-Australia archipelago would be the hardest to get along without. Among the tea trees, bottle brushes and pittosporums are found species which grow in the most impossible locations—on high, arid, windswept ridges, along the beds of dry rivers, and almost in the surf of the Pacific where they are constantly drenched with salt-spray. The acacias we use, all of which are native to Australia, are legumes, which make them particularly adapted to California's normally nitrogen-thin soils.

We especially thank Australia for the eucalypts. Although very few of the many hundreds of native Australian species of this tree have been imported, their mark on the state's landscape has been tremendous. In fact, many people think the eucalyptus a California native.

The first experimental plantings of eucalyptus in California toward the end of the last century were almost exclusively blue gum (e. globulus). There is hardly an older farm home in the valleys of the state that does not have at least one of these trees. Because of their fast growth and great size, these trees are popularly supposed to be much older than they are.

In the early 1900's experimental commercial plantings of this tree and a few other species were made many places in the state as a new and highly promising source of timber. Perhaps as many as two million acres were planted. For various reasons the plantings did not prove commercially feasible. Eventually it was realized the native conifer forests were the best timber producers for California, and this only where soil and rainfall were favorable.

Contour grading makes the cut slopes look like natural rolling terrain. Upper edges of cut slopes are rounded off and entire area planted to grass. Natural growth is retained where possible.

Blue gum is not used on roadsides today because it gets too big, its constant leaf drop and bark sloughing is untidy, and its brittleness requires constant maintenance lest its big branches fall into the highway. Because of blue gum's bad characteristics, the entire family of eucalypts has gotten a bad name, and it is not unusual to run into local prejudice when the smaller and better behaved varieties are planted in an area.

The eucalypts used on the highways are the smaller species which have proven just as hardy and adaptable as the blue gum, but do not have the avaricious root system, nor the shedding habits of the larger species. The dwarf blue gum, a rounded, compact tree almost shrub-like in habit, is used extensively for screens. Lehman Eucalyptus or Bush Yate as it is called in Australia, is another excellent low growing variety. Its globular shape and low, spreading branches make it very desirable from a maintenance man's standpoint. Some of the Mallee varieties are being used in recent plantings as decorative shrubs.

Among the tree forms Camaldulensis is better behaved than blue gum. Rudis is used extensively. Polyanthemos and sideroxylon are two excellent smaller varieties for structure delineation and similar uses. These are varieties which have been selected as outstanding after many years experience with them. Dozens of other varieties would probably do just as well if they were available in quantities from the nurseries.

Obviously, the "native" plant for use in planting on California roadsides is the one which can survive conditions which are as difficult as any plant anywhere could be subjected to. Some of them must live where salt spray is continuously coating their leaves, others in a true desert climate. Plants which have evolved to survive in these conditions are the ones that must be planted, as the creation of artificial environments is prohibitively expensive on a statewide basis.

This reprint booklet is made of four articles which appeared in the Cali-

fornia Highways and Public Works Magazine, plus a supplementary list describing nearly 100 plants and trees. The list is made up of the most useful of these plants and trees as proven over the past 30 years, and describes their habit, adaptability, good and bad points. This list has been compiled in the hope it will be of assistance to communities elsewhere in California and other places in the world with similar Mediterranean and sub-tropical steppe climates.

Doubtlessly there are a number of other plants which could be added to the list—certainly some which are unknown to the Division of Highways landscape architects, and others with which it has not been practicable to experiment. This is not surprising, since botanists have classified more than 120,000 different species of higher order plants in the earth's plant kingdom.

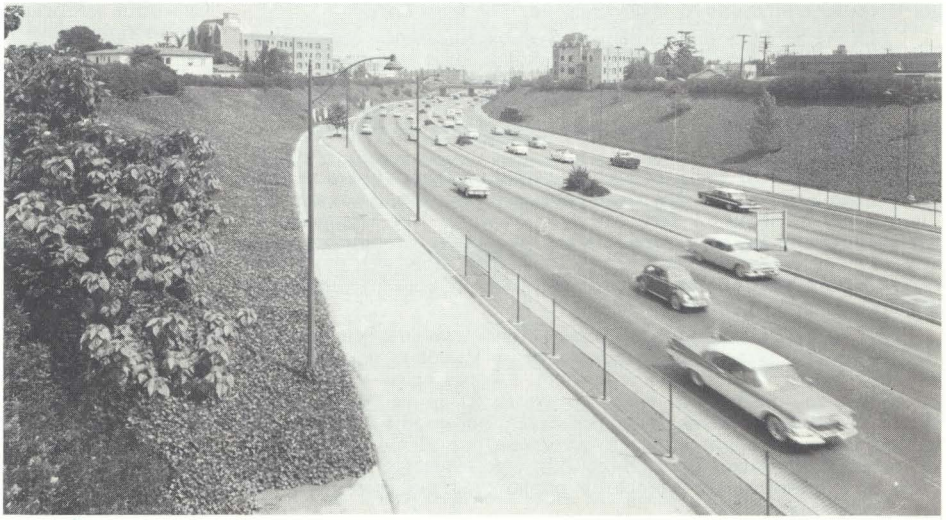
The list then is not to be considered a comprehensive inventory of all the hardy, rugged plants which might be used in difficult situations such as are found along our state highways in California. Rather it is an offering to be added to the literature on such plants. Insofar as possible it records the cumulative experience over a number of years of a number of Division of Highways landscape architects.

For those who refer to this plant list, it must be kept in mind the plants used on California roadsides must satisfy very difficult requirements. Ideally, they must be drought-resistant, adaptable to various kinds of soil, able to take heat and exhaust fumes; preferably be fast-growing, evergreen, and with branches which grow close to the ground for weed control. Very few trees and shrubs meet these specifications completely, but in the interests of avoiding monotony, a number which approach the ideal are used.

The list is divided into separate sections for trees, shrubs, and vines and/or ground covers. Each of the sections is divided into two groups—those most desirable and a list for second choice or specialized use. Especially satisfactory plants are marked with one or two asterisks, the two asterisk ones being the best.

Hillside in the Santa Cruz area planted with native Monterey pines. These fast-growing native trees are ideal for this climate and will quickly bind the slope.

Screen plantings of dwarf blue gum (Eucalyptus globulus compacta) on Nimitz Freeway in Alameda County. Hardy, evergreen, dense and fast growing, this tree is almost as valuable as the oleander.



