EUCALYPTUS

*Its
History,
Growth
and
Utilization*

*Issued September 15
1910*

Price \$1.00

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By C. H. SELLERS

Formerly Assistant State Forester of California
Suite 24-25 Elks' Bldg., Sacramento, California

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Born 1871 in Wales, served in the Himalayas with the British Transport Corps and in the Boxer Rebellion, helped construct the C.P.R., fought with the Canadian Expeditionary Force 1914-17, a resident of Vancouver for forty years, still a reader at 94, donated his collection of 4,000 books in 1965.

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Its History, Growth, and Utilization

By

C. H. SELLERS

Formerly Assistant State Forester of California

Suite 24-25 Elks Building, Sacramento, California

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INDEX

State Forester's Review.....	4
Preface	6
History	7
Introduction into California.....	9
Present Interest	11
Range	13
Forest Formation.....	15
Timber Species Used in Australia.....	17
Eucalyptus in Hawaii.....	19
Strength and Durability of California Grown Eucalyptus.....	23
Uses of Eucalyptus in California.....	25
Eucalyptus Used by Baker & Hamilton.....	25
Australian Hardwood Co.'s Letter.....	26
Eucalyptus Oil.....	27 ✓
Increase in Cut Since 1880.....	27
The Drain Upon the Forests.....	37
a.—Round Mine Timbers.	
b.—Wood for Distillation.	
c.—Veneer.	
Lumber Prices Greatly Increased.....	39
Present Prices of Telegraph Poles.....	41
How the Hughes Manufacturing & Lumber Co. Season Eucalyptus.....	41
Seasoning Hardwoods.....	43
a.—Time Required.	
b.—Cost.	
c.—Use of Kiln Dried Woods.	
d.—Results of Mistreatment.	
e.—Parts.	
f.—Methods of Operating.	
g.—Auxiliary Equipment.	
<i>E. globulus</i>	47 ✓
<i>E. tereticornis</i>	55
California Souvenir Co.'s Letter.....	56
Record of Durability of the <i>Tereticornis</i> in Australia.....	59
<i>E. rostrata</i>	63
<i>E. corynocalyx</i>	67
<i>E. resinifera</i>	71
<i>E. diversicolor</i>	73
<i>E. rudis</i>	73
<i>E. sideroxylon</i>	73
<i>E. viminalis</i>	75
<i>E. citridora</i>	75
<i>E. gunnii</i>	75
<i>E. amygdalina</i>	77
<i>E. robusta</i>	77
<i>E. ficifolia</i>	77
Raising Eucalyptus Seedlings.....	77
Field Planting.....	79
Effect of Alkali in Soil.....	83
The Presence of Alkali Harmful to Vegetation.....	82
Means of Clearing Lands of Alkali.....	83
Eucalyptus Tables:	
Volume of All Trees on Acre.....	50
Volume of 8 Inches in Diameter and Over on Acre.....	51
Bailey Groves, 1 and 2.....	52
Volume Table Diameter Breast High on Age.....	60

Baldwin Plantation.....	64
Hill Plantation.....	68
Sexton Plantation.....	72
Hunter Plantation.....	74
De Witt Plantation.....	76
Report of Mecham's Eucalyptus Plantation.....	78
Mecham Plantation, 6 years.....	80
Mecham Plantation, 9 years.....	82
Mecham Plantation, 18 years.....	84
Mecham Plantation, 20 years.....	86
Eucalyptus Species in California.....	87
Spacing.....	87
Size and Quality of Seedlings.....	88
Determining the Accretion of a Forest.....	89
A Method of Investigating Timber Growth.....	89
Conclusion.....	90

LIST OF ILLUSTRATIONS.

E. viminalis.....	8
E. globulus.....	10
E. viminalis.....	12
E. globulus.....	14
E. globulus.....	16
E. globulus.....	18
E. globulus.....	20
Plantation.....	22
Eucalyptus Growing in Rock Pile.....	24
E. rostrata.....	26
Articles Made from Eucalyptus.....	28
Eucalyptus Rocker and Table.....	30
Showing Eucalyptus Samples.....	32
Preparing Seed Beds.....	34
New Method of Transplanting Seedlings.....	38
Eucalyptus Seedlings.....	40
Preparing Land for Field Planting.....	42
Rockwell Grove, San Pasqual Valley.....	44
Trees Grown in the Open.....	46
Trees Crated Ready for Shipment.....	48
E. globulus.....	53
E. maculata, spotted gum.....	54
E. globulus, Los Angeles Co.....	57
E. globulus, Los Angeles Co.....	58
E. globulus Plantation, Escondido Valley.....	61
E. globulus, Escondido Valley.....	62
Mecham's Plantation, 7 years old.....	65
E. globulus, Second Growth.....	66
Showing Poor Forest Management.....	69
Showing Benefit of Good Forest Management.....	70
E. tereticornis.....	81
Eucalyptus Used as Shade Trees.....	85
Young Globulus Plantation.....	88
Conclusion.....	90
Showing Characteristic Long, Clear Boles.....	92
Eucalyptus Table.....	93

STATE FORESTER'S REVIEW

I have reviewed with keen interest the following treatise on Eucalyptus, written by C. H. Sellers, which is the result of nearly eight years of practically uninterrupted investigations. His familiarity with nearly every Eucalyptus grove in the state, acquired while in the service of both the federal and the State Forestry departments, has enabled him to contribute much authentic data that is urgently needed upon the important subjects of rate of growth, yield, and management of the several species considered. The table showing the number of board feet, by groves, is particularly valuable, since some of them have been cut and permanently destroyed to make room for the growth of the several towns near which they were located.

Since the tables were based on actual forest measurements of sample plots ranging from six to twenty-four years of age, and a careful study made of the soil and climatic conditions, together with a history of the care and management of each grove, the figures will be of practical value in approximating the yield that may be expected from plantations established under similar conditions.

California is thoroughly alive to the need for immediate action in furthering the forestry movement, and has responded to the active propaganda so strenuously conducted for the past few years by the establishment of commercial Eucalyptus plantations, destined eventually to play an important part in supplying a suitable hardwood for manufacturing purposes. The choice of merchantable species actually tried out in the state may be made from many, but several of the Eucalyptus have been successfully grown throughout the coast regions, the Sacramento, San Joaquin and Los Angeles valleys, and their tributaries, for over forty years. As Mr. Sellers has shown, in the case of many of

them, because of their rapid growth, suitability for varied uses, and adaptability to California conditions, it is possible to raise and harvest a crop within an astonishingly short period as compared with nearly all of our native trees.

Forest planting for commercial purposes is now an established industry, and should be encouraged. The success of any plantation depends upon good soil, climatic conditions, selection of species for a given locality, the times and method of planting, and subsequent care and management. These essential points are discussed in a comprehensive manner based upon a very extensive silvical investigation.

These data should be of interest and value, not only to the planter and investor but to the teachers and students of forestry and to the professional foresters as well.

Signed,

G. M. HOMANS,
State Forester of California.

PREFACE

Within the past few years there have been many changes in our business and social standards, and among them none is better known on account of the contests that have resulted than that by which the United States and many of the State Governments have ceased to encourage settlement at the cost of exploitation. Not long ago the Federal Government gave tremendous areas of land to encourage railroad building and the beginning of a settlement. The policy accomplished its purpose, but as a result the lands so easily obtained were quickly plundered of those resources that made them valuable and the settler moved on to obtain further gifts from the Government's so called "inexhaustible" supply. To this policy we are all paying yearly tribute in less fruitful labor on impoverished soils, channel-filled rivers and wasted, denuded forests. And we must continue to do so until the balance of Nature is once more restored.

It is probable that we will suffer longer and more acutely from the reckless despoilation of our forests than from any other cause. Long years of slender supplies obtained at famine prices must ensue before the once glorious forests of this country can supply by yearly growth what our civilization demands within that period. We learn from authorities not to be doubted that the capital on which we have drawn so freely is nearing depletion. In this emergency it seems the duty of every landowner, regardless of profit, to devote some portion of his holdings to timber-growing purposes.

Fortunately for California, and indeed for the entire nation, it has recently been discovered that the wood of the rapid-growing Eucalyptus forms a substitute for Eastern hardwoods that is even superior to them. This fact has led to the establishment of immense plantations of this wonderful tree just at the time when the Eastern competitors are disappearing from the market. What relief this remarkable genus may afford can not now be more than predicted. It promises to be the means of making California the home of the large wood-using industries and of causing this State to be even more prominent than did the discovery of gold.

G. B. LULL,
Formerly State Forester of California.

EUCALYPTUS

Its History, Growth and Utilization

HISTORY

The native home of most species of the *Eucalyptus* is Australia, some species are found in Tasmania, New Guinea, Timor, or one of the Moluccas. Both in Australia and in the above named islands, the *Eucalyptus* form a large part of the forests. Because of their abundance, their recognition as a genus came practically simultaneously with the discovery of Australia, also for the same reason they were the most used woods in the settlement and development of that continent. This use brought about an early recognition of the great strength, durability and adaptability of the woods and also a knowledge of the great rapidity of growth of the genus.

The value and importance of this genus having been recognized in its native habitat travelers in those countries became interested and carried seed with them to other countries having a similar semi-tropic climate. In this way early in the 19th century, representatives of the genus, probably *Eucalyptus globulus*, were first taken to foreign countries. However it was not until near the middle of the century that dissemination of *Eucalyptus* began on a large scale which has continued up to the present time and which since its start has resulted in the introduction of the genus into practically every region of the world where climatic conditions permit of its growth. The work of the present and future with *Eucalyptus* therefore is no longer introductory but development, the spreading of knowledge of its great values and determining those species best suited to certain conditions of climate and soil and of giving to the general public those facts concerning the genus, which prove its great economic worth is bringing about extensive plantations and a broader and more intensive use.

The first introduction of *Eucalyptus* to countries having climatic conditions similar to those of its native habitat and suitable to the growth of the trees was early in the last century when the seeds of one or more species were carried to southern Europe and northern Africa. The trees from these seeds were regarded as curiosities as objects of beauty or as botanical specimens, and it was not until the middle of the century that their economic importance began to be generally recognized by the people of these countries. To Baron Ferd Von Mueller, Government Botanist for Victoria, and Director of the Botanic Gardens of Melbourne, are these Mediterranean

Eucalyptus viminalis, Yuba County. 4 Feet in Diameter, 33 Years Old.

countries especially indebted, as he was among the first to recognize the great economic importance of the Eucalyptus, was the first to bring the trees to the attention of the public and urge their planting. To his work and to that of others inspired by his example and success is due all credit for the widespread plantations and use of this genus in that region.

Following close upon its naturalization in the Mediterranean countries came the introduction of Eucalyptus into India and Southern Asia, Southern Africa and California. In Southern Asia, India and Southern Africa, the growth in recognition of the importance and possibilities of the genus has been a little behind that of the Mediterranean countries and advantage has been taken of the lessons learned in the latter region. These countries therefore, are also greatly indebted to Baron Ferd Von Mueller for his present knowledge and high rating of the genus Eucalyptus and so indirectly for the many advantages secured through the cultivation of the trees.

The Eucalyptus seems destined to revolutionize silviculture in France, Algeria, Italy, Spain, Corsica, Portugal, Cape Colony, and the American Southwest, not only on account of the many remarkable properties of the tree, its resin, its wood and its rapid growth, but also its great power of absorbing enormous quantities of water from wet and swampy lands, drying them and rendering them fit for cultivation, as well as its tendency to thus eliminate malarial conditions from the lands where it grows.

