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PART III

Horticultural Studies and Experiments on the
New World Cypresses

by

CARL B. WOLF

INTRODUCTION

This portion of this paper dealing with the New World cypresses is devoted to the horticultural aspects of the various species. In the two preceding portions, the botanical, distributional and pathological problems of the group have been discussed. Data presented in those two portions have provided the essential background for this, the third portion, and in order fully to understand and utilize the material presented in this latter section, it is essential that the reader should first familiarize himself with those portions of the text.

The information about the propagation, culture and uses of the New World cypresses which is presented in the following pages is largely derived from first-hand experiences gained through the years of growing these plants at Rancho Santa Ana Botanic Garden. However, every other possible source of information has been consulted and where usable has been incorporated in the text.

On March 10, 1927, the first lot of seeds of Cypress (*Prop. No. 16, Tecate Cypress*) was planted at Rancho Santa Ana Botanic Garden. By late fall of 1930, the last of the then known kinds of cypresses native to California had been planted in the nursery, and it is doubtful if much additional work would have been subsequently undertaken with the genus if it had not been for the rapidity with which the Cypress Canker attacked the Monterey Cypress in California between 1930 and 1933. In 1933 Dr. Wagener visited the Garden, showed us the numerous Cypress Cankers in our Monterey Cypresses and left us with the thought that, perhaps, some of the other species which we had under cultivation might remain free from infection and prove to be useful in horticulture as substitutes for the Monterey Cypress. In 1934 an extensive project was outlined for the collecting and propagating of the cypresses of California, and during the years that have followed the cypress project has been given primary consideration, as evidenced by the number of plants that have been grown and tested.

Although we have devoted a rather large part of our time and efforts since 1933 to the propagation and culture of cypresses in an effort to find out which species will not only grow satisfactorily and have horticultural merit, but will also remain reasonably free from Cypress Canker, we have never made a serious attempt to popularize or promote the planting of cypresses. This can best be illustrated by referring to our windbreak tests in which we feel that the Smooth Arizona Cypress and the Tecate Cypress can be used satisfactorily under some conditions. Yet we do not advocate the use of cypresses in preference to other trees such as eucalyptus. In other words, our interest in the horticulture of cypresses has been largely one of making comparative studies within the genus; and, if other plants are superior to cypresses, they should be used.

HORTICULTURAL LITERATURE

Most of the published information about cypresses has been included in the botanical section of this paper under the references at the end of each species and in the section entitled Taxonomic Treatments, where the major important writings on the genus have been discussed. Although these are largely to be considered as botanical in their significance, they also deal with most of that which has been written on the horticultural aspects of the New World species. On the whole, the horticultural literature of the New World species of *Cupressus* is so confused as to the species to which it actually refers, that much of it can only be used where the primary interest is only with cypresses in general, but even then the reader must ascertain if the writer included the related genus *Chamaecyparis* in *Cupressus*.

In California there have been a few books or papers which have included information about *Cupressus* on a basis other than taxonomic. Some of these in order of their publication are:

1). Abrams, L. R. The Gymnosperms Growing on the Grounds of Leland Stanford Junior University. Dudley Memorial Volume, pp. 106-108. 1913. New World cypresses then growing on the campus were: *Cupressus macrocarpa*, *C. Goveniana* and *C. Macnabiana*.

2). Pratt, M. B. Shade and Ornamental Trees of California, California State Board of Forestry, pp. 23-25. 1922. New World cypresses discussed are: *Cupressus macrocarpa*, *C. guadalupensis* and *C. arizonica*, although by his reference "from the mountains of northern Arizona" for the latter species, I am certain that he had in mind *C. glabra*.

3). Wolf, C. B. Other Species of California *Cupressus* as Substitutes for *Cupressus macrocarpa* (Monterey Cypress). Proc. Fifth West. Shade Tree Conf., pp. 34-42. 1938. In this paper presented at the Shade Tree Conference in April, 1938, and later printed, I outlined the experimental work being done on cypresses by Rancho Santa Ana Botanic Garden and by Dr. Wagener. Only the species native to California were discussed. At that time, I recommended that further plantings of the Monterey Cypresses should not be made; that the Gowen and Mendocino Cypresses were also unsuitable; that the McNab Cypress had little horticultural value; that the Piute and Modoc Cypresses were likely to be useful as gray-green specimen trees; and that the Sargent, Dutton and Tecate Cypresses were the most promising for hedges and windbreaks.

4). Wilson, Albert. Distinctive Trees, Shrubs and Vines in the Gardens of the San Francisco Peninsula, pp. 52-56. 2 Figs. 1938. New World cypresses in cultivation in the region which this book embraces are listed as follows: *Cupressus glabra*, *C. Goveniana*, *C. guadalupensis* (figured), *C. lusitanica* var. *Knightiana*, *C. Macnabiana*, *C. macrocarpa*, *C. macrocarpa* var. *lutea* (figured), and *C.*

Sargentii var. *Duttonii*. The age, size, condition and the location are given for specimens of the different species. Of particular interest is his report of a tree of *Cupressus guadalupensis* 35 years old, 35 feet high and fruiting, in excellent condition in the garden of R. D. McElroy, Prospect Road, Los Altos.

5). Wolf, C. B. Other Species of Cypressess as Substitutes for the Monterey. Calif. Citrograph **24**: No. 6. 5 Figs. April, 1939. This article summarized the work being done by Rancho Santa Ana Botanic Garden in an effort to find suitable species or strains of cypresses as substitutes for the Monterey Cypress.

6. Thompson, D. J. Tecate and Sargent's Cypressess Offer Promise for Windbreak Use. Calif. Citrograph No. 6. April, 1939. This was written as a companion article to the one above but was primarily a discussion of the possibilities of certain cypresses for hedges and windbreaks for citrus plantings.

7). Wolf, C. B. California Native Plants for Hedges, Windbreaks and Background Plantings. Thirtieth Annual Calif. Spring Gard. Show. Cat. 55. April 28, 1942. In this article cypresses are briefly mentioned. Further plantings of Monterey Cypress are discouraged. Experimental work by Rancho Santa Ana Botanic Garden and Dr. Wagener is mentioned. "At this time *Cupressus Bakeri*, *Forbesii*, *Sargentii* and *Sargentii Duttonii* are the outstanding native kinds, but are still insufficiently tested to warrant their recommendation for general use."

8). Wolf, C. B. In Search of a Cypress. Los Angeles Times Home Magazine, pp. 9 & 12. 2 Figs. May 10, 1942. In this article a resume of the experimental work on cypresses by Rancho Santa Ana Botanic Garden was presented. The Monterey, Gowen, Mendocino, Mexican and an unnamed species from the Santa Cruz Mountains (now called Santa Cruz Cypress) were listed as species which should not be planted. The other cypresses native to North America were briefly described and evaluated for horticultural usage.

9). Wolf, C. B. Natives—Santa Ana—San Diego. Calif. Gard. **33**: No. 10. 1. Summer, 1942. This article discusses the merits of certain San Diego County native plants for horticulture as tested at Rancho Santa Ana Botanic Garden. *Cupressus Forbesii* (Tecate Cypress) is discussed at some length. Its botanical history, natural distribution, propagation at Rancho Santa Ana Botanic Garden, and possibility for successful use in horticulture are pointed out. The conclusion reached at that time was: "Thus far *Cupressus Forbesii* is among the several most promising of the kinds under test, but several years of additional observations will be necessary before it can be safely recommended for general use."

SEED COLLECTING, CLEANING AND STORING

Seeds of *Cupressus* are so easily obtained, so readily cleaned, and so conveniently stored, that most of the elaborate methods of harvesting, cleaning and storing other wild seeds or forest tree seeds are unnecessary. It is extremely unlikely that a demand will ever arise for large quantities of cypress seeds; and, for this reason, the rather crude methods suggested below may well be efficient enough for small quantities of seeds. On the other hand, if large amounts of seeds of *Cupressus* were desired, it might be worth while to consult such works as Mirov and Kraebel* and Baldwin**, although they do not deal with seeds of *Cupressus*.

In North America the New World species of *Cupressus* are cultivated only in the mild regions which, for all practical purposes, means California, Arizona and parts of Mexico. Of these, in California, at least, only the Monterey Cypress (*C. macrocarpa*) and the Smooth Arizona Cypress (*C. glabra*) produce cones in sufficient amounts to make it feasible to collect seeds from the cultivated stands. The Guadalupe Cypress (*C. guadalupensis*) has long been in cultivation in California, but even trees forty or fifty years of age seem never to set cones. Thus, for the most of the cypresses of the New World, it is necessary to visit wild groves in order to obtain seeds. Since many of the wild stands of cypresses are in remote areas and cannot be reached from roads, the obtaining seeds becomes a considerable problem, for unless rather large amounts of a given species are needed, the cost becomes excessive. However, if there were a continuing demand for such seeds, it would be possible to arrange with local residents to gather cones each year, and thus do away with the necessity of making special trips. In the meantime, seeds of many of the cypresses will likely be difficult to obtain for general propagation unless botanic gardens such as Rancho Santa Ana or botanical collectors will make an effort to supply seeds.

In California one commercial seed collector now gathers seeds of the Tecate Cypress (*C. Forbesii*) from Otay Mountain, San Diego County. In Arizona at least two collectors have supplied seeds of the Smooth Arizona Cypress (*C. glabra*) under the name Arizona Cypress. One of these has gotten seed mainly in the Sedona area, while the other (Mrs. Rapse Collom, Payson, Arizona) has for years collected seeds on the headwaters of Rye Creek in the Mazatzal Mountains.

Cones of most kinds of cypresses remain closed for several years after maturity, often for as many as six or eight years. The exceptions to this among the New World species seem to be the San Pedro Martir Cypress (*C. montana*) and the Mexican Cypress (*C. lusitanica*),

*Mirov, N. T. and Kraebel, C. J., Collecting and Handling Seeds of Wild Plants, Civilian Conservation Corps Forestry Publication No. 5. 1939. (42 pp. Illus.)

**Baldwin, H. I., Forest Tree Seed of the North Temperate Regions, 1942. (240 pp. Illus.)

at least as it is known to me in cultivation in California. The cones of these two species appear to regularly open shortly after the seeds mature at the close of the second season. Thus, with these exceptions, cypress seeds may be gathered at any season of the year, although we have collected most of our seeds in the fall. However, when collecting seeds in the fall, care must be taken to select cones which are fully mature, that is, either cones which matured the previous season, or if of the current season, those in which the seeds have thoroughly darkened. Two-year-old cones collected from January to March are certain to contain fully matured seeds.

Most cypress trees are of such small stature and nearly always have branches so close to the ground that no special climbing tools are required. The best clusters of cones are ordinarily produced in the upper portions of the trees and on branches well out from the main leader. In ordinary practice, we have found it most convenient to cut small branches bearing clusters of cones and after removing the surplus foliage to bring them back to the Garden for processing. With a little extra effort and time, it would be just as satisfactory to clip all of the cones from the branches when they are still in the field. This would result in considerable saving of space and weight for transportation. Regardless of when the excess foliage is removed, the cones should be thoroughly cleaned and then spread out in shallow trays to dry in a well ventilated room (not out in the sun as this is likely to kill the seeds). One to two months are usually required before the cone-scales spread apart sufficiently to allow the seeds to fall out. In this fashion, practically pure seeds are obtained, although by running them through a fanning mill the light or sterile seeds can readily be blown out. In order to obtain seeds more quickly, the cones may be cut in half with an ordinary clipper after which they dry very rapidly, and only a small percentage of the seeds is spoiled. We have also dried the cones in an electric drying cabinet using a temperature of 100-110° F. and a fan for circulation. Although this is a rapid method of opening the cones, it should not be used unless the seeds are needed in a hurry, for there is considerable danger that the seeds may be injured.

Cone size is so variable in different kinds of cypresses that it is difficult to give an average figure as to seed production. A safe basis is to collect at least one pound of clean, fresh cones for each one ounce of seeds desired. Thus, on the basis of our experience, an hour spent in cutting cones from a tree will yield from eight to sixteen ounces of clean seed.

Cypress seeds remain viable for several years on living trees, but in our experience it is unsafe to expect good results from seeds stored for more than five years. Our usual method of storing seeds has been to place them in tightly closed glass jars kept in a basement store-

room in subdued light at temperatures ranging mainly from 50-70° F. and probably never going much below 40° or over 80° F.

Although cypresses are wind-pollinated, and therefore any individual tree in a grove is likely to be pollinated by all of its neighbors, we have followed a practice of usually taking cones from trees with the most desirable growth habits rather than from those which produce the most cones. We have very little evidence to substantiate our belief that this is an advantage; but, in a few instances, two or more collections of cypress seeds taken from individual trees in a single area have produced offspring with pronounced differences which seem to have been inherited from the maternal parent. In view of this, we suggest that seed collecting should be only from trees with the most desirable horticultural characteristics.

PROPAGATION IN THE NURSERY

Cypresses may be propagated from seeds, by cuttings, or by grafting. Although all of these methods are satisfactory, this Garden has never grown any cypresses except from seeds. Transplanting of wild seedlings is unsatisfactory because they are ordinarily found in rocky soil and in other difficult situations where the roots are severely injured in digging.

In California the columnar form of the Italian Cypress has long been grown from cuttings by nurserymen. According to B. D. Stark, formerly nurseryman at Rancho Santa Ana Botanic Garden, but now owner of his own commercial nursery, cuttings of this species a few inches long taken with a heel, placed in beds of sand in a lath house in December and January, root readily and can be potted in about three months. He also reports that some other nurserymen are having good success using bottom heat. Several years ago Prof. C. O. Smith of the Citrus Experiment Station, Riverside, California, took cuttings of a number of the California cypresses from this Garden and rooted them readily for crown gall experiments which he was conducting at the time. It would, therefore, seem that most kinds of cypress may be rooted rather satisfactorily from cuttings. This method of propagation is, of course, more time consuming and expensive than by seeds and should only be resorted to where seedlings may not produce the required uniformity.

Grafting of cypresses has not been resorted to very extensively in California and probably not much more so elsewhere. Theodore Payne, Los Angeles, has used the Monterey Cypress as a rootstock for selected strains of Italian Cypress and Herbert Swim of Armstrong Nurseries, Ontario has used the Smooth Arizona Cypress as a stock for a columnar form of that species. As in the case of most other conifers, grafting should not be resorted to unless propagation by means of seeds is not satisfactory and by cuttings not successful.

The following information regarding the propagation of cypresses from seed is largely derived from the experiences in handling this group of plants at Rancho Santa Ana Botanic Garden in the years from 1927 to 1945. During this period, all of the New World entities of cypress, with the exception of the Smooth Arizona Cypress (*C. glabra*) have been grown. This Garden has successfully propagated by seeds 15 kinds of cypresses, consisting of 109 different lots of seeds for a total of 147 different planting dates, using 388 $\frac{3}{4}$ oz. of seeds. From these some 31,223 plants were grown to planting size. No figures are available as to seedlings left in the flats or seed beds and which were never utilized in any way. However, in many lots of seedlings, only a small percentage was ever transplanted and the balance discarded.

Seeds of cypress have been planted in outside seed beds in screen-covered frames, usually in a mixture of sand and silt or merely in one or the other of these ingredients. The principal objective in preparing soil for such beds is to obtain a well-drained bed which is not too rich in food materials, and one from which the seedlings may easily be transplanted. The principal objection to this method of starting cypresses is that the seedlings early develop a long taproot with few laterals and are, thus, difficult to transplant. Largely because of this difficulty as well as the extra effort required to prepare such outdoor beds, this method has not been used for more than 10 years.

All recent Garden propagations of cypress have been in standard redwood seed flats about 18 inches square and 3 inches deep. In most instances, the seedling mixture has been composed of about equal parts of coarse sand and ordinary garden loam. After this mixture is firmly pressed down in the flat, the seeds are scattered broadcast over the surface and lightly covered with about $\frac{1}{4}$ inch of a similar mixture. As a general practice, 2 ounces of seeds have been used per flat, although when a given lot of seed germinates exceptionally well, this results in the seedlings being too crowded. The seed flats are next partially immersed in shallow pans of water and allowed to become thoroughly soaked. They are then placed on benches in an unheated glasshouse and kept moist until germination takes place. At the Garden, seeds planted in early fall (September or October) frequently germinate the same year; whereas, if planting is delayed until November or December, the seedlings are unlikely to appear before March or April. Seeds planted in February and March usually germinate rather quickly, but if planting is delayed until May or June, no germination is likely until the following fall. Continued watering of such seed flats during the hot summer months is almost certain to result in rotting the seeds, so that in the case of valuable seeds, any flat which has not germinated by June or July should be set aside until the following fall when watering can be resumed.

FIGURE 47. Cypress seedlings. See opposite page.

Germination is usually rather slow and somewhat sporadic, although in *C. Forbesii*, *C. Goveniana*, *C. pygmaea* and *C. macrocarpa*, good even stands are most often produced. Even in the best lots of seeds, the percentage which can be made to germinate is very low, and on the average not over 10 or 15 percent of the seeds planted ever germinate. Germination seldom occurs in less than a month and usually requires longer. However, as shown in Table XIII (Number of Days After Seeding to 1st Transplanting), one lot of *C. Forbesii* was transplanted 38 days after seeding. The average for the best lot of each species grown, however, was 91 days. Seeds of *C. Macnabiana* and *C. Sargentii* have, in most instances, germinated rather poorly, and I have no good explanation for this unless they require fires such as is essential for proper germination of many California chaparral plants.

In recent years shredded Sphagnum Moss has been tried out extensively for general use in seed propagation, largely through the work of Stoutemyer and his associates* at Glenn Dale, Maryland. This method has been tried at this Garden with varying success with numerous plants including cypresses. Apparently, the chief cause of difficulty with us has been that we were using the garden grade peat moss which is partially decomposed instead of the coarse Sphagnum which is commonly known as florists' moss and is gathered from the living layers of Sphagnum. With a little more experience in handling Sphagnum as a seeding medium, it is probable that this method will prove to be the most satisfactory of all for the germination and early development of cypress seedlings.

For many years it has been the practice at this Garden to transplant the cypress seedlings into 2-in. cement pots (similar to clay pots but stronger) when they were about 1 to 2 inches high. For this purpose, several soil mixtures containing sand, loam and leaf mold in various proportions have been used, the general object being to provide a potting medium with good drainage, but at the same time one which is not too rich since cypresses make too much top growth in very rich soils. Later these seedlings were transferred to 4-inch pots and after another interval to 6-inch pots. Thus, when a plant was approximately one year old from germination, it would be 6 to 12

*Stoutemyer, V. T., Close, A. W., and Hope, C. Sphagnum Moss for Seed Germination. U. S. Dept. of Agriculture Leaflet 243, Nov. 1944. (6 pp. Illus.)

FIGURE 47. Pressed seedlings of *Cupressus*. Photos July 10, 1945.

A—*C. macrocarpa* Coll. No. 7800, collected in Garden nursery May 19, 1936, from a 4-inch cement pot. Seed planted March 28, 1935. Prop. No. 2177. This specimen illustrates the coiled root which so frequently develops when cypresses are grown in pots and which prevents proper growth later. Neg. No. 6187.

B—*C. macrocarpa*, Herb. No. 4192. Planted Jan. 20, 1932, pressed Aug. 19, 1932. Prop. No. 1190. Never placed in a container or pot. Neg. No. 6190.

C—*C. Goveniana*; pressed May 29, 1931; grown from Prop. No. 1069; planted Dec. 3, 1930; never placed in a container or pot. Neg. No. 6194.

inches high in a 6-inch pot and was considered ready for planting out.

In many cases, the seedlings grew too rapidly in the seed beds or flats to be put in 2-inch pots so were first transplanted into 4-inch pots, thence into 6-inch pots. In recent years, most cypresses have been transferred to 4-inch pots and then into 1-gallon cans where they developed until set out. This has been a great improvement over carrying cypress trees through the nursery in pots; but, in my opinion, it is a pernicious practice to grow a cypress tree in a pot at any stage of its development, for it is almost certain to develop coiled roots which eventually (often several years after the tree is planted) leads to trouble. (See Figure 48-A of a pressed seedling taken from a 4-inch cement pot, and which had developed badly coiled roots.)

In an effort to get away from the defects of growing cypresses in pots, we have tried several methods. Some of the species have done fairly well when transplanted to standard flats (18 in. x 18 in. x 3 in.) with about 64 trees to the flat, but did not transplant as readily as the old-time Monterey Cypress or Italian Cypress, both of which have been grown in flats of 100 plants in California for many years. Another method was to use small tar paper open-end straight-sided pots for first transplanting and a 4-inch square by 12-inch high tar paper pot for final growth. These produced excellent plants in the case of *C. Forbesii* (in 1936-37) but were a little hard to handle without breakage. Probably a slightly smaller sized container of approximately 3 inches square by 8 or 10 inches high would be more satisfactory and would certainly be worth the extra effort required to handle etc. to produce plants with a normal uncoiled root system. With some other lots of cypresses, the seedlings were first transplanted from the seed flats into flats containing about 64 plants. Later these were transferred to gallon cans with excellent results, including the eventual development of a fine root system. This method is, perhaps, the most desirable from a number of standpoints but is rather costly in that for hedges and windbreaks large numbers of low-cost plants are usually preferred. For this reason, plants set close together from flats or small tar paper containers are an advantage even if rather large losses do occur in transplanting.

Under our conditions, the young cypress seedlings have been kept in a lath house during most of their growing period or in lath-shaded outside beds, except during the winter months or just prior to planting when it has been the practice to expose them to full sunlight in order to let them dry out or to harden them. During this period in the nursery, it is especially important to water carefully making certain that the soil of the entire container is thoroughly soaked, but that no water stands in the container afterwards or following a rain. In such instances, repotting or recanning is necessary to produce a good plant.

PLANTING OUT

Cypresses propagated from seeds at this Garden have been planted out extensively within the confines of the Garden (7112 plants), in numerous test plots throughout southern and central California (6670 plants) and in numerous other private and public plantings such as city parks (3071 plants). In addition to continued observations on these plantings, I have made it a practice since 1934 in my extensive travels throughout California and Arizona to pay particular attention to all cultivated plantings of cypresses regardless of species. As a result of these studies and observations, I feel qualified to make a number of more or less general observations and recommendations on planting cypresses in California and Arizona. More specific information is given under the discussion pertaining to the horticultural usage of each species.