Hollywood Freeway in Los Angeles area. Algerian ivy has proved one of the best vines for this type of slope planting, if sprinkling is provided. Screen at top is Japanese privet. Trees are catalpa and liquidambar, both of which will become much more significant in the overall design as they grow larger.

Favored Plant Materials of California Division of Highways

TREES MOST OFTEN USED

ACACIA melanoxylon—Blackwood Acacia or Black Acacia. Widely distributed at cooler elevations in Australia and Tasmania. Stately, upright, dark green tree, growing to 60 feet. Light yellow profuse bloom in early spring. Evergreen, drought resistant, frost hardy to 15 degrees. Fast growing, alkali tolerant, not soil fussy, smog resistant. Use as hedge, screen, or single tree. Suckers badly where has plenty of moisture.

CERATONIA siliqua—Carob, Algaroba, St. John's Bread. From eastern Mediterranean. Evergreen, wide branching tree to 30 feet. Slow growing but drought and soil tolerant; alkali resistant. Frost hardy to about 15 degrees. Seems to have no insect pests or diseases. Some people object to seed pods. Grows close to ground when young, and can be used as large screen shrub or tree. Recommended for southern California, and warmer areas, where often used as street tree.

CERCIDIUM floridum (torreyanum)—Palo Verde. Native to Colorado desert in southern California, also Arizona and lower California to Sonora. Grows in dry washes. Deciduous during hot season. Very drought and heat resistant; interesting yellow flowers and bright green winter foliage. Hard to get young stock, but one of best trees for desert. Small shapely tree to about 20 feet. Fairly fast growing when has some water. Alkali tolerant, but will not take much frost, nor poor drainage.

CINNAMOMUM camphora (Camphora officinarum)—Camphor Tree. Native to eastern Asia. Long lived but slow growing evergreen tree of wide, spreading habit in maturity but rounded and compact in youth. Grows to 80 feet. Will take heat, frost to 10 degrees, somewhat drought and alkali resistant. Constantly sheds leaves or seeds, brittle, surface roots, difficult to transplant. Not recommended for street tree, but good for background or park tree.

** EUCALYPTUS camaldulensis (Eucalyptus rostrata)—Longbeak Eucalyptus. Inland river courses (sometimes dry on surface) and on river banks and alluvial flats over Australia. Evergreen and fast growing to over 100 feet but not as coarse as E. globulus or E. viminalis. Tolerant of soil, takes cold to about 15 degrees, drought tolerant, stands heat. One of best eucalypts for hot, interior valleys when larger trees desired. Sheds bark some.

EUCALYPTUS citriodora—Lemon Eucalyptus or Lemon-Scented Gum. Tropical and sub-tropical tree growing close to coast in Queensland. Graceful, light-silhouette eucalyptus for Los Angeles smog area and other warm areas. Good skyline and park tree with beautiful white bark. Not frost hardy.

EUCALYPTUS cladocalyx—Sugar Eucalyptus or Sugar Gum. Native in heavy acid soil of southern Australia, but does well anywhere. Robust but not fast growing, tree to about 100 feet. Well formed, drought resistant, evergreen, widely used in Australia in arid and semi-arid areas as windbreak and rough timber tree for farms and ranches. Mallee form "nana" used for hedges. Young trees hard to get. Excellent in southern California, but not frost hardy.

** EUCALYPTUS polyanthemos—Redbox Eucalyptus or Redbox. Grows in open forests or savanna woodlands, drier areas and poorer soils of New South Wales and Victoria. Relatively slow growing for Eucalyptus, but shapes up well in good soils. Very adaptable evergreen tree, reaches about 75 feet maximum. Takes considerable frost, to perhaps 15 degrees.

* EUCALYPTUS rudis—Moitch Eucalyptus, Desert Gum. Grows along inland rivers and dry river courses in western Australia. Medium sized, to about 75 feet, but fast growing. Not recommended for shallow soil as blows over. Very adaptable, drought resistant, attractive, evergreen. Takes heat and some frost, does well near ocean or in hot interior valleys. Particularly good in cool Mediterranean climate of San Francisco Bay region.

* EUCALYPTUS sideroxylon rosea—Mulga Ironbark Eucalyptus or Red Ironbark. Native to coastal slopes of Victoria, western slopes of New South Wales. Graceful, light textured tree with characteristically red-black bark, which grows to 50′ in height and more. Beautiful red-pink blooms. Light for screen, but good for background or delineation. Drought resistant, evergreen, one of most frost hardy of the eucalypts, adaptable to most soils. One landscape architect says "sort of a substitute for Lombardy poplar" but not tolerant of wet feet like poplar.

GREVILLEA robusta—Silk Oak Grevillea or Silk Oak. Native to scrublands of northern Queensland and New South Wales. Hardy, medium to fast growing, tall, narrow habit, to 120 feet in maturity. Does well in deeper soils in southern California. Good dark green foliage, interesting orange bloom, evergreen. Frost hardy to 15 degrees. Sheds leaves constantly, branches are brittle.

LIBOCEDRUS decurrens—California Incense Cedar. Native to mountains of California from 2000 to 7000 feet. Excellent drought resistant and cold hardy conifer, somewhat formal in habit, for use to relieve monotony of broadleaf plants. Rather slow growing, but Division of Highways would use this tree more if it were always readily available at nurseries. Grows normally under cultivation to about 50-60 feet, but some stands in good locations in the mountains grow over 100 feet. Requires virtually no maintenance.

** LIQUIDAMBAR styraciflua—American Sweetgum. Widely distributed deciduous tree in woodlands of eastern U.S. as far north as Connecticut. Upright, "narrow exclamation point growth" when young, will grow to 100′ and become more spreading like elm. Clean, good form, excellent fall color, but sometimes troubled by pests such as red-hump caterpillars, scale insects, and crown borers. Survives well in poorly drained and poor soils too, but chlorotic in alkaline soils. Vigorous rooter, but not drought resistant. Needs water.

** LIRIODENDRON tulipifera—Tulip Tree, Whitewood. Native to woodlands of eastern U.S. from Massachusetts to deep South. Deciduous, stately tree which grows to 100′ and more; elm-like in maturity; interesting foliage and blooms; good growth habits, no known pests. Fast growing with limited maintenance when it has adequate water, but not very drought resistant.

** PINUS halepensis—Aleppo Pine. Native to the southern Mediterranean region, including the vicinity of Aleppo, Syria. One of hardiest pines. Attractive light green foliage; fast growing to about 60 feet when water is provided; but relatively drought resistant. Grows in almost any soil. Will take considerable frost.