INTRODUCTION INTO CALIFORNIA

In North America, the history of the genus is practically a record of its introduction into California and in that state the growth spread through the adaptability of the trees to many uses and later the recognition of the great strength of the wood and value for use in many ways. That the history of Eucalyptus in the United States is their history in California is due to the fact that for commercial purposes, at least, climatic conditions practically confine the genus to certain parts of that State, however, the possible range in North America also includes very small portions of Arizona, New Mexico, the Gulf States and Mexico. In California, it has already been proven profitable to produce the timber on a commercial scale. The genus has passed the experimental stage and their planting has begun to assume an important position among the industries of California. The history of these trees in California is of the greatest interest to the people of this State and of the United States. It is probable that the genus was first introduced into California by Mr. Walker of San Francisco, who is credited with having planted 14 species in 1853. These, the first trees in California, therefore were started long after the introduction of the genus to the Mediterranean countries and Southern Asia, in fact not until after the trees had come to be quite widely known in those countries and especially in southern Europe. It was not until 1860 that the importation of Eucalyptus seed was started by nursery men, but in that year, Mr. Stephen Nolan of Oakland, who had been attracted by the rapid growth and evident adaptability of Mr. Walker's trees, commenced the importation of seed and the raising of the trees as

Eucalyptus globulus, Solano County, California. Trees Tall and Straight.

nursery stock and for sale to the general public. Mr. Nolan continued for several years to raise *Eucalyptus* trees and to him is due credit for the first actual distribution of these trees through this State, although it is doubtful if any of his trees were used in the establishment of plantations of commercial importance. The trees were new to the people and without doubt were bought largely in an experimental mood as curiosities or for shade or ornamental purposes.

Others of the pioneer nurserymen soon followed Mr. Nolan's example and as a result, by 1870 the genus through individuals mostly *Eucalyptus globulus*, was becoming well known throughout its possible range in this State.

Hon. Abbot Kinney, of Los Angeles, who, as Chairman of the California Board of Forestry from 1886 to 1888, rendered great service to the State by spreading a knowledge of the great possibilities and adaptability of the genus, so being the cause of the planting of many thousands of the trees of this genus. Under Mr. Kinney's administration, the Board distributed many trees to planters throughout the State. It is these trees that form a large percentage of the *Eucalyptus* other than *Eucalyptus globulus*, that are now growing in California; it is therefore largely due to the efforts of Hon. Abbott Kinney that we are now able to gain a good working knowledge of the possible results from, and the requirements of the *Eucalypts* other than *Eucalyptus globulus*. Since the termination of his service with the California Board of Forestry, Mr. Kinney has continued or brought others to plant many of the trees. Further, it is probable that, first starting in his official position and continuing in his later private life, he has written more on this genus than any other American.

PRESENT INTEREST

Within the past few years the interest in *Eucalyptus* has again been aroused and as a result many plantations of large size are being started. This interest of the present time has been aroused not through the efforts of one man or group of men but is due to a general recognition of the great strength and adaptability of the woods of the many species brought about by increasing scarcity and price of the eastern hardwoods. Because of this increasing cost and increasing difficulty in securing adequate supplies of the Eastern hardwoods, manufacturers of these woods started a search for substitutes. California being farthest from the source of supply first felt this growing scarcity and naturally tried *Eucalyptus* as a substitute. This wood soon proved its worth by actual use in vehicles, implements and for similar purposes and through tests was found to be at least equal in strength to the best eastern hardwoods. The general recognition of the strength and adaptability of the wood of the *Eucalypts*, has rapidly moved eastward and is now generally known throughout the United States.

The present interest in *Eucalyptus* and their culture is due then to economic reasons and those reasons will tend to increase rather than diminish that interest. The rapid growth of many species of *Eucalyptus* is generally known and it is this combination of rapid

Eucalyptus viminalis, Yuba County, California. 25 Years Old.

growth producing a hard, strong and durable wood that gives to these trees their great commercial value and makes their cultivation a profitable business. Reports of the Forest Service, U. S. Dept. of Agriculture, show that at the present rate of consumption, the supply of eastern hardwoods will be exhausted in about 16 years.

The present condition of the hardwood market and supply is such that in from 10 to 20 years the supply will be approaching practical exhaustion while the demand has greatly increased. Here in California practical experience has shown that the woods of certain Eucalypts will satisfactorily replace all eastern hardwoods and that these trees will grow to a satisfactory commercial size in from 8 to 12 years. At the end of 12 years the trees will be ready to be cut. The owner of Eucalyptus timber can then manufacture his timber into vehicles, furniture, etc., here at home or he can ship the rough lumber in either case. The Panama Canal will be completed, thus affording cheap water transportation for his product. The opening of the Panama Canal means the opening of the markets of the Atlantic, both in the United States and Europe to California lumber and especially to the strong, hard durable woods of the Eucalyptus. The rapid growth of Eucalyptus, the possibility of repeated cuttings and the steady demand for their product at high prices has afforded a generous return on planting investments. Groves established in California, on fertile soil have yielded from 50 to 80 cords per acre at every cutting. A yield of 95 cords per acre in seven to eight years has been frequent. It is apparent from the above yield that the planting of Eucalyptus for fuel, on agricultural land in California, would prove a good investment. Eucalyptus when sawed into lumber has been sold at from \$100.00 to \$140.00 per thousand feet. It retails for 14 cents per foot for finished, and 10 to 12 cents rough timber. The high stumpage value and extremely high price that the rough lumber is being sold at should be an inducement to the planting of the Eucalypts even on agricultural land.

RANGE

The range of Eucalyptus in California embraces the coast valleys from Oregon to Mexico and in the interior from the base of Mt. Shasta to the Tehachappi. In the oak belt of the Sierra foothills the eucalyptus has been grown successfully at an elevation of 2000 feet. In Southern California they have succeeded well on the Sierra Madre and other ranges up to 3000 feet above the sea level. The eucalypts are intolerant of low temperatures.

The size of the genus permits such ample choice that one or more species may be selected that are adapted to practically any phase of California's varied climate, where the minimum temperature does not drop below 18 degrees F. and maximum temperature does not exceed 110 degrees F. However, few species will survive temperatures below 16 F., and many will hardly endure a drop below 22 F. They are especially frost tender when seedlings and may then be killed by a few degrees below freezing. With age they become hardy and after even one year's growth saplings will endure frosts of considerable severity. Rapid changes in temperature are more injurious than continued cold weather.

Eucalyptus globulus, Mecham Plantation, Sonoma County, California.
12 Years Old.

For their best development, the eucalypts prefer a hot climate. Atmospheric dryness causes no injurious effects so long as the supply of soil moisture is adequate. The section best suited for the growth of most eucalypts is found in the moderate climate of the coast region or the valleys in which the influence of ocean fogs most is felt. Fogs alone enable some species to grow on dry situations without irrigation. While *Eucalyptus* will grow where the soil moisture is deficient the rate of growth will be much slower than where the tree gets all it needs. For commercial purposes, it is unwise to attempt to produce eucalyptus where the soil moisture is deficient. Deficient soil moisture is supplemented by atmospheric moisture in the fog belt. Where fog is condensed by contact with the foliage, the *Eucalyptus* tree drips as if from a shower, and the ground under the trees becomes soaked over night. However, good soil, climate and sufficient water is most essential. When trees are planted and left to grow by themselves without care, they do not attain marketable proportions as quickly as trees which have been given care and thoroughly cultivated during the dry season.

FOREST FORMATION

It is as forest trees that the eucalypts are most useful; planted as ornamental or as shade trees they are often disappointing. Planters who have put them out as forest trees are the ones who have derived the greatest benefit from them. Besides enjoying the beauty and shade of the groves as well as the beneficial change they have wrought in the climate of the region, they have for many years received from them an annual income of no inconsiderable amount. Those who have planted single trees or in small groups as ornamental or shade trees have received little or no financial return and have, in some cases, been disappointed in the trees because not serving, as they had hoped, the purpose for which they were planted.

It was not until 1904 that *Eucalyptus* was planted on a commercial scale for timber. Its wood had always been looked upon as inferior timber, the result being that it was planted as wind-breaks for citrus fruits, and in groves for fuel. However, public opinion has changed in the last three years. With the knowledge gained through tests of the mechanical properties of *Eucalyptus* timber, the practicability of planting *Eucalyptus* more extensively for timber than heretofore has been demonstrated. Up to the last few years planting of *Eucalyptus* has been confined almost exclusively to the treeless sections of the State. The redwood cut-over land in the northern coast counties affords good planting areas and no doubt in the near future many thousands of acres of this cut-over land will be reforested with *Eucalyptus*. The sprout growth from the redwood stumps is not sufficiently dense to replace the stand or to stimulate the growth of the sprout trees into merchantable timber. The planting of *Eucalyptus* in mixture with the redwood sprout growth will solve the problem of reforestation of these areas with valuable commercial timber.

In many of the semitropic portions of the globe the eucalypts are the trees most suitable to plant for forest cover. Much of the tree-

Eucalyptus globulus. 14 Years Old.

less land of California might be covered with these trees. As the conditions under which the different eucalypts grow in Australia are quite diverse, it is evident that if the species are properly selected, they will thrive in the most varied conditions here in California. Although there are over one hundred and fifty species in this genus, certain ones, notably *Eucalyptus globulus*, *E. tereticornis*, *E. resinifera*, *E. corynocalyx*, *E. rostrata*, *E. saligna*, *E. citriodora*, may be distinguished by the value of their timber, the rapid growth and the character of their development as timber eucalypts. However there are several other species of the genus *Eucalyptus* which may be considered very valuable as timber *Eucalyptus*, but their growth is not quite as rapid as the species just mentioned.

TIMBER SPECIES USED IN AUSTRALIA

For Australia and the neighboring islands the eucalyptus is one of the important sources of the general timber supply, and is the chief source of the hardwood timber used there. The uses made of *Eucalyptus* timber are remarkably numerous. It enters into the construction of ships, bridges, railroads, piers, telegraph lines, fences, paving, vehicles, agricultural implements, furniture, barrels, and a great variety of minor articles. Mr. Joseph H. Maiden, Director of the Botanical Gardens at Sydney, New South Wales, who is considered one of the best authorities on the eucalypts, names twenty-five "special purposes" for which the timber of the eucalypts is used in that colony. Six species are named as valuable for bridge timbers, five as valuable for piles, nine for paving, eight for posts, three for railroad ties, four for railway coaches, five for lumber and shingles, seven for the various parts of vehicles, two for barrels and casks, and two for broom and tool handles. Eleven "special purposes" are assigned to the timber of the Spotted Gum (*E. maculata*), ten to the timber of the Iron Bark (*E. sideroxylon*), eight to that of Red Mahogany (*E. resinifera*) and Tallow Wood (*E. microcoryx*), six to that of Gray Gum (*E. tereticornis*), five to that of Red Gum (*E. rostrata*), and a lesser number to that of seven other species. Not only in Australia is the timber of *Eucalyptus* used thus extensively, but it is exported in large quantities, the bulk of the hardwood lumber shipped being from these trees. R. Dalrymple Hay, in his work entitled "The Timber Trade of New South Wales," names thirteen species that furnish timber export. He gives the annual output of lumber from the 108 mills of the colony as 59,500,000 superficial feet, a large part of which is from *Eucalyptus* trees. Shipments are made to distant parts of the globe, including Africa and even England.