In California the most ideal time to plant cypress trees is in the fall, preferably in October. In this way, the plants often make some growth during the rather warm fall months; but, more important, they become well established so that when the brief winter cool weather is past in January and February, they begin growing. As a result, they are well established by June and are able to survive the first dry summer with only an occasional irrigation. Spring plantings made as late as the first of March are also satisfactory; but, thereafter, the plants are more difficult to establish, require much more frequent irrigation during the first summer and the losses are correspondingly high. Under no conditions should plantings of cypresses be made between June and September. In many parts of California it is possible to grow cypresses successfully without irrigation, provided they are given occasional water for the first two or three summers. It is important to remember that when young cypress trees show signs of wilting it is then generally too late to help them by irrigation, and that soil moisture must be checked frequently while the plants are young and their root systems small.

Cypresses have been planted in almost every kind of soil and in practically every sort of habitat in California with varying results and with little consideration of the fact that in the wild most species grow in rocky or coarse soils which are rather sterile with mainly good drainage, and which are ordinarily dry during the summer months. The exceptions to this seem to be *C. lusitanica*, *C. glabra*, and *C. arizonica* which receive summer rainfall, and at least the two latter often grow adjacent to streams so that their roots reach water at all times.

Successful plantings of cypresses can be seen in California in soils ranging from heavy adobes (clays) to decomposed granite or pure sand, as well as rocky situations. However, in richer soils such as clay loams where irrigation is practiced the trees grow too much top in

proportion to their root system, and severe winds following a prolonged rainy period often result in many trees being blown over. In the same heavy soils without irrigation, the top growth is much less rapid, and the trees are seldom blown over. Sandy soils are satisfactory unless they are adjacent to rivers or in low situations where the water table is high during the winter, in which case, such as some of the Garden's test plots east of Anaheim, California, the trees do not make satisfactory growth and are subject to numerous insect pests as well as physiological disturbances, indicated by failure to properly shed their old branchlets, burned tip growth and general yellowing of the foliage. In alkaline situations such as the soils around Los Alamitos, Orange County, California, practically no ordinary trees will grow, and a large test planting of cypresses made in 1936 was abandoned at the end of the first year because, in most instances, the roots were actually killed by the alkaline salts.

Care should be exercised in planting out small cypress trees to be sure that the spot selected is not a low or poorly drained situation where water is likely to stand after rains or irrigations. It is also essential that the plant be set at about the same level as it was when grown in the nursery. The practice of "burying" the plant several inches deeper than it grew originally is certain to cause root difficulties, particularly in heavy soil. On hillsides where basins are dug, it is vitally important that the root crown be set on a line with the original grade or slope, and not in a depression several inches deep which will eventually be filled with the loose soil from above.

Perhaps, of even more importance than soils is the selection of the proper kind of cypress for the region in which it is to be grown. In California it is possible to grow cypresses in almost all portions of the state except in the high mountains and on some of the lowest and hottest deserts (mainly the Colorado Desert and the Death Valley region). Species native to the interior regions do not thrive on the immediate coast, and coastal species do not grow well in the interior. Similarly, those species from high elevations may not be long-lived at low elevations, and species from low elevations with mild climates are not hardy at high elevations.

Species which are best suited to growth on the immediate coast are: *C. Abramsiana*, *C. Goveniana*, *C. macrocarpa*, *C. pygmaea*, and perhaps *C. guadalupensis*. Species best suited to the dry interior sections are: *C. arizonica*, *C. Bakeri* subsp. *typica* and *Matthewsii*, *C. Forbesii*, *C. Macnabiana*, *C. montana*, *C. nevadensis*, *C. Sargentii*, and *C. Stephensonii*. At least in the Riverside region of southern California, *C. guadalupensis* has done well, and trees forty or fifty years old have made splendid specimens. On the Mojave desert and in many of the higher parts of Arizona, the Smooth Arizona Cypress (*C. glabra*) has been used extensively. There are many fine plantings

in the vicinity of Palmdale, Little Rock and Victorville on the Mojave Desert. For exceptionally cold regions, whether they be the mountainous areas of California or elsewhere, the hardiest cypresses are probably *C. Bakeri* subsp. *typica* and *Matthewsii*, *C. arizonica* and *C. glabra*. Probably the most tender species is *C. lusitanica*, but even in California it is not entirely happy and seems to miss the damp air of its native home and is subject to a great many insect pests and often shows great distress from drouth at the close of our long dry season.

Most cypresses are likely to lose their lower branches when planted too close together. The old standard Monterey Cypress was less subject to shading out than many of the other species. Those species from inland habitats, particularly *C. nevadensis* and *C. Sargentii*, are very likely to lose their lower branches when crowded. A fine planting of *C. nevadensis* in the Botanic Garden is so crowded that its real beauty has been destroyed as its lower branches have browned and died. Reduction of this planting of about 50 trees to half this number five or six years ago would have provided ample space, and the trees which are now around 25 feet in height would still be beautiful. For this reason, it is important to make provision for this feature either by allowing ample space or by not counting on having lower branches. In the case of hedges or windbreaks, a more satisfactory growth is usually made where the rows run north and south than when they run east and west, in which latter case the north side may have sparse foliage. They are also generally unsatisfactory as a filler for eucalyptus windbreaks because they cannot compete with the more vigorous eucalyptus and also because they are so shaded that they make an open straggly growth.

Pruning of cypresses, particularly clipping them for hedges has long been practiced, especially in the case of the Monterey Cypress. In recent years a few clipped hedges have been produced on plantings of *C. glabra* and *C. Forbesii*. In the case of the latter species, the finely cut foliage is an advantage and makes a splendid hedge. In removing lower or other branches from cypresses, it is important that the cuts be made close to the main trunk and smoothed off so that they can heal over properly. Otherwise, insects or fungi such as *Coryneum* may gain a foothold. With a little care in this regard, cypress trees may be trimmed up to any desired height of clean trunk on which no unsightly scars remain. The cypress windbreaks of the Limoneira Company, Santa Paula, California, are fine examples of careful pruning of the lower branches which has resulted in clean smooth trunks. That company also uses a power saw for pruning or clipping the sides of their cypress windbreaks, and frequent cuttings result in almost perfect vertical walls of green or gray-green foliage.

Drying desert winds of southern California, which generally come from September to November, are variously known as Santa

Anas, north winds, or east winds. They are particularly hard on citrus trees, garden ornamentals and even burn or damage the common eucalyptus trees used so abundantly in California for windbreaks. On the other hand, cypress trees are remarkably well fitted to withstand such desiccating winds, and species such as *C. Forbesii*, *C. arizonica*, *C. glabra* and *C. Bakeri* in our test plots have gone through some severe winds with scarcely a sign of damage. In our test plots on the Hagen Ranch at Chatsworth, California, the lemons and oranges and eucalyptus trees surrounding these groves have been severely defoliated by such winds, while our cypress trees consisting of *C. Forbesii*, *C. arizonica*, *C. Bakeri* (both subspecies), *C. Sargentii* and *C. Macnabiana* have emerged in fine condition.

Growth rates of cultivated cypresses vary greatly as to species and are discussed elsewhere, but there is also a great deal of variation in growth of similar cypresses under various conditions. This is not restricted to cultivated trees but has been frequently noted in several species where dwarfs in sterile soils may be forty or fifty years old, while nearby in good soil a similar aged tree may be ten times as high. Under cultivation this same diversity in growth is evident, and in one test plot in Riverside, trees of *C. Forbesii* planted in 1936 are still less than five feet high, while in better situations trees from the same lot of seeds have reached heights of over 30 feet.

TEST PLOTS ESTABLISHED IN 1936-1937

The numerous cypress test plots established in 1936-37 are discussed in some detail below. When plans were first begun for the extensive testing of the cypresses in California, it was my hope to have a rather large number of plots, each of which would enable me to plant some individuals of all of the different lots of cypresses. It was soon discovered that this would not be possible for several reasons. The main difficulties were, however, in locating areas where the owners were willing to have experimental plantings and the actual work involved in making the plantings and their subsequent annual inventorying. As finally worked out, there were 18 separate blocks of trees planted in test plots (not including Dr. Wagener's tests at Stanford) which totaled some 7467 plants made up of 72 different strains and comprising 15 species or subspecies (only the Smooth Arizona Cypress was omitted).

Planting of these numerous test plots involved a great deal of work, and I personally supervised every planting to insure, as far as humanly possible, that there would be no mix-ups. Before leaving the nursery, every load of plants had each pot marked with its propagation number. Replants due to losses in 1936 were made in 1936 and early in 1937, but with one or two exceptions no further plantings were made after that time.

Care given to the various plots has been entirely up to the owners; and, for this reason, the results have been so various that it has been difficult to make direct comparisons as to performance due to differences in locality, soils or features of habitat. Nevertheless, I feel that these test plots have been invaluable in gaining an understanding of the different species.

With a few exceptions, those test plots which have been maintained have been carefully checked annually, usually between October and January, at which time the growth and condition of every tree was recorded. This has meant considerable work but has resulted in my becoming familiar not only with the conditions at the various plots but also with the minute differences exhibited by some of the different strains of cypresses. One outstanding lesson which I learned was that trees which were runts at the end of the first season remained so, and it would have been better to have replaced them at the end of the first year.

Most of the test plots described below have served the purpose for which they were set out, and several should be removed, or at least certain portions should be removed for the species which they contain are now known to be of little permanent horticultural value.

RANCHO SANTA ANA BOTANIC GARDEN TEST PLOT

The Rancho Santa Ana Botanic Garden Test Plot was laid out along the west side of the Garden and consisted of sunny slopes and a part of an old grain field. Only a few trees were allocated to protected slopes, the remainder were south, east and west exposures. The old grain field area was covered mainly with annual introduced grasses such as wild oats and foxtail, while the rest of the area was covered with a low growth of sages (*Salvia leucophylla* and *S. mellifera*) and sagebrush (*Artemisia californica*). In the extreme north or upper portions of the plot, the soils are broken down shales and are of very fine texture. Over most of the rest of the area, the soil is a heavy dark clay commonly called adobe in California, and which swells when wet and cracks deeply when dry. One portion of the plot consists of alluvial deposits with water worn rocks mixed with the soil. Lack of uniformity of soils, slopes and exposures make it exceedingly hazardous to draw too fine conclusions as to performances of cypresses in this plot.

As originally planned, this plot was to contain about 15 trees of each of the lots of California cypresses included in the tests. These were to be placed about 15 to 20 feet apart so that they would have ample room to develop over a period of years, and if later became crowded, could be thinned by removing the poorest trees. Mr. Theodore Payne supervised the exact locations for the original plantings. In the spring of 1936, the first plantings were made consisting of

FIGURE 48. Cypresses. See opposite page.

479 trees set out from 4-inch pots and comprising 47 different lots of materials. The remaining plants were not then ready to be set out, but in the spring of 1937, 853 additional plants were included. These made a total of 1332 plants composed of 66 different lots. By May, 1945, the trees in this plot totaled 487, comprised 49 different propagation numbers, but still included all of the recognized California cypresses except *C. Bakeri* subsp. *Matthewsii*. These figures taken without explanation would indicate that the plot has not been a success, but this is hardly the case, and the following explanations are of importance.

Shortly after the plantings were made in 1936, it was discovered that a large number of the trees had been eaten to the ground by rodents (mainly field mice). Wire guards were then placed around the plants, but this did not entirely remedy the situation. Later deer browsed on many of the cypresses. In order to control the weeds consisting mostly of wild oats, the area was mowed with a horse-drawn mower; and, in the process, many little trees hidden by the tall grasses were cut off close to the ground. As a result of these early losses, a much larger number of plants was included in the 1937 planting than had been planned for. Thus, when better rodent control was established and fewer trees were lost, the planting grew up much too thick for permanent success, and many of the weaker trees have been removed. In recent years Cypress Canker has struck several of the species rather severely so that large losses have occurred. In the fall of 1939, a number of trees had to be removed when a new entrance road was built into the Garden. In January, 1943 following a prolonged rainy period, a wind of nearly hurricane intensity swept over most of coastal California. Hundreds of trees were blown over in the Garden, and large eucalyptus with trunks nearly 2 feet in diameter were uprooted on adjacent Rancho Santa Ana. In the Garden's Cypress Test Plot, over 100 trees were blown over and had to be removed. Most of these were Monterey Cypresses (*C. macrocarpa*) and Mendocino Cypresses (*C. pygmaea*) which occupied an especially windswept area adjacent to the nursery. Many of these trees were also infected with Canker and would have died soon. The other losses of cypresses were scattered through numerous different lots and appeared to be mainly of individuals with poor root systems. However, it should be noted in passing that due to the heavy adobe (clay soil) over much of the area, neither cypresses nor most other trees can develop the substantial root system that they do in rocky or coarse soils.

FIGURE 48.

West side of Pine Canyon, Rancho Santa Ana Botanic Garden showing cypresses and other conifers. Trees in foreground are Siskiyou Cypresses (*Prop. No. 2131*); to the left are Tecate Cypresses (*Prop. No. 2315*); in the center are Sargent Cypresses (*Prop. No. 1058*) about 8 m. (24 ft.) high; to their right are Piute Cypresses (*Prop. No. 956*). Photo June 20, 1944. Neg. No. 5524.

On October 8, 1943, a disastrous fire swept over nearly one-third of the Botanic Garden, and the Cypress Test Plot suffered severe losses among several species. All of the plants of *C. nevadensis* and *C. Bakeri Matthewsii* were killed. All but three plants of *C. Macnabiana* were lost, while one lot of *C. Forbesii* was wiped out and several others partially lost. Several trees of *C. Bakeri typica* and *C. Stephensonii* were killed from the heat of the fire, although they were not actually burned.

During the first four years, the ground around the individual trees was cultivated regularly to eliminate weeds, and basins were installed to irrigate each plant during the dry summer months. Since then the basins have been closed, and no irrigation has been practiced except as incidental to certain adjacent plantings. In a few instances, shrubby growth has been removed, but no attempt has been made to control the annual grasses and weeds. At the end of some exceptionally long dry seasons, the cypress trees have shown a distinct yellowing of foliage due to drouth, but have recovered following the first fall rains. However, due to the present close planting which is still on an average of 15 to 20 feet, the trees are likely to continue to suffer from drouth and may need to be irrigated or still further reduced in numbers to permit proper development.

For the most part, the trees of this plot are rather uniformly dense-foliaged and show the advantages of ample lighting for proper development and retention of foliage to the ground. A few of the trees of *C. Forbesii* in the bottom of one canyon are tall and slender. In comparison with other test plots, these trees have not made a very rapid growth.

Trees in this plot are still too young to indicate their eventual performance, but the most outstanding have been: *C. Forbesii*, *C. Sargentii* and both subspecies of *C. Bakeri* (subspecies *Matthewsii* was destroyed in the 1943 fire but was excellent at that time). *C. macrocarpa* and *C. pygmaea* have proven to be so highly susceptible to Cypress Canker, that it is doubtful if any trees of these two species will be alive by the end of 1945. *C. Goveniana* and *C. Abramsiana* have been less susceptible to Cypress Canker but are unlikely to persist for more than a few years. To a limited extent Cypress Canker is present in some of the lots of *C. Sargentii*. Prompt removal of all cypress trees within the Garden area on which Cypress Cankers are discovered would be highly desirable as a means of prolonging the life of the planting. Aside from the value of this plot as a test of the various cypresses, it is, in my opinion, of considerable landscape value to the Botanic Garden and should be maintained with proper consideration given to replacements, thinning and other standard cultural practices.

RANCHO SANTA ANA TEST PLOT

The Rancho Santa Ana Test Plot consists of approximately three acres of land with a south sloping exposure. The soil is comparatively heavy clay (adobe) and when thoroughly dry has huge cracks. As originally laid out, this plot comprised 52 north and south rows of trees 20 feet apart and spaced 5 feet apart in the rows, with most rows containing 15 or 20 trees. Along the north side adjacent to the railroad right-of-way, a single row with the same spacing was put in and consisted of 204 trees. Altogether this block provided space for 1277 trees. In general, the end tree of each row, as well as at least one tree in the middle of each row, was a check tree of *C. Forbesii* (Prop. No. 2319). The original planting along the railroad fence was also of the same number of *C. Forbesii*, but some replacements were of another number. Every propagation number used in the 1935-36 test plantings was included in this plot, mainly on a double planting basis using 5 or 6 trees in a spot to insure survival in case of local damage of any sort. The largest part of the plot was set out on February 7, 1936. During the spring, the early losses were replaced. The remainder were set out on January 5, 1937. Last replacements were made on May 11, 1937. In the two years during which replacements were made, there were 128 set out, making a total of 1405 plants actually set out. This represented about a 10 per cent loss of plants which can be written off as due to transplanting, covering in cultivation or miscellaneous losses.

For about three years after these plantings were made, the plants were irrigated regularly by furrow irrigation and reasonably clean cultivation was practiced. This was discontinued about 5 years ago, and except for the removal of some dead trees, those highly susceptible to Canker, and the several hundred which were blown over by the windstorm of 1943, this plot has received absolutely no care.

In January, 1937, southern California experienced a severe cold spell, and tank cars with smudge oil were unloaded adjacent to the test plot. Trucks ran over a considerable number of the trees as a result.

In 1939 the railroad maintenance crew in burning the right-of-way severely burned the north side of about 45 trees of *C. Forbesii*. In an effort to repair this damage and also determine the effects of trimming, this portion of the row was trimmed to a uniform height of 8 to 10 feet and about 4 feet in thickness. It has now fully recovered from the fire damage and has made a fairly presentable hedge about 12 feet in height, but it should be trimmed at least twice a year for best results.

In the fall of 1942, it was decided to remove those species which were highly infected with and highly susceptible to Cypress Canker. These included *C. Abramsiana* (a few were inadvertently left), *C. Goveniana*, *C. macrocarpa*, and *C. pygmaea*. The first tree of each

FIGURE 49. Cypresses. See opposite page.

row adjacent to the railroad fence line row was also removed to permit more space.

In January of 1943, a severe wind followed a prolonged rain, and several hundred trees were blown over and had to be removed.

At present, there remain 716 trees in the plot. The original spacing in 20 foot rows has proven too close, and there has been a great deal of "light killing" of the lower branches. Trees on which branches have flopped over, particularly in species such as *C. Forbesii*, have not been trimmed, and it is almost impossible to walk between the rows. Between many of the rows wild Tobacco (*Nicotiana glauca*) has also grown up in thickets to heights of 12 or 15 feet. No good purpose can be served by continuing this plot, and all of the trees except those along the railroad fence should be removed since the principal objectives in having it have been attained.

FIGURE 50.

Portion of Rancho Santa Ana Test Plot, looking east. Fifty-two north and south rows and one east and west row made up this plot in which 1405 trees were set out. Row at left is No. 19 with the first tree Tecate Cypress (*Prop. No. 2319*), the second a Sargent Cypress (*Prop. No. 2175*), the latter was 4 m. (13 ft.) high at the time. Photo Mar., 1940. Neg. No. 5091.

FIGURE 49.

Portion of Rancho Santa Ana Botanic Garden Cypress Test Plot. Trees at left side of picture are Sargent Cypress; most of those in the right foreground and middle distance are Tecate Cypress; those on the distant hillside are McNab Cypress. Photo March 4, 1942. Neg. No. 5427.

RANCHO SANTA ANA MEXICAN VILLAGE

The planting around the Mexican Village at Rancho Santa Ana was designed as a test of species which were at the time thought to be likely to remain free from Cypress Canker. The planting consisted of a double row with the trees spaced 5 feet apart in the rows and between the rows. Space was sufficient for 409 trees, but during the springs of 1936 and 1937, replants brought this up to 476 trees, or nearly a 15 per cent early loss. At present, the plot contains approximately 271 trees. Species used were *C. Forbesii*, *C. Abramsiana*, *C. Sargentii* and *C. nevadensis*.

In the spring of 1938, a disastrous flood swept down the Santa Ana River, and part of this plot was under four or more feet of water. Many trees were thrown over and were never righted. Ever since the trees were planted, the Mexicans in the village have used the space between them for chicken coops, wood piles and other similar things so that many trees have been injured or damaged. For the first three years, the trees were regularly watered and kept free of weeds, but since then no care of any sort has been given. Despite the lack of care, the trees have done rather well and afford a fine wall of living green which effectively stops the winds so common in the canyon. The trees of *C. Forbesii* and *C. Sargentii* average about

FIGURE 51.

PIUTE CYPRESS—*Cupressus nevadensis*.
At Rancho Santa Ana Mexican Village. *Prop. No.* 2160, about 3-4 m. (11-13ft.) high. Planted March 30, 1936. Photo July 9, 1945. Neg. No. 6111.

16 to 18 feet in height while those of *C. nevadensis* are 12 to 13 feet in height. Trimming of undesirable branches, removal of dead trees, rubbish, chicken pens, etc. would insure this plot serving the purpose for which it was primarily planted.

LIMONEIRA COMPANY, SANTA PAULA

Two separate plots were set out on the Limoneira Company's properties. The first was adjacent to Telegraph Road on Olive Road, and the second was at the Del Mar Division's headquarters.

The planting on Olive Road is an ideal one from an experimental standpoint, in that the land slopes from north to south on a practically even grade; Valencia orange trees are continuous 8 or 10 feet to the west; a 6-foot steel fence is less than 2 feet to the east of the cypresses; a drainage ditch is a few feet east of this; and the soil is a medium dark clay loam. No other cypress test plot provides such uniform conditions for all of the trees. On March 10, 1936, 420 trees were planted; on May 26, 1936, 3 replacements were put in; on December 30, 1936, 11 replacements were made bringing the total plantings up to 434 trees, comprising 55 different lots and including all of the species under test except Guadalupe and San Pedro Martir Cypresses. Thus, the losses from transplanting and cultural practices during the first year were only slightly over 3 per cent, which is an indication of the excellent attention and care which this plot has received. As of December 20, 1944, the plot contained 397 trees. The losses of trees have been so small and so well distributed that they are hardly noticeable.