* PINUS radiata—Monterey Pine. Found growing naturally only on a few square miles of land on Monterey Peninsula, but probably is world's most widely used pine. Has been planted heavily in New Zealand as timber tree. One of fastest growing pines, dark silhouette, survives in most soils with some water, but best along coast. Frost hardy to 10 degrees. Not alkali tolerant, not as drought resistant as some other pines. Excellent for seedling planting.

PISTACIA chinensis—Chinese Pistache. Native of China. Slow growing, very frost hardy deciduous tree to about 60 feet. Good foliage, drought and heat resistant, best fall coloring tree for California. Sometimes erratic growth structure when young.

* PLATANUS racemosa—California Sycamore, Western Sycamore, California Plane. Commonly grows along streams and dry stream beds at low elevations over much of California in dryer areas. Excellent deciduous tree for native type plantings where some moisture available. Fast growing to about 100′ in good soil, attractive foliage and trunk; a massive, picturesque tree. Subject to a spring blight which defoliates, but trees quickly recover. Also suffers in some locations from mildew, red spider, and scale. Sheds leaves, bark and seed balls most of year. Despite drawbacks, an excellent tree for California landscape. Frost hardy in low elevations over state. Should not be staked, but allowed to form own shape. Sometimes planted in clumps of three, like birch.

SCHINUS molle—California Pepper Tree, California Pepper. A native of Central and South America to Peru. Fast growing, graceful, picturesque evergreen growing to about 50 feet in maturity. Light textured foliage with willow-like habit, interesting seed balls in season. Takes limited amount of frost. Greedy root system, but very drought and soil tolerant; needs little care.

SCHINUS terebinthifolia—Brazil Pepper Tree, Christmasberry Tree. Native to Brazil. Fast growing but stiff looking small evergreen tree with heavy foliage. Drought and soil tolerant; needs little care. Spreads close to ground for weed control; Division of Highways uses as tall screen shrub often. Recommended only for southern California climate.

SEQUOIA sempervirens—Coast Redwood. Famous coast redwood, native only to coastal ranges of northern California. Rarely found directly on coast, but inland a short distance, growing best in deep alluvial soil of river valleys. Fast growing and pest free; popular because of sentiment, as well as good habits. Needs some water, grows well only close to northern and central coast. Can be planted as bare root seedling in reforestation style at right season. Best effect planted in clumps or small groves. Frost hardy to about zero.

* ULMUS parvifolia—Chinese Elm. Native to China and Japan. Graceful, spreading small tree. Some selected forms (called Evergreen Elm) are evergreen most of year, but may lose leaves in winter if hit by heavy frost. Grows well over most of California at low

elevations. Not as frost hardy, drought resistant, or fast growing as U. pumila, but low shrublike growth inhibits weeds and is more ornamental. Hardy and adaptable to most soils. Does well in watered plantings.

* WASHINGTONIA robusta—Mexican Washington Palm, Mexican Fan Palm. Closely related to California fan palm, grows in desert conditions in Mexico much like California species, but is much taller and slenderer. Faster growing, and can stand more wind than California palm. Very common in southern California, and widely used wherever tropical atmosphere desired. Both species of these palms require considerable maintenance as dead fronds cling to trunk. If not removed they may fall in windstorms and injure passersby; also birds and rodents infest dead foliage.

SECONDARY TREE LIST

(Slightly less dependable alternates or special use species)

ACACIA baileyana—Cootamundra-wattle or Bailey Acacia. Native to inland areas of New South Wales and South Australia. (Australians call all acacias "wattles." Wattle once meant the twigs and branches used to build "wattle and daub" buildings of the early settlers there, but today is accepted to mean acacia.) Small rounded evergreen tree to about 25 feet, very fast growing if watered, grey foliage, spectacular yellow bloom for short period in early spring, for which it is most often planted. Hardy, drought and heat resistant, greedy roots, short-lived, brittle branches. Division of Highways cuts back to make good screen. Can be used for erosion control; will take perhaps 10 degrees of frost.

AILANTHUS altissima (glandulosa)—Tree-of-Heaven Ailanthus or Chinese Tree of Heaven. Native of China. Presumably brought to California by Chinese miners during Gold Rush. Very hardy and drought resistant; also survives in worst smog. Deciduous, but female trees bear beautiful red orange seed clusters in fall. Colonizes and seeds badly to become a pest in many locations.

ALBIZZIA julibrissin—Silk Tree Albizzia or Silk Tree. Native of Asia from Persia to Japan. Medium sized deciduous spreading tree with feathery tropical-looking foliage and tufty pink flowers carried over long blooming period. Grows to about 35 feet with spreading branches and flat top; general appearance similar to several of the acacias. Shallow rooted and short lived, fairly fast growing, good for variation occasionally, best in hot interior valleys, where sometimes planted as street tree.

ALNUS rhombifolia—Sierra Alder or White Alder. Grows in California canyons and along river banks in foothills and low ranges. Birch-like tree, grey bark, fresh-looking foliage, good for clump planting. Hardy, deciduous, to about 60 feet. Will grow in very moist areas.

CUPRESSUS macrocarpa—Monterey Cypress. Native to small strip of coast on Carmel Bay, California, only. Very interesting silhouette, dark green conifer, grows to about 40 feet. Limited use to California coast from Santa Barbara north. Susceptible to coryneum canker in many areas and Arizona cypress should be substituted. One of very best trees for ornamental and windbreak plantings in windy coastal areas. Often seen in massive old square-pruned hedges around residences along coast.

EUCALYPTUS ficifolia—Scarlet Eucalyptus, Red Flowering Gum. Native to Western Australia. Small evergreen tree with dense, coarse foliage, brilliant scarlet blossoms, and interesting fruits. Grows to about thirty feet. Very popular with laymen because of spectacular bloom, but not a very serviceable tree. Fairly drought resistant, and normally a neatly shaped ornamental, but touchy as to soil, shallow rooted, takes no frost, may become unshapely when old, and flower colors vary with individuals.

EUCALYPTUS viminalis—Ribbon Eucalyptus, Ribbon Gum, Manna Gum, or White Gum. Prefers elevated valleys of New South Wales, Victoria, Southern Australia, and Tasmania, but very adaptable. A big tree, may get to 125 feet or more, normally about two-thirds the size of E. Globulus, with beautiful creamy bark. Fairly fast growing, frost hardy to about 15 degrees, needs plenty of space. Only bad habit is bark sloughing. Beautiful background or specimen tree.