Mr. Pagan, in his report to the Queensland railways, had the following: "Tereticornis is chiefly used in Normantown for wagons and makes excellent felloes of wheels, and is suitable for use as a substitute for hickory, oak and ash in manufacturing all kinds of implements and utensils requiring strong, durable timbers." A box drain of this timber was laid at 79 mls. 75 chs. in 1867, about 6 inches under formation of lime. The center of this drain was in a

Eucalyptus globulus, Santa Barbara, California.

fair state of preservation, but the ends were decayed.

Some Blue Gum (*E. globulus*) sleepers have recently been taken out of the Killarney branch—age 21 years.

In referring to sleepers, Mr. Pagan states:

In referring to sleepers, Mr. Pagan states:

a degree tests so many qualities, its durability, strength, elasticity, toughness, weight, hardness and good seasoning qualities. All these combined, when of high quality, would undoubtedly make the ideal sleeper. For this reason, great stress is laid upon the life of a timber as a sleeper.

“Station Carpenter Clark states that the scantling and weatherboards of his residence in Toowoomba, built about 30 years ago, which are Blue Gum from Rosewood Station nine miles from Forest Hill, are still perfectly sound. White ants attacked the pine but have not touched the Eucalyptus.

“There were several of the original blue-gum girders and piles in the old Dawson River Bridge, recently taken down, which had done the work for 40 years. These were found to be in good and sound condition, but it must be remembered that the close decking of the bridge added materially to the life of the girders and piles.

“In February, 1864, I built a bridge for the Public Roads Department over Brandy Gully on the old road from Ipswich to Toowoomba. It is about $2\frac{1}{2}$ miles on the Toowoomba side of Rosewood Station and within 15 or 20 chains of the railway line. When inspecting Mr. Quinlan's district in 1903, (Bridge Inspector Miller and Permanent Way Inspector Fagg being with me) we had a look at this bridge, and I was surprised to see the good outward condition of the girders after such a long time. They were of Blue Gum, and were felled by myself on the flat at the edge of the scrub, then at head of gully. It being now over 41 years since these girders were placed in the bridge.”

EUCALYPTUS IN HAWAII

In a report to the Territory of Hawaii Board of Agriculture and Forestry—Division of Forestry—Ralph S. Hosmer, Superintendent, Mr. L. von Tempsky-Makawno, Mani, has the following to say in reference to the growth of Eucalyptus on the Haleakala Ranch Company's property in the Territory of Hawaii.

“I have planted this last year some 19,665 trees. Owing to the unprecedented drought which we passel through (which entails watering some ten thousand trees) the expense was greater than in former years, and also, I have been trying the planting of trees in cultivated land, as against the ordinary furrow and kipikua method, which of course entails a larger outlay at first, but which I think from the quicker growth obtained will in the long run prove the cheaper plan of the two.

“In September, 1907, I measured off a rectangular piece of land containing exactly four acres. One acre I furrowed out, and “kipikuaed” holes six feet each way. The other three acres I plowed and harrowed twice, and as the Manienie sod was very heavy I had to hand work the whole piece, going over it with “kipikuas” and packing out what wouldn't burn. As the weather was quite

Eucalyptus globulus, Solano County, California.

wet, I could not get a fire on the grass prior to plowing; this of course made the preparation of the three acres very expensive. I selected this spot especially as I thought it would be a good place to determine the maximum cost of preparing land for planting trees in this style.

"The seedling trees I selected were, *Eucalyptus amygdalina*, *E. botryoides*, *E. corymbosa*, *E. corynocalyx*, *E. leucoxylyon*, *E. paniculata*, and *E. rudis*, which were recommended to me by the Australian Forestry Service as being considered by them to be among the best of their trees for railroad ties and fence posts.

"One year from planting the trees the following measurements were made:

"The tallest tree in the uncultivated lot was 5 feet three inches, a *Eucalyptus botryoides*, and the average height of the whole of that piece was 3 feet.

"In the cultivated lot the tallest tree measured 16 feet, *E. rudis*, the other tall ones being: *E. botryoides*, 15 feet; *E. corynocalyp*, 12 feet; *E. leucoxylyon*, 12 feet; *E. paniculata*, 12 feet; *E. corymbosa*, 6 feet.

"Considering the unusually dry weather we have had for the last twelve months. I consider the growth of the trees in the cultivated lot remarkable.

"Under normal conditions, that is, where there is not a heavy growth of Manienie to contend with, the cultivation of the trees should cost very much less.

"The difference in favor of the cultivated as against the uncultivated trees is so great in favor of the former, that I shall favor the cultivation of all trees hereafter planted on the ranch, wherever the location is such as to make it possible.

"As showing what the possibilities are of fence post production, I would call attention to figures heretofore reported, viz: That last year I cut 244 good fence posts, five to twelve inches in diameter, from 38 second-growth *Eucalyptus rostrata* trees, twelve years old. Some of these posts have been put in the ground plain and the balance subjected to creosote treatment by the Kahului Railroad Company. All of these posts will have the date stamped on them, and the place of use recorded in the Ranch Forestry book, so that their respective life in the ground can be ascertained accurately.

"Trees planted by the Haleakala Ranch Company during the year 1910:

Eucalyptus amygdalina
Eucalyptus botryoides
Eucalyptus crebra
Eucalyptus gunnii
Eucalyptus paniculata
Eucalyptus polyanthema
Eucalyptus rostrata
Eucalyptus rudis
Eucalyptus siderophloia
Eucalyptus silveriana

Planted at from 2,500 to 3,000
feet elevation.

Thaxter Plantation, Florence, Los Angeles County.
The above is the fourth growth in thirty-two years.

STRENGTH AND DURABILITY OF CALIFORNIA GROWN EUCALYPTUS

The strength and durability of Eucalyptus wood, as demonstrated by recent strength tests conducted at the University of California, are not unlike those of Eastern yellow birch, hickory, oak and ash. These tests have shown that the wood of Eucalyptus is even superior to most of the eastern hardwoods.

The wood of different species differs in strength and durability but in general the timber is very strong, heavy and hard, with a close-grained and homogeneous structure. The specific gravity of the wood of Eucalyptus globulus is greater than that of water, the dry wood of blue gum averaging over 60 pounds per cubic foot, varying from 50 to 70 pounds, according to the age of the timber. The wood of other species is still heavier. It is very tough, resisting indentation, tension and torsion. This is of advantage, for it will not crack nor break out under strain at joints or bolt holes. The wood is stiffer and less elastic than Eastern hickory, and ranges in color from white to dark brown. The heart and sapwood of many species are indistinguishable.

The timber of different species of Eucalyptus differs very much in character. While that of all species is hard, the degree of hardness, the strength, durability, flexibility, color and many other qualities are quite different. Great difference exists also in the timber of the same species grown in different soils and climates. To these variations are due, largely, the great variety of uses that the timber of these trees serve.

The following tables are based upon the measurement of 112 sticks nominally 2 by 2 inches in cross-section and 30 inches long. The sticks were measured as soon as they were cut from the logs and then remeasured after air seasoning and kiln-drying. A summary of the computed volumes shows the following ratios of the green volume to that of the kiln-dried wood.

Species	No. of Tests	Ratio of green volume to kiln-dried volume		
		Average	Maximum	Minimum
Manna Gum, <i>E. viminalis</i>	23	1.29	1.40	1.19
Red Mahogany, <i>E. resinifera</i>	4	1.28	1.32	1.22
Leather-jacket, <i>E. punctata</i>	13	1.23	1.32	1.08
Red Gum, <i>E. rostrata</i>	9	1.20	1.25	1.18
Blue Gum, <i>E. globulus</i>	27	1.19	1.36	1.17
Sugar Gum, <i>E. corynocalyx</i>	19	1.16	1.19	1.13
Karri, <i>E. diversicolor</i>	17	1.15	1.19	1.04

Showing Eucalyptus Trees One Year Old Planted in Land Cleared by Rock Crusher.

The shrinkage in the direction of the length of the timber was very small, in general amounting to less than 1-10 of one per cent. of the length. In the cross-section the shrinkage was about 40 per cent. greater tangential to the rings than it was in a radial direction.

Species	Age	Bending		Compression parallel to grain	
		No. of tests	Modulus of rupture per sq. in., lbs.	No. of tests	Crushing Strength per sq. inch.
Sugar Gum	15	5	25,344	11	11,290
Blue Gum	30	12	23,265	15	12,310
Leather-jacket	15	3	19,267	10	10,908
Karri	15	8	18,386	17	8,795
Blue Gum	15	28	16,900	34	8,190
Red mahogany	15	4	14,550	2	7,920
Red Gum	15	9	14,380	6	7,723
Manna gum	15	12	13,093	20	7,309

It is of special interest to note if one compares the above table with the table showing the size of the trees at the age of fifteen years, that, with the exception of the leather jacket, the species of Eucalyptus which show the greater strength and density are also the more rapid growing trees.

Tests by the Forest Service give the following figures upon the strength of four commercial grades of dry hickory:

Grade	Bending	Compression parallel to grain
	Modulus of rupture per sq. in. lbs.	Crushing strength per sq. in., lbs.
Second growth hickory	27,896	10,596
Black hickory	25,693	11,747
XXX hickory	22,469	10,814
XX hickory	20,693	10,176

A comparison of the strength of hickory with that of Eucalyptus, shows us that the blue gum when thirty years old exceeds the strength of XXX hickory; and that sugar gum at the age of fifteen years nearly equals the strength of black hickory and represents 91 per cent. of the strength of the best grade of second growth hickory.

As has already been noted, the wood of a blue gum 30 years old was about 50 per cent. stronger than that obtained from a 15 year old tree. This large increase in strength may not be due to age alone, since the test trees grew in different places, nor may we get a like increase in the more mature trees of the other species. It is fairly certain, however, that the strength of the sugar gum will increase in the more mature trees and will equal if not exceed the strength of the best commercial hickory.

USES OF EUCALYPTUS IN CALIFORNIA

The Eucalyptus probably serve more useful purposes than the trees of any other genus grown on the globe. Their uses are very diverse. As they grow they serve as a forest cover to mountains, hills, plains and swamps, as wind breaks and shade trees. While

Eucalyptus rostrata. Elsinor, California.

growing, they are also a source of many gums and resins, and of honey. When cut, they furnish valuable timber, excellent fuel, and a very valuable oil. Besides all this, many of them are ornamental, and they have the reputation of improving the climate of the region in which they grow. Being hardwood trees, they serve the useful purposes the hardwood trees ordinarily serve, and besides, furnish many valuable products similar to those obtained from a variety of other trees and from shrubs and herbs. This great variety of uses is made valuable in regions where they have but recently been introduced, by reason of their very rapid growth, it being possible to enjoy many of their uses while the trees are still standing and obtain from them many useful products within a very few years after planting.

The scarcity of good second growth hickory has caused manufacturers of all sorts of implements which require hard, tough wood, to take notice of the Eucalyptus.

Mr. T. A. Price, of Oxnard, California, whose costly house is floored and finished in Blue Gum, says that it is as hard as iron, with an effect of onyx, and the most beautiful hardwood floor he has ever seen.

Mr. J. Reimers, Chief of the Santa Fe Railway Forestry Dept., says: "There is a fortune in the foresting of Eucalyptus for the men who go into it now. I know of no better investment in an agricultural line than this. I believe that the uses to which the timber of these remarkable trees can be put in house-building, railway ties, piles, implements, plow beams, wagon material, fence posts, furniture, telegraph and telephone poles, will secure for this wood an unlimited market in the United States, as soon as Eucalyptus can be (and will be) produced in marketable quantities. With the hardwood famine which America is facing there can be no doubt as to enormously profitable foresting of Eucalyptus in California, which is practically the only State in the Union where the tree will grow."