About 5 years ago the Limoneira Company began trimming off the lower branches, and now the trees in this plot have clean trunks for about 4 or 5 feet above the ground. This was done to permit air circulation during cold weather as a means of protection to the adjacent orange grove. The company has also used a power trimmer and has sheared the sides of this row of trees which has resulted in a uniformity of appearance despite the numerous strains of cypresses in the plot.

This plot is only a few miles inland from the ocean, and certain of the cypresses from dry interior climates are not too thrifty. In particular, Piute, Arizona and McNab Cypresses do not seem to be happy in the moist coastal air, although they have done better than in some of the other plots.

An outstanding feature of this plot is the freedom from Cypress Canker, even in species and strains which have been highly susceptible elsewhere. When last checked the Monterey Cypresses appeared free from Canker, while the most serious infections seemed to be in the Mendocino Cypress.

Growth rates of most of the species have been excellent (see

FIGURE 52. Cypresses. See opposite page.

Table XIX). The rather outstanding performance of the numerous lots of the Tecate Cypress led Mr. Jensen, Superintendent of the Limoneira Company, to propagate thousands of this species for plantings elsewhere on the properties. The best strains of the Tecate Cypress have produced trees over 30 feet in height, while the Monterey Cypress in the same plot has reached a maximum of 36 feet in height. This difference is not important when it is remembered that the latter species has a very slender whip-like leader of little value in stopping wind and also because the species is so likely to be killed by Canker.

The planting at the Del Mar Headquarters of the Limoneira Company is located about 3 miles from the ocean, is in rather heavy poorly drained soil and along the south edge of a lemon grove where excess irrigation water sometimes collects. The planting originally consisted of 37 trees made up of 13 different lots and representing 10 different kinds of cypresses. One tree was replaced in 1936. In December, 1944, there were 29 trees alive. The best trees were those of the Monterey Cypress and the Mexican Cypress. Trees of the McNab Cypress, the Modoc Cypress, Santa Cruz and Mendocino Cypresses have done poorly. However, the principal problems in this plot have been those of soil and improper drainage so that little reliance can be placed upon the differential performance of the species.

HAGEN RANCH, CHATSWORTH

The Hagen Ranch is located about 1 mile east of Chatsworth and at the base of the hills forming the north end of the San Fernando Valley. The soil is mostly a light loam with underlying strata of white marine rocks of a chalky texture and appearance. During the summer months, the temperatures on the Hagen Ranch frequently rise to over 100° F. while in winter there is an occasional frost, although Mr. Hagen does not have heaters for his lemons and oranges. At infrequent intervals, but mainly in the fall of the year, severe drying winds sweep in from the deserts to the north and cause some damage to orchards which are not protected by adequate windbreaks, and even eucalyptus windbreaks are sometimes quite severely defoliated. Mr. Hagen set out his oranges and lemons in 1936-37 and, at the same time, planted extensive windbreaks of eucalyptus and also permitted us the privilege of planting a number of cypress for windbreak tests.

In making the selection of kinds of cypresses for planting on

FIGURE 52.

Test Plot at the Limoneira Company, Santa Paula, looking north along Olive Road, showing nearly the entire planting which extends for one-half mile. The first three trees on left are Tecate Cypress (*Prop. No. 2319*) and are 6-8 m. (19-24 ft.) high; the next trees are Monterey Cypress (*Prop. Nos. 2184, 2178 & 2177*) of which the tallest are over 11 m. (36 ft.). The next trees are McNab Cypress and are very low. Photo April 12, 1945. Neg. No. 5907.

the Hagen Ranch, it was thought best to limit it to species of the interior and to those which at the time were believed to be most likely to be relatively immune to the Cypress Canker. The planting consisted of the following kinds: Santa Cruz, Arizona, Modoc, Siskiyou, Tecate, McNab, Piute and Sargent Cypressess. Eight separate blocks of trees were set out and originally spaced 5 feet apart in single rows. Later, in a few instances, Mr. Hagen planted eucalyptus adjacent to these (on the north side) in order to give greater wind protection. The plantings on the Hagen Ranch totaled 486 trees of which 330 were still alive in December, 1944. Early in 1940 the trees of the Santa Cruz Cypress, totaling 130 individuals, were removed because it had been discovered that the species was highly susceptible to Cypress Canker. Certain other trees were taken out for driveways, and also some lost when one block of trees was partially transplanted when adjacent citrus trees were contour-planted. Thus, when these deliberate removals are subtracted from the totals originally planted, it will be noted that the plots have done remarkably well, and the losses have been almost negligible. No losses occurred in the plantings of Arizona, Modoc and Siskiyou Cypressess. Losses of some of the trees of Sargent Cypress from Cypress Canker may have been partly

FIGURE 53.

View of Hagen Ranch, Chatsworth, Calif., showing lemons and cypress test plantings; both set out in 1936. Block 5, consisting of trees of Tecate Cypress (*Prop. No. 2315*), is shown in center, runs west to east, and the trees average 20 ft. (nearly 7 m.) in height. Block 6 is shown in the rear, and the trees visible are mainly Arizona (*Prop. Nos. 2357 & 2358*) and Piute (*Prop. No. 2160*) Cypressess. Photo Dec. 20, 1944. Neg. No. 5751.

due to the poor condition of the trees after having been moved.

Several blocks were planted using alternate trees of the Tecate and Santa Cruz Cyresses (at the time thought to be Sargent Cypress). When the latter were removed in 1940, this left a 10 foot spacing between the Tecate Cypress trees which have developed into fine compact specimens. Early in 1945 Mr. Hagen had the lower branches removed from some of the cypress trees in order to provide air drainage through his groves as a measure for frost protection. The tallest tree in the plantings was 26 feet high in December, 1944, and was a specimen of Sargent Cypress (*Prop. No. 2157*). However, many of the trees of the Tecate Cypress were nearly equally tall and appear to be much more satisfactory. Those of *Prop. Nos. 2333 and 2334* had trees 25 feet high and averaged 23 feet.

The cypresses on the Hagen Ranch, although far outstripped in growth by the eucalyptus windbreaks, have done exceedingly well. They have never been blown over by the occasional severe winds, and they have shown only a little tip burn on their foliage when adjacent eucalyptus trees have been severely defoliated. The plantings of the Tecate Cypress which had eucalyptus planted a few feet to the north several years afterwards are showing their inability to compete with eucalyptus and are now making very little growth. Their north sides are also thinning out due to "light killing" and demonstrate how essential it is to provide adequate light for this species if its lower branches are to be retained.

CITRUS EXPERIMENT STATION

The test plot at the Citrus Experiment Station of the University of California at Riverside, California, is located in a low, nearly level area in the southwest corner of the Station grounds. The soil is basically decomposed granite and is rather deep. Prior to utilizing this for a test plot of cypresses, it had been used for citrus, but these were removed because it was too cold. Following this usage, the area had been used for experimental plantings of sugar beets by the U. S. Department of Agriculture. The entire area utilized for the cypress planting consists of a triangular piece of land of somewhat less than one acre. In order to utilize the existing irrigation facilities, the rows were somewhat irregular, but were mainly about 20 feet apart with the trees set 5 feet apart in the rows. In this way, space was permitted for the planting of 368 trees. During 1936 and '37, there were 22 replacements required. In May, 1945, there were 272 trees alive. Losses were high in the Monterey, Gowen and the Mendocino Cyresses and somewhat less in Sargent Cypress from Canker as well as from an obviously unsuitable habitat, for at least all but the latter species. The wind storm of 1943 was responsible for the loss of a number of trees of Tecate Cypress which although not killed

were blown over and have been counted as dead. The reason for the loss in this species from the wind was because the full force of the wind struck these trees which were on the outside row. The only other severe damage to the planting occurred in the spring of 1938 when flood waters did not drain through a drainage pipe, and silt was deposited around some of the trees. Prompt removal of the debris reduced the losses to a few trees.

For the first few years this plot was carefully maintained, was regularly irrigated and cultivated, but as the trees grew to rather large size, cultivation was no longer possible and irrigations have been infrequent. Since the war little attention has been given the plot, and fallen trees have not been removed. The original spacing of 5 feet apart in rows about 20 feet apart has proven too close, and the lower branches on trees in the inside rows are showing "light killing". Trees of the Mexican Cypress look fine during the winter months, but suffer from the lack of moisture and the very dry climate. On the other hand, trees of the Tecate and the Arizona Cypresses appear to be very well suited to the Riverside climatic conditions. The Modoc, the Siskiyou and the Piute Cypresses also appear to be suited to the region but need adequate light and space.

FIGURE 54.

Citrus Experiment Station Cypress Test Plot, Riverside, Calif. View from south. Planted Feb. 28, 1936, with space for 368 trees. Most of the trees visible in the picture are Tecate Cypresses, but the large third tree from right is a Sargent Cypress (*Prop. No. 2168*) and is about 9 m. (27 ft.) high. Photo May 23, 1945. Neg. No. 5927.

One row of this plot was planted with trees of the Tecate Cypress alternating with trees of the Santa Cruz Cypress. The latter species is susceptible to the Cypress Canker and will likely die out rather soon at Riverside since Cankers have been noted since 1941. These two species look practically alike in this row and can only be distinguished by close examination.

WARDMAN RANCHES, RIVERSIDE

As originally laid out, the plots on the Wardman Ranches, Riverside, comprised four main plantings adjacent to citrus lands in the Jurupa Hills west of Riverside. All of these were planted with species which were thought to be likely to succeed in the district, as well as to be relatively immune to the Cypress Canker. In these four blocks, space was allotted for 772 trees. Replacements made during 1936 and 1937 brought the total to 874 trees. One of the blocks consisting of 380 trees was parallel to an irrigation canal but was adjacent to raw land. This had to be watered by tank wagon, and there seemed to be no easy way to control the damage from rodents (squirrels, rats and rabbits). Accordingly, after a year of futile replacements, the entire block was abandoned. The other three blocks have been maintained and now serve as effective windbreaks. Of an original total planting of 461 trees, there now are 329 trees alive. Most of these losses occurred during 1936-37 while the trees were very small and were largely losses from drouth, since most of the trees were watered from a tank wagon, and the porous ground became exceedingly dry between waterings.

Block 1, known as the Opal Street Ranch in our records, consisted of a planting of 241 trees of Tecate Cypressess parallel to an irrigation canal but on an average 5 or 6 feet above its water level. The canal is an old one; and, apparently, there are numerous cracks in the portion along the south half of the cypresses. All replacements made during 1936 consisted of trees of the Tecate Cypressess, but in 1937 a few Arizona Cypressess were used. These latter are now hidden by the adjacent Tecate Cypressess which had gotten a head start. For the first two or three years, these trees were watered with a tank wagon, and especially during the first two years the major losses were due to the inability of the little plants to survive between waterings. The northern portion of this block, consisting of over 75 trees, has made very little growth, and the trees are now averaging less than 10 feet in height. They have received no water for years; and, apparently, are unable to get any from the adjacent canal. They demonstrate very nicely that without water Tecate Cypressess can barely remain alive in this area. On the other hand, the remaining south portion of the block is a fine hedge averaging over 20 feet in height. The trees in this portion must certainly have sent their roots down into the moist soil due to numerous cracks in the irrigation canal. There is no evidence that more than 2 or 3 trees have ever been blown

over by windstorms. Almost throughout its length this block receives adequate light, as indicated by the dense foliage down to the ground surface.

Block 2 is south of a lemon orchard and consisted of 68 trees of Arizona Cypresses with a few Tecate Cypresses for checks. Replacements in 1936-37 consisted of 9 trees. As of May, 1945, there were 62 trees alive. Three trees had been removed for a driveway. The block runs east and west, and the trees spaced 5 feet apart are on the outer edge of a terrace so are never wet for very long. Between 1941 and 1942 these trees were topped at an average height of 10 to 12 feet which seems to have been a good practice for the lower growth has thickened, and the ensuing top growth has been of several shoots.

Block 3 is adjacent to Block 2 but runs north and south and lies between two lemon groves. It provided space for 83 trees set 5 feet apart in the row. Replacements in 1936 and 1937 consisted of 9 trees. As of May, 1945, there were 70 trees alive. Missing trees are so spaced that they do not impair the effectiveness of the planting as a windbreak. Several years ago the owners began pruning off the lower branches of the trees in this block, and they now have clean trunks for 4 or 5 feet from the ground. The few trees of the Cuyamaca Cy-

FIGURE 55.

TECATE CYPRESS—*Cupressus Forbesii*.
At the Opal Street Ranch, Wardman, Riverside, Calif. These trees are practically all Prop. No. 2334, planted on March 7, 1936, and are now 6-7 m. (20-25 ft.) high. The tree exactly opposite the front end of the field car is No. 184 and is over 7 m. (24 ft.) high. Photo May 23, 1945. Neg. No. 5041.

press and the Mexican Cypress are unlikely to be of permanent value in this planting, but the Tecate and Arizona Cypressess are, apparently, going to be successful.

WARDMAN RANCHES, EAST OF ANAHEIM

The plantings on the Wardman Ranches east of Anaheim were all located west of the Santa Ana River in what was practically pure sand. Two of the plots were on or adjacent to Wagner Road; the other two were to the north of Ball Road. These plantings were all single row plantings spaced 5 feet apart. One of the plantings was adjacent to an established eucalyptus windbreak, and the little cypresses were unable to even get started and were all disced under the first fall after they were planted.

In the spring of 1938, the Santa Ana River flooded portions of Orange County, and all of the cypresses in these blocks were covered with 2 or 3 feet of water. This damaged the trees, and many never seem to have recovered properly since. In order to clear out the debris in the adjacent orange groves, many cypresses were sacrificed, and one block of 230 trees along Wagner Road was so torn up that it was abandoned.

By 1940 the Cypress Canker had become so common in the trees of the Santa Cruz, Gowen, Mexican, Monterey and Mendocino Cypressess that all of the trees of these species in the Wardman Anaheim blocks were removed and replaced with trees of the Tecate Cypress.

Although some of the trees in the two blocks have made fair growth, the entire area seems to be unsuitable to cypresses of any kind. The difficulty may be due to the sandy soil and a water condition during the winter or to other factors; but, at any rate, these tests indicate that none of the cypresses used in the tests is suitable for planting in this area. It is likely that all of these trees will be removed this year by the present owners.

The plantings made in the 1936-37 seasons and their present status are indicated below:

Block 1 North of Wagner Road—265 trees planted; 152 alive 1945.

Block 2 Along Wagner Road—230 trees planted; abandoned, a few alive.

Block 3 North of Ball Road—227 trees planted; 76 alive.

Block 4 Ball Road Eucalyptus—55 trees planted; abandoned.

JORDAN RANCH, ATWOOD

The test planting on the Jordan property southwest of Atwood, Orange County was located only a few hundred feet from the Santa

Ana River and in an area where the Santa Ana Winds from the east strike with their greatest force. The land is practically pure sand. The planting consisted of 195 trees spaced 10 feet apart and running east and west. About 10 feet to the south, a double row of eucalyptus was set out at the same time. All trees planted in this plot were Tecate Cypresses (*C. Forbesii*). The original trees were set out from flats but a considerable number of these were lost, and 39 replacements were made from pots during 1936. As soon as the eucalyptus really began to grow, they overshadowed the cypresses, and although the cypresses eventually attained heights of 12 to 15 feet in 1940 and '41, they were slender in growth and weaklings. No attempts were made to inventory these trees after 1940 since it was obvious that they could not compete with the eucalyptus, but at that time 176 trees were alive. They were also severely damaged by the flood of 1938. The owners removed the remaining trees in 1943.

SHELDON RANCH, CARPINTERIA

The Sheldon Ranch is located a mile or two to the south of Carpinteria and within one-fourth of a mile of the ocean. The original plantings consisted of trees of the Santa Cruz, Tecate, Gowen and Mendocino Cypresses for a total of 260 trees of which 14 were replacements during the first year. Very little of value was learned from this planting due to conditions beyond our control which resulted in the trees receiving practically no care. As a result, the plot was abandoned following the inventory in 1938, at which time about 220 trees were alive. A further check was made in 1939 on part of the plantings, but it has not been inspected since. Trees of Gowen Cypress produced ovulate cones in 1938 (less than four years old). Trees of the Tecate Cypress planted where they received the full force of the damp ocean winds never grew normally and indicated that the species is unsuitable for planting on the immediate coast.

BRYANT RANCH, LONG BEACH

The area used for a test plot on the Bryant Ranch was located about 1½ miles east of Los Alamitos Boulevard and ran from Bryant Avenue on the north to Bixby Avenue on the south, a distance of approximately ¾ of a mile. During the spring of 1936, 668 trees were planted, but due to the alkaline nature of the soil, the plot was abandoned the first year. Examination of many of the plants that died showed that their roots had been killed, apparently by the burning action of the alkaline salts.

EVALUATION OF CYPRESSES FOR HORTICULTURE

In the following accounts dealing with each of the 16 recognized entities of New World cypresses, an attempt has been made to present information regarding the first use of the species in horticulture and some ideas as to their values. Some species have been cultivated far from their original homes, and exact information about them is difficult to obtain. Others do not appear to have ever been cultivated prior to their introduction by this Garden. For the most part, the information presented is based on California conditions and performances and largely upon the plants grown and planted out by this Garden over the period from 1927-1945.

Of the 16 entities here recognized in cypress, several are ruled out for use because of their susceptibility to Cypress Canker, although they may still have horticultural merit in regions where that disease is not an important factor. These are: Monterey Cypress (*Cupressus macrocarpa*), Gowen Cypress (*C. Goveniana*), Mendocino Cypress (*C. pygmaea*), and Santa Cruz Cypress (*C. Abramiana*).

Somewhat less susceptible to Cypress Canker are: McNab Cypress (*C. Macnabiana*), Sargent Cypress (*C. Sargentii*) and Mexican Cypress (*C. lusitanica*)*. The first of these has shown itself to be of no horticultural merit; the second is of no great beauty in cultivation because of several features of color and growth; while the Mexican Cypress, although a beautiful species, does not appear to be adapted to the long dry California seasons.

Too little is known about Stephenson Cypress (*C. Stephensonii*) and the San Pedro Martir Cypress (*C. montana*) to properly evaluate them at this time.

The Piute Cypress (*C. nevadensis*), Siskiyou Cypress (*C. Bakeri Matthewsii*) and Modoc Cypress (*C. Bakeri typica*) appear to have possibilities for use as gray-foliaged specimen trees. The first of these, the Piute Cypress, is probably only suited to mild regions, whereas, the other two can probably be used in climates too severe for any other species of the genus.

Of the remaining four species, only two are likely to be much used in horticulture. The Smooth Arizona Cypress (*C. glabra*) is already so extensively planted in parts of California and Arizona that it would be difficult to substitute the real Arizona Cypress (*C. arizonica*) unless the latter were demonstrated to be superior in some important features. On the other hand, the Guadalupe Cypress (*C. guadalupensis*) has proven itself to be well suited to California conditions, but has a limited use because of its bluish foliage. Its close

*This species may not be nearly as susceptible to Cypress Canker as its appearance under our conditions would indicate for many resin flows are apparently lacking the fungus.

FIGURE 56. McNab Cypress. See opposite page.

relative, the Tecate Cypress (*C. Forbesii*), has most of the good features of the Guadalupe Cypress plus fine green foliage. This latter feature is important in that among all of the cypresses tested this is the only green-foliaged species that is reasonably immune from Cypress Canker and has a vigorous growth rate. It is, therefore, likely that the Smooth Arizona Cypress with gray foliage and the Tecate Cypress with green foliage will be the most widely used species for California conditions, although neither one is satisfactory on the immediate coast.

McNAB CYPRESS—*Cupressus Macnabiana*

The McNab Cypress was discovered in California in 1854 and was immediately thereafter cultivated in England where it was received with considerable enthusiasm. Perhaps its performance in that country has been vastly different than in California, but the species has never shown itself to be of any real value in California gardens.

Under cultivation the McNab Cypress tends to develop a bushy growth, usually somewhat open habit and dull gray, glandular foliage. A central leader is ordinarily lacking or, at least, is soon displaced by lateral branches, and the crown becomes broader than high. Unless given adequate space, the plants "light kill" and become exceedingly unattractive. Some confusion in horticultural literature has resulted about the cultivation of McNab Cypress because plants of the Siskiyou Cypress were actually being grown. Rehder (*Man. Cult. Trees & Shrubs* 16. 1927) regarded *C. Bakeri* as a synonym of *C. Macnabiana* and stated that the latter was "The hardiest of the true Cypresses". In 1939 Dr. Rehder visited the Garden and saw living trees of McNab, Siskiyou and Modoc Cypresses. Partially as a result of this visit, he listed *C. Bakeri* as "The hardiest of the true Cypresses" (*Man. Cult. Trees & Shrubs* ed. 2. 56. 1940) and gave *C. Macnabiana* only incidental mention.

We have grown 21 different lots of McNab Cypresses in the nursery from seeds. The first of these was in 1929; the most recent in 1944. In most instances, the germination has been poor, and the number of plants produced has been small. Within the confines of the Botanic Garden, there are now only 8 plants of McNab Cypress alive, the rest were destroyed by the fire of 1943. Prior to the fire, the plantings of the species at the west side of the Garden were partially destroyed while very small by rodents and deer. Although it is probable that other cypresses would have been similarly attacked, it also seems that McNab Cypress is especially palatable when small and, for this reason, needs early protection by wire cages.

FIGURE 56.

McNAB CYPRESS—*Cupressus Macnabiana*.

In Rancho Santa Ana Botanic Garden Test Plot. *Prop. No.* 2148; tree No. 1; 4 m. (13 ft.) high; planted Feb. 12, 1937. Photo July 9, 1945. Neg. No. 6057.

FIGURE 57. Modoc Cypress. See opposite page.

In the various test plots planted in 1936-37, the McNab Cypress has shown themselves to be entirely unsuited for use as windbreaks or hedges, particularly near the coast or in areas where they have received much water. The smallest tree is still only 3 feet high, the largest 20 feet high, and the average 12 feet in height. In the wild most stands grow in rocky situations, mainly serpentine, whereas, the test plots are largely clay soils. It may well be that this accounts for the rather poor performance of the species.