FICUS retusa (nitida)—India Laurel Fig. Native of India. Small, shapely evergreen tree, slow growing, but has excellent color and texture in foliage and bark. Takes dirty city conditions and may be planted in confined areas. Good street tree for warm sections.

GLEDITSIA triacanthos Thornless (inermis)—Thornless Honey Locust. Native to eastern U.S., Pennsylvania south to Texas and Florida. Hardy, drought resistant, excellent foliage color and texture, fast growing to about 40 feet. Should be given room. May be erratic when young but graceful as it matures into elm-like shape. Takes almost any soil, needs water to get established, large seed pods may be objectionable. Newer, named varieties are sterile and thornless.

JACARANDA acutifolia—Sharpleaf Jacaranda. Native to Brazil. When growing well, a beautiful spreading evergreen tree to about 30 feet with lacy foliage and handsome, long panicles of blue bloom. Another tree which sentiment has over-popularized. Seems best suited to vicinity of Santa Ana in southern California, but may suffer from smog, as in recent years this tree has not been very successful. Takes heat and drought but very little frost. Growth habit may be erratic, often loses leaves while in bloom, seems fussy about soil.

MAGNOLIA grandiflora—Southern Magnolia. Native to southeastern United States. A majestic, spreading evergreen tree to sixty feet, with handsome, shining leaves and large, creamy white fragrant blooms. One of the world's fine shade trees, but needs deep and good soil and irrigation to do well. In the right locations this tree is quite hardy, but it is very slow growing. Is frost hardy in practically all of California. Exceptionally fine street tree plantings in Beverly Hills.

PARKINSONIA aculeata—Jerusalem Thorn. Native to tropical America. Small, rounded tree to about 25 feet, deciduous, colorful yellow bloom in spring, interesting foliage and bark. Adapted to desert conditions and very drought and heat resistant. Branches can freeze with heavy frost, but recover. Thorny to maintain and weak crotches cause splitting.

PERSEA americana—American Avocado. Native to Central America. Bushy evergreen tree to about 30 feet; fast-growing, dense-foliaged, drought resistant. Grows heavy foliage close to ground if unpruned, and Division of Highways uses for tall screen where space permits. Is not frost hardy, is subject to some pests, and when it fruits may draw interlopers. Requires some supplementary watering.

PRUNUS serrulata Kwanzan—Flowering Cherry (Kwanzan variety). Native to Japan, Korea, and China. Small deciduous tree of stiffly upright habit, very profuse rich pink blooms in late spring. Does better in northern California. One of hardiest of flowering cherries, but slow growing and subject to several pests. Requires considerable spraying.

QUERCUS agrifolia—California Live Oak, Coast Live Oak. Native to coastal ranges of California. Exceptionally good evergreen oak, well-shaped rounded form, usually about 30 feet in height, but may be larger in deep rich soil with adequate water. Attractive dark green shiny foliage, neat appearance. Biggest drawback is slow growth, but is much faster if has plenty of water and good deep soil. Takes considerable frost, drought, temporary wetness, and heat. Best in belt near coast, but will grow almost anywhere in California with some water.

QUERCUS coccinea—Scarlet Oak. Native to eastern United States, Maine to Florida and west to Missouri. Cold-hardy, best in northern California. Deciduous, well-shaped tree, growing to about 80 feet in maturity, and its scarlet colored leaves in fall are a main component of the autumn color in eastern woods. Needs frost to color well. Slow growing, but somewhat faster than pin oak, not as well shaped when young. Less fussy as to soil than pin oak, does not retain dead leaves.

QUERCUS palustris—Pin Oak. Native to eastern United States, Massachusetts to Delaware, west to Arkansas. Symmetrical deciduous tree with dark green leaves, growing to about 80 feet. Tends toward almost formal pyramidal shape when young, spreading in maturity. Good fall color tree, but dead leaves are retained through winter. Beautiful tree but rather slow growing, and becomes chlorotic in alkaline soils.

TIPUANA tipu—Common Tipu Tree. Native of South America. Small tropical-looking evergreen tree to about 30 feet, bushy when not pruned. Graceful with attractive flowers. Not frost hardy but drought resistant; also takes considerable wind. Best in southern California.

ULMUS pumila—Siberian Elm, Dwarf Asiatic Elm. Native from Turkestan to North China. Not a dwarf but fairly shapely deciduous tree growing to 50 feet and more in good conditions. Exceptionally hardy and fast growing. Thrives in any soil, very drought and wind resistant, takes cold to far below zero. Foliage somewhat thin, seeds heavily in spring, and suckers when roots damaged. Recommended for difficult situations.

WASHINGTONIA filifera—California Washington Palm, or California Fan Palm. Native to alluvial fans and oases in the inland mountains of southern California around the Colorado desert. Takes considerable drought and very heat resistant. Is beautiful in native situations where over the years has accumulated thick mass of dead fronds almost like skirts, but vandals enjoy firing these dead fronds which usually kills tree. Slower growing, shorter, much thicker trunk than Mexican fan palm described in preferred list, also not as adaptable. Row of trees in Capitol Park on N Street, Sacramento, have grown to about 60 feet, but dead fronds require constant maintenance.

SHRUBS MOST OFTEN USED

* ACACIA cyclops—Cyclops Acacia. Native to arid areas of southern and western Australia. Evergreen shrub 6-8 feet in height with colorful yellow blooms in spring. Drought resistant, compact, good for foreground or intermediate screen, or any limited space. Attractive, frost resistant to about 20 degrees, only drawback is it will not take poor drainage.

** ACACIA longifolia—Sydney Acacia. Occurs naturally over much of Australia and Tasmania. Fast growing evergreen shrub or small tree to about 20 feet, frost hardy to about 20 degrees. Colorful yellow blooms in spring. Particularly good on coast and in southern part of state, but needs water in arid areas. Grows close to ground if headed back when young. One of best for quick effect, but susceptible to psylla and chlorosis.

ACACIA retinodes—Wirilda Acacia, Swamp Wattle. Native of southern Victoria, and South Australia. Fast growing evergreen shrub or small tree to about 25 feet, rather light foliaged, one of best acacias for bloom. More erect habit than A. longifolia, so should be used in combination with latter or other mass plantings to give it wind protection. Likes light, well drained soil. Very susceptible to psylla. Frost hardy to about 18 degrees.

** CALLISTEMON lanceolatus (citrinus)—Lemon Bottlebrush. Grows naturally on east coast of Australia and up divide to slight elevation. Evergreen, fast-growing, bushy shrub to about 10 feet. Spectacular crimson blooms, rather picturesque habit, clean, prunes well. Does equally well in San Francisco Bay area, San Bernardino, and Sacramento Valley. Frost hardy to about 20 degrees. No significant pests.