The John Breuner Furniture Company of Sacramento and San Francisco are now manufacturing the finest furniture from Eucalyptus and find it has important points of superiority. It works up very nicely, does not check, is very close-grain and takes a very beautiful finish, dainty, rich and attractive, equal to natural finished mahogany. Also in dark mahogany finish and fumed and weathered to represent oak it is excellent.

Mr. Anson Blake, Reeiver for the Schofield Construction Company, writes as follows: "We are importing 300,000 feet of seasoned Eucalyptus for use as bilge and keel blocks at the Mare Island Dry Dock, price in Australia \$57.50 per M. Freight, etc., bring the price to \$73.00 per M., on wharf, San Francisco. This pays us, however, as it is a substitute for and better than Oak. The price of the latter is \$100.00 per M. The launching ways for the Collier 'Prometheus' built at Mare Island, were made of the same Eucalyptus timber."

Mr. Grant Wallace of Carmel, has grown Eucalyptus extensively. He says the eastern papers are calling attention to the fact that the

5 Useful Articles Made From Eucalyptus.

main supply of hardwoods in the United States, will, according to government reports, be exhausted in fifteen years. Walnut, Winecask Oak, and others are already exterminated. Furniture factories, implement and wagon shops, cooperage and stave factories, lumber and planing mills will have to shut down unless new sources of hardwood lumber can be found. He says that California has come to the rescue. That practical use shows Eucalyptus to be superior in every way to Oak, Ash, Hickory, Walnut and Maple, and equal to Mahogany. That as Eucalyptus cannot be grown East of the Sierras, every available acre in California, if planted, would be insufficient to supply the future demand and the price would continue to advance. That lumber companies and other corporations are putting out large plantations and over 25,000 acres will be planted this season.

Reichenback of Los Angeles, and the Homecrafts Manufacturing Company at Los Angeles, have used Eucalyptus in special orders, and are fully satisfied that it fills every requirement for all sorts of furniture and cabinet work. It takes a high piano finish, or a dull finish, shows its grain to perfection and takes any color or stain desired. It works up solid or in veneer the same as any other desirable hardwood, does not warp, check, twist, and neither does it open at the joints when properly seasoned.

Mr. Charles Glum, representing a large Philadelphia furniture manufacturer, is reported by the San Rafael Independent as having said: "We have been on the coast for several weeks, with a view of acquiring lands for the growing of the red Eucalyptus tree. The rapid disappearance of the Eastern hardwood has compelled the Eastern manufacturers to look around for a substitute for the same. We have ascertained that the Eucalyptus tree is the solution of the problem. As the quality of gum wood compared with the oak, I am of the opinion that the gum was a harder wood and is more suitable for furniture purposes. That it is cured easily and takes a better polish. It will be necessary for us to move our factories to this coast. In fact, all the large eastern manufacturers are working along the same lines."

Mr. C. H. Rodgers, of Watsonville, had a room finished in Eucalyptus about which he writes as follows: "You ask about the Eucalyptus finish in our living room. It is now ten years since the house was built and there is no evidence of warping or checking. The eucalyptus-finished room has given us more satisfaction and has been admired more by visitors than any of our native wood-finished rooms. The trees from which the finish in my house was made, were cut in March, and by forced seasoning—steam and kiln dried—the finish was placed in the house in September of the same year."

White & DeHart Co., Watsonville, Cal., write as follows: "The first Eucalyptus we sawed was about eight years ago. We sold most of this to the Hardwood Planing Mill Company of San Jose. I think they used a large part of it for insulator pine and heavy work, such as wagon reaches, poles, etc. We have used quite a lot of it for wagons and such work ourselves. In regard to supplying this

Eucalyptus Rocker and Table.

timber, we wish to say that we have only a small stock on hand at present for our own use and we do not care to dispose of it."

Mr. T. J. Gillespie, manager of the Hardwood Planing Mill Co., of San Jose, writes the following: "I would say that the Hardwood Planing Mill Company is operating almost exclusively in eucalyptus wood because it is the best hardwood in California to-day for high grade work. This wood is used in lieu of a second growth hickory, ash and oak, and is considered equal to any of them."

Train & Williams, as architects of the Grosse Building, have the following to say: "We specified Peruvian mahogany for the finish and doors. The Hughes Mfg. Co. furnished the finish and doors of the same wood as sample the first brought to us. We enclose a letter from Hughes Mfg. Co., which explains about the wood. Our clients are well pleased with the wood in above mentioned building and so are we. We recommend the wood from the sample. This finish wood is worth about \$130.00 per thousand, against about \$155.00 for mahogany. The appearance of the wood when finished is pleasing and beautiful as mahogany and receives any depth of color required in the staining. The durability of the wood is great, but should be well seasoned and kiln dried before being installed in buildings. We believe that the use of finish wood like the Grosse Building should be encouraged by architects, as it is eminently satisfactory. We will be pleased to specify the E. globulus (Blue Gum) for finish flooring."

Messrs. Train & Williams, City.

Gentlemen:—

Replying to your inquiry relative to the kind of wood used for the interior finish in the Grosse Building of this city, desire to say that we imported that lumber from Australia and know the wood by no other name than Australian Mahogany. This same wood has been carried in stock in San Francisco and sold there as Australian Mahogany. If there is any other name for it, it is unknown to us.

Very truly yours,

HUGHES MFG. & LUMBER CO.

Mr. Sutor, foreman of the Hughes Mill, states that the boards when received were of various widths, ranging up to thirty inches wide, and that the pieces were perfectly straight, neither checked nor warped. The doors of the Grosse Building were made of the regular three-ply veneer, but all of the balance of the interior was solid. An inspection of this building will show that the wood has never warped, checked, shrunk, split nor sprung. Australian Mahogany is worth in this market, \$125 to \$140 per thousand feet, board measure. Peruvian mahogany is worth \$155 to \$250 per thousand.

It is also ascertained that Australian mahogany has been used in many residences without the owners' knowledge that the wood is really Eucalyptus. No deception has been practiced, because the mahogany varieties of Eucalyptus are commonly called Australian Mahogany. A former foreman of the carpenter department of the Pullman Car Shops, makes the statement that Eucalyptus has for years been largely used in finishing Pullman coaches. It has been

Description on Opposite Page.

ascertained that this wood has also been used by other car builders for finishing Pullman coaches, and that other varieties of *Eucalyptus* are used by some in the structural work of their cars.

Sells Brothers' Circus, and Shepherd & Teague, of Fresno, have repeatedly made the statements that the *Eucalyptus* is the strongest and toughest timber that can be obtained for tent stakes and wagon poles, and outlasts the best second growth hickory. Plow beams, neck yokes, whiffletrees, felloes and spokes are turned out in large quantities by the Hardwood Planing Mill Company of San Jose. They are in use generally throughout central California.

Mr. F. B. Stratton, collector of the port of San Francisco, is authority for the statement that the *Eucalyptus* woods passing through the port of San Francisco from Australia "are largely used for sheathing vessels, especially those used in Alaskan trade, and for side stakes on vessels where they chafe against docks."

DESCRIPTION OF PICTURE ON OPPOSITE PAGE.

AA	Plow beam	P	Sample <i>Eucalyptus</i> Globulus
BB	Neck yoke	Q	Card receiver
CC	Double-tree	R	Cane, Blue Gum
DD	Single-tree	S	Insulator Pin
EE	Chair rocker	T	Paper Knife
FF	Felloe	U	Fire wood
GG	Paving block, 12 years, 6 months (July 1881—December, 1893) at Melbourne.	V	Pin cushion, Yucca center
HH	Brake block	W	Gavel
A	<i>Eucalyptus</i> Botryoides	X	Baton
C	Chessmen	Y	Pruning handle
D	Candlestick	Z	Walking cane, Rostrata
E	Cup	1	<i>Eucalyptus</i> Microcorys
F	Tenpin	2	<i>Eucalyptus</i> Remedies
G	Diavolo	3	Heron's Blue Gum Liniment
J	<i>Eucalyptus</i> Rostrata	4	Heron's <i>Eucalyptus</i> Oil
K	<i>Eucalyptus</i> Rostrata Paper Veneer	5	Heron's <i>Eucalyptus</i> Salve
L	Plate, <i>Eucalyptus</i> Globulus	6	Heron's <i>Eucalyptus</i> Cough Drops
M	Cribbage board, <i>Eucalyptus</i> Rostrata and Globulus	7	Heron's <i>Eucalyptus</i> Soap
N	Sample Resinifera	8	Heron's Cream of <i>Eucalyptus</i>
O	Sample <i>Eucalyptus</i> Globulus	9	Heron's <i>Eucalyptus</i> Oil
		10	Heron's <i>Eucalyptus</i> Hair Restorer
		11	Sample Blue Gum

Preparing Seed Beds. Soil Worked Up To Almost Powder Before Seeds Are Sown.

EUCALYPTUS USED BY BAKER & HAMILTON.

SACRAMENTO

SAN FRANCISCO

LOS ANGELES

NEW YORK

Baker & Hamilton

MILL, MINING
AND RAILROAD SUPPLIES
MOTORS AND CYCLES
SUPPLIES

IMPORTERS, JOBBERS AND MANUFACTURERS OF

HARDWARE, AGRICULTURAL IMPLEMENTS

DAIRY
AND CREAM FACTORY
EQUIPMENT
ENGINEERS AND BOILERS

IRON, STEEL, AXLES, SPRINGS, COAL
AND VEHICLES

MANUFACTORY, BENICIA, CAL.

REG. U.S. TO 112 J BY. 1887 TO 1888 BY
SACRAMENTO, CAL.

Sacramento, Cal., Jan. 7, 1909.

Mr. C. H. Sellers, Assistant Forester,

Capitol Building,

Sacramento, Calif.

Dear Sir,-

In reference to Eucalyptus timber, will say that our factory at Benicia has been using the Australian Blue Gum for some several years with marked success.

We have been furnishing various construction companies, who have contracts for constructing the road-bed of the Western Pacific railroad, with their construction plows. At first we furnished plows with hickory beams and some with steel beams but neither the hickory or steel beams were strong enough to stand the strain put on them.

We then experimented with the Australian Blue Gum which proved to be better adapted for that work than either the hickory or the cast steel.

We also use the Blue Gum for singletrees, doubletrees, lead bars, etc., and in every case it has been a marked success.

Yours truly,

HJR/H

BAKER & HAMILTON.

*Applied
Manager*

The following letter was received from the Australian Hardwood Lumber Company, wholesale and retail dealers in native and foreign Eucalyptus and other hardwoods:

San Francisco, Cal., August 6th, 1910.

Mr. C. H. Sellers,

Forest Expert,

Elks Building,

Sacramento, Cal.

Dear Sir:—

In reply to your enquiry as to the opportunities for Eucalyptus hardwoods in the United States, would say that we carry a stock of local Eucalyptus on hand at all times. We are also the largest importers of Australian Eucalyptus timbers in the United States.

Since we have created a market for these timbers we have no difficulty whatever in making sales, in fact most of our customers who have in the past used Eastern woods exclusively, prefer Eucalyptus, finding it superior both in strength and quality and clear of knots, so prevalent in the grade of lumber shipped to California since the forests are being exhausted.

As soon as the Eucalyptus trees already being planted are matured sufficiently to be milled, there is little doubt but it will revolutionize the hardwood lumber market of the United States.

We beg to remain,

Yours very truly,

AUSTRALIAN HARDWOOD LUMBER CO., Inc.