For several years it was thought that the McNab Cypress would be practically immune to the attacks of Cypress Canker, but infections were found in the older plantings in the Botanic Garden as early as 1938 and in the Citrus Experiment Station plot in 1941 (trees 6-7 years old from seed).

It is my opinion that, at least for California conditions, the McNab Cypress has no horticultural value, and unless it is desired for its botanical significance, it should not be grown.

MODOC CYPRESS—*Cupressus Bakeri* subsp. *typica*

The Modoc Cypress does not appear to have been cultivated prior to its introduction to Rancho Santa Ana Botanic Garden in 1930, although its close relative, the Siskiyou Cypress, was cultivated considerably earlier under the name of McNab Cypress.

In general appearance, the Modoc and Siskiyou Cypress are much alike in that they both have gray foliage and are rather glandular although, in most instances, the Modoc Cypress is much grayer and is much slower growing.

Our first lot of Modoc Cypress was from the Timbered Crater area in 1930 (*Prop. No. 1006*). The seeds germinated readily, and no difficulties were encountered in growing the seedlings. A bed planting of 100 plants was made in 1931 on a west slope hillside in the upper portion of the Garden. By the fall of 1943, there were still 77 of these trees alive, the largest of which were 16 feet in height. They had not yet begun to crowd each other, and many were exceptionally beautiful gray specimens. Unfortunately, all of these were lost in the fire of 1943. A few trees of this same lot were held in the nursery until 1934 when they were set out along the south side of the Garden in an irregular row. These are now about 20 feet high and are fine specimens.

In 1934 two additional lots of Modoc Cypress were obtained from the Timbered Crater area (*Prop. Nos. 2127 and 2128*). These

FIGURE 57.

MODOC CYPRESS—*Cupressus Bakeri* subsp. *typica*. In Rancho Santa Ana Botanic Garden, border of desert section. *Prop. No. 1006*, 8 m. (24 ft.) high, a beautiful gray slender tree planted March 12, 1934. The trees immediately to right and left are Tecate Cypress (*Prop. No. 1111*) also planted March 12, 1934. Photo July 9, 1945. Neg. No. 6106.

FIGURE 58. Modoc Cypress. Explanation on opposite page.

were also readily propagated, and over 700 plants were produced which were used extensively in the test plantings in 1936-37. Average height for all of the Modoc Cypresses in 1944-45 was 12 feet, with the largest tree being 17 feet high. The finest Modoc Cypresses are at the Hagen Ranch, although there are some almost equally fine at the Citrus Experiment Station.

A collection of seeds (*Prop. No. 3204*) from the Burney Springs locality obtained in 1938 through Dr. Wagener has not yet attained sufficient size in the Garden's plantings to draw any conclusions about its performance.

The Modoc Cypress appears to be a possible addition to the list of fine gray conifers which can be planted in hot interior sections of California. It is probably hardy in any region where the winter temperatures do not drop much below zero. The species grows too slowly for hedges or windbreaks but should be planted in groups or as specimens. It is exceedingly unlikely that it will ever prove to be highly susceptible to Cypress Canker since in our test plots there has been only one minor infection noted (at the Citrus Experiment Station), and which when examined by Dr. Wagener in April, 1945, was regarded by him as likely to callus over and make no headway. The Modoc and Siskiyou Cypresses are very similar, and it will be many years before it will be possible to determine which is superior for horticulture, or it may well be that the differences exhibited by the two will be sufficient to warrant both being used.

SISKIYOU CYPRESS—*Cupressus Bakeri* subsp. *Matthewsii*

The Siskiyou Cypress seems to have been introduced into cultivation in 1917 according to Rehder (*Man. Cult. Trees and Shrubs* ed. 2. 56. 1940), although in previous papers he had referred to the Oregon plants cultivated at the Arnold Arboretum as *Cupressus Macnabiana*. The correction of this error was possible because Dr. Rehder visited this Garden in 1939 and was able to see at first hand living plants of the Siskiyou, Modoc and McNab Cypresses. Rehder used the name *C. Bakeri* and called his plant the Modoc Cypress, nevertheless, he gives the distribution as Oregon so that there is little doubt but that he had in mind the plant here discussed as the Siskiyou Cypress. In California there are few, if any, cultivated trees of the Siskiyou Cypress, except those which have been grown by this Garden.

The Siskiyou Cypress closely resembles the Modoc Cypress but has several botanical differences which set it apart. The wild trees

FIGURE 58.

MODOC CYPRESS—*Cupressus Bakeri* subsp. *typica*. Limoneira Ranch, Santa Paula, Calif. Tree adjacent to cement standpipe is a Tecate Cypress, *No. 141* (*Prop. No. 2319*) and is over 7 m. (22 ft.) high. The next seven trees to left are Modoc Cypresses (*Prop. No. 2127*) mainly over 4 m. (12-14 ft.) high. The next two trees are *Prop. No. 2128*. Photo April 12, 1945. Neg. No. 5878.

grow to much greater heights, and in our cultivated plots, it has averaged about 50 per cent greater growth. The trees are also much greener than the Modoc Cypress and have ultimate branchlets which are much longer.

Our knowledge of the performance of the Siskiyou Cypress is based mainly on two collections of seeds (*Prop. Nos. 2130 and 2131*) from Seiad Creek in 1934. From these two lots of seeds, about 350 seedlings were grown and used extensively in the various test plots in 1936-37. Approximately 260 trees were set out at that time, of which 136 were still alive in 1944-45. These ranged in height from 7 to 23 feet, with an average of 17 feet. The tallest tree was at the Limoneira Ranch, but the best planting was at the Hagen Ranch. Plantings on the west side of the Botanic Garden were lost in the 1943 fire, but a second planting (*Prop. No. 2131*) west of the large reservoir is in excellent condition with the approximate 60 trees well spaced and 10 to 15 feet in height. A 1944 collection of seeds from Goose Nest Mountain (*Prop. No. 5051*) has not yet been planted out, although it has grown normally in the nursery.

The Siskiyou Cypress, like its close relative the Modoc Cypress, is probably not suitable for use as a hedge or windbreak tree but should be planted in groups or as specimens. In view of its hardness,

FIGURE 59.

SISKIYOU CYPRESS—*Cupressus Bakeri* subsp. *Matthewsii*.
At Hagen Ranch, Chatsworth, Calif. Block 6, with tall tree at right No. 89.
Prop. No. 2131, tallest tree is behind post in center of picture and is about 6 m.
(18 ft.) high. Photo Dec. 20, 1944. Neg. No. 5734.

it may prove to be a valuable gray-foliaged conifer for colder regions; and, as indicated by Rehder as well as by my notes on its botanical habitat, it is probably the hardiest of all species. Long time tests are needed to determine whether the Siskiyou Cypress will prove to be a more desirable plant for horticulture than its close relative, the Modoc Cypress, but the former certainly grows faster.

SAN PEDRO MARTIR CYPRESS—*Cupressus montana*

The San Pedro Martir Cypress has probably never been cultivated except for the very limited number of trees grown at Rancho Santa Ana Botanic Garden from seeds supplied by Dr. Wiggins. The first lot of seeds (*Prop. No. 2067*) consisted of a mere trace taken from the Type Collection of the species. These were planted in the nursery in April, 1933 and yielded only 2 plants. These two plants were then set out adjacent to the o'd Garden nursery. In March, 1936, these were transplanted to the Rancho Santa Ana Test Plot, at which time they were 18 to 20 inches high respectively. By December, 1942, they had grown to heights of 16 and 17 feet respectively, were dull gray-green in aspect and were of rather narrow growth form, being only 3 to 4 feet in spread. Unfortunately, the severe wind of 1943 which destroyed so many other trees blew over these two in the test plot.

In 1938 Dr. Wiggins obtained some additional seeds of the San Pedro Martir Cypress which he presented to the Garden. These were planted in 1939 (*Prop. No. 3367*), and 99 plants were grown to 4-inch pot size, or about 4 inches in height. Most of these were distributed to various public parks in Southern California. About 10 plants were set out at Chatsworth by Mr. Hagen where they have grown well in a sunny canyon bottom. The largest of these was 9 feet high in April, 1945 and was as slender as an Italian Cypress, but gray in color.

The plants of the San Pedro Martir Cypress, which we have grown, are too limited in number to draw upon for any reliable conclusions as to the merits of the species for horticulture. Nevertheless, on the basis of their performance, it would seem that the species would only be of interest as specimen plantings and would have no value for hedges or windbreaks. The rather drab gray color of the foliage is not as attractive as that of some other species, and yet it is not green enough to be regarded as green-foliaged. In view of the morphological similarities of the San Pedro Martir Cypress to the Piute Cypress and the Arizona Cypress, it is reasonable to suspect that it will prove to be as resistant to Cypress Canker as they are. For this reason, it is hoped that additional seeds may be obtained for propagation of the San Pedro Martir Cypress so that it can be tested extensively in the interior areas of California and, perhaps, elsewhere.

FIGURE 60. San Pedro Martir Cypress. See opposite page.

ARIZONA CYPRESS—*Cupressus arizonica*

The Arizona Cypress (*Cupressus arizonica*) has long been confused in that seeds of the Smooth Arizona Cypress (*C. glabra*) have been collected extensively in central Arizona and distributed to all parts of the world. It is possible that from the specimens of the original collection sent to England by Greene that some plants were grown. According to Dallimore and Jackson (Handb. Conif. 193. 1923), "It was introduced into England in 1882 from the Arnold Arboretum, and only small trees are known in this country." They also state: "most of our cultivated plants have conspicuously glandular leaves and therefore belong to *C. glabra* as defined by Sudworth." I have examined a great many plantings of cypresses in California in an attempt to see if any true Arizona Cypresses are in cultivation, but thus far every planting has proven to be the Smooth Arizona Cypress.

Our knowledge of the Arizona Cypress in cultivation is based upon plants grown from two lots of seeds collected by Dr. L. S. Gill in the Chiricahua Mountains of southeastern Arizona in 1935. The first of these (*Prop. No. 2357*) came from Faraway Ranch at the lower end of Bonita Canyon; the second (*Prop. No. 2358*) came from Rucker Canyon.

Plantings of the Arizona Cypress made in 1936 and 1937 totaled 408 trees, of which 320 were alive in 1945. This is about as good performance as any species under test and demonstrates the hardiness of the species. Performance of both *Prop. Nos. 2357* and *2358* has been so nearly alike that there is little to choose from between them, although the table (Table XIX) shows that, in most plots, the tallest trees were of *Prop. No. 2357*, there being trees 28 feet high in the Citrus Experiment Station plot. The average for all trees of *Prop. No. 2357* was 18 feet, against an average of 17 feet for *Prop. No. 2358*.

At the Hagen Ranch, Chatsworth; the Wardman Ranches, Riverside; and the Citrus Experiment Station, the Arizona Cypresses seem most at home and have developed beautiful gray foliage and appear thrifty and vigorous. At Rancho Santa Ana and at the Limoneira Ranch, the species has done well but, apparently, is not well suited to situations so close to the coast. East of Anaheim in sandy land the species has done poorly, but this has been true of almost all other cypresses as well, and in our plots this area is the only one where we have found Cypress Canker on this species and, in this instance, not serious.

There is probably little reason except chance that the Arizona Cypress has not become popular in cultivation instead of the Smooth

FIGURE 60.

SAN PEDRO MARTIN CYPRESS—*Cupressus montana*.
At Hagen Ranch, Chatsworth, Calif. *Prop. No. 3367*, planted in 1940, nearly 3 m. (9 ft.) high. Photo April 12, 1945. Neg. No. 5912.

Arizona Cypress, for the two are very similar, except that the Arizona Cypress is much less glandular-foliaged and later develops a rough bark on the main trunk.

In view of the cold winters to which the Arizona Cypress is subjected in many of its native habitats, it is probable that it could be used successfully over a great many portions of the interior of the Pacific slope of North America and, perhaps, elsewhere in dry climates.

PIUTE CYPRESS—*Cupressus nevadensis*

The Piute Cypress does not appear to have been cultivated prior to 1930 when seeds were collected (*Prop. No. 952*) near Bodfish, Kern County, California for propagation at Rancho Santa Ana Botanic Garden. Perhaps, some local resident in the region around Bodfish has transplanted a tree or two, but I have not been able to verify this. In more recent years, the United States Forest Service

FIGURE 61.

ARIZONA CYPRESS—*Cupressus arizonica*.
At Hagen Ranch, Chatsworth, Calif. Trees in left two-thirds of picture are *Prop. No. 2357*; those at right one-third are *Prop. No. 2358*. These are splendid specimens 6-7 m. (18-22 ft.) high. Planted March 7, 1936. Photo Dec. 20, 1944. Neg. No. 5729.

FIGURE 62.

ARIZONA CYPRESS—*Cupressus arizonica*.
At Limoneira Company, Santa Paula, Calif. Trunk at extreme right is tree No. 89. It and next 6 trees are *Prop. No. 2157*; all of the next trees to left (6 trunks and foliage of one) are *Prop. No. 2158*. Largest tree in view is 8 m. (26 ft.) and is No. 94 (6th from right), planted March 10, 1936. Photo April 12, 1945. Neg. No. 5873.

FIGURE 62. Arizona Cypress. See opposite page.

FIGURE 63. Piute Cypress. Explanation on opposite page.

nurseries in California have grown a few trees, but I have no information as to their disposition or performance.

Seeds of the Piute Cypress do not germinate as readily or in such good percentages as some other species; and, for this reason, we have never had a sufficiently large supply of seedlings to make really extensive plantings or to distribute surplus to others who would.

Our first planting of the Piute Cypress consisted of 64 small seedlings in December, 1931, on an east slope hillside above the large reservoir in the Garden. These were planted only 5 or 6 feet apart, and in the fall of 1934 about 7 of the poorest were removed, leaving 54 trees 4 to 9 feet in height. For the next few years, these Piute Cypressess were beautiful slender spires of soft gray and as shapely as could be desired. In 1940 they reached heights of from 8 to 25 feet and were beginning to crowd each other. In the years which have followed, the lower branches have light-killed to heights of 6 to 10 feet from the ground, and the entire planting has lost its beauty. This has demonstrated the need for ample space and light for this species. Probably under no conditions should the trees be closer than 30 or 40 feet if they are to develop properly with branches and foliage to the ground surface.

Our next plantings of the Piute Cypress were from seeds gathered in 1934 (*Prop. Nos. 2159 and 2160*). All of those within the confines of the Garden were lost in the fire of 1943. In the various test plots, these two lots of material have had varying success. They are obviously unhappy near the coast and in the sandy land east of Anaheim. Tallest trees are 24 feet high at the Citrus Experiment Station (average 17 feet), but they are too crowded and are beginning to lose their branches. Those at the Hagen Ranch, Chatsworth, average 17 feet high with the tallest being 18 feet high and are beautiful specimens.

The Piute Cypress will probably prove to be of little value for hedges or windbreaks, since other gray-foliaged species such as the Arizona or Smooth Arizona Cypress are superior. The principal value of the species is as a specimen tree for interior localities where it thrives and will probably remain practically free from Cypress Canker (unless crowded or weakened in some manner so that it is not growing properly). If specimen trees could be grown to heights of 30 or 40 feet with a spread of 25 or 30 feet, such as is common in some of the wild trees near Bodfish, there is every reason to believe that the Piute Cypress would be one of the most highly prized species of the genus.

FIGURE 63.

PIUTE CYPRESS—*Cupressus nevadensis*.
In Rancho Santa Ana Botanic Garden in Pine Canyon. *Prop. No. 952*, about 7 m. (21 ft.) high, planted Dec. 3, 1931. These were outstanding gray spires until crowding caused them to lose their lower branches. Photo March 4, 1942. Neg. No. 5411.

FIGURE 64.

PIUTE CYPRESS—*Cupressus nevadensis*.
At Hagen Ranch, Chatsworth, Calif. Prop. No. 2160, in block 6, planted March 7, 1936, now 5-6 m. (15-18 ft.) high. This species thrives in the hot dry air of the San Fernando Valley. Photo Dec. 20, 1944. Neg. No. 5731.

CUYAMACA CYPRESS—*Cupressus Stephensonii*

The Cuyamaca Cypress is, perhaps, the least known in cultivation of any of the New World cypresses. Only two plants of any age or size are known in cultivation. According to information supplied by the late Ranger Stephenson, after whom this species is named, the two trees on the old abandoned Kelly Ranch at the Pine Hills Guard Station were transplanted there from the wild stand on King Creek by Charles Kelly, who picked them up while out riding for cattle about 1900. The old Kelly Ranch has been abandoned for many years, and the cypresses can hardly be considered to be cultivated now, although they must have received care when they were young.

I visited the old Kelly Ranch in December, 1938 and collected specimens from the two trees. One was about 40 feet high, the other about 30 feet high. Both had smooth cherry red bark, grayish foliage and rather broad open crowns. The area surrounding the trees

FIGURE 65.

CUYAMACA CYPRESS—*Cupressus Stephensonii*.
At Kelly Ranch, Pine Hills Guard Station, Cuyamaca Mts., San Diego Co., Calif. Coll. No. 9469, 13. m. (40 ft.) high. Planted about 1900 by Charles Kelly. Photo Dec. 2, 1938. A—Habit. Neg. No. 4722. B—Trunk, 6 dm. in diam. at smallest point below branching. Note the smooth, exfoliating bark. Neg. No. 4732.

FIGURE 65. Cuyamaca Cypress. Explanation on opposite page.

FIGURE 66. Cuyamaca Cypress. Explanation opposite.

was packed hard from frequent campers and driving. Both trees were apparently healthy but were not making very much new growth.

The only other known plantings of the Cuyamaca Cypress are those made from seedlings grown by this Botanic Garden. The first lot of seeds was obtained in December, 1934 (*Prop. No. 2313*, our King Creek No. 1 Strain) from a lone tree situated over a mile from the rest of the stand. Subsequent performance of the seedlings has convinced me that they were abnormally weak due to the practical certainty that the seeds had been produced as the result of self-pollination. Only 65 young trees of this collection were grown to planting size. These were all planted in the spring of 1936 and, at the time, were thought to be Tecate Cypresses. However, their distinctive features were soon evident. For example, Mr. Charles Jensen, Superintendent of the Limoneira Company, before they were three years old noted that they were different from the trees of the Tecate Cypress. Of the 65 trees grown, 7 were sent to Dr. Wagener for his inoculation experiments and 8 were planted on the Bryant Ranch in a plot which was early abandoned. Of the remaining 50 trees, only 18 are now alive. The smallest is 8 feet high, the largest 13 feet, and the average height is 11 feet. The best trees are on the Limoneira Ranch, although the 4 trees at the Botanic Garden are also good. Trees in the Rancho Santa Ana Test Plot have done poorly, possibly because of lack of light due to crowding.

The second attempt to grow this species was by means of seeds collected in 1938 (*Prop. Nos 3370 and 3371*, our King Creek No. 2 and No. 3 Strains). For some unexplainable reason, only seeds of No. 3370 germinated. From these, 211 seedlings were grown to planting size, but only a few were used. A small planting was made in the Botanic Garden early in 1942 (see Table XIV). Several trees were given to the Santa Barbara Botanic Garden. The plants at Rancho Santa Ana Botanic Garden are now 3 to 4 feet high, are slender, gray-green, and rather glandular-foliaged. They are, apparently, normal in every way and show none of the weaknesses exhibited by plants of the first collection (*Prop. No. 2313*).

No reliable evaluation of the horticultural merits of the Cuyamaca Cypress can be made on the basis of the present information, for the two trees on the Kelly Ranch have long been neglected and are really not in cultivation, while the plants of *Prop. No. 2313* do not appear to be normal for the species, and those of *Prop. No. 3370* are still too young to indicate their eventual performance. Additional plantings of this species under more varied conditions are essential, especially in interior areas and because it is likely to remain relatively immune to Cypress Canker. However, in my opinion, the Cuyamaca

FIGURE 66.

CUYAMACA CYPRESS—*Cupressus Stephensonii*.
In Rancho Santa Ana Botanic Garden Test Plot. *Prop. No. 2313*, tree No. 12,
over 3 m. (11 ft.) high. Planted March 28, 1936. Photo July 9, 1945. Neg. No. 6060.

Cypress is unlikely to ever prove to be an outstanding species for horticulture, particularly in view of its similarity to the Arizona Cypresses, species whose distinctive features it tends to combine.

SMOOTH ARIZONA CYPRESS—*Cupressus glabra*

The Smooth Arizona Cypress has been cultivated for many years and, in almost every instance, as Arizona Cypress. On the other hand, the true Arizona Cypress does not appear to have been cultivated to any extent. According to Dallimore and Jackson (Handb. Conif. 193. 1923), the Arizona Cypress "was introduced into England in 1882 from the Arnold Arboretum". However, they state, "most of our cultivated plants have conspicuously glandular leaves and therefore belong to *C. glabra* as defined by Sudworth". There has been so much confusion regarding the Arizona Cypress and the Smooth Arizona Cypress in Europe that I would not venture an opinion as to the identity of any of the material cultivated abroad unless I could see the living trees or adequate specimens.

In California the Smooth Arizona Cypress has been cultivated rather extensively for many years under the name Arizona Cypress. One of the oldest plantings of which I know borders the highway from Saugus to nearly a mile south of Newhall, Los Angeles County. These trees are over 30 years old and were originally grown from seeds by Theodore Payne. Many of them have been broken or injured by cars or trucks, but there are also many fine specimens over 30 feet high with good crowns of gray foliage, and trunks 1 to 1½ feet in diameter with smooth cherry-red exfoliating bark. These trees may have received irrigation when first set out, but in over 20 years time that I have known them, they have never been watered or cared for except for weed cleaning by the California State Highway crews.

Another fine planting of Smooth Arizona Cypress is at the Victorville School grounds at Victorville, San Bernardino County. This area is on the Western Mojave Desert. The trees are at least 15 years old and form a beautiful gray, untrimmed hedge about 18 to 20 feet high. They are, apparently, regularly watered.

Between Victorville and Palmdale on the Western Mojave Desert on an abandoned ranch, there is a windbreak row of Smooth Arizona Cypress 10 to 15 feet high. It is at least 10 years since the ranch was abandoned, yet the trees appear to be thriving without care.