CASSIA tomentosa—Wooly Senna. Native of Mexico. Fast growing, evergreen, small shrub to about 8 feet, small, light green leaves, drought-resistant, not frost hardy, showy yellow blooms in late winter and spring. Best close to coast in the southern portion of State.

CORTADERIA selloana—Selloa Pampas Grass. Native to pampas of Argentina. Vigorous growing clumps of saw-toothed grass reaching 6-8 feet in height, with spectacular plumes in fall. Voracious and spreading, but good accent. Drought resistant, but dry leaves are fire hazard, and saw edges difficult to work around. Frost resistant; usually comes back from roots after freezing.

** COTONEASTER lactea (parneyi)—Parney Cotoneaster. Native to China. Gracefully branching, fast growing shrub to about 8 feet with heavy, attractive, dark green foliage and colorful berries in fall. Needs water in dry locations, but one of most dependable roadside shrubs. Takes fairly heavy frost, not soil-fussy, stands heat.

CYTISUS racemosus—Easter Broom. Originated probably as a hybrid from southern European parents. Stiffly arching, vigorous growing shrub with fine foliage and heavy yellow bloom in spring. Grows 6-8 feet high, short-lived, susceptible to olive scale, does not like wet soil. Frost hardy to about 20 degrees. Does particularly well in the cool San Francisco Bay area and in coastal locations, but needs full sun. Not to be confused with C. scoparius, Scotch broom, which has become a pest in a number of mountain areas in central California.

** ERIOGONUM fasciculatum—Flattop Eriogonum, Wild Buckwheat, Flat Top. Native to dry mountain slopes and chaparral of central and southern California. Hardy, drought-resistant low clumpy shrub with attractive rust-colored seed heads growing about 2 feet high. Naturalizes well from seeds, grows almost anywhere in any kind of soil, quite frost hardy. Not very effective in weed control. Best honey producing plant in California after white and black sage.

* EUCALYPTUS globulus compacta—Dwarf Tasmanian Blue Eucalyptus. Compact form of E. globulus which is native to cool Tasmanian climate. Large evergreen shrub or small oval-shaped tree to about 30′, with dense, compact blue foliage when young. Drought resistant, fast growing, excellent for tall, dense screen at bottom of fill slopes. Not good for weed control as does not spread well at ground level. Will take about same amount of frost as E. Globulus.

** EUCALYPTUS lehmanni—Lehmann Eucalyptus, Bushy Yate. Native of Western Australia but considered very adaptable by Australians. Almost perfect ball-shaped evergreen shrub to 12-15 feet with medium green foliage. Fast growing and drought resistant. Has proven very useful in smog areas of Los Angeles as background planting and screen. Low maintenance. Not frost hardy.

JASMINUM humile revolutum—Italian Jasmine. Native of southern Europe. Multi-stemmed evergreen shrub with habit of growth much like an oleander. Cutting back when young, thickens base growth. Hardy, drought-resistant, with long blooming period of yellow flowers through late summer and fall. Very good slope cover in warm climate. Needs some water.

* MELALEUCA armillaris—Drooping Melaleuca, Bracelet Paperbark, Honey Myrtle. Grows in various situations in Queensland, New South Wales, Victoria. Likes light moist soil, takes very little frost. Picturesque, evergreen, spreading shrub to 12 feet with fine foliage and relatively small white "bottle brush" type flowers. Excellent for San Francisco Bay area and coastal conditions, and where exposed to ocean winds. Drought resistant; excellent color, texture, and growth habits; disease and insect free.

* MELALEUCA nesophila—Pink Melaleuca, Tea Myrtle. Native to coastal regions of West Australia. Evergreen shrub, similar in habit to M. armillaris—will grow to 25 feet if pruned to a single trunk for tree form, but characteristically shrublike to 12 or 15 feet. Grows in salt or alkaline soil, quite drought resistant, good cover shrub, takes sea winds, prunes easily, virtually pest free. Blooms are somewhat small, lavender pink, appearing at tips of branches. Outstanding shrub for coastal plantings, but can not take much cold weather, so not recommended for interior valleys.

** NERIUM oleander—Common Oleander. Native to the shores of the Mediterranean and Asia Minor. Multi-stemmed evergreen shrub 6-15 feet high depending on variety. This is the shrub most widely planted by California Division of Highways. It is often used in full landscaping jobs, and by process of elimination, has proven the only known shrub really suitable for freeway median plantings. Takes drought, exhaust fumes, standing water on heavy soil in winter, frost to about 15 degrees. Good recovery after accident damage. Needs some irrigation to get established, but grows rapidly into dense globe-shaped shrub forming good headlight screen. Will take almost any soil but does best in sandy, moist soils. Likes heat, and is particularly good in interior valleys, or even Imperial Valley with water. Blooming period through spring into summer. Poisonous foliage, and susceptible to olive scale and aphids. Most of the Division of Highways plants are single red variety, but there are several other good colors, both single and double. The salmon variety, Mrs. Roeding, is very compact and slower growing.

** PHOTINIA arbutifolia—Christmas Berry, California Toyon. Native to California, found growing in foothills and lower ranges over most of state from 10 to 3500 feet altitude. Evergreen, rounded shrub to about 10 feet, with fairly compact growth, rich, dark green foliage, and generous crops of berries under good conditions. Drought resistant, adaptable to poor soils, fast growing. Best all around native but needs perfect drainage. Because of this it has not been too successful for median plantings; also does not recover well from accident damage. Frost hardy, but susceptible to scale insects and apple twig borer.

PITTOSPORUM crassifolium—Karo Pittosporum. A native of New Zealand—chiefly the east coast of the North Island where it grows right on the seashore. Has developed thick cuticle and epidermis to protect it from excess transpiration by sea winds. Somewhat stiff, erect, evergreen shrub to about 15 feet, greyish-green pubescent foliage. Good drought resistant shrub for screen. Takes difficult sea coast conditions and even standing water around roots temporarily. Used close together for hedges, about 3′ apart. Can take some alkali; not very frost hardy; should be used in moist coastal climate as pubescent leaves collect dust in dry climate.

* PUNICA granatum—Pomegranate. Native to eastern Mediterranean and southern Asia. Deciduous shrub and small tree to 15 feet in maturity. Excellent foliage, colorful orange flowers, interesting and attractive scarlet fruit about size of large apple. Very drought resistant, fast growing, loves heat, frost hardy, and not too fussy about soil. No serious diseases or pests—an excellent shrub, the only drawback of which is its loss of leaves in winter.