F. RICHARDS,

Vice-Pres. and Manager

Die. F. R.

EUCALYPTUS OIL

The manufacture of oil may well be considered as a source of revenue upon the exploitation of extensive Eucalyptus plantations. It is obtained by a process of distillation, in which the leaves and small brush are utilized. There are a number of manufacturers located in different parts of the State, the chief producers operating in Los Angeles, Garden Cove and Santa Monica. Their output varies from a few hundred pounds to one or two tons a year, but that of the largest manufacturer annually reaches the neighborhood of nine tons. Eucalyptus oil is recognized in the U. S. Pharmacopia as a valuable drug, and is recommended for the cure or relief of a considerable variety of complaints, notably throat and bronchial troubles. The demand for California oil is sufficient to maintain it at a price which makes its extract profitable and it is probable that its manufacture will be greatly increased in the future. A liquid by-product of distillation is known to contain a high percentage of tannin, and a valuable tanning extract may be produced from this source.

THE DRAIN UPON THE FORESTS

Every American who is abreast of current affairs is aware that the forests of the country are being cut down much faster than they are growing, but few have any very definite idea of just how much more wood is being cut than is being produced, nor of how long it may be, under present conditions and methods, before certain woods, now abundant, will be used up.

In the United States today, there are 2,482 furniture factories with an annual output of \$170,000,000; 5,143 factories manufacturing vehicles and agricultural implements with a total output valued at \$150,000,000; 712 factories manufacturing barrels and cooperage stock with a total output of \$14,000,000. Added to these few here enumerated are many other industries which consume an even greater quantity of lumber, both hard and soft, but these herein mentioned will suffice to give the reader a comprehensive idea of the enormous drain upon our timber supply.

INCREASE IN CUT SINCE 1880.

(Forest Circular 129.)

The total lumber production reported by the censuses of 1880, 1890, 1900, 1906 and 1907, is shown below. The cut has more than doubled since 1880.

	1880
	18,087,356,000 feet.
	1890
	23,494,853,000 feet.
	1900
	34,780,513,000 feet
	1906
	37,550,736,000 feet
	1907
	40,256,154,000 feet.

New Method of Transplanting Seedlings. (Patent Applied For.)

The railroads are importing millions of ties and are making contracts years in advance. 100,000,000 cross ties are used every year by the railroads of the United States. The telephone, telegraph and electric light companies reported the purchase of 3,493,025 round poles exceeding twenty feet in length during the year 1906.

ROUND MINE TIMBERS

According to data gathered by the Forest Service and the Geological Survey upon the consumption of timber in mines in 1905, the quantity of round timbers used underground annually exceeds 165,000,000 cubic feet, of which over half consists of hardwoods. Like the making of hewed cross-ties, the cutting of round mine timbers takes large quantities of young timber, and in many localities constitutes a most serious drain upon the forests.

WOOD FOR DISTILLATION

The amount of wood reported as used for distillation in 1906 was 1,195,130 cords, of which a little over 50,000 cords consisted of pine and the balance of hardwoods. The hardwoods distilled are chiefly birch, beech and maple, but it is impossible to state the proportions. In some cases the wood used for distillation consists of the waste incident to logging and lumber manufacturing operations and so constitutes a saving, while in other cases the wood is cut especially for distillation.

VENEER

Not less than 326,000,000 feet, log scale, of timber were used for the production of veneer in 1906. Many woods are made into veneer, reports upon some 20 kinds being received, but the larger portion is furnished by a comparatively few species. Over one-fifth of the total amount consisted of red gum and about one-seventh of oak, followed by yellow pine, maple, cottonwood, yellow poplar, hardwood, birch, elm, tupelo, spruce, beech, ash and walnut. The making of thin lumber from pine, cottonwood and similar woods on veneer machines for boxes, baskets and crates has increased rapidly in recent years. The veneering of such woods is for a wholly different purpose than that of the veneering of oak, maple and other ornamental woods, where the sheet of veneer is spread upon a backing of inferior material.

LUMBER PRICES GREATLY INCREASED.

Within the last eight years, owing to the dwindling supply of hardwood, statistics show that the price of quartered oak increased from \$55 to \$80 per thousand; hickory from \$48 to \$65 per thousand; yellow poplar from \$33 to \$53.50 per thousand; and maple from \$22 to \$32.50 per thousand. There is every reason to expect that the prices of these woods will soar still higher during the next 15 years because wood must be used in increasing quantities to supply the demand of building operations. It is estimated by the Federal Forest Service that in sixteen years there will be very little if any, left. In the year 1906 the total cut of hickory of all states was 148,212,000 board feet; walnut, 48,174,000 board feet.

Eucalyptus Seedlings.
4 Months

6 Months

2 Months

PRESENT PRICES OF TELEGRAPH POLES.

35 foot poles, 6 inches across the top.....	\$ 6.00 each
40 foot poles, 6 inches across the top.....	7.00 each
45 foot poles, 6 inches across the top.....	8.00 each
50 foot poles, 6 inches across the top.....	9.25 each
55 foot poles, 6 inches across the top.....	11.25 each
60 foot poles, 6 inches across the top.....	12.50 each

HOW THE HUGHES MANUFACTURING & LUMBER CO., SEASON EUCALYPTUS.

The following letter written by the Hughes Manufacturing & Lumber Company, dealing in Sash, Doors, Mill Work and Lumber, Wholesale and Retail, Main Office and Yards, 1430 S. Alameda St., Los Angeles, California, will explain their method of seasoning and uses of Eucalyptus Lumber:

Los Angeles, Cal., April 26, 1910.

C. H. Sellers,
24 and 25, Elks Bldg.,
Sacramento, Cal.

Dear Sir:— —

In reply to your inquiry regarding our experience with eucalyptus, we have found a practical method whereby we can dry eucalyptus about the same as plain oak, and when dry, use it for manufacturing all kinds of cabinet work.

We find by sawing the logs up to about 3 inch or 4 inch planks and placing in water for four or five days, gradually letting the water get hot and gradually letting the same water cool, then we pile the lumber to air dry for several months, and before we use it for cabinet work we kiln-dry it.

We have used eucalyptus for different classes of work for the last four or five years. We have used this wood for the manufacture of bank and office fixtures, furniture, interior house finishing, decoration work, flooring, and for various other uses where a high polish is needed, and find it very satisfactory for construction and wagon work. The wood is very hard and takes a high polish. When the lumber is thoroughly dry, we do not have any trouble about it warping or cracking, and we see no reason why it should not take the place in the commercial world as one of the most beautiful cabinet woods.

Yours very truly,
HUGHES MFG. & LBR. CO.,

Per J. A. SOUTER.

JAS—SB.

Supt.

Preparing Land For Field Planting By Plowing 7 Inches Deep.

SEASONING HARDWOODS.

Manufacturers say that Eucalyptus presents no greater difficulties in seasoning and handling than any other Eastern hardwoods, which are annually cut and seasoned by the million feet in the Eastern States. The success that has already been attained by several experienced manufacturers proves that Eucalyptus yields readily to thorough and proper methods. The following extracts from circular 48, issued by the Forest Service, Washington, D. C., entitled Kiln-Drying Hardwood Lumber—by Frederick Dunlap, shows the method of seasoning eastern hardwoods.

TIME REQUIRED

The time consumed in drying, one of the most important items in the expense account, varies very widely among operators. Take, for example, 1-inch plain white oak, which is a standard material dried throughout the region studied. As a rule, this is dried from one to two weeks, yet many operators, even when crowded for kiln space, double this period, whereas at the larger and more progressive plants, especially those drying hardwood flooring, it is reduced to five, four, or even three days. Where the kiln is larger than necessary it is not an uncommon practice to use it as a storage room for surplus stock. The time of drying differs widely also with the species, as well as with the intended use. Quarter sawed oak usually requires half again as long as plain oak. Mahogany requires about the same time as plain oak; ash dried in a little less time, and maple, according to the purpose for which it is intended, may be dried in one-fifth the time needed for oak or may need a slightly longer treatment. For birch, the time required is from one-half to two-thirds, and for poplar and basswood, from one-fifth to one-third that required for oak.

COST

The information secured upon cost indicates, especially among smaller operators, where economies are less carefully studied, the widest divergence. The extreme figures, for products not widely different, are 75 cents and \$5.00 per thousand feet.

USE OF KILN-DRIED WOODS

With the exception of structural timber, nearly all hardwoods are kiln-dried before they are made into the finished product. A surface finish such as that demanded in furniture and interior work and the high degree of strength and stiffness demanded in vehicle and implement stock are impossible without thorough drying, and this drying is most quickly accomplished in a kiln.

RESULTS OF MISTREATMENT

Mistreatment of the material results in numerous defects, chief among which are warping and twisting, checking, case hardening, and honeycombing. Many woods, as, for example, tupelo and red gum, will warp and twist in drying unless special care is taken. This difficulty is not confined to kiln-drying, but is quite as great in air-drying. Indeed, drying in the open with exposure to the sun often develops the worst examples. In both cases the remedy lies in proper piling. In piling lumber for the kiln, the cross sticks should always be placed directly over the trucks, following a per-

Rockwell Grove, San Pasqual Valley, 8 Miles East of Escondido.
E. globulus, 20 Years Old. Average Diameter 30 Inches,
Average Height 165 Feet. Area 8 Acres.

pendicular line. Successful kiln-drying depends chiefly upon these two principles and upon keeping separate the two distinct stages of the process which they govern. To carry out proper drying principles, a correctly constructed kiln is necessary. The essentials of kiln construction, deferring details for the present, include the following points: The system of heaters and radiators should be capable of maintaining the desired temperature at all times. The temperature and humidity of the drying chamber should be under perfect control and protected from outside influences. Simple devices should control the circulation as desired, both between the kiln and the outer atmosphere and between the two ends of the kiln. Toward the end of the process abundant and vigorous circulation should be provided for, due care being taken not to lower the temperature.

PARTS

The essential parts of a dry kiln are the drying chamber, the steam coils and the ventilating device. The drying chamber varies greatly in length, according to the output desired and the process used. It may be as short as fifteen feet or as long as 150 feet. In most cases its height is from 6 to 8 feet, with a width of from 10 to 30 feet. Though it may be made of a number of materials, wood is widely used where the building laws permit. The choice of material depends otherwise upon the kind of lumber to be used and the thoroughness of drying desired. Some of the best drying is done in brick kilns with concrete foundations.

METHODS OF OPERATING

There are two methods followed in kiln operation—the progressive and the charge systems. The progressive system requires a kiln of considerable length, say upwards of 50 feet. Temperature and moisture are so distributed in the kiln that in passing from the green to the dry, a load of lumber is first moistened, then heated, and finally dried out. In this way all stages of the process are under way in the different parts of the kiln at once. Circulation may be carried on by a draft lengthwise of the kiln which carries back the moisture from the dry end of the kiln and deposits it on the wood in the wet end, or, where the extreme of moist-air drying is practiced, there may be no such longitudinal circulation and very little circulation of any kind. The temperature may be fairly uniform throughout the whole length of the kiln, in which case the wood must be very hot on exit to insure the removal of residual moisture, or a difference of 20 to 40 F. or more may exist between the two ends. The progressive system of operating is most widely employed in factories where the wood to be dried is of fairly even thickness and quality and where the drying is done in large amounts and continuously.