Throughout the interior cismontane sections of Southern California such as the San Fernando Valley, Pomona, Ontario, San Bernardino, Riverside and interior San Diego County, there are thousands of trees of the Smooth Arizona Cypress. The species thrives in these interior areas where the air is dry and hot; but, in

most places, trees which do not receive adequate regular irrigations during the dry season are not making much growth.

Near the coast in Southern California, the Smooth Arizona Cypress has not been successful; and, like its relative the Arizona Cypress, it should not be planted for it develops a rather poor growth habit, a dirty gray-green foliage, and does not appear to shed its branchlets properly.

Unfortunately, we did not obtain seeds of the Smooth Arizona Cypress when we made our main test plantings in 1935 so that this species has not been included in our detailed studies. In 1942 when we finally were able to study the two Arizona Cypresses in Arizona, we had to forego growing the Smooth Arizona Cypress at the Garden because of wartime curtailments.

While we were in Arizona in 1942, we visited Mrs. Rose Collom on Rye Creek in the Mazatzal Mountains. She has collected many hundreds of pounds of Smooth Arizona Cypress seeds from the headwaters of Rye Creek in an area known as the Cypress Thicket. She has sold this seed to numerous dealers over a period of many years as Arizona Cypress. Mrs. Collom told us of a columnar cypress on Rye Creek which we found. It was approximately 30 feet high, 6 feet in spread and had a trunk 14 inches in diameter at the ground but soon branched into 3 main trunks. It formed a slender gray column as symmetrical as the typical columnar Italian Cypress of gardens. Cuttings taken from this tree (Coll. No. 11421) on October 10th were carefully wrapped and kept in our ice box until October 14th when we turned them over to Mr. Herbert Swim of Armstrong Nurseries, Ontario, California. Mr. Swim successfully grafted some of these on rootstalks of the regular Smooth Arizona Cypress. Perhaps, this gray tree will prove to be of value in horticulture in the interior sections of California and Arizona.

Armstrong Nurseries in their 1945 catalogue, page 24, in listing this cypress state: "*Cupressus arizonica*. C5. 'Arizona Cypress.' 20-40 ft. 10°. A beautiful bluish-green cypress of narrow pyramidal form from the mountains of Arizona and northern Mexico. A splendid medium sized bushy windbreak or specimen tree for desert or coast."

The California Nursery Company, Niles, California, in their 1944 catalogue, page 25, describe this cypress as follows: "*Cupressus arizonica* (Arizona Cypress). Growth compact; branches somewhat stout; foliage silvery blue; tree of very good form. More hardy than Monterey Cypress, especially for warm locations."

The Smooth Arizona Cypress is probably the most valuable New World species of the genus for the dry interior sections of California, Arizona and, perhaps, for other similar areas. It has proven itself over a period of years to be suited to cultivation in such

FIGURE 67. Smooth Arizona Cypress. Explanation opposite.

areas and is practically immune to the Cypress Canker. Its close relative, the Arizona Cypress, is so similar that unless some future performance of that species makes it outstanding there is little likelihood that it will supplant it. Other gray-foliaged species such as the Modoc, Siskiyou and Piute Cypresses have different growth habits and cannot be directly substituted. The principal species which is likely to be used instead of the Smooth Arizona Cypress is the Tecate Cypress which, in some instances, would be more desirable because of its green instead of gray foliage.

MEXICAN CYPRESS—*Cupressus lusitanica*

The Mexican Cypress was the first of the New World species of the genus to be described and was also the first to be introduced into cultivation. However, due to various confusions as to its origin, it became known variously as the Cedar of Goa or Portuguese Cypress. Later it was described under several new names by European botanists who based their descriptions on material from the mountains of Mexico and Guatemala. According to Rehder (Bailey, Cult. Evergr. 210. 1925), the species was introduced to Portugal from Mexico about 1600.

It is likely that in Mexico, Guatemala and Costa Rica the material of the Mexican Cypress is not all uniform, and that several well-marked horticultural varieties or even botanical subspecies may eventually be recognized, but as pointed out in the botanical section of this paper, it has been impossible for me to do anything in this regard. Instead I have relied on the performance of material grown from seeds obtained near Mexico City (*Prop. No. 2356*), and which have produced trees whose characters agree with plants described and figured over 100 years ago, and which were then known as *Cupressus lusitanica*.

Our strain of the Mexican Cypress (*Prop. No. 2356*) was grown in 1935 from seeds and planted out in the numerous test plots during 1936. A total of 119 plants were grown; 108 of these were planted out of which 54 were alive in May, 1945. The species has proven to be a remarkably fast growing tree of graceful shape and worth while horticultural features but is not suitable for Southern California for several reasons. Its chief drawback seems to be that it does not thrive during our long dry season and suffers from drouth. This can not be remedied entirely by irrigation, for it appears that moist air is also essential. As a result, the

FIGURE 67.

SMOOTH ARIZONA CYPRESS—*Cupressus glabra*.

Along highway south of Newhall, Los Angeles Co., Calif. This is one of the earliest plantings in southern California, and the trees are well over 30 years old. *Coll. No. 7689*. Photos Dec. 11, 1935.

A—Tree about 8 m. high Neg. No. 3872.

B—Trunk 8 dm. in diam. Neg. No. 3874.

FIGURE 68. Mexican Cypress.

trees have shown obvious distress in some of the plantings, have numerous Cypress Cankers, and the accompanying insect borers.

Trees of the Mexican Cypress in our tests which were alive in 1945 had attained an average height of 23 feet with a minimum of 16 feet and a maximum of 32 feet (largest Monterey Cypresses in tests were only 36 feet high). The best trees of the Mexican Cypress were at the Limoneira Ranch where they averaged 29 feet in height. On the other hand, trees in the sandy land east of Anaheim were removed in 1940 because of numerous Cypress Cankers and general lack of vigor. Trees at the Citrus Experiment Station and the Wardman Riverside Ranch have demonstrated the unsuitability of the species to dry interior habitats. Although the trees have grown rather rapidly, they have shown yellowing of the foliage and other indications of drouth each summer and fall, and also have a few Cypress Cankers.

The bluish-green gracefully drooping foliage and the whitish young cones make the Mexican Cypress a truly beautiful species, and judging from the information about the use of the species in Mexico and in parts of Europe, it is truly a valuable ornamental. However, its susceptibility to Cypress Canker and its obvious need of a moister climate make it an undesirable species for use in California.

TECATE CYPRESS—*Cupressus Forbesii*

The Tecate Cypress was long confused with Gowen Cypress, Sargent Cypress and Guadalupe Cypress, and it is only in recent years that its distinctive identity has been established. There is no evidence that anyone ever considered the Tecate Cypress of horticultural interest until after this Garden propagated it in 1927, unless some individual or nurseryman in the San Diego region grew a few plants. However, this was only natural for practically all of the wild plants in the mountains of San Diego and Orange Counties are so unattractive that no one would suspect that they would respond so well under cultivation.

I think it is of particular interest to mention that after this Garden has spent more than 10 years in studying and testing cypresses from all parts of the New World in an attempt to find suitable substitutes for the Monterey Cypress, one of the most outstanding should be the Tecate Cypress which grows within a mile or two of the Botanic Garden and can be seen on practically every day of the year.

FIGURE 68.

MEXICAN CYPRESS—*Cupressus lusitanica*.
South of Mexican Village, Rancho Santa Ana. Prop. No. 2356, tree 6-7 m. (21 ft.) high, planted April 5, 1937. Note the flexible or pendulous branches. Trees in background are Arizona Cypresses (Prop. No. 2357) planted at the same time. Photo July 9, 1945. Neg. No. 6109.

FIGURE 69. Tecate Cypress. See opposite page.

We have propagated 16 different lots of Tecate Cypressess from seeds for a total of nearly 10,000 young plants in the nursery. Of these, nearly 5,000 were used in the Botanic Garden, the various test plots and miscellaneous plantings. The remaining 5,000 were largely distributed to various parks and individuals in California, and we unfortunately do not have records as to their performance. Of the approximately 5,000 Tecate Cypressess which we can account for as having been planted, there are over 2,000 still alive.

In the nursery the Tecate Cypress has consistently shown itself to be one of the easiest species to grow and nearly every planting of seeds has yielded a surplus of seedlings over and above all that were required for use. It is of interest to note that a single ounce of Tecate Cypress seed has produced 750 plants (plantable size), and that of all species grown, the average for the best lot of each was only 293 plants. It is also of interest that, in general, the seeds of the Tecate Cypress germinate quickly and are soon ready for transplanting, the best record for the species being 38 days, whereas, no other species grown was ever first transplanted before 62 days, and the average for the best performance of all species was 91 days.

Plants of the Tecate Cypress grown in flats and transplanted direct to the field have not proven as easy to handle as the old standard Monterey Cypress, but even where sizeable losses are incurred by such methods, closer planting can be practiced and still be more economical than planting from containers.

By the time the various cypress test plots were being laid out for planting in the spring of 1935, the Tecate Cypress had already given promise of being a valuable species for use as a substitute for the Monterey Cypress. It was, therefore, used more extensively than most of the other species and has, thus, been more thoroughly tested.

The various strains of Tecate Cypress have exhibited certain minor differences which under cultivation are of some significance but could probably never have been detected in the wild, and which do not appear to be worth designating by any system of names except that of locality. The different lots of Tecate Cypressess can be discussed as Guatay Mountain (*Prop. Nos. 2314 and 2315*), Sierra Peak (*Prop. Nos. 2319 and 2320*), Mt. Tecate (*Prop. Nos. 2330 and 2331*) and Otay Mountain (*Prop. Nos. 2332, 2333, 2334, 2335 and 2336*).

Trees of Tecate Cypress from Guatay Mountain have been rather consistently somewhat slower growing than those from the other localities but have produced a rather fine compact growth and

FIGURE 69.

TECATE CYPRESS—*Cupressus Forbesii*.

In Rancho Santa Ana Botanic Garden Test Plot, *Prop. No. 2315*, tree No. 2, about 4 m. (12 ft.) high, planted March 28, 1936. The narrow growth is typical for this and *Prop. No. 2314*, both of which came from Guatay Mt. Photo July 9, 1945. Neg. No. 6062.

FIGURE 70. Tecate Cypress. Explanation opposite.

have not had so many side branches which flop over out of place.

Trees of the Tecate Cypress from Mt. Tecate have been more rapid in growth and are little less compact than those from Guatay Mountain.

There is little difference in the appearance of trees of the Tecate Cypress from Sierra Peak and Otay Mountain. However, from the point of vigor and actual total amount of growth, the Otay Mountain plants have proven to be slightly superior. For this reason, it would probably be best for horticultural purposes to gather seeds from Otay Mountain.

The Tecate Cypress has been an outstanding species in all of the test plots except those where all species were poor or the plot was abandoned for lack of care. Trees at the Limoneira Company of all lots of Tecate Cypress are outstanding with many individuals over 30 feet in height (maximum was 32 feet in height of *Prop.* No. 2319). Trees of the Monterey Cypress in the same plot reached a maximum of 36 feet, of which the last 5 or 6 feet is made up of a slender whip-like leader, whereas, the Tecate Cypress lacks such a slender tip. East of Anaheim in sandy land the Tecate Cypress, along with the other species, has shown itself poorly suited to such conditions, and it is doubtful if it should be planted elsewhere under such soil and moisture conditions. In the Riverside and Chatsworth plots the Tecate Cypress has performed beautifully and appears to be likely to be a useful tree for such interior areas. However, in such interior areas, the Tecate Cypress is not sufficiently drouth resistant to do more than barely remain alive unless irrigated. When furnished adequate water, it thrives and does not in the least suffer from the hot dry summer and fall weather. At both Riverside and Chatsworth, the Tecate Cypresses have survived the most severe east or desert winds so common in the fall months without more than minor tip burn of the foliage, while adjacent eucalyptus and citrus have been severely defoliated.

The Tecate Cypress is unlikely to prove as valuable for some types of plantings as the old familiar Monterey Cypress because it loses its lower branches or "light kills" when deprived of adequate light. For this reason it should not be crowded and is not satisfactory as a filler for eucalyptus windbreaks. As an untrimmed hedge or windbreak, it makes excellent growth provided there is adequate space and proper drainage. Very few clipped hedges have been attempted. The Limoneira Company has trimmed the sides of their Tecate Cypress with a power clipper, and the results are fine. In

FIGURE 70.

TECATE CYPRESS—*Cupressus Forbestii*.
In Rancho Santa Ana Botanic Garden near the garage. *Prop.* No. 221, about 5 m. (16 ft.) high, planted 1931. Tree to right is a Tecate Cypress (*Prop.* No. 2335). This tree shows the rounded crown which is likely to develop in this species. Photo July 6, 1945. Neg. No. 6019.

FIGURE 71. Tecate Cypress. Explanation on opposite page.

1939 part of our test planting at Rancho Santa Ana was burned by the Santa Fe Railroad section crew. At the time the Tecate Cypressess were 12 to 13 feet high and about 5 to 6 feet spread. In an effort to restore this portion of the row, it was trimmed into a hedge 10 feet high and about 4 to 5 feet thick. Since then it has received one annual clipping and has filled in beautifully, demonstrating that the species will stand clipping. In this respect, it may prove to be superior to the Monterey Cypress, for its branches and branchlets are much finer and are less difficult to trim.

In only two instances, have plantings of Tecate Cypress been made in close proximity to the ocean. A few trees were planted on the Sheldon property at Carpinteria, and a few were tested by Eric Walther in Golden Gate Park. In both instances, the plants were obviously out of place and did not thrive, indicating that the species is definitely not suited to immediate coastal conditions.

For many years we thought that the Tecate Cypress was immune to Cypress Canker, but this has not proven to be the case. One of the first infections was in *Prop. No. 2314* in Rancho Santa Ana Test Plot, but the tree did not die for over 5 years. Numerous other infections have been found, especially branch infections which seem to have started as the result of abrasions of the bark. In some instances, these have existed for several years without spreading. In no instance thus far, has a Tecate Cypress died quickly from Cypress Canker as several other species do when attacked.

The Tecate Cypress has not yet been tested sufficiently long to determine if it has gained a permanent place in California horticulture. It has been accepted by numerous nurserymen who sell it for hedges and windbreaks. Mr. Jensen, of the Limoneira Company, upon watching the performance of it in our test plots, decided it was a better gamble than the Monterey Cypress so he grew thousands of seedlings which have been planted into miles of wind-break rows for their citrus orchards.

Of all of the cypresses tested in an effort to find a substitute for the Monterey Cypress, the Tecate Cypress has emerged as the only one with green foliage which is reasonably free from Cypress Canker, and which seems likely to merit horticultural consideration from other standpoints. It probably never will grow as tall as the Monterey Cypress, will not thrive so well when crowded, and will not grow on the immediate coast, but is likely to prove superior in interior sections.

FIGURE 71.

TECATE CYPRESS—*Cupressus Forbesii*.

At Hagen Ranch, Chatsworth, Calif. Block 5 from S.W. *Prop. No. 2315*, first tree at left is about 6 m. (20 ft.) high, planted March 4, 1937. Originally these trees were alternated at 5-foot spacing with Santa Cruz Cypress (*Prop. No. 2186*), but these were removed in spring of 1940. The additional spacing has been beneficial to the Tecate Cypressess. Photo Dec. 20, 1944. Neg. No. 5723.

FIGURE 72. Tecate Cypress. See opposite page.

GUADALUPE CYPRESS—*Cupressus guadalupensis*

The Guadalupe Cypress was early introduced into cultivation. Seeds seem to have been sent to Europe about 1880 and about the same time to California. Scattered around the Los Angeles region and the San Francisco Bay region of California are many fine old Guadalupe Cypressess of 50 or 60 feet in height, oftentimes of 30 or 40 feet in spread and with trunks up to 4 feet in diameter. Because of their bluish foliage, these trees are frequently called Blue Cypress. Even the oldest and largest trees which I have seen in California have smooth exfoliating dark red or purple-red bark. An old ranch at the corner of East 8th Street and Chicago Avenue in Riverside, California has nearly a dozen old trees which the owner told me were approximately 50 years old. The largest of these are nearly 60 feet high and have trunks between 3 and 4 feet in diameter. A specimen in the California Academy of Sciences Herbarium is said to have come from a tree 70 feet high, 50 feet spread and a trunk 3 feet in diameter. It was collected 2 miles from Napa, California on September 11, 1927 at the C. J. Buhmar property. A photograph in the same institution shows a tree which grew at San Rafael, Marin County, California which appears to be about 60 feet high and 30 feet in spread.

The Guadalupe Cypress has demonstrated over a long period of years that it will thrive in California from San Diego to the Bay Region and inland at least to Riverside. However, nowhere have I ever seen a specimen bearing cones. As a result, nurserymen have had to depend on seeds from Guadalupe Island or else grow the species from cuttings. In recent years it has been practically an impossibility to purchase a Guadalupe Cypress in any California nursery.

In 1933 we obtained a limited amount of seeds of the Guadalupe Cypress through the courtesy of Mr. J. T. Howell, of the California Academy of Sciences, who had recently collected the species on Guadalupe Island. From this seed, 50 plants were grown to planting size. In 1934, 20 of these were planted along the southwest boundary of the Botanic Garden. In 1936, 2 of these were transplanted to the Rancho Santa Ana Test Plot as little trees 30 and 36 inches high each. These were 24 and 21 feet high in 1942, but the latter tree was blown over in the windstorm of 1943. The other tree is now 32 feet high, about 10 feet in spread and is only slightly bluish-foliaged. The remaining 18 trees in the Garden are under 20 feet

FIGURE 72.

TECATE CYPRESS—*Cupressus Forbesii*.
At the Limoneira Company, Santa Paula, Calif., along Olive Road. These trees now 5 m. (16 ft.) high, spaced about 2.5 m. (7.8 ft.) apart, the trunks 1.5 dm. (6 in.) in diam. Trees planted out about 1938, grown from seed by the Limoneira Company. Several miles of similar plantings have been made by the company. Photo Dec. 20, 1944. Neg. No. 5754

FIGURE 73. Guadalupe Cypress. Explanation opposite.

high, are much bluer in color, but are in a dry situation and have not been irrigated for many years.

The Guadalupe Cypress has fine foliage very similar except for its bluish color to that of the Tecate Cypress. The two species are alike in many other respects, especially in their rounded crowns which generally lack a central leader and in their smooth exfoliating cherry-red or purplish-red bark. The Guadalupe Cypress is, apparently, a much larger tree at maturity than the Tecate Cypress.

I have yet to see a cultivated tree of the Guadalupe Cypress in California which has contracted Cypress Canker. This is an important consideration when it is remembered that, in most instances, Monterey Cypresses have died out with Cypress Canker in surrounding areas.

MONTEREY CYPRESS—*Cupressus macrocarpa*

The Monterey Cypress appears to have first been cultivated in England about 1838 from seeds distributed by Lambert. For convenience, Gordon called the plants *Cupressus Lambertiana*, but the name was not properly published. About the same time, Low's nursery at Clapton grew plants from seeds obtained from Dr. Fischer at St. Petersburg, and which were said to be a new species from California. Thus, by 1847 when Hartweg's description of *Cupressus macrocarpa* was published, the species had already become rather well known in English gardens as *Cupressus Lambertiana*. Differences in growth habit of seedlings confused the European botanists and gardeners, and even up to recent times there has been an attempt to differentiate between *Cupressus macrocarpa* and *C. Lambertiana*. In addition to this confusion, there have been several horticultural varieties described including varieties *fastigiata*, *Crippsii*, *lutea*, *farallonensis*, and *pygmaea*. In addition, *Cupressus Reinwardtii* and *C. Hartwegii* are merely variants. None of these variations, except the golden form (var. *lutea*), seems to have ever been cultivated in California.

The Monterey Cypress has been introduced into many of the warm regions of the world and has been particularly successful in South Africa, New Zealand and Australia. In a letter to me dated July 16, 1940, S. H. Wimbush, Assistant Conservator of Forests, Nairobi, Kenya, East Africa, requesting seeds of cypresses stated: "We have planted some 15,000 acres of cypresses during the past 15 years in Kenya, mostly *Cupressus macrocarpa* and various types of *Cupressus lusitanica*. They are being grown for timber on a 40-years rotation; we hope to get 24 inch diameter logs in this time. Our

FIGURE 78.

GUADALUPE CYPRESS—*Cupressus guadalupensis*.
At Rancho Santa Ana Botanic Garden, south of desert section. Prop. No. 2069,
planted March 12, 1934. Center tree is nearly 6 m. (18 ft.) high. Photo July 9,
1945. Neg. No. 6107.

FIGURE 74. Guadalupe Cypress. Explanation opposite.

oldest *Cupressus macrocarpa* is 30 years old and has reached 120 feet in height."

In California the Monterey Cypress occupied a unique position in that it was for many years a very reliable fast growing tree for use as a hedge, windbreak or as an individual specimen. Its ease of propagation, transplanting and minimum requirements as to care made it a most useful plant. Prior to 1930, the Monterey Cypress was always in great evidence in every nursery where flats of 100 small plants 6 to 12 inches high were sold for a few dollars. Larger plants of 2 to 3 feet in height were offered in gallon cans, often for only 10 or 15 cents each. Because of their cheapness, as well as their ability to thrive under so many conditions, they were extremely common throughout California.

Golden Gate Park in San Francisco owed much of its charm for many years to the thousands of Monterey Cypresses which grew to heights of 75 feet or more and produced massive trunks several feet in diameter. The Arboretum and other parts of the Stanford University Campus were dotted with large Monterey Cypresses. Similarly, many large specimens were on the University of California Campus at Berkeley, California. In Southern California from Santa Barbara to San Diego the coastal areas had thousands of Monterey Cypress hedges for gardens and hundreds of miles of windbreaks for citrus plantings, particularly in Ventura and Orange Counties. North of San Francisco Bay, and especially along the immediate coast, there are still many fine massive hedges and windbreak rows of Monterey Cypresses. Some of these are walls of green 40 to 50 feet high and have been clipped on their sides to uniform widths of 30 feet or more.