* PYRACANTHA crenato-serrata (yunnanensis)—Firethorn. Native of China. Very hardy and vigorous spreading evergreen shrub to 8 or 10 feet in California, covered with white bloom in spring, and many clusters of red berries in fall and early winter. Rich green foliage, drought resistant, compact growth. Best planted where pruning will not be required. Thorns hamper maintenance, but little maintenance required on these shrubs.

* PYRACANTHA koidzumi (formosana)—Formosa Firethorn. Native to Formosa. Similar to P. crenato-serrata, but somewhat more upright in habit, fruits more heavily. (Generally speaking, most named varieties of Pyracantha have been developed primarily for exceptionally heavy fruiting characteristics. Santa Cruz is a spreading variety suitable for slope cover.) All pyracanthas are frost hardy in lower altitudes of California, but are susceptible to pear and fire blight, particularly in the warmer sections of the state.

* RHAMNUS californica—California Buckthorn, Coffee Berry. Native to most of mountain areas of California in somewhat varying forms. Evergreen shrub to about 10 feet, fast growing with heavy branching habits. Foliage sometimes rather dull. Hardy, drought re-

sistant, dependable, free of insects and disease, does best along coast. Should be planted in masses.

* RHUS laurina—Laurel Sumac, California Sumac. Grows naturally in southern California coastal mountains. Evergreen, compact, spreading shrub, to about 8 feet, with attractive foliage and bright red new growth. Good weed control, very drought resistant, sensitive to wet soil. Fast growing; freezes easily but regrows from roots. Does well without water near coast once established.

XYLOSMA senticosa—Shiny Xylosma. Native of southeast China. Very attractive evergreen shrub with shiny yellow green foliage. Grows to 8 or 10 feet and spreads well at base for weed control. Fast growing, but best with watering and good soil. Touchy on drainage. Not very frost hardy. Particularly useful in exceptionally hot exposures. Not successful for highway use in San Francisco Bay area. Can be adapted to any shape by pruning—low and spreading, hedge, or espalier.

SECONDARY SHRUB LIST

(Slightly Less Dependable Alternates or Special Use Species)

ACACIA decurrens dealbata—Silvergreen Wattle Acacia, Black Wattle. Naturally occurs in wide distribution in Coastal Queensland, New South Wales, South Australia. Small fast growing evergreen shrubby tree to 30 feet with olive green feathery foliage which sets off bright yellow bloom in spring. Hardy and drought resistant, adapts to poor soils, makes quick effect but short lived and tends to become woody and leggy if not cut back or planted thickly. With pruning can be kept to dense hedge of eight to ten feet in height. Seeds and suckers prolifically, wood brittle.

ACACIA linearis—Needle Acacia. Native to Coastal Queensland and New South Wales. Exceptionally fast growing evergreen shrub to about 15 feet, angular branches, attractive foliage with long narrow leaves. Excellent shrub for quick effect, very drought resistant, but subject to frost damage especially when young. Growth rather heavy and brittle; susceptible to psylla.

CEANOTHUS thyrsiflorus—Blue Blossom Ceanothus, California Lilac, Blue Myrtle. Native to California coast ranges, Monterey county northward, and plentiful in redwood belt. Somewhat stiffly branching evergreen shrub growing anywhere from 3 to 15 feet high depending upon soil and prevailing winds, blue blossoms in spring. Variety repens is very good for slopes as it has low spreading growth, deep blue flowers. Both shrubs are good with native plantings, hardy, drought resistant, frost resistant, but usual ceanothus problems of susceptibility to scale and aphids, and touchiness toward too much water and poor drainage.

CERCIS occidentalis—California Redbud. Native to dry foothill areas and stream canyons, central and southern California up to 4000 feet. Deciduous shrub 6 feet to small tree of 15 feet or so, with showy, dense, red-pink blooms in spring before leaves appear. Leaves are shiny, oval, handsome; and seed pods persistent. A favorite among California native plant enthusiasts because of bloom. Needs water to establish, but very drought resistant after established. Not particularly functional, should be used in other native plantings or with other drought resistant plants. Takes considerable freezing, fairly fast growing, but will not tolerate wet soil. Susceptible to red hump caterpillar.

CHAENOMELES lagenaria — (Cydonia japonica) — Flowering Quince. A native of China. Vigorously growing, multi-stemmed, large deciduous shrub or small tree to 20 feet, primarily planted for beautiful bloom before leafing out in early spring. An attention getter in bloom, but nondescript otherwise. Low maintenance, but too open for screen or weed control in off season. Easy prey to aphids. Thorny branches make good barrier, but pyracantha better for this in most cases. Use flowering quince sparingly with other shrubs.

CUPRESSUS arizonica—Arizona Cypress. Found growing naturally in desert areas of Arizona, New Mexico, Mexico. Evergreen coniferous tree to 50 feet somewhat similar to Monterey cypress but foliage is much greyer, and habit of growth more erect. In native environment with little water is slow growing and deep rooted. In good soil with water tends to grow much faster and be shallow rooted, which allows it to blow over easily. Very drought resistant, much more resistant to pests than Monterey cypress, and in inland areas is a substitute if cypress desired. Should not be heavily watered in order to force a good root system. Best in desert areas.

ERIOGONUM arborescens—Island Buckwheat. Found growing naturally on Channel Islands of California only. Very drought resistant evergreen shrub averaging 4′ in height, developing thick center trunk and rose colored seed heads. Resembles English lavender in form, color and texture. Colorful, drought-resistant and hardy, not very effective in weed control. For dry and special areas. Drawback is it gets woody, leaving little foliage for effect.

FORSYTHIA suspensa—Weeping Forsythia. A native of China. Deciduous shrub with whip-like branches, grows to about 6 feet, spectacular yellow bloom in spring. Vigorous grower, excellent early spring accent shrub, hardy in colder areas (used extensively in East), does well in San Francisco Bay area, but does not have good blooming period in southern part of state. Used occasionally for color accent on roadsides.

FREMONTIA californica—California Fremontia. Grows in middle altitudes, central and southern California mountains. Evergreen shrub with sparse, fuzzy foliage, and handsome, large, sulfur-yellow flowers in late spring; grows to picturesque, stiffly branching form in maturity, reaching about 15 feet. Hardy, exceptionally drought-resistant, but must have perfect drainage. Fuzz on leaves is irritating to roadside workers. Temperamental. F. mexicana—San Diego Fremontia—is better behaved, although growth characteristics and environmental needs are similar. Fremontias are good native plant specimens for special uses, best with other natives, particularly ceanothus.