Kilns for operation in the charge system are typically square. The kiln is charged and this charge is dried before fresh material is admitted. Wheeled carriages may be used to carry the material, or it may be piled upon the floor or arranged along the walls. For novelty works and other establishments with a highly varied product of which smaller amounts are dried at once, this method is widely employed, and wherever particular attention must be paid

Trees Grown in the Open, Exposing Them to all Conditions of Weather.

to the thickness and quality of the stock it probably yields the best results. Conditions are controlled entirely from outside the kiln and are varied to suit the operator's ideas of the requirements of the case.

Drying may be continuous or intermittent. From necessity or economy many kilns are operated only by day. At night, in such cases, the heat is shut off, the blower is stopped, and the temperature is allowed to fall, while the humidity may reach the day-point. Intermittent operation is not adapted to yielding the best quality of product. It would be highly expensive, owing to the loss in heat in restoring the drying temperature in the morning, were it not that in this case only exhaust steam is used.

Where the drying is continuous, the kiln is supplied with live steam when the engines are shut down at night. This means that drying progresses evenly. The material is held at a regular temperature and, provided the humidity does not fall too low, checking and warping are less apt to occur.

AUXILIARY EQUIPMENT

It is essential to know what conditions of temperature, humidity, and circulation obtain in the kiln when the output is being properly dried, since these are probably the most important and are certainly the most readily determined elements of the operation. Successful kiln-drying depends, therefore, not only upon the adequacy of the drying equipment, but also upon the auxiliary equipment for showing at every moment the conditions within the drying chamber.

EUCALYPTUS GLOBULUS.

The blue gum is the most widely adaptable of the *Eucalyptus* planted in California. Its requirements for favorable environment are moderate, and it occupies an intermediate position among *Eucalyptus* which endure extremes of drought and cold. The section within the influence of the moderate coast climate is most favorable for its best development. Though its growth is especially thrifty in the northern coast counties and in the coast valleys of Southern California, its timber production appears most rapid in the Santa Clara, Sacramento and other valleys opening about San Francisco Bay. In the treeless sections of Southern California many extensive *Eucalyptus Globulus* plantations have been set out to supply fuel demands. The exploitation of these groves at recurrent periods of 4 to 8 years has in a large measure supplied this region for the past 40 years with fuel.

The early growth of the blue gum is very rapid. Under favorable moisture conditions, trees have attained the height of 175 feet in 12 to 20 years and diameters of 2 to 5 feet. The root system consists mostly of numerous strong laterals: the tap-root rarely penetrates to a depth of more than 10 feet. Abundant supply of moisture is demanded and as the roots grow quickly toward water *Eucalyptus globulus* should never be planted near wells, cisterns, water pipes, irrigating ditches or similar water impounding structures. In loose, sandy or gravelly soils the large lateral roots penetrate to great depth, and extend almost incredible distances. In digging wells,

Trees Crated, Ready For Shipment.

large roots have been discovered at a depth of 45 feet below the surface and the surface roots of large trees frequently spread over 100 feet away from the trunk of the tree.

The *Eucalyptus globulus* is a species of no great drought endurance. It is drought-hardy in Southern California only so far east as the head of San Bernardino Valley. Long continued periods of drought and the lowering of the water level in some of the Southern California valleys have had a very injurious effect upon the plantations. During the sapling age, if summers are very long and dry, cultivation should be given the soil or the leaves will turn brown and fall. In many localities in the interior valley and in the mountain foothills blue gum endures unfavorable conditions but the result is stunted and slow growth; more hardy species should be selected for planting. The blue gum groves upon the dry slopes and crests of the Coast Range hills owe their thrift principally to the prevalence of fogs, for ordinarily they will not succeed in dry localities. Owing to fog moisture, however, the valleys opening into San Francisco Bay are rendered the most favorable region for blue gum (*Eucalyptus globulus*) planting in California. The Los Angeles and San Bernardino valleys average nearly the same annual rainfall, but in the latter region the amount is inadequate for the best growth of blue gum. Frequent fogs, however, make the Los Angeles valley a very favorable region for the growth of this and other species. It is little inferior in suitability to the Bay counties though the annual precipitation is but half as great. Blue gum will grow where the water level is very high and will even endure standing water for a time. On portions of the tule marshes in the central part of the State, where the level of the brackish water is within a foot of the surface, blue gum has been grown on very soft, spongy soils and stimulated to very rapid development. This species and the red gum have grown upon soil where their roots were supplied by brackish water. Eucalypts have never been successfully planted on tide flats or flooded salt marshes and trees have died out on land which has become salt-marsh by inundation.

In Southern California deep sandy loam soils have been found to support the best growth while clay-loam and adobe soils support maximum growth both in the Bay counties and in the coast valleys of Southern California. Few situations in which blue gum plantations have been set are sufficiently well watered to support maximum growth. This species will not tolerate excessive alkaline soils, but as a general rule they will grow on partially alkaline soils.

Blue gum is not so frost enduring as red, desert, gray and manna gums, but more so than sugar and lemon gums. It remains very sensitive to frost as long as the immature foliage is retained. Saplings will survive a temperature of 22 degrees F., and both blue and sugar gum will endure more frost than citrus trees.

This species shows the most persistent vitality of all *Eucalyptus* and produces prolifically by sprouting, and to a considerable extent by seed. Fuelwood groves over 30 years old have sprouted up vigorously after the fourth and fifth cutting, and seedling trees over 30 years old sprout after cutting as thriftily as younger trees. Repro-

VOLUME OF ALL TREES ON ACRE.

OWNER OF GROVE	LOCATION	Original Spacing	Age of Trees	Trees per Acre.....	Volume— cubic feet	California Cords.....	Volume— board feet	
Baldwin	Arcadia	12x12	18	166	5,881	87.7	28,855	Seedlings
Baldwin	Arcadia	10x12	18	300	6,384	95.5	28,000	Seedlings
Baldwin	Arcadia	10x10	24	362	34,570	515.9	213,796	Seedlings
Mecham	Mecham	7x 7	6	1,341	18,644	278.3	73,365	Sprouts
Mecham	Mecham	6x 6	9	960	22,802	340.2	107,385	Seedlings
Mecham	Mecham	8x 8	20	564	22,139	330.6	116,064	Seedlings
Mecham	Mecham	10x10	18	388	25,086	371.2	140,464	Seedlings
Bailey	Santa Ana	6x10	8	474	17,808	265.9	87,960	Seedlings
Bailey	Santa Ana	6x10	9	666	9,604	143.4	39,040	Seedlings
Newton	Newton Ranch	8x10	7	840	6,807	101.6	23,210	... Sprouts
Micheaux	Compton	8x 8	7	570	4,404	65.9	12,700	Seedlings
Micheaux	Compton	8x 8	9	1,198	9,144	136.5	27,480	.. Sprouts
Newman	Santa Ana	10x10	8	684	11,976	179.2	49,790	 Sprouts
Jennie	Coyote	4x 5	7	1,468	18,292	273.1	72,080	Seedlings
Olebenhain	Olebenhain	8x 8	16	542	22,392	334.3	109,840	Seedlings
Diamond Coal Co. .	Compton	8x 8	6	559	4,543	67.8	11,125	Seedlings
Lassing	Compton	10x10	8	880	6,187	92.4	15,630	... Sprouts
Harrison	Harper	8x 8	6	608	6,269	93.6	20,440	Seedlings
Martin	Harper	6x 6	6	728	4,924	73.5	9,660	Seedlings
Montigne	Compton	8x 8	7	1,466	4,570	68.1	2,840	... Sprouts
Sexton	Compton	8x 8	11	1,116	9,847	146.9	33,170	... Sprouts
Thaxter	Nedean	10x10	8	718	13,306	198.6	58,270	... Sprouts
Stewart	Compton	6x 6	6	1,640	6,730	100.5	8,880	... Sprouts
DeWitt	Harper	7x 7	5	782	6,410	95.8	18,320	Seedlings
Hunter	Bairdstown	8x 8	7	538	13,690	204.2	64,360	Seedlings
Watson	Watson	6x 8	16	590	8,462	126.4	34,200	Seedlings

The above table represents 26 different plantations located in various parts of the State, containing one acre each. A sample acre which appeared to be the average condition of the plantation was carefully selected and every tree from 2 inches in diameter and over was measured and afterwards computed. In taking these measurements, only the clear lengths of the trees were considered.

Example—Baldwin plantation. One acre measured, spaced 12x12, 18 years. Trees on acre, when measured, 166. Volume cubic feet, 5,881 when computed. If the trees were cut into cord wood it would produce 87.7 cords of wood. (California cord, 96 feet.) If cut into lumber the result would be 28,885 board feet.

VOLUME OF 8 INCHES IN DIAMETER AND OVER ON ACRE

OWNER OF GROVE	LOCATION	Original Spacing ..	Age of trees.	Trees per Acre.....	Value, cubic feet.....	California Cords	Board feet...	
Baldwin.....	Arcadia	12x12	18	151	5,771	86.1	28,855	Seedlings
Baldwin.....	Arcadia	10x12	18	180	5,600	83.7	28,000	Seedlings
Baldwin.....	Arcadia	10x10	24	334	34,338	512.5	213,796	Seedlings
Mecham	Mecham	7x 7	6	739	14,673	219.0	73,365	... Sprouts
Mecham	Mecham	6x 6	9	705	21,477	320.5	107,385	Seedlings
Mecham	Mecham	8x 8	20	453	21,487	320.9	116,064	Seedlings
Mecham	Mecham	10x10	18	376	24,994	372.9	140,464	Seedlings
Bailey	Santa Ana	6x10	8	558	19,066	284.6	87,960	Seedlings
Bailey	Santa Ana	6x10	9	334	7 808	116.5	39,040	Seedlings
Neton	Newton Ranch ..	8x10	7	286	4,642	69.3	23,210	... Sprouts
Micheaux	Compton	8x 8	7	160	2,540	38.0	12,700	Seedlings
Micheaux	Compton	8x 8	9	320	5,496	82.0	27,480	... Sprouts
Newman	Santa Ana	10x10	8	346	9,958	148.9	49,790	... Sprouts
Jinnie.....	Coyote	4x 5	9	732	14,416	57.9	72,080	Seedlings
Olibenhain	Olibenhaim	8x 8	16	474	21,968	328.0	109,840	Seedlings
Diamond Coal Co. .	Compton	8x 8	6	153	2,225	33.2	11,125	Seedlings
Lassing	Compton	10x10	8	196	3,126	46.7	15,630	... Sprouts
Harrison	Harper	8x 8	6	248	4,088	61.0	20,440	Seedlings
Martin	Harper	6x 6	6	124	1,932	28.8	9,660	Seedlings
Montique	Compton	8x 8	7	40	568	59.7	2,840	... Sprouts
Sexton	Compton	8x 8	11	354	6,636	99.0	33,170	... Sprouts
Thaxter	Nedean	10x10	8	371	11,634	174.0	58,270	... Sprouts
Stewart	Compton	6x 6	6	120	1,776	26.5	8,880	... Sprouts
DeWitt	Harper	7x 7	5	216	3,864	54.8	18,320	Seedlings
Hunter	Bairdstown	8x 8	7	378	12,872	192.0	64,360	Seedlings
Watson	Watson	6x 8	16	316	6,850	82.2	34,200	Seedlings

The above table represents the same 26 plantations as are shown on opposite page. When computing the figures that were secured in the field, nothing under 8 inches in diameter was considered. All diameters below 8 inches were thrown out. This was done to see what the difference would be by comparing all diameter classes from 2 inches and over, as against 8 inches in diameter and over, results of which are shown in above table, by comparison with the table on the opposite page.