In view of the extensive usage that had been made of the Monterey Cypress in California, it was only natural that the species should be grown in large quantities in the early stages of Rancho Santa Ana Botanic Garden. Seeds planted in 1927 (*Prop. Nos. 39, 40 and 239*) produced over 5000 young trees, of which hundreds were used in the Garden, on adjacent Rancho Santa Ana, and most of the remainder were distributed to parks and other public places in Southern California. By 1934, the Cypress Canker had so seriously attacked the plantings of Monterey Cypress in the Garden and on the adjacent Rancho Santa Ana that it was no longer deemed advisable to plant the species except in conjunction with tests to find substitutes.

Plants grown from seeds from the trees at Point Lobos and from Point Cypress are far from uniform, and it is little wonder that European botanists and horticulturists have segregated and named so many variations, all of which seem to be perpetuated when propagated from cuttings. In California, however, the plants used in

FIGURE 74.

GUADALUPE CYPRESS—*Cupressus guadalupensis*.
Cultivated at San Rafael, Marin Co., Calif. Photo March, 1921, by Lewis Allen.
From the collections of the California Academy of Sciences, courtesy of J. T. Howell.

FIGURE 75. Monterey Cypress. Explanation on opposite page.

horticulture have been almost exclusively grown from seeds, and no attempt at standardization of growth form or shape was ever seriously attempted, nor could it be done profitably when it is remembered that the plants were sold at extremely low prices.

Dr. Wagener has noted that a few isolated instances of apparent resistance to the attacks of Cypress Canker have been found among Monterey Cypresses and has suggested that work should be undertaken to test these in the hope of finding such usable material. There are several merits to his proposal, but the most important is that none of the cypresses which have been propagated in our tests is in every sense of the word a good substitute. The Tecate Cypress, which is the only truly green-foliaged species, is splendid in some localities but has not proven itself to be at all suitable for planting on the immediate seacoast.

Perhaps, the Monterey Cypress will remain free from Cypress Canker in other parts of the world, but in California it should no longer be planted because of its high susceptibility to the disease. This recommendation applies to all parts of California except the areas immediately adjacent to the coast in Sonoma, Mendocino and Humboldt Counties where the damp climate or other conditions are such that the Cypress Canker has not yet gained a foothold.

MENDOCINO CYPRESS—*Cupressus pygmaea*

The Mendocino Cypress has been little used in cultivation, and reports of it in England and Europe are regarded with doubt because of the great confusion that has existed regarding it and Gowen Cypress and Sargent Cypress. A few plantings of hedges of Mendocino Cypress have been made in the vicinity of Fort Bragg and elsewhere on the Mendocino County coast of California, but I have not had time to check on their history. Prof H. E. McMinn has a few trees of this species growing in his California native plant garden at Mills College, and there are also some specimens at the Santa Barbara Botanic Garden, but both of these plantings are comparatively limited and of small size so that they do not need to be discussed in detail.

We have grown the Mendocino Cypress since 1927 when the first lot of seeds (*Prop. No. 270*) yielded 1720 plants in the nursery. In 1930 another lot of seeds (*Prop. No. 1044*) was obtained at Fort Bragg, and 80 plants were grown (many seedlings were discarded). In 1934 the species was again collected for propagation (*Prop. Nos.*

FIGURE 75.

MONTEREY CYPRESS—*Cupressus macrocarpa*.

On Rancho Santa Ana Botanic Garden Test Plot. A—*Prop. No. 2178*, tree No. 18, planted Feb. 12, 1937, over 7 m. (23 ft.) high. Compare this open growth with that in B. Of 24 trees of number 2178 planted in this area, only 2 remained at the time this picture was taken and both had Cankers. Photo July 9, 1945. Neg. No. 6084. B—*Prop. No. 2184*, planted Feb. 12, 1937, 6.7 m. (19-22 ft.) high. Small trees are Cuyamaca Cypress. Photo July 9, 1945. Neg. No. 6086.

FIGURE 76. Mendocino Cypress. See opposite page.

2133, 2134, 2135 and 2137), and from these seeds approximately 1060 plants were grown.

The Mendocino Cypress has more features in common with the Monterey Cypress as to growth habit and appearance than it does with the Gowen Cypress to which it seems to be much more closely related and to which it has often been reduced to synonymy. Cultivated plants of the Mendocino Cypress early develop a long, whip-like leader, a rather open branching system and pronounced straight central axis, in which respect the species has more of the desirable qualities of a forest or timber tree. In contrast to the Monterey Cypress, the individual branchlets are not so coarse, but the color of the foliage is a dull dark green and is not as attractive as the Monterey Cypress, which is usually a good deep green. On the other hand, both the Gowen Cypress and the Santa Cruz Cypress have a rich bright green foliage.

In our 10-year-old test plots, the tallest trees of the Mendocino Cypress are 34 feet in height and are located at the Limoneira Ranch where, under the same conditions, the tallest trees of the Monterey Cypress are 36 feet high. However, there is probably about fifty per cent more woody growth in the Monterey Cypress of the same height. Cultivated trees grown from seeds collected at Fort Bragg and Mendocino City are rather uniform in appearance and performance, but the seedlings of the Anchor Bay material (*Prop. No. 2137*) are straggly narrow trees and, in most every feature, are undesirable horticulturally.

In practically every planting except those at the Limoneira Company, the Mendocino Cypress has done poorly. It is obviously unsuited to dry interior situations and suffers from lack of moisture during the summer months. As a result, or at least as a corollary, it is highly susceptible to Cypress Canker, borers and other damage. For these reasons, it could only be used in situations on the seacoast and might have some value along the north coast of California where Cypress Canker is practically unknown. However, in those regions, the Monterey Cypress would be superior in every way.

GOWEN CYPRESS—*Cupressus Goveniana*

The Gowen Cypress was introduced into cultivation in England in 1846-47 by Theodore Hartweg, who had collected the original specimens and seeds on Huckleberry Hill, Monterey County. Hartweg also introduced the Monterey Cypress at the same time, al-

FIGURE 76.

MENDOCINO CYPRESS—*Cupressus pygmaea*.
At Rancho Santa Ana Botanic Garden Test Plot. A—*Prop. No. 2133*, tree No. 5, planted March 28, 1936, 5 m. (16 ft.) high. Photo July 9, 1945. Neg. No. 6079.
B—*Prop. No. 2137*, tree No. 7, planted March 28, 1936, over 4 m. (14 ft.) high. Open growth characteristic of this strain. Photo July 9, 1945. Neg. No. 6082.

FIGURE 77. Gowen Cypress. See opposite page.

though the species seems to have been introduced slightly earlier via the Russians.

The Gowen Cypress was, apparently, immediately popular in England. It soon reached France, and in a short time several horticultural varieties and even new specific names were applied to its variants in cultivation. The most important of these were: *C. californica* Carr. (1855); *C. cornuta* Carr. (1866); *C. Goveniana* var. *attenuata* Carr. (1867); var. *pendula* Elwes & Henry (1910); and var. *viridis* Carr. (1867). The importance of these variants in English or Continental gardens can not be determined without first-hand studies. In California, none of these seems to have been used or recognized by horticulturalists. Statements in literature regarding the cultivation of Gowen Cypress must be interpreted with considerable caution since for many years the name was applied to plants which, in this treatment, are listed as the Santa Cruz, Sargent, Mendocino or Tecate Cypresses.

In 1926 and '27, there was a small tree of Gowen Cypress in the experimental botanical garden at Stanford University. It had been grown by Prof. McMurphy from seeds collected at Huckleberry Hill. At that time, it was about 15 feet high. There were also several other specimens of the species on the Stanford Campus, but I think they have all died or have been removed. At the present time, I do not know of any cultivated trees of this species in California, except a few in Prof. McMinn's experimental garden at Mills College and at the Santa Barbara Botanic Garden.

My knowledge of Gowen Cypress in cultivation is, therefore, based almost exclusively on the plants grown at this Garden from seeds collected from the wild trees on Huckleberry Hill and back of Point Lobos. In the fall of 1930, I collected two lots of seeds (*Prop. Nos. 1069 and 1070*) from trees at Huckleberry Hill. From these seeds, about 1150 plants were grown to planting size in the nursery without difficulty. Seventy-five plants of each of these two lots were set out in the Garden in the fall of 1931. These grew well, and few were lost during the first few years. In 1935 thinning accounted for 19 trees. Thereafter, the Cypress Canker began to take its toll, and only 16 trees were left when the fire of 1943 swept through the bed and killed them all. However, several of these were infected with Canker but had grown to maximum heights of about 25 feet.

In 1934 two lots of seeds were collected back of Point Lobos (*Prop. Nos. 2179 and 2181*) and two lots from Huckleberry Hill

FIGURE 77.

GOWEN CYPRESS—*Cupressus Goveniana*.
In Rancho Santa Ana Botanic Garden Test Plot. *Prop. No. 2182*, tree No. 18, planted Feb. 12, 1937, over 4 m. (14 ft.) high. Infected with Canker. Photo July 9, 1945. Neg. No. 6076.

FIGURE 78. Santa Cruz Cypress. Explanation opposite.

(Prop. Nos. 2182 and 2183). Over 1000 plants were grown in the nursery from these, and approximately 415 were used in various plantings of which only 73 were still alive in 1945. The best trees are on the Limoneira Company plot and are 26 feet high with an average of 20, 22 and 23 feet in height for the different lots and mainly free from Canker. In contrast to these, the Gowen Cyresses at the Citrus Experiment Station had all died but one which was 16 feet in height. Losses were due to a combination of Cypress Canker and an unsuitable environment. In the Rancho Santa Ana Test Plot, all Gowen Cyresses were removed in 1943 because of their high infection with Cypress Canker, although many were beautiful dense trees over 20 feet in height. In the Botanic Garden, the trees still alive range from 4 to 16 feet in height and average from 7 to 14 feet for the different lots. For several years they have received no irrigation, and their growth has been slowed. This has also slowed down the rapidity of the spread of the Canker, and trees with infections have remained alive for several years.

Gowen Cypress is a fast growing small tree with fine soft rich green foliage, and if it were not for its high susceptibility to Cypress Canker, it would be a highly desirable tree for planting along the immediate coast of California and other mild regions. Even if it were immune to Canker, it would not be a suitable tree for the hot interior sections, as evidenced by its performance at Riverside and to a lesser extent at Rancho Santa Ana. Along the immediate coast of northern California in Sonoma, Mendocino and Humboldt Counties, it is probable that Gowen Cypress could be used safely for low hedges and windbreaks. Because of its denser growth and softer foliage, it might be more desirable than the old familiar Monterey Cypress.

SANTA CRUZ CYPRESS—*Cupressus Abramsiana*

Although the Santa Cruz Cypress has long been known to occur in the Santa Cruz Mountains of California, it has heretofore been referred either to Gowen Cypress or Sargent Cypress.

The only evidence to indicate that the species was ever cultivated prior to its propagation at Rancho Santa Ana Botanic Garden from seeds collected at Bonnie Doon in 1934 was supplied me by Mr. John F. Boylan of Mount Hermon, Santa Cruz County, California who wrote me regarding the Bonnie Doon Cyresses under date of February 5, 1940, in part, as follows: "About 60 years ago two seedlings from this grove were transplanted into richer soil about two miles distant, and when they were cut down recently, they

FIGURE 78.

SANTA CRUZ CYPRESS—*Cupressus Abramsiana*.
In Rancho Santa Ana Botanic Garden Test Plot. Prop. No. 2185, tree No. 3,
5-6 m. (18 ft.) high, planted March 28, 1936. Photo July 9, 1945. Neg. No. 6072.

FIGURE 79. Santa Cruz Cypress. See opposite page.

measured 4 feet in diameter at the stump and they had a spread of 50 feet. None of the trees in the grove is that large."

We have grown the Santa Cruz Cypress from two lots of seeds collected in 1934 (*Prop. Nos. 2185 and 2186*, our Bonnie Doon No. 1 and No. 2 Strains). A third collection of seeds from Eagle Rock in 1943 (*Prop. No. 4910*) has not yet been propagated because of wartime labor shortages. Since the plants at Bonnie Doon had been referred to Sargent Cypress, we first carried them in the nursery under that name, although we had realized that they differed from typical Sargent Cypress. The seedlings of the Santa Cruz Cypress early showed a bright green color in contrast to the dull green of Sargent Cypress. In fact, they looked a great deal like those of Gowen Cypress. No difficulties of propagation were encountered; and, in general, it can be said that the Santa Cruz Cypress is about as easily propagated from seed as any other cypress. Approximately 1200 plants were grown to usable size from seeds of *Prop. Nos. 2185 and 2186*. Of these, 1108 were utilized in the various plantings, but only 185 are now alive. In test plots abandoned at the end of the first or second year, 162 were used; 130 were planted on the Hagen Ranch but were removed when it became evident that the species was highly susceptible to Cypress Canker; 481 were planted in Pine Canyon in the Botanic Garden but were destroyed in the fire of 1943. Of the remaining trees, the smallest is 5 feet high, the largest is 30 feet high (at the Limoneira Ranch), and the average for all is 16 feet. Trees of the Santa Cruz Cypress planted adjacent to those of the Tecate Cypress at the Citrus Experiment Station are hardly distinguishable from a distance, although the foliage of the former is slightly harsher.

It was a great disappointment to find that the Santa Cruz Cypress was highly susceptible to Cypress Canker, although I had come to the conclusion that it would be because of its botanical affinities with the Gowen Cypress, a species which was known to be highly susceptible to the Cypress Canker. In the Botanic Garden planting, the 25 trees of *Prop. No. 2185* are still practically without Cypress Canker, while adjacent to it are 16 trees of *Prop. No. 2186* of which most of the trees are infected. This is, perhaps, the result of chance rather than differences in resistance.

Since no wild trees of the Santa Cruz Cypress are known which are much over 30 feet in height, and the largest which we have grown are of about the same height, it is difficult to suggest what the maximum height will be; but, in view of Mr. Boylan's data on the two old trees grown near Bonnie Doon, it would seem that the

FIGURE 79.

SANTA CRUZ CYPRESS—*Cupressus Abramsiana*.
At the Limoneira Company, Santa Paula, Calif. Seven trees to right of gap are *Prop. No. 2185*, planted March 10, 1936; largest tree is over 8 m. (28 ft.) high. Photo April 12, 1945. Neg. No. 5891.

FIGURE 80. Sargent Cypress. Explanation opposite.

species would attain rather sizable proportions under good conditions. However, it is our recommendation that the Santa Cruz Cypress should not be cultivated anywhere in Southern California because of its high susceptibility to Cypress Canker. On the other hand, its dense growth of fine green foliage indicates that it would be a superior tree for trimmed hedges or low windbreaks. It would, therefore, be well worth trial along the immediate coastal areas of northern California in Sonoma, Mendocino and Humboldt Counties in situations where the Monterey Cypress is too coarse and likely to be too large.

SARGENT CYPRESS—*Cupressus Sargentii*

Sargent Cypress was so long included under Gowen Cypress that it is difficult to determine when it was first cultivated. However, as far as I have been able to determine, it has never received any serious consideration in horticulture. Van Rensselaer (Trees of Santa Barbara 31. 1940) reports a 30-foot tree in the garden of Edgar B. Davison in Ballard, California, propagated from seeds collected by him in the San Rafael Mountains in 1908. A few other trees are known to be in cultivation in California, but they are no older than many of those grown at this Garden.

In general appearance, most trees of Sargent Cypress in cultivation are a rather dull, dusty green and are neither distinctly gray, as in some species such as the Piute or Modoc Cypresses, or green, as the Gowen or Tecate Cypress. This foliage feature, although desirable for certain usages, is generally not as acceptable as a more pronounced color. Most strains of Sargent Cypress develop a definite central trunk, rather stiff lateral branches, and a rather slender growth habit. There are, however, some broad low-growing strains which will be mentioned below.

We have grown 27 different lots of Sargent Cypress seeds in the Garden nursery. These represent practically every known wild locality where the species grows. The first Sargent Cypresses grown were planted in 1927 (Prop. Nos. 252, 266 and 267). All of these in the Garden bed plantings were lost in the fire of 1943, at which time many were 18 feet high and had been producing cones for several years. Numerous instances of Cypress Cankers in these trees had been noted as early as 1940. A few trees of these (Prop. No. 252) are in the vicinity of the Administration Building where several on a southeast sloping hillside with adequate room have developed into

FIGURE 80.

SARGENT CYPRESS—*Cupressus Sargentii*.
In Rancho Santa Ana Botanic Garden Test Plot. A—Prop. No. 2157, tree No. 11, in center is 5-6 m. (18 ft.) high, planted Feb. 12, 1937. Photo July 9, 1945. Neg. No. 6074. B—Prop. No. 2141, tree No. 13, planted Feb. 12, 1937, about 3 m. (10 ft.) high. Notice the broad growth characteristic of trees of this species from Sonoma and Marin Cos. This tree with Canker. Photo July 9, 1945. Neg. No. 6066.

fine specimens about 20 feet high. Others in a crowded planting are largely losing their lower branches. In 1930 seed of Sargent Cypress was collected on Cedar Mountain, Alameda County (*Prop. No. 1058*). Trees grown from this locality have proven to be rather more vigorous than those from some other localities. In the Garden, a planting of 49 trees now has 44 trees, of which the largest are over 21 feet high. They are, however, too closely planted and are beginning to lose their lower branches.

In the various test plots set out in 1936-37, Sargent Cypress was used rather extensively because it was then thought it would remain relatively free from the Cypress Canker. This has not proven to be the case, but even if it had, there are other features which make it appear that Sargent Cypress is not suitable as a windbreak or hedge tree in areas where cultivation and irrigation are practiced. The principal defects of Sargent Cypress for such usage seem to be its need for adequate light and its preference for dry, rocky situations, neither of which can be provided in most such plantings. Tallest trees in the test plots are about 30 feet high and are at the Limoneira Ranch; some almost equally tall are at the Citrus Experiment Station. The best average growth is shown at the Hagen Ranch, Chatsworth where they have attained 23 feet in height, whereas, the average of all plots is 16 feet. This high average is largely due to the fine performance of trees of *Prop. Nos. 2157 and 2158* from Cedar Mountain, Alameda County which are especially vigorous in all localities.

Only at Rancho Santa Ana Botanic Garden, where the trees of Sargent Cypress are adequately spaced, has it been possible to really study their differences. Those from Camp Meeker and Occidental, Sonoma County (*Prop. Nos. 2140 and 2141*) and from Mt. Tamalpais, Marin County (*Prop. No. 2156*) are obviously different from all of the rest of the Sargent Cypresses. Nearly every tree is broader than high. One tree of the Occidental Strain (*Prop. No. 2141*) in May, 1945, was 9 feet high by 11 feet spread. Among the other numerous strains, there is little to indicate which are superior, except that the Cedar Mountain Strains (*Prop. Nos. 2157 and 2158*) and the Chorro Creek Strains (*Prop. Nos. 2167 and 2168*) are more vigorous. On the other hand, the Los Burros Strains (*Prop. Nos. 2174 and 2175*) are obviously weaklings or scrubs. Trees grown from an exceptionally gray or glaucous tree at Aetna Springs (*Prop. No. 2149*) have not been any grayer than those from the other lots of materials.

Although Sargent Cypress may yet prove itself to be valuable in horticulture in other regions, it is my conclusion that it merits little or no consideration in California gardens, largely because it has rather coarse foliage of a drab or neutral color, a rather poor growth habit, and a high susceptibility to Cypress Canker.

EXPLANATION OF TABLE XI

These counts were carefully made from selected samples of seeds, most of which have been stored in tightly closed glass jars. Variation is considerable, even between the counts of the same species, and is partially due to the presence of sterile or poorly developed seeds. Size of seeds or the number per unit of weight appears to have little or no correlation with the success of germination.

TABLE XI
APPROXIMATE NUMBER OF SEEDS OF CUPRESSUS
PER UNIT OF WEIGHT

Name	Source	1 Gram	1 Ounce (Avoir.)
ABRAMSIANA	Prop. No. 2185	140	4000
	Prop. No. 2186	145	4100
ARIZONICA	Herb. No. 11368	225	6400
	Herb. No. 11407	170	4800
BAKERI MATTHEWSII	Prop. No. 2130	280	8000
	Prop. No. 5051	350	9900
BAKERI TYPICA	Prop. No. 1006	280	8000
	Prop. No. 2128	315	9000
FORBESII	Prop. No. 2319	115	3200
	Prop. No. 2336	85	2400
GLABRA	Herb. No. 7690	140	4000
	Herb. No. 11426	140	4000
GOVENIANA	Prop. No. 2181	255	7200
	Prop. No. 2183	310	8900
GUADALUPENSIS	J. T. Howell No. 8297	55	1600
LUSITANICA	Prop. No. 2356	250	7000
	*Herb. No. 11292	525	14800
MACNABIANA	Prop. No. 2154	150	4200
	Prop. No. 5047	200	5700
MACROCARPA	Prop. No. 2177	145	4100
	Prop. No. 2184	135	3900
MONTANA	Prop. No. 3367	440	12400
NEVADENSIS	Prop. No. 2159	125	3500
	Prop. No. 2160	155	4400
PYGMAEA	Prop. No. 2135	235	6600
	Prop. No. 2137	250	7000
SARGENTII	Prop. No. 2141	150	4200
	Prop. No. 2168	100	2800
STEPHENSONII	Prop. No. 2313	95	2700
	Prop. No. 3370	125	3500
TOTAL		6085	172300
AVERAGE		228	5743

*This collection of seeds taken from plants cultivated in a test plot, and many of the seeds appear to be poorly developed and sterile, hence the large number.

EXPLANATION OF TABLE XII

This table represents the best production of plants obtained in the nursery for each species. It does not represent total germinations. In the cases of *C. guadalupensis* and *C. montana*, the figures should not be taken too seriously, for the original amounts of seeds planted were less than one ounce and were not originally weighed on a delicate balance. The average of 293 plants per one ounce of seeds, based on the best lot of each species, is nearly three times the average production of all lots for all species grown.

TABLE XII
BEST PRODUCTION RECORD PER 1 OZ. SEEDS PLANTED

Prop. No.	Name	No. of Plants
2186	ABRAMSIANA	350
2358	ARIZONICA	117
2131	BAKERI MATTHEWSII	125
2128	BAKERI TYPICA	225
2319	FORBESII	750
1070	GOVENIANA	400
2069	GUADALUPENSIS	200
2356	LUSITANICA	59
2154	MACNABIANA	192
239	MACROCARPA	205
3367	MONTANA	792
2160	NEVADENSIS	100
270	PYGMAEA	688
2149	SARGENTII	125
3370	STEPHENSONII	70

Average 293 plants per oz. for best lot of all kinds tried.