LAGERSTROEMIA indica—Crapemyrtle. Native to China. Somewhat irregularly growing deciduous shrub or small tree to 25 feet in maturity. Smallish leaves and somewhat thin foliage, beautiful bleached grey bark, spectacular blooms in reds, pinks, whites, and lavenders, depending upon variety. Good flowering accent for color in late summer. Drought resistant but needs some water. Good in hot climates, mildews in humid areas. Good fall color tree when touched by frost. Hardy. Clean.

LEPTOSPERMUM laevigatum Reeves—Reeves Victoria Tea Tree, Coast Tea Tree, Australian Myrtle. Leptospermum grows in the most exposed and windswept parts of all Australian states, and in sandy coastal areas. Considered ideal in Australia as a wind break, and widely grown in Capetown as a hedge. Species form gets big and twisted, with picturesque, shaggy trunks 6 inches in diameter in maturity, but sparse foliaged. Compact form is slower growing but better behaved. Both forms particularly good in San Francisco Bay area. Drought resistant, evergreen, fairly formal in growth, no disease or insect problems noted.

LIGUSTRUM lucidum—Glossy Privet. A native of China, Japan, and Korea. Typical privet-like shrub and small tree to 30 feet, with larger leaves than common privet, evergreen in California. Prominent panicles of white bloom in spring, with pollen which affects some hay fever sufferers. Good screen shrub with good foliage and color, low branching habit makes it excellent to mow into on the edge of a lawn. Fast growing, but needs water and good soil. Can be clipped as desired. Carried by most nurseries as "L. japoncium."

MYOPORUM laetum—Myoporum, Ngaio Tree. Native of seashore and coastal areas of New Zealand. Evergreen shrub and small tree to about 20 feet. In maturity somewhat resembles small California live oak. Used as a shrub grows thick and low to the ground, good weed control. Probably best shrub where salt air is a problem. Limited to coastal use.

MYRICA californica—Pacific Wax Myrtle. Grows from north coastal California to north Washington on moist flats or hillsides, redwood forest slopes, or rocky declivities near the ocean. Tall, somewhat birchlike in habit, evergreen shrub, or small tree, to 20 feet. Fast growing, hardy, needs water, grows in moist soils. Good shrub for variation and special areas.

PITTOSPORUM undulatum—Orangeberry Pittosporum, Mock Orange. Native to cool eastern sections of Australia. Clean, evergreen shrub or even medium-sized tree to about 25 feet under good conditions. Excellent foliage, color, good growth habits, relatively drought resistant, sensitive to too much water. Does well in southern California and along coast. Good for mass plantings and tall screens. Somewhat insignificant flowers, and handsome berries. Sometimes difficult to establish, needs good soil, good plants are scarce.

PRUNUS caroliniana—Carolina Laurel Cherry. Grows in eastern U. S., mostly near coast, N. Carolina to Texas. Evergreen shrub or small columnar tree to 40 feet or more. Good foliage, heavy branching makes it good for tall screens. Frost hardy, somewhat drought resistant, needs good drainage.

PRUNUS lyoni—Catalina Cherry. Native to the Channel Islands of California. Evergreen, upright shrub to 12 feet and sometimes a small tree to 25 feet. A little fussy to grow—must be in masses to prevent blowing over. Takes a little more water than most California natives. Colorful and clean, no serious insect problems, good for combination with other natives.

RHUS integrifolia—Lemonade Sumac, Lemonade Berry. Native to southern California coastal regions. Thickly branched, low spreading evergreen shrub to about 6′, drought resistant, attractive grey-green foliage. Good for use in southern California if soil conditions right. Sensitive to too much water.

VINES, GROUND AND SLOPE COVERS MOST OFTEN USED

** HEDERA canariensis—Algerian Ivy. Native to the Canary Islands and North Africa. Similar to English ivy but leaves are bigger, shinier, and brighter green. Best ground cover where sprinkling system provided, except for extreme heat of interior valleys. Holds soil well on slopes; requires considerable water; occasionally must be trimmed back from trees and shrubs. Takes only a few degrees of frost.

JUNIPERUS chinensis Pfitzer—Pfitzer Juniper. Native to China and east Asia. Low, vigorously branching, evergreen, coniferous foliaged shrub, grey green foliage to about 4 feet maximum. Habit varies somewhat according to conditions, but excellent slope control shrub, hardy anywhere in California, fairly drought resistant, normally planted about 4′ on centers for ground cover. Not ideal cover, as weeds and grasses do survive in it to some extent. Frost hardy to at least 10 degrees below zero.

MESEMBRYANTHEMUM croceum—Ice plant. Native to South Africa. Very low growing succulent creeper, spreading rapidly under good conditions. Fairly drought resistant but the mesembryanthemums do best in coastal climate and in good soil. Red flowers in the spring which turn copper color. For best results in poor soil they should be fertilized periodically. Takes frost to not less than 20 degrees.

** MESEMBRYANTHEMUM edule—Hottentot Fig, Iceplant. Native to South Africa. Essentially the same as M. croceum, but flowers are creamy-yellow which turn purplish as they age, and general character of plant is coarser, more vigorous. Best "ice plant" for general ground cover and slope control and has been used widely on roadsides in central and southern California coastal regions. Will take salt spray winds and frost to perhaps 20 degrees.

PLUMBAGO capensis—Cape Plumbago. Native to South Africa. Evergreen half-vine, half-shrub, spreading over ground, with prominent light blue flowers over long blooming season starting in early summer. Good weed control, perfect form for slope cover but apparently fussy as to soil, not frost hardy. Needs water, does best along coast.

* ROSA californica—California Rose. Native to California, widespread, often in thickets, along river and creek banks and near springs from sea level to several thousand feet. Very hardy, low growing, deciduous shrub with attractive pink flowers from late spring until autumn, blooming at peak in June, attractive red hips in fall and winter. Fast growing, about three feet high, dense thicket-type growth habits, good slope control and good weed control most of year. Should be mass planted, but drawbacks are deciduous period in winter, rapid spreading by underground runners, thorny to maintain. Drought resistant, but looks better with some water.