Example—Baldwin plantation. Spaced 12x12. Age of grove, 18 years. Trees per acre, 151. Volume cubic feet, 5,7771. (California cords, 86.1). Board feet, 855. By comparing these figures with figures on the opposite page, it will be noticed, while the total board fee secured is the same, the cord volume is 86.1, as compared with 87. The volume cubic feet is 5,771, as against 5,891. The trees per acre are 151, as against 166.

BAILEY GROVE No. 1

SANTA ANA, CAL.

Eucalytus Globulus. Seedlings.
9 years old.This grove has never been irrigated
or cultivated.**BAILEY GROVE No. 2**

SANTA ANA, CAL.

Eucalyptus Globulus. Seedlings.
8 years old.

Cultivated for the first 5 years.

D. Bh.	No. of Trees, per Acre	Cubic Feet	Cords	Board Feet	D. Bh.	No. of Trees, per Acre	Cubic Feet	Cords	Board Feet
3.....	44	40	.6	.....	7..	24	216	3.2	... ..
4.....	64	128	1.9	.....	8.....	42	546	8.1	2,730
5.....	56	280	4.2	.....	9.....	6	102	1.5	510
6.....	82	574	8.6	.....	10.....	36	756	11.3	3,780
7.....	86	774	11.6	.....	11..	36	936	14.0	4,680
8.....	74	962	14.4	4,810	12.....	60	1,860	27.8	9,300
9.....	38	646	9.6	3,230	13.....	72	2,664	39.8	13,320
10.....	74	1,554	23.2	7,770	14.....	78	3,354	50.1	16,770
11.....	58	1,508	22.5	7,540	15.....	42	2,100	31.3	10,500
12.....	52	1,612	24.1	8,060	16.....	42	2,436	36.4	12,180
13.....	18	666	9.9	3,330	17.....	6	408	6.1	2,040
14.....	20	860	12.9	4,300	18.....	30	2,430	36.3	12,150
Totals...	666	9,604	143.4	39,040	Totals..	474	17,808	265.9	87,960

The above groves are located within 1,000 yards of each other, but there appears to be a difference in their growth as is shown from the measurements. Grove 1 has never received any care. The trees were planted and left to grow at will, while the trees in Grove 2 were cultivated for the first five years. So it is apparent that cultivation is necessary for the successful and rapid growth of the Eucalyptus. By thorough cultivation the soil is kept stirred up, thus retaining the soil moisture near the surface. When the roots of the trees once reach the moisture they will follow it down.

NOTE:—Other portions of grove No. 2 have been measured by various parties, and in some cases higher results have been obtained. It is believed, however, that the figures given above express quite accurately the average stand.

E. globulus, 28 Years Old, Santa Barbara County, Calif.

Eucalyptus maculata. Spotted Gum. Australian Eucalyptus Forest Conditions.

duction from seed is especially common in plantations near Santa Barbara, where saplings three years old have been noted which have reached a diameter of 3 inches and height of 25 to 30 feet. The blue gum reproduces with great facility in the groves in the Santa Clara Valley and about San Francisco Bay and even over drier situations on the Piedmont hills. A notable evidence of the vitality of the *Eucalyptus globulus* was given in the last decade during the long continued period of excessive drought in Southern California.

The *Eucalyptus globulus* may be grown practically through the *Eucalyptus* range and its ease of propagation and its unexcelled rate of growth to large merchantable proportions make it the most valuable *Eucalypt* for planting for timber production. In strength tests its wood ranks high among the stronger *Eucalyptus* timbers, and it has been found suitable for all the great variety of uses which have placed *Eucalyptus* timber in its present favorable estimation. Seasoned *Eucalyptus globulus* timber has been substituted in the San Francisco market for orders of hard maple, hickory, and "ironwood" without the knowledge of the purchaser, but to the full satisfaction of the uses to which the timber was put.

To secure best results it should be cut during the winter, peeled and worked up while green, corded up away from contact with the soil, and allowed to season two or three months before using. A superior grade of charcoal may be made from gum wood.

The dry wood of *Eucalyptus globulus* averages 61 pounds per cubic foot, varying from 52 to 70 pounds, according to the age of the timber and the degree of seasoning. Its color is whitish or straw color and in both color and grain closely resembles the appearance of hickory or ash. The heart is but little darker than the sap.

EUCALYPTUS TERETICORNIS—GRAY GUM.

Gray Gum attains a good size under favorable conditions, quite rapidly, and gives promise of reaching fully the size the trees do in their native home. When growing near together, or among other trees, they are very tall and straight with an even trunk, but when growing scattered they develop a great many branches and are more stocky. On a ranch near Santa Barbara, their rate of growth has been about two-thirds that of *Eucalyptus globulus*, the fastest-growing species. The bark is commonly smooth and grayish, frequently flaking off in thin layers. The leaves of the young seedlings are broad, with very short stalks, but as the young tree increases in size the leaves that appear are more scattered, longer-stalked and more slender. The flowers are above medium size, in open clusters of 4 to 8 on slender stalks. The seed cases are usually below medium size and are top-shaped or goblet-shaped, with prominent protruding valves.

The Gray Gum thrives under quite a variety of climatic conditions. It endures a considerable drought and succeeds on the lower hilly situations in Southern California. It proves one of the best species for planting in the frosty portions of the central interior valley, and will endure considerable amount of alkali. It will with-

The following letter was received from the California Souvenir Company, manufacturers of Eucalyptus:

Los Angeles, Cal., Aug. 4, 1910

Mr. C. H. Sellers,

Sacramento, Cal.

Dear Sir:—

The accompanying illustration (on page 93), represents a table made by us, entirely of Eucalyptus. The top is solid and the corner designs and border are inlaid, as well as the center piece. The table is composed of about one thousand pieces, seven different species being used in its construction. It is on exhibition in the Los Angeles Chamber of Commerce at the present time.

We have used Eucalyptus in the manufacture of a great variety of articles such as canes, chairs, police clubs, parquet flooring, rulers, chisel and hammer handles, neck yokes, single and double trees, for which it is well adapted, equal in strength to hickory.

It will displace mahogany and the hardwoods for furniture and interior finish. In our experience we have found that it takes any stain and finishes most beautifully, equal to any mahogany with which we are acquainted. A certain per cent of the Eucalyptus wood has a most beautiful grain, which is brought out by the finish.

When mature trees felled in the proper season are sawed, the ends of the lumber painted, piled with air space in tall stacks, or weighted down, very little difficulty should be met with in air seasoning.

Very truly yours,

A. H. SCHWAN.

Manager, California Souvenir Co.

E. globulus, Los Angeles County, 6 Years Old.

E. globulus, Los Angeles County, 8 Years Old, Fourth Growth in 32 Years.

stand minimum temperatures of 15 to 20 F., and maximum temperatures of 110 to 112 F. This species has been known to still live and revive quickly after a drop in the temperature to 12 F. It also grows without injury in the frosty parts of the San Joaquin and Sacramento Valleys where young blue gums are frequently killed to the ground, and where sugar gum may not be successfully grown.

The trees of this species furnish an excellent red-colored timber that is very hard and very durable under-ground. It is used for general building purposes, for ship building, for wheelwright work, for railway ties, telegraph poles, posts, fencing, and fuel, its characteristics and uses being much the same as those of *Eucalyptus rostrata*. By some the timber is considered more durable than that of the latter. Mr. Maiden reports a post of this species that remained quite sound for fifty-five years, according to the same author, Mr. Howitt, the eminent authority on Victorian trees, places *Eucalyptus tereticornis* at the head of all commercial timber trees of that colony. Gray gum is closely related to the red gum. The tree possesses a similar degree of hardness, strength and durability that make the red gum so valuable for commercial purposes, but its form development is greatly superior; it develops a clear, straight bole of large dimensions. This timber will undoubtedly supply adequately a great variety of commercial uses.

RECORD OF DURABILITY OF THE TERETICORNIS IN AUSTRALIA.

According to the Forestry Branch, this species is plentiful, and generally found on mountain slopes or in deep gullies on and near the coast of Southern Queensland.

Toowoomba—Mr. Butler, of Dalveen, where this timber grows plentifully, pointed out some fencing erected of this timber, 35 years old. The posts have stood better than the rails, but the fence is still serviceable. Some of the sleepers near Dalveen Tunnel are of this timber, and in good order, age 24 years. Station Carpenter Clark considers it is equally durable in buildings, and of the same appearance when sawn or split as grey ironbark.

Townsville—This timber very much resembles Ironbark. In the Townsville jetty, piles and girders of Grey Gum, used some 13 years ago, show no signs of decay. Very hard to distinguish Grey Gum from Ironbark, when dressed, but the best way, I find, is to saw a small piece off at the end, when Ironbark will be found to be smooth, Grey Gum being a little woolly on end of grain.

Six tests from 2 samples of timber, Nos. 32 and 33, one from Pomona on the North Coast line and the other from Murphy's Creek on the east side of the main range, gave an average modulus of rupture of 16,409 lbs., and an average modulus of elasticity of 2,149,400 lbs. These speak well for the strength of this timber, but more tests are required to obtain reliable averages.

A sample taken from a girder renewed at Bridge No. 1, Kilarney Branch, in March, 1906, about 13 years old, showed a modulus of rupture of 20,770 lbs., and modulus of elasticity of 2,585,567 lbs.

VOLUME TABLE

Diameter Breast High On Age.

Table No. 1

Table No. 2.

77,186 Trees measured All trees 8 inches and up		118,682 Trees measured All trees 2 inches and up	
Age of Tree	Diameter Breast high	Age of Tree	Diameter. Breast-high
6	9.5	6	7.
7	9.9	7	7.5
8	10.4	8	8.2
9	10.8	9	8.9
10	11.2	10	9.4
11	11.4	11	9.9
12	11.9	12	10.5
13	12.1	13	11.
14	12.5	14	11.5
15	13.	15	12.2
16	13.6	16	12.7
17	14.3	17	13.5
18	15.0	18	14.4
19	15.7	19	15.2
20	16.5	20	16.
21	17.4	21	17.2
22	18.4	22	18.4
23	21.5	23	20.2
24	23.9	24	23.7

Table 1 represents the diameter, breast high, of each age class. 77,686 trees were computed to secure the results. All trees were 8 inches in diameter and over.

Example—Tree six years old would have an average diameter of 9.5 inches. 7 years old, 9.9 inches.

Table 2 represents the average diameter, breast high, of all trees 2 inches in diameter and over. 118,682 trees were measured and computed to secure results. While a tree 6 years old averages 7 inches in diameter, when all diameter classes have been considered, from 2 inches up, by dropping all the diameters below 8 inches, it gives an average of 9.5 inches for trees 6 years old.

In taking the measurements on these trees, the diameter was secured 4½ feet from the ground, note being made each time of the clear length of the tree up to a 6 inch top diameter.

E. globulus Plantation in Escondido Valley, San Diego County,
7½ Months Old, Averaging 9 Feet High.

E. globulus, Escondido Valley, San Diego County, 14 Months Old.

Particulars have been obtained of 917 sleepers renewed in the Brisbane and Toowoomba districts, their average life being 17.53 years. As usual the best life is in the Toowoomba district, where 268 half-round sleepers show a life of 20.98 years, while in the Brisbane district 150 squared sleepers give a life of only 12.94 years.

In April, 1901, Mr. E. C. Quinlan reported as follows: "On the Warwick side of Gargett's tunnel there are nine rail lengths, and on the Stanthorpe side, 5 rail lengths laid with these sleepers. About half have been renewed and the remainder will be taken out in the next 2 or 3 years." They have been in the road 21 years.