EXPLANATION OF TABLE XIII

Figures in this table were obtained from the data presented in Table XI. Although there is no assurance that transplanting or potting took place as soon as the plants were ready, it is true that, in general, all such work has been done very nearly at the proper time. In the case of *C. montana*, the seedlings were probably held in the original flat longer than necessary in order to permit as many as possible to germinate.

TABLE XIII
NUMBER OF DAYS AFTER SEEDING TO FIRST TRANSPLANTING
OR POTTING
(BASED ON BEST PERFORMANCE IN EACH SPECIES)

Prop. No.	Species	No. of Days
2186	ABRAMSIANA	62
2357	ARIZONICA	142
2130	BAKERI MATTHEWSII	133
2319	FORBESII	38
2179	GOVENIANA	64
2069	GUADALUPENSIS	Record missing
2356	LUSITANICA	98
1970	MACNABIANA	78
2184	MACROCARPA	66
3367	MONTANA	218
2160	NEVADENSIS	62
2135	PYGMAEA	62
2168	SARGENTII	62
3370	STEPHENSONII	104

91 days average for best lot of each kind.

EXPLANATION OF TABLE XIV

Plantings made in the Botanic Garden in regular beds have been maintained somewhat differently than miscellaneous plantings, in that those in beds have been regularly inventoried as to size and condition each fall, usually about October 1st. Included in the plantings of Table XIV are the trees also regarded elsewhere as the Rancho Santa Ana Botanic Garden Test Plot. The fire of 1943 caused great losses, but some of the species which were highly susceptible to Cypress Canker were already seriously reduced in numbers.

TABLE XIV

SUMMARY OF PLANTINGS OF CUPRESSUS IN REGULAR BEDS
IN BOTANIC GARDEN

	Total Prop. Nos.	No. Plants Planted	No. Alive May, 1945
ABRAMSIANA	2	53	41
BAKERI MATTHEWSII	2	47	0
BAKERI TYPICA	4	165	6
FORBESII	13	387	166
GOVENIANA	6	241	40
MACNABIANA	12	277	3
MACROCARPA	6	447	7
NEVADENSIS	3	117	51
PYGMAEA	6	360	11
SARGENTII	26	787	304
STEPHENSONII	2	36	19
TOTALS	82	2917	648

No. Kinds = 11

EXPLANATION OF TABLE XV

The plantings of cypresses in Table XV are those which come under the general classification of Cover Plantings or Miscellaneous Plantings. Such plantings usually have metal tags for each plant but are not regularly inventoried, although their location in the Garden is accurately recorded in the records. The entire east side of Pine Canyon in the Garden has been planted to an open stand of cypresses, but almost all of these were lost in the 1943 fire. Most early plantings of Monterey Cypress had died out from Cypress Canker prior to the fire.

TABLE XV

SUMMARY OF MISCELLANEOUS PLANTINGS OF CUPRESSUS IN THE BOTANIC GARDEN

Species	Total Prop. Nos.	No. Plants Planted	Approx. No. Alive - 1945
ABRAMSIANA	2	543	60
BAKERI MATTHEWSII	1	68	60
BAKERI TYPICA	3	433	18
FORBESII	10	1249	469
GUADALUPENSIS	1	20	18
MACNABIANA	4	839	5
MACROCARPA	3	429	1
NEVADENSIS	1	7	6
PYGMAEA	1	25	1
SARGENTII	12	582	50
TOTAL	38	4195	688

No. Kinds = 10

EXPLANATION OF TABLE XVI

This table presents information on a number of miscellaneous plantings of cypresses. Unfortunately, no records were kept on the distribution of a great many lots of surplus cypress trees, of which several thousand have been given away, mostly to public parks and other similar institutions.

TABLE XVI

SUMMARY OF MISCELLANEOUS PLANTINGS OF CYPRESS
EXCLUSIVE OF THOSE IN BOTANIC GARDEN OR IN FORMAL
TEST PLOTS.

Species	Total Prop. Nos.	No. Plants Planted	Approx. No. Alive - 1945
ABRAMSIANA	2	56	34
ARIZONICA	1	175	155
BAKERI TYPICA	1	100	?
FORBESII	4	577	115
LUSITANICA	1	31	9
MACNABIANA	1	52	42
MACROCARPA	3	1566	?
MONTANA	1	66	10
NEVADENSIS	1	1	?
PYGMAEA	2	237	40
SARGENTII	2	204	53
STEPHENSONII	1	6	?
TOTAL	20	3071	358

No. Kinds = 12

EXPLANATION OF TABLE XVII

This table shows the number of each lot of cypresses used in the test plots set cut in 1936-37. The upper figure of each column indicates the number planted; the lower figure of each column indicates the number alive 1944-45. Totals are indicated for the individual lots as well as for the different test plots.

PLANTINGS OF CYPRESSES IN TEST PLOTS — 1936-37

indicate number of trees alive 1944-45.

[illegible]

Limoneira Company

Wardman Riverside Wardman Anaheim

Species and Prop. No.

Rancho Santa Ana
 Botanic Garden
 Rancho Santa Ana
 Test Plot
 Rancho Santa Ana
 Mexican Village
 Harwood Orchard
 Del Mar Division
 Hagen Ranch
 Citrus Experiment
 Station
 Block 1 - Opal St. Ranch
 Block 2 - South of
 Lemons
 Block 3 - West of
 Lemons
 Block 4 - South of Canal
 North of Wagner Road
 Along Wagner Road
 North of Ball Road
 Ball Road Eucalyptus
 Jordan, Atwood
 Sheldon, Carpinteria
 Bryant Ranch
 Wagner
 Canker Tests, Stanford*

Totals

BAKERI MATTHEWSII

2130

2131

BAKERI TYPICA

2127

2128

FORBESII

2314

2315

24	13	7	5	5	5	8	10	2	8	7	89
0	12	7	5	5		0	6	0	0	0	35
23	19	7	5	5		16	11	2	8	7	103
0	19	6	5	5		0	6	0	0	0	41
26	15	7	5	5		8	13	2	8	7	99
2	12	7	5	5		0	0	0	0	0	33
29	14	7	5	5		8	12	2	8	7	97
5	12	7	5	5		0	0	0	0	0	34
20	18	19	6	31	8	6	12	4	21	7	177
0	12	15	6	31	4	6	0	0	0	0	95
13	12	18	7	86	5	7	20	2	8	7	210
11	9	17	7	81	5	3	14	0	0	0	169

EL ALISO

		11	529	36	47	3	61	78	74	8	19	48	22	33	34	37		8	75	7	1130
2319		2	276	22	43	3	51	65	25	7	13	0	21	0	21	0		0	0	0	549
		10	29	18	7		5	5	24		5		6	1		2	122		8	7	249
2320		9	21	10	6		5	4	15		5		4	0		0	0		0	0	79
		12	13	21	7		26	6	20		5		6	29		2			8	7	162
2330		6	5	8	6		25	4	17		4		6	0		0			0	0	81
		25	12	24	8		5	7	23		5		7			2	112		8	7	245
2331		2	3	11	8		5	4	19		5		4			0	0		0	0	61
		27	13	22	7		3	14	21		5		6	26		2		12	8	7	173
2332		21	9	17	7		3	10	14		3		4	0		0		0	0	0	88
		10	12	18	7		5	5	22		5		6			2			8	7	107
2333		10	4	11	7		5	3	16		5		6			0			0	0	67
		27	12	30	8		5	7	20		5		6			2			8	7	137
2334		23	9	10	7		5	5	19		4		6			0			0	0	88
		28	12	21	7			5	20		5		7	27		2			8	7	149
2335		15	9	12	7			3	16		5		0	0		0			0	0	67
		31	12	20	7			5	22		5		7			3			8	7	127
2336		22	7	7	7			3	13		5		1			0			0	0	65
GOVENIANA																					
		17	12		8			5					6			2		64	23	7	144
2179		5	0		7			1					0			0		0	0	0	13
		25	11		7	3		5					6			2		10	18	7	94
2181		15	0		7	2		3					0			0		0	0	0	27
		19	12		7			5					7			2		10	18	7	87
2182		12	0		5			0					0			0		0	0	0	17

Species and Prop. No.				Limoneira Company		Wardman Riverside Wardman Anaheim	
2183	20	10	8	0	7	6	3
GUADALUPENSIS	Rancho Santa Ana Botanic Garden						
	Rancho Santa Ana Test Plot						
	Rancho Santa Ana Mexican Village						
	Harwood Orchard						
	Del Mar Division						
	Hagen Ranch						
	Citrus Experiment Station						
	Block 1 - Opal St. Ranch						
	Block 2 - South of Lemons						
	Block 3 - West of Lemons						
	Block 4 - South of Canal						
LUSITANICA	North of Wagner Road						
	Along Wagner Road						
	North of Ball Road						
	Ball Road Eucalyptus						
MACNABIANA	Jordan, Atwood						
	Sheldon, Carpinteria						
	Bryant Ranch						
	Wagner Canker Tests, Stanford*						
2111	15	12	0	15	17	7	3
2112	0	13	7	10	2	0	21
2114	0	9	0	10	9	0	0
2069	2	1	1	2	1	2	1
2356	26	19	7	3	10	6	10
2111	15	12	0	15	17	7	3
2112	0	13	7	10	2	0	21
2114	0	9	0	10	9	0	0
Totals				100	16	100	16

	22	6							8	7	43	HORTICULTURE OF NEW WORLD CYPRESSES
2115	0	4							0	0	4	
		2									2	
2116		2									2	
	9	1									10	
2117	0	0									0	
	25	12	8	5	5	8	10	2	32	7	114	
2118	0	9	6	5	3	0	6	0	0	0	29	
	15	12								7	34	
2119	0	9								0	9	
	15	12								7	34	417
2121	0	12								0	12	
	15	12								7	34	
2122	1	11								0	12	
	15	15	7		7	8	10	3	7	72		
2125	0	11	7		4	0	7	0	0	29		
	15	13							7	35		
2126	0	9							0	9		
	14	15	7		5		11	2	8	12	74	
2143	0	6	5		3		6	0	0	0	20	
	15	12	7		5		10	2		12	63	
2144	1	9	7		5		5	0		0	27	
	16	12	8				10	2	8	12	68	
2148	1	6	5				1	0	0	0	13	

[illegible]

2160	23	12	67	7	3	20	15	25	10	2	8	7	204		
PYGMAEA	0	10	48	7	3	20	15	0	7	0	0	0	110		
2133	21	12		7	3		5			10	2	60	18	7	145
2134	3	0		7	2		0			0	0	0	0	0	12
	22	11		7			5			10	2	10	18	7	92
	1	0		7			1			0	0	0	0	0	9
2135	20	11		7			5			10	3	9	18	7	90
	2	0		4			1			0	0	0	0	0	7
2137	23	11		7			7			11	2	20	18	12	111
SARGENTII	5	0		7			4			0	0	0	0	0	16
2140	16	12		7				8	6	2		16	12		79
	8	5		6				0	5	0		0	0		24
2141	15	12											12		39
	7	6											0		13
2142	16	5													21
	14	5													19
2145	26	14		7					7				12		66
	20	9		7					5				0		41
2146	15	10		7			5	8	6	4		8	12		75
	4	2		4			0	0	1	0		0	0		11
2147	21	13		7			6		6	2		9	12		76
	19	8		7			0		5	0		0	0		39
2149	22	12	19	7		10	5	42	6	17	2	16	12		170
	15	3	14	7		8	4	0	6	0	0	0	0		57

HORTICULTURE OF NEW WORLD CYPRESSES

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	Species and Prop. No.	Limoneira Company	Wardman Riverside	Wardman Anaheim
2151	16 12 11 3	Rancho Santa Ana Botanic Garden		
2152	20 12 13 8	Rancho Santa Ana Test Plot		
2156	27 12 18 8	Rancho Santa Ana Mexican Village		
2157	25 12 25 10	Harwood Orchard		
2158	15 12 14 7	Del Mar Division		
2167	33 12 8 5	Hagen Ranch		
2168	16 14 10 8	Citrus Experiment Station		
	4 4	Block 1 - Opal St. Ranch		
	6 4	Block 2 - South of Lemons		
	4 4	Block 3 - West of Lemons		
	4 4	Block 4 - South of Canal		
	5 5	North of Wagner Road		
	5 5	Along Wagner Road		
	5 5	North of Ball Road		
	0 5	Ball Road Eucalyptus		
	0 5	Jordan, Atwood		
	0 5	Sheldon, Carpinteria		
	0 5	Bryant Ranch		
	0 5	Wagner Canker Tests, Stanford*		
	41 41	Totals		

	15	13		7		5												8	7	55
2170	9	3		7		2												0	0	21
	17	15																	7	39
2171	10	13																0		23
	8	7																		15
2172	8	0																		8
	27	12	26	7		5	5			8	6		2					8	12	118
2173	16	4	6	7		4	3			0	1		0					0	0	41
	23	12		7		4	6			10	14		5					8	12	101
2174	8	3		6		3	2			0	1		0					0	0	23
	22	12																	7	41
2175	6	4																0		10
STEPHENSONII																				
	20	12		7						5	6							8	7	65
2313	4	3		6						3	2							0	0	18
TOTAL	1316	1395	476	434	38	486	389	302	77	92	421	265	240	227	146	234	260	669	519	7986
	477	715	271	397	29	330	272	197	62	70	0	152	0	76	0	0	0	0	0	3048

*These represent the total number of plants taken by or sent to Dr. Wagener. In some instances, lesser numbers were actually planted.

EXPLANATION OF TABLE XVIII

This table attempts to summarize by species the approximate number of cypresses grown in the nursery, where they are planted, and how many were alive in 1944-45. Upper figures in Planting Columns indicate number of trees planted; lower figures the number of trees alive 1944-45.

TABLE XVIII
SUMMARY OF CYPRESSES PROPAGATED AND PLANTED

Name	Approx. No. Grown to Planting Size in Nursery	Plantings			
		Rancho Santa Ana Botanic Garden	Test Plots	All Other Miscell. Plantings or Known Uses	Totals as of 1945
		596	456	56	1108
ABRAMSIANA	1200	101	50	34	185
			251	175	426
ARIZONICA	684		165	155	320
		115	145		260
BAKERI MATTHEWSII	350	60	76		136
		598	141	100	839
BAKERI TYPICA	1075	24	60	0	84
		1636	2652	577	4865
FORBESII	9858	635	1288	115	2038
		241	344		585
GOVENIANA	2226	40	33		73
		20	2		22
GUADALUPENSIS	50	18	1		19
			77	31	108
LUSITANICA	119		45	9	54
		1116	555	52	1723
MACNABIANA	2115	8	215	42	265
		876	135	1566	2577
MACROCARPA	6561	8	25	0	33
			2	66	68
MONTANA	101		0	10	10
		124	237	1	362
NEVADENSIS	369	57	136	1	194
		385	352	237	974
PYGMAEA	2860	12	33	40	85
		1369	1276	204	2849
SARGENTII	4034	354	430	54	838
		36	45	6	87
STEPHENSONII	276	19	14	6	39
		7112	6670	3071	16853
TOTALS	31878	1336	2571	466	4373

EXPLANATION OF TABLE XIX.

To evaluate properly the figures presented in this table which show the smallest, largest, and average size for each lot of trees in each of the important test blocks as of 1944-45, it is essential that the number of trees involved be borne in mind by checking the figures given in Table XVII and also by giving due consideration to the variables of care, location and soil discussed under the section dealing with the various test plots. From the figures presented in this table (No. XIX), it is evident that some of the plots show a pronounced superior performance for practically all species.

TABLE XIX

SUMMARY OF PERFORMANCE OF TREES IN TEST PLOTS
BY SPECIES

Figures are in feet: Upper figure of each column indicates smallest tree, middle figure in each column indicates largest tree, and lower figure in each column indicates average of all trees.

Scientific Name	Rancho Santa Ana Botanic Garden	Rancho Santa Ana Test Plot	Mexican Village	Limoneira Company	Hagen Ranch	Citrus Experiment Station	Wardman Riverside	Wardman Anaheim	Totals
ABRAMSIANA	5 20 11	12 20 15	18 20 19	16 30 23		12 25 21			5 30 16
ARIZONICA		12 22 17		18 26 21	12 22 19	13 28 21	6 20 14	6 23 19	6 28 17
BAKERI MATTHEWSII		7 19 13		15 23 18	12 18 15	18 20 19		10 22 17	7 23 17
BAKERI TYPICA	6 15 12	5 14 9		5 16 13	10 16 14	8 17 14			5 17 12
FORBESII	5 21 13	7 28 19	6 22 17	9 32 23	7 25 17	5 31 24	3 27 18	7 25 18	3 32 19
GOVENIANA	4 16 10			10 26 22		15 16 15			4 26 15
GUADALUPENSIS		*32 32 32							32 32 32

*2 years older than rest of the trees in test plots.

Scientific Name	Rancho Santa Ana Botanic Garden	Rancho Santa Ana Test Plot	Mexican Village	Limoneira Company	Hagen Ranch	Citrus Experiment Station	Wardman Riverside	Wardman Anaheim	Totals
LUSITANICA		17 26 21		26 32 29		24 28 25	16 20 19		16 32 23
MACNABIANA	8 13 10	8 18 12		11 18 13	7 16 9	3 20 16		4 11 7	3 20 12
MACROCARPA	11 23 20			24 36 31		30 30 30			11 36 28
MONTANA									
NEVADENSIS		13 15 14	7 15 12	15 18 16	14 18 17	13 24 17		13 19 15	7 24 14
PYGMAEA	7 17 13			11 34 25		16 26 19			7 34 20
SARGENTII	4½ 19 12	7 23 16	10 22 16	8 30 22	20 26 23	9 29 21		8 26 19	4½ 30 16
STEPHENSONII	8 11 10	8 12 10		9 13 13			8 11 9	8 8 8	8 13 12

EXPLANATION OF TABLE XX.

This table attempts to present an estimate of the maximum size to which each of the New World cypresses will grow under ideal California conditions in a ten-year period from seed. The figures are based largely on an evaluation of the data which have been obtained from growing the species at Rancho Santa Ana Botanic Garden and from the plants set out elsewhere in test plots and miscellaneous plantings.

TABLE XX

Estimated maximum growth heights in feet to which each kind of cypress will grow in a 10 year period in California under ideal conditions based on the performance of all trees observed and tested 1927-1945.

1. Monterey Cypress	36 feet
2. Mendocino Cypress	34 "
3. Tecate Cypress	32 "
4. Mexican Cypress	32 "
5. Sargent Cypress	30 "
6. Santa Cruz Cypress	30 "
7. Arizona Cypress	28 "
8. Smooth Arizona Cypress	28 "
9. Gowen Cypress	26 "
10. Guadalupe Cypress	26 "
11. Piute Cypress	24 "
12. Siskiyou Cypress	23 "
13. McNab Cypress	20 "
14. San Pedro Martir Cypress	19 "
15. Baker Cypress	17 "
16. Stephenson Cypress	13 "

EXPLANATION OF TABLE XXI

This table presents in numerical order all Propagation Numbers of *Cupressus* and gives the Collection Number (if there is one), the collector, date of collection and source.

TABLE XXI
DATA ON ALL PROPAGATION MATERIALS OF CUPRESSUS

Prop. No.	Coll. No.	Species**	Collected By*	Date Collected	Source
16		Forb.	E.R.J.	1-16-27	Santa Ana Mts., Orange Co., Calif.
39		macr.	Payne	1926	From trees cultivated southern Calif.
40		macr.	Payne	1926	From trees cultivated southern Calif.
221	621A	Forb.	Howell & Stark	8-10-27	Santa Ana Mts., Orange Co., Calif.
239	662	macr.	Howell & Stark	8-19-27	Point Cypress, Monterey Co., Calif.
252	678	Sarg.	Howell & Stark	8-22-27	Mt. Tamalpais, Marin Co., Calif.
266	690	Sarg.	Howell & Stark	8-24-27	Butts Valley, Napa Co., Calif.
267	691	Sarg.	Howell & Stark	8-24-27	Butts Valley, Napa Co., Calif.
270	701	pyg.	Howell & Stark	8-25-27	Fort Bragg, Mendocino Co., Calif.
310	800	Forb.	B.D.S.	11-1-27	Otay Mt., San Diego Co., Calif.
449	1183	Mac.	E.R.J.	8-30-28	Whiskytown, Shasta Co., Calif.
952	1689	nev.	C.B.W.	10-20-30	Bodfish, Kern Co., Calif.
1006	1746	B. typ.	C.B.W.	10-19-30	Timbered Crater, Siskiyou Co., Calif.
1044	1788	pyg.	C.B.W.	10-31-30	Fort Bragg, Mendocino Co., Calif.
1058	1802	Sarg.	C.B.W.	11-4-30	Cedar Mt., Alameda Co., Calif.
1069	1813	Gov.	C.B.W.	11-7-30	Huckleberry Hill, Monterey Co., Calif.
1070	1814	Gov.	C.B.W.	11-7-30	Huckleberry Hill, Monterey Co., Calif.
1111	2247	Forb.	B.D.S.	6-10-31	Santa Ana Mts., Orange Co., Calif.
1190	2321	macr.	C.B.W.	8-17-31	Point Lobos, Monterey Co., Calif.
1191	2322	macr.	C.B.W.	8-17-31	Point Cypress, Monterey Co., Calif.
1256	2383	Mac.	C.B.W.	8-31-31	Whiskytown, Shasta Co., Calif.
1783	4532	Forb.	B.D.S.	3-17-33	Santa Ana Mts., Orange Co., Calif.
1959	5496	Mac.	C.B.W. & B.D.S.	9-24-33	Grass Valley, Nevada Co., Calif.
1970	5509	Mac.	C.B.W. & B.D.S.	9-26-33	Hough Springs, Lake Co., Calif.