** VINCA major—Bigleaf Periwinkle. A native of Europe, but naturalized many places in United States. Evergreen, spreading plant to average 1 foot in height, attractive blue flowers in spring. Very drought resistant, may die back but revives rapidly with water, and looks best with some watering. Covers rapidly, easy to establish, selective weed control chemicals can be used on it, one of most indestructible plants we have. Good ground and slope cover, excellent weed control, very frost hardy. Excellent results in northern and central California, both coastal and interior, but probably would do as well in southern California where Algerian Ivy is now being used.

SECONDARY LIST—VINES, GROUND AND SLOPE COVERS

(Slightly less dependable alternates or special use species)

BACCHARIS pilularis—Prostrate Baccharis. Grows naturally on mountain slopes, hills, and sand dunes along central coast of California. Evergreen, spreading, and rounded shrub with green, fine textured foliage to average 3 feet in height. Neat, attractive, very drought resistant, and covers ground well when planted 3 feet apart. Few insect pests but often mildews.

CEANOTHUS griseus var. horizontalis—Carmel Creeper Ceanothus. A native of the California central coast. Low growing, spreading, evergreen shrub with rich green foliage and bright blue bloom in spring. Grows to green mass about 2-3 feet high, but gets "leggy" as it ages. Fast growing, excellent ground and slope cover for weed and erosion control for a few years. Must have good drainage, needs water for best results, not satisfactory in interior valleys.

CISTUS ladaniferus maculatus—Crimsonspot Gum Rockrose. Native to the Mediterranean region of North Africa. Drought resistant, hardy shrub, evergreen grey foliage and large, pinkish blooms in early summer. Sensitive to too much water and bad drainage. Rough textured leaves pick up soot and dust badly. Fast growing. Widely used in gardens, but not best shrub for roadsides of busy highways except close to coast where atmosphere is moist and cleaner.

LONICERA japonica halliana—Halls Japanese Honeysuckle. Native to eastern Asia but naturalized in North America. Usually evergreen vine to 15 feet or more with characteristic honeysuckle bloom in spring and early summer fragrance. Goes deciduous if frosted. Good ground cover and slope cover for weed and erosion control in warm climates but very vigorous. Will get woody beneath surface and old stems are a fire hazard. Susceptible to red spider, and its tendency to climb trees and shrubs is a maintenance problem. Needs some water, but quite drought resistant. The Division of Highways today rarely uses it as a ground cover, but sometimes as a cover for divider fences.

PARTHENOCISSUS tricuspidata—Japanese Creeper, Boston Ivy. A native of Japan and China. Fast growing, deciduous, "creeper" type vine which clings to rock and concrete. Used by the Division of Highways only as a vine cover for structures to soften their massiveness for which it has excellent color and texture. Frost hardy anywhere in California. Somewhat drought resistant. (Virginia Creeper colors better but does not cling.) Drawbacks are its loss of leaves in winter and susceptibility to scale.

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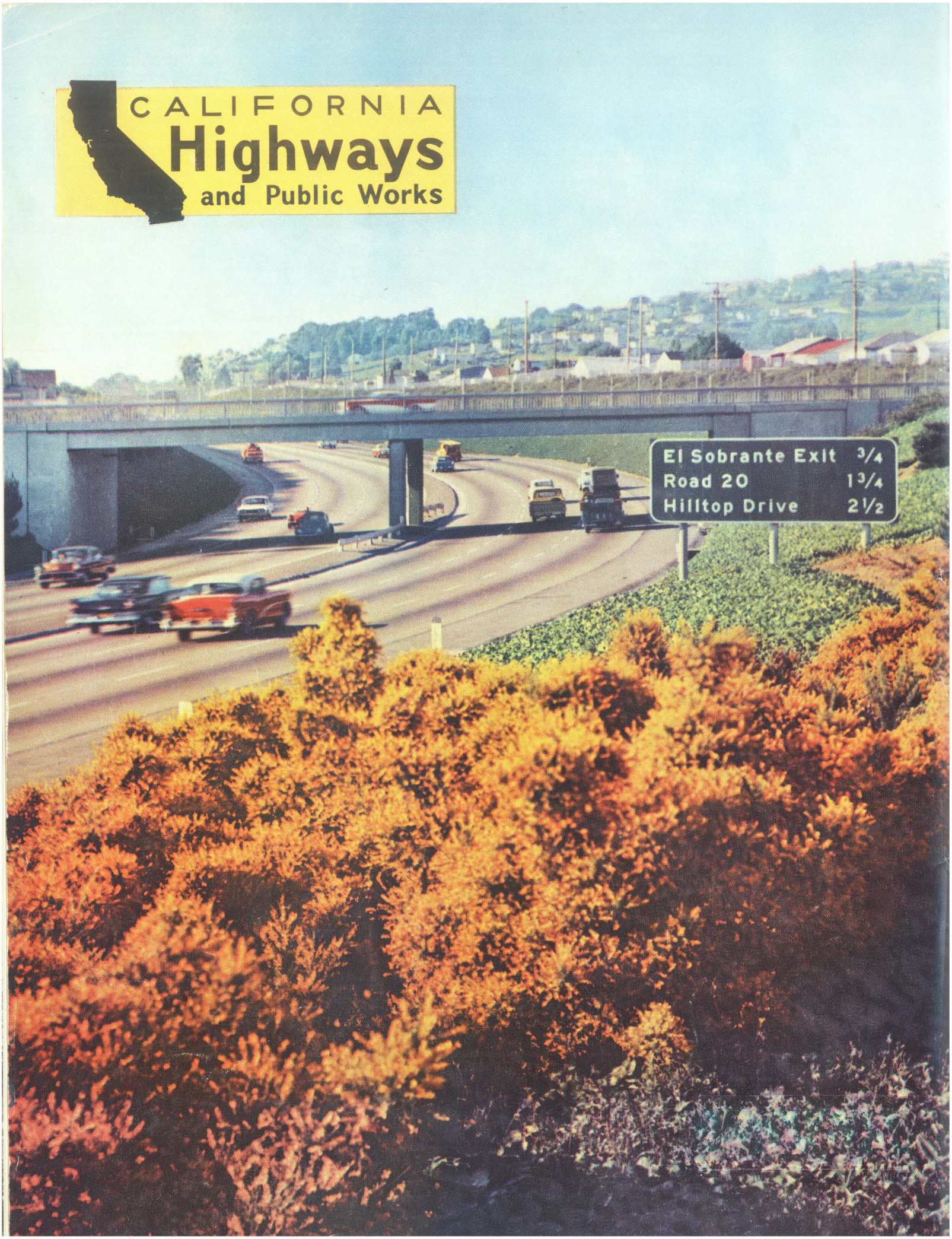
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