Prop. No.	Coll. No.	Species**	Collected By*	Date Collected	Source
2067		mont.	Wiggins & Dem. No. 4990	9-22-30	Sierra San Pedro Martir, Baja Calif., Mexico
2068		guad.	J.T.H. No. 8297	3-17-32	Guadalupe Island, Baja Calif., Mexico
2069		guad.	J.T.H. Misc. Coll.	3-17-32	Guadalupe Island, Baja Calif., Mexico
2111	6144	Mac.	C.B.W. & E.R.J.	10-2-34	Aukum, Amador Co., Calif.
2112	6145	Mac.	C.B.W. & E.R.J.	10-2-34	Aukum, Amador Co., Calif.
2114	6143	Mac.	C.B.W. & E.R.J.	10-3-34	Grass Valley, Nevada Co., Calif.
2115	6149	Mac.	C.B.W. & E.R.J.	10-3-34	Grass Valley, Nevada Co., Calif.
2116	6151	Mac.	C.B.W. & E.R.J.	10-3-34	Texas Hill, Yuba Co., Calif.
2117	6152	Mac.	C.B.W. & E.R.J.	10-3-34	Texas Hill, Yuba Co., Calif.
2118	6156	Mac.	C.B.W. & E.R.J.	10-4-34	Indiana Creek, Yuba Co., Calif.
2119	6157	Mac.	C.B.W. & E.R.J.	10-4-34	Indiana Creek, Yuba Co., Calif.
2121	6160	Mac.	C.B.W. & E.R.J.	10-5-34	Magalia, Butte Co., Calif.
2122	6161	Mac.	C.B.W. & E.R.J.	10-5-34	Magalia, Butte Co., Calif.
2125	6164	Mac.	C.B.W. & E.R.J.	10-6-34	Whiskytown, Shasta Co., Calif.
2126	6165	Mac.	C.B.W. & E.R.J.	10-6-34	Whiskytown, Shasta Co., Calif.
2127	6166	B. typ.	C.B.W. & E.R.J.	10-8-34	Timbered Crater, Siskiyou Co., Calif.
2128	6167	B. typ.	C.B.W. & E.R.J.	10-8-34	Timbered Crater, Siskiyou Co., Calif.
2130	6169	B. Matt.	C.B.W. & E.R.J.	10-9-34	Seiad Creek, Siskiyou Co., Calif.
2131	6170	B. Matt.	C.B.W. & E.R.J.	10-9-34	Seiad Creek, Siskiyou Co., Calif.
2133	6174	pyg.	C.B.W. & E.R.J.	10-12-34	Fort Bragg, Mendocino Co., Calif.
2134	6175	pyg.	C.B.W. & E.R.J.	10-12-34	Fort Bragg, Mendocino Co., Calif.
2135	6176	pyg.	C.B.W. & E.R.J.	10-12-34	Mendocino City, Mendocino Co., Calif.
2137	6178	pyg.	C.B.W. & E.R.J.	10-13-34	Anchor Bay, Mendocino Co., Calif.
2140	6183	Sarg.	C.B.W. & E.R.J.	10-13-34	Camp Meeker, Sonoma Co., Calif.
2141	6184	Sarg.	C.B.W. & E.R.J.	10-13-34	Occidental, Sonoma Co., Calif.
2142	6187	Sarg.	C.B.W. & E.R.J.	10-14-34	Pieta Rd., Lake Co., Calif.

2143	6186	Mac.	C.B.W. & E.R.J.	10-14-34	Pieta Rd., Lake Co., Calif.
2144	6187	Mac.	C.B.W. & E.R.J.	10-14-34	Hough Springs, Lake Co., Calif.
2145	6188	Sarg.	C.B.W. & E.R.J.	10-14-34	Hough Springs, Lake Co., Calif.
2146	6189	Sarg.	C.B.W. & E.R.J.	10-15-34	Cook Springs, Colusa Co., Calif.
2147	6191	Sarg.	C.B.W. & E.R.J.	10-16-34	Reiff, Lake Co., Calif.
2148	6192	Mac.	C.B.W. & E.R.J.	10-16-34	Reiff, Lake Co., Calif.
2149	6193	Sarg.	C.B.W. & E.R.J.	10-16-34	Aetna Springs, Napa Co., Calif.
2151	6195	Sarg.	C.B.W. & E.R.J.	10-17-34	Cobb P. O., Lake Co., Calif.
2152	6196	Sarg.	C.B.W. & E.R.J.	10-17-34	Mt. St. Helena, Napa Co., Calif.
2154	6198	Mac.	C.B.W. & E.R.J.	10-18-34	Hooker Canyon, Sonoma Co., Calif.
2156	6200	Sarg.	C.B.W. & E.R.J.	10-18-34	Mt. Tamalpais, Marin Co., Calif.
2157	6201	Sarg.	C.B.W. & E.R.J.	10-19-34	Cedar Mt., Alameda Co., Calif.
2158	6202	Sarg.	C.B.W. & E.R.J.	10-19-34	Cedar Mt., Alameda Co., Calif.
2159	6203	nev.	C.B.W. & E.R.J.	10-20-34	Bodfish, Kern Co., Calif.
2160	6204	nev.	C.B.W. & E.R.J.	10-20-34	Bodfish, Kern Co., Calif.
2167	6213	Sarg.	C.B.W.	11-1-34	Chorro Creek, San Luis Obispo Co., Calif.
2168	6214	Sarg.	C.B.W.	11-1-34	Chorro Creek, San Luis Obispo Co., Calif.
2170	6216	Sarg.	C.B.W.	11-3-34	Cypress Mt., San Luis Obispo Co., Calif.
2171	6217	Sarg.	C.B.W.	11-3-34	Cypress Mt., San Luis Obispo Co., Calif.
2172	6218	Sarg.	C.B.W.	11-4-34	Pine Mt., San Luis Obispo Co., Calif.
2173	6219	Sarg.	C.B.W.	11-4-34	Pine Mt., San Luis Obispo Co., Calif.
2174	6220	Sarg.	C.B.W.	11-5-34	Los Burros, Monterey Co., Calif.
2175	6221	Sarg.	C.B.W.	11-5-34	Los Burros, Monterey Co., Calif.
2177	6227	macr.	C.B.W.	11-7-34	Point Lobos, Monterey Co., Calif.
2178	6228	macr.	C.B.W.	11-7-34	Point Lobos, Monterey Co., Calif.
2179	6229	Gov.	C.B.W.	11-7-34	San Jose Creek, Monterey Co., Calif.
2181	6230	Gov.	C.B.W.	11-7-34	San Jose Creek, Monterey Co., Calif.
2182	6231	Gov.	C.B.W.	11-8-34	Huckleberry Hill, Monterey Co., Calif.

Prop. No.	Coll. No.	Species**	Collected By*	Date Collected	Source
2183	6232	Gov.	C.B.W.	11-8-34	Huckleberry Hill, Monterey Co., Calif.
2184	6233	macr.	C.B.W.	11-8-34	Point Cypress, Monterey Co., Calif.
2185	6235	Abrams.	C.B.W.	11-9-34	Bonnie Doon, Santa Cruz Co., Calif.
2186	6236	Abrams.	C.B.W.	11-9-34	Bonnie Doon, Santa Cruz Co., Calif.
2313	6266	Steph.	C.B.W.	12-28-34	King Creek, San Diego Co., Calif.
2314	6268	Forb.	C.B.W.	12-28-34	Guatay Mt., San Diego Co., Calif.
2315	6269	Forb.	C.B.W.	12-28-34	Guatay Mt., San Diego Co., Calif.
2319	6278	Forb.	C.B.W.	1-2-35	Santa Ana Mts., Orange Co., Calif.
2320	6279	Forb.	C.B.W.	1-2-35	Santa Ana Mts., Orange Co., Calif.
2330	6280	Forb.	C.B.W.	1-16-35	Mt. Tecate, San Diego Co., Calif.
2331	6281	Forb.	C.B.W.	1-16-35	Mt. Tecate, San Diego Co., Calif.
2332	6282	Forb.	C.B.W.	1-16-35	Otay Dam, San Diego Co., Calif.
2333	6283	Forb.	C.B.W.	1-17-35	Otay Dam, San Diego Co., Calif.
2334	6284	Forb.	C.B.W.	1-17-35	Otay Dam, San Diego Co., Calif.
2335	6285	Forb.	C.B.W.	1-17-35	Otay Mt., San Diego Co., Calif.
2336	6285	Forb.	C.B.W.	1-17-35	Otay Mt., San Diego Co., Calif.
2356		lusit.	M. Nava	1934	Canada del Batan, Delegacion, Cuajimalpa, D. F., Mexico
2357		ariz.	L.S.G. No. 2	2-4-35	Bonita Canyon, Cochise Co., Arizona
2358		ariz.	L.S.G. No. 4	2-5-35	Rucker Canyon, Cochise Co., Arizona
3204	9433	B. typ.	W. W. Wag. & G. A. Zent.	7-9-38	Burney Spring, Shasta Co., Calif.
3367		mont.	I.L.W.	9-22-38	Sierra San Pedro Martir, Baja Calif., Mexico
3370	9467	Steph.	C.B.W.	11-30-38	King Creek, San Diego Co., Calif.
3371	9468	Steph.	C.B.W.	12-1-38	King Creek, San Diego Co., Calif.
3374	9473	Sarg.	C.B.W.	12-13-38	East of Zaca Peak, Santa Barbara Co., Calif.

3375	9474	Sarg.	C.B.W.	12-13-38	East of Zaca Peak, Santa Barbara Co., Calif.
4910	11441	Abrams.	C.B.W.	2-20-43	Eagle Rock, Santa Cruz Co., Calif.
5038	11464	Sarg.	C.B.W.	10-24-44	Red Mt., northern Mendocino Co., Calif.
5047	11474	Mac.	C.B.W.	10-28-44	Whiskytown, Shasta Co., Calif.
5051	11478	B. Matt.	C.B.W.	10-29-44	Goose Nest Mt., Siskiyou Co., Calif.
5053	11481	B. typ.	C.B.W.	10-30-44	Timbered Crater, Siskiyou Co., Calif.
5062	11490	nev.	C.B.W.	11-5-44	Back Canyon, Piute Mts., Kern Co., Calif.

*Initials indicate collectors as follows:

Dem.—Demaree
L.S.G.—L. S. Gill
J.T.H.—J. T. Howell

E.R.J.—E. R. Johnson
B.D.S.—B. D. Stark
W.W.Wag.—W. W. Wagener

I.L.W.—I. L. Wiggins
C.B.W.—C. B. Wolf
G.A.Zent.—G. A. Zentmyer

**Abbreviations of species are as follows:

Abrams.—Abramsiana
ariz.—arizonica
B. typ.—Bakeri typica
B. Matt.—Bakeri Matthewsii
Forb.—Forbesii

Gov.—Goveniana
guad.—guadalupensis
lusit.—lusitanica
Mac.—Macnabiana
macr.—macrocarpa

mont.—montana
nev.—nevadensis
pyg.—pygmaea
Sarg.—Sargentii
Steph.—Stephensonii

SUMMARY OF HORTICULTURAL INFORMATION AND CONCLUSIONS

1. The horticultural section of this paper deals with the New World species of *Cupressus*. Information presented is largely derived from the first-hand experiences gained by growing cypresses at Rancho Santa Ana Botanic Garden from 1927-1945.

2. The extensive cypress project which has been carried on at the Garden has been primarily one in which attempts have been made to find suitable substitutes for the Monterey Cypress (*Cupressus macrocarpa*) which are reasonably free from Cypress Canker. These efforts should in no way be misconstrued as advocating the planting or use of cypresses in preference to other plants unless the cypresses are particularly better fitted for such usage.

3. Most of the horticultural literature pertaining to the New World cypresses is included in the botanical section of this paper, either in the references at the close of the treatment of each species or in the section entitled Taxonomic Treatments. Papers dealing with cypresses in horticulture in California are reviewed as follows: Abrams, (1913), Pratt (1922), Wilson (1938), Thompson (1939), and Wolf (1938, 1939 and 1942).

4. Collecting of seeds of the New World species of *Cupressus* is not difficult, except that the wild stands are usually in remote areas, and there are few opportunities to obtain seeds from cultivated trees. Seeds of the Monterey, Smooth Arizona and Tecate Cypresses are obtainable from commercial collectors. Cones of cypresses often remain closed for six or eight years after maturity and still contain viable seeds. Seeds may be collected at almost any time of the year, but in California and Arizona the newly matured cones may be collected from late fall to early spring for immediate use. Cut cones dry out, open, and shed their seeds rather quickly and yield comparatively clean seeds. Seeds stored in tight jars remain viable for several years but can not be expected to produce good results after five years. No real proof is offered in support of the belief that better seedlings are obtained by selection of seeds from the best trees, either wild or cultivated, but it is recommended.

5. Cypresses may be propagated from cuttings by grafting or by seeds. All cypress trees propagated at Rancho Santa Ana Botanic Garden have been grown from seed. Since 1927 the Garden has propagated 15 kinds of cypresses, consisting of 109 different lots of seeds, for a total of 147 different planting dates, using 388¾ ounces of seeds. From these it is estimated that some 31,878 plants were grown to plantable size. Seeds have been planted in outside seed beds or in standard flats, usually in a mixture of sand and loam, but more recently with success in a mixture of sphagnum and sand or soil. Most plants have been transplanted to pots, but this method has serious objections in that coiled roots are easily developed. Transplanting

from seed flats to standard flats is preferable, and if larger plants are then required, a second transplanting into gallon cans produces excellent results. Seeds may be planted from fall to early spring. Germination usually requires several weeks, and the percentage is ordinarily rather low. First transplanting usually is about 90 days after seeding. Average production of plantable size seedlings for best lots of all species grown is 293 per one ounce of seeds. Seedlings are ordinarily held in the nursery for nearly a year before they are sufficiently large to be set out.

6. Of the thousands of cypresses grown at this Garden, 7112 have been set out within its confines, 6670 have been used in various test plots in California, and 3071 are known to have been distributed or used in various miscellaneous plantings. In California the most ideal time to plant cypress trees is in the fall, preferably in October, but satisfactory results may be obtained by planting as late as March. Plantings made at other seasons require a great deal more care to establish and greater losses are incurred. Cypresses have been planted in almost every type of soil but really prefer coarse soils with good drainage and will not tolerate a wet soggy situation. The different cypresses are not all suited to the same climatic conditions, and species from the coast are unsatisfactory inland and vice versa. Most species lose their lower branches when too closely planted, and this is particularly true of species from the interior sections. Cypresses grow at varying rates depending on the species, but they also vary greatly depending on their care, water and other factors. Over a ten-year test period, we have found that the maximum height is 36 feet in the case of the Monterey Cypress, while the Cuyamaca Cypress is only 13 feet in a similar period.

7. In 1936-37, numerous test plots were established in Southern California for thoroughly testing the various cypresses in an effort to find out if any were suitable substitutes for the Monterey Cypress. With a few exceptions, those plots which have been maintained have been carefully checked every year, and the performances of individual trees recorded. In the nineteen separate blocks of trees in the tests, including the Botanic Garden test plot and the Wagener plot at Stanford, a total of 7986 trees were used. Seven of these plots have been abandoned; some were discontinued the first year because of unsuitable conditions. Of the remaining twelve blocks, in which 5497 trees were planted, there were 3048 trees alive as of May, 1945. Several of these blocks have served their experimental purpose and should be abandoned, while others are worth continuing, at least in part. Test blocks were located as follows: Rancho Santa Ana Botanic Garden; Rancho Santa Ana; Limoneira Company, Santa Paula; Wardman Ranches, Anaheim; Wardman Ranches, Riverside; Jordan Ranch, Atwood; Sheldon Ranch, Carpinteria;

Bryant Ranch, Long Beach; and Wagener Canker Tests, Stanford University.

8. The sixteen entities here recognized as comprising the New World cypresses are evaluated somewhat as follows for horticultural usage, mainly based on California conditions and performances and largely upon the plants grown by Rancho Santa Ana Botanic Garden from 1927-1945:

a). The Monterey Cypress (*Cupressus macrocarpa*), Gowen Cypress (*C. Goveniana*), Mendocino Cypress (*C. pygmaea*) and Santa Cruz Cypress (*C. Abramsiana*) are so highly susceptible to Cypress Canker that they should not be planted except on the immediate coast of northern California or other similar regions where the Cypress Canker is not an important factor.

b). McNab Cypress (*C. Macnabiana*), Sargent Cypress (*C. Sargentii*) and Mexican Cypress (*C. lusitanica*) are of little use in California. The first is unattractive in most situations; the second is of no great beauty because of several features of color and growth habit; the third is not adapted to California's dry climate, although it is a beautiful species. All of these are rather susceptible to Cypress Canker.

c). The Cuyamaca Cypress (*C. Stephonsohnii*) and San Pedro Martir Cypress (*C. montana*) are still too little known in cultivation to be properly evaluated at this time.

d). The Piute Cypress (*C. nevadensis*), Siskiyou Cypress (*C. Bakeri* subsp. *Matthewsii*) and Modoc Cypress (*C. Bakeri* subsp. *typica*) appear to be possibilities for use as gray-foliaged specimen trees, of which the first is probably suitable only for mild regions; the other two will probably grow under conditions too cold for any other members of the genus.

e). Smooth Arizona Cypress (*C. glabra*) is already well established in horticulture and is unlikely to be superseded by the Arizona Cypress (*C. arizonica*), which is probably equally good but by accident was not introduced into cultivation to any extent. Both are well suited to hot interior sections and are practically immune to Cypress Canker.

f). The Guadalupe Cypress (*C. guadalupensis*) has been in cultivation in California for many years and has produced large trees 50 feet or more in height. It has done well as far inland as Riverside, although it is a coastal species. It has not become very popular, possibly because of its bluish color or because seeds have been difficult to obtain for propagation. It is highly immune to Cypress Canker.

g). The Tecate Cypress (*C. Forbesii*) is a close relative of the Guadalupe Cypress but probably will not grow as large and has

green foliage. In our tests it is the outstanding species in that it is the only one with green foliage that is relatively immune to Cypress Canker. Its growth rate is nearly as great as that of the Monterey Cypress, being estimated at a maximum of 32 feet in 10 years from seed. It is satisfactory for areas of the interior of California or reasonably near the coast but has not proven satisfactory on the immediate coast. Although the Smooth Arizona Cypress has been tested longer and has some better features, it is likely to be superseded in many areas by the Tecate Cypress because of the latter's green foliage which is more desirable. However, the Tecate Cypress has not yet demonstrated that it will acquire a permanent place in horticulture in California or similar regions.

NOTE ON TWO PAPERS ON MEXICAN CYPRESSES

After this book was already in press, copies were received of two papers by Professor Maximino Martinez of Mexico City, notice of which should be taken here:

The first one is entitled *Sobre la no Existencia del Cipres Cupressus thurifera* H. B. K. (Soc. Bot. Mex. Bull. 5: 10-11. 1947). *Cupressus thurifera* H. B. K. is shown by Professor Martinez to be *Juniperus flaccida* var. *poblana*. He reached this conclusion after having examined a fragment of the type of the former. This disposes of one of the most perplexing names in the genus *Cupressus* and is much more satisfactory than merely excluding it from the genus, as I did in my text. (see page 247).

The second one is called *Los Cupressus de Mexico* (Anal. Instituto Biología 18: 71-149. 48 fig. 1947). Unfortunately this extensive paper on the cypresses of Mexico was received after my text was in page proof and ready for preparation of the index. This precluded the possibility of giving it adequate attention in the text. However, Professor Martinez's paper is of outstanding interest and sheds much light on the cypresses of Mexico, so I am very grateful for the opportunity of discussing some of its features very briefly, but suggest that those who are interested in Mexican cypresses consult his text for his detailed discussions and informative illustrations.

To be brief, Professor Martinez recognizes the following species of *Cupressus* as native to Mexico:

1. *C. montana* Wiggins
2. *C. guadalupensis* Wats.
3. *C. Forbesii* Jepson
4. *C. arizonica* Greene
 - a). forma *typica* Martinez (1947). page 121. "Habitat in Los Lirios, Arteaga, Coah. Typus in Instituto de Biología (Martinez, 12000 A.)"
 - b). forma *glomerata* Martinez (1947). page 129. "Habitat in La Quebrada del Jaral, Durango. Typus in Instituto de Biología (Blanco, 201 A.)"
 - c). forma *minor* Martinez (1947). page 133. "Habitat in Cruz de Piedra, Llano Grande, Dgo. Typus in Instituto de Biología (Lozoya 180.)"
5. *C. Benthamii* Endl.
6. *C. Lindleyi* Klotsch

There is no need to discuss Professor Martinez's disposal of *C. montana*, *C. guadalupensis* and *C. Forbesii*, since these species are distinct from the others and are treated in accordance with my text. As to his treatment of *C. arizonica*, I have no doubt but that his

three forms are valid entities recognizable geographically and morphologically. His designation of a new type specimen for his form *typica* is not in accord with recognized procedure in the United States, where Greene's type of *C. arizonica* from the mountains near Clifton, Arizona would be designated.

The problem as to *C. Bentharii* and *C. Lindleyi* is not so easily disposed of, especially since I have to rely solely upon his text and do not have access to his herbarium material.

Professor Martinez has made a careful study of the Mexican cypresses which have been variously regarded as *C. lusitanica* Mill.; *C. Bentharii* Endl. and *C. Lindleyi* Klotsch, with the result that he excludes *C. lusitanica* as a Mexican species, but is unable to trace it to its native habitat. He separates *C. Bentharii* from *C. Lindleyi* partially on "Ramillas distichas" and "no distichas". His comparison of *C. Lindleyi* with *C. lusitanica* (based on Portuguese material) indicates that he regards the latter as much closer to *C. Lindleyi* than to *C. Bentharii*.

The cypress described in my text as *C. lusitanica* (pp. 147-158) is authentically Mexican in origin, and would, no doubt, be assigned to *C. Lindleyi* by Professor Martinez. Nevertheless, I regard it as equally close to European material of *C. lusitanica* (consult my text for discussion).

Therefore in view of my inability to study Professor Martinez's herbarium material or to see the living trees in Mexico, I concede that acceptance of his treatment recognizing *C. Bentharii* and *C. Lindleyi* as valid species and the elimination of *C. lusitanica* from consideration as a valid name to be applied to any Mexican cypress is probably in the best interests of systematic botany in clarifying the problem.

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Fillmore, California
January 22, 1948