In April, 1902, Mr. L. Hassell examined 300 sleepers which, he was assured, were Grey Gum. They were put down on the third curve of the Warwick side of Dalveen about 21 years before and were still in very good order; only one or two had been renewed, and the balance looked as if they would give a total life of 30 years.

Ties of *Eucalyptus tereticornis*, twenty to thirty years; fence posts, thirty to thirty-five years; box drains, thirty years.

Average strength in lbs. per square inch.

Transverse strength Modulus of Rupture, 54 in. x 6 in. x 4 in.—19,600.

Tensile strength, 22,000.

Compressive strength, 12 in. x 3 in.—9,500.

Shearing strength, 6 in. x 6 in. x 2 in.—2,100.

E. ROSTRATA—RED GUM.

Individuals of Red Gum make fairly rapid growth, and are commonly above medium size. The tree varies considerably in habit and appearance, in some cases being erect and stately, and in other cases unsymmetrical and irregular in growth. It is one of the leading forest trees of the Australian continent. Baron von Mueller says of it that it is "perhaps the most important of the whole genus." Mr. Maiden says: "I do not suppose there is a person resident in Victoria or South Australia for six months who does not well know what *rostrata* is; it is the tree which produces directly to the colony by far the most revenue of all our trees."

The *rostrata* grows under a great variety of climatic conditions. It is scattered over most of the southern part of Australia, growing there in a great variety of situations. While it prefers moist river bottoms with an equable climate, it will endure much heat, severe frost, and considerable drought. In California, it thrives along the coast, on the dry mesas, in the foothills, and in many of the dry, hot valleys of the interior. In the latter region it endures minimum temperatures of 15 to 20 F., and maximum temperatures of 110 to 115 F. It thrives in the moist, foggy sections of the coast regions of California and endures the desert conditions of Southern Arizona. *Rostrata* grows in standing water in Australia, and will endure more soil moisture than probably any other eucalypts grown in California. Young trees planted on low land and for a time entirely submerged have survived and continued to grow. Around the borders of overflowed tule lands about the junction of the Sacramento and San Joaquin Rivers in the Central Valley of the State, *rostrata* is the most suitable species for planting, though Blue Gum may be successfully grown. Besides enduring such extreme climatic conditions as

BALDWIN PLANTATION, ARCADIA, CAL.

Eucalyptus Globulus. 24 Years Old. Seedlings.

Diameter, Breast—High	Number of Trees	Cubic Feet.	Cords	Volume, Board Feet
6	10	70	1.0	
7	18	162	2.4	
8	8	104	1.6	520
9	14	238	3.6	1,190
10	6	126	1.9	630
11	10	260	3.9	1,300
12	28	868	13.0	4,340
13	30	1,110	16.6	5,550
14	18	774	11.6	3,870
15	16	800	11.9	4,000
16	12	696	10.4	3,480
17	26	1,768	26.4	8,840
18	10	810	12.1	4,050
19	16	1,520	22.4	7,600
20	28	3,040	4.9	17,600
21	8	1,008	15.0	6,720
22	14	1,988	29.7	13,253
23	14	2,240	33.4	14,933
24	18	3,186	47.6	21,240
25	12	2,328	34.7	15,520
26	6	1,272	19.0	8,480
27	8	1,848	27.6	12,320
28	4	1,012	15.1	6,747
29	4	1,112	16.6	6,080
30	6	1,392	20.8	9,280
31	4	1,260	19.3	6,400
32	8	1,968	29.4	13,120
33	10	2,510	37.5	16,733
Totals....	362	35,070	525.9	213,796

The above plantation is 24 years old, planted 10x10. The trees are tall, with exceptionally long, clear boles, holding taper well up into the top, which accounts for the volume of 213,796 board feet. The soil where this grove is growing is very deep, rich sandy loam, water table about 12 feet. The trees were cultivated for the first 2 years. At 10 years of age the crooked and small trees were culled out leaving nothing but the healthy and best ones standing. Some of the trees in this plantation which are growing on the outer edge will measure over 4 feet in diameter. But in taking the measurements on this grove, particular care was exercised that an average acre was measured.

Mecham Plantation, *E. globulus* 7 Years Old.

E. globulus, Second Growth, 5 Years Old, Los Angeles County.

indicated, this species is also tolerant of considerable alkali.

The *rostrata* furnishes a timber that is very valuable for many purposes. When first cut, the wood is a rich, red color that grows darker as it is exposed to the air. It is close-grained, the fibres being interlocked and thus rendering it quite difficult to split. It is very hard and strong—Mr. Maiden says, “almost as hard as iron, when thoroughly dry.” The great usefulness of the timber is due, principally, to its durability, both underground and in water.

Baron Von Mueller says, in his “Introduction to Botanical Teachings,” “Well-matured trees of this species, cut at the season when the circulation of the sap is least active and carefully placed for drying, have proved one of the most durable of any timbers of the whole globe.” The principal uses of the timber in Australia are for ship-building, bridge-building, paving blocks, telegraph poles, posts, piles, house-blocks and street curbing. It is quite resistant to the attacks of marine animals and white ants. The timber is one of the most highly esteemed in all Australia among that of eucalypts. It answers the universal demand for a hardwood of uniform quality.

In California, the principal uses made of the *rostrata* have been for fuel and posts, shade trees, wind-breaks, and as a forest cover in a great variety of situations. It may be planted with profit as a forest cover in ravines, on hillsides, plains and in desert situations.

EUCALYPTUS CORYNOCALYX—SUGAR GUM.

Sugar Gum is now being grown in commercial plantations in California. The seedling period is shade-demanding and the sapling stage requires full exposure to sunlight. Root development is rapid, early growth sending down a large taproot. The well known habit of *Eucalyptus* roots to spread, and grow toward moisture makes it impracticable to plant this species near wells, cisterns, ditches, water pipes and any structure impounding water. Reproduction takes place readily by both seeds and sprouts. Its reproduction is less exacting than *globulus* and *rostrata* in demands for soil moisture. Seedlings grow up freely or under isolated parent trees and survive the dry summers in many localities in California. They are frequently found on exceedingly hard, dry and stony soils, which appear inhospitable for seedling growth.

This species is much more sensitive to cold than *globulus*. Seedlings are often killed in nurseries in cold winters, and difficulty is experienced in starting plantations in many parts of the State. On very frosty lands it cannot be grown, but it is generally planted on less frosty situations too dry for the growth of other species. In low valleys it may be set out late in the season when frost danger is past, owing to its ability to grow with scanty soil moisture. After one year's growth, trees are rarely killed down by frosts of the second winter, though often the lower limbs of saplings are defoliated.

Corynacolyx is notable for its endurance of most excessive heat and foliage, and is not burned during the summer months in the Imperial Valley. For drought resistance and endurance of soil aridity, the sugar gum surpasses any other planted tree in California. Trees remain thrifty when ground moisture drops in summer

HILL PLANTATION, GARDEN GROVE, CAL

E. Sideroxylon. Seedlings...27 Years Old.

Diameter, Breast-high	Number of Trees	Volume, Cubic Feet	Cords	Volume, Board Feet
4	4	8	.1	....
5	28	140	2.1	....
6	36	252	3.8	....
7	44	396	5.9	....
8	32	416	6.2	2,080
9	40	680	10.1	3,400
10	16	336	5.0	1,680
11	24	624	9.3	3,120
12	24	744	11.1	3,720
13	12	444	6.6	2,220
14	32	1,376	20.5	6,880
15	4	200	3.0	1,000
16	4	232	3.5	1,160
17	4	272	4.1	1,360
18	4	324	4.9	1,620
Totals	308	6,444	96.2	28,240

The above plantation located near Garden Grove, California, was planted out as an experiment to see what growth the *Sideroxylon* would make in this country. From results given in the table above the growth of the trees have not proved that it is possible to plant this species as a commercial tree if reasonable results are to be expected in from 10 to 15 years. The wood of this species has been used with marked success in Australia and no doubt will prove a commercial wood in this country, if one could afford to wait 25 to 50 years for trees to establish a commercial diameter.

Some of the trees are very tall but very crooked with large branches. The grove seems to have been greatly affected by the prevailing winds of the locality, which have caused the trees to bend in various directions, thus causing them to grow crooked. Part of the grove has been cut off at various times in the past ten years.

The above picture shows the result of not trimming the 2nd growth down to 2 to 5 sprouts. On page 70 shows the benefit of forest management.

Note the straightness and the healthy looking appearance of the sprouts.
If 4 of the larger ones had been left on the stump shown in
the picture, the result would have been much better.

to great depths below the surface, and nature trees planted upon very unfavorable sites have suffered no injury during long continued periods of exceptional drought. In drought-hardiness it outranks *rostrata*, *tereticornis*, *viminalis* and *citriodora*. *Corynocalyx* is very intolerant of excess of moisture. Large trees have been quickly killed in very wet and overflowed soils.

The planting range of *corynocalyx* is somewhat limited by its susceptibility to cold, but it should be selected for planting in situations too dry for the successful growth of *globulus*. In Southern California it succeeds through the range of the *globulus*. It may be successfully grown upon all the lower foothill slopes of the Sierra Nevada, Sierra Madre and the Coast Ranges. With the *globulus* it will be the best species for planting upon the cutover lands of the Coast redwood belt. Its planting is apparently precluded in the Imperial section, and in lower portions of the central interior valley. The lack of frost-hardiness of the *corynocalyx* is unfortunate since it is well adapted to endure the aridity and deficient soil moisture during the summer season in both these sections.

This species is little inferior to the *globulus* as a species for extensive commercial planting. While of slower growth, especially in diameter, than the *globulus*, it exhibits many superior characteristics. It is persistent in growth and will reach equal dimensions in height and diameter to the blue gum. Trees have reached 125 feet and a diameter of 14 inches in 12 years. It is characterized by its clear and even bole, uniformly straighter than that of most other *Eucalypts*, and therefore affords a most desirable timber form. The timber is straight and even grained, and also proves durable in contact with the soil. By strength test it has proven the strongest of the commercial species planted in California, the strength of seasoned wood exceeding that of the best grades of second-growth hickory. It excels any other *Eucalypt* planted in California in the endurance of drought. Timber may be grown in dry situations where other species will not attain merchantable proportions.

This species has been comparatively recently introduced. It has previously been planted to only a limited extent in the region south of the Tehachapi, where advantage has been taken of its drought-resisting qualities for planting in dry situations. It has not until recently been considered for extensive commercial planting, owing to its slower rate of growth. Several extensive plantations have been made in recent years, however to furnish a future market supply of this valuable timber. The *corynocalyx* is especially valuable for posts, poles, piles, ties and vehicle stock, and will later undoubtedly supplant blue gum for many of the purposes which have developed for its employment.

E. RESINFERA—RED MAHOGANY

The trees of this species, when planted in grove formation, are the most erect growing of the *eucalyptus* family. The bark of the young trees is a deep reddish brown changing to light grey and brown as the trees grow old; it is rough, fibrous and persistent. The leaves are slightly curved, of a leathery texture, dark green on the upper side and several shades lighter on the under surface.

SEXTON PLANTATION, COMPTON, CAL

Eucalyptus Globulus. Sprout Growth. 6 Years Old.

Diameter, Breast—High	Number of Trees	Volume, Cubic Feet	Cords	Volume, Board Feet
3	268	241	3.6	....
4	108	216	3.2	....
5	112	560	8.4	....
6	144	1,008	15.0	....
7	132	1,188	17.7	....
8	148	1,924	28.7	9,220
9	62	1,054	15.7	5,270
10	68	1,428	21.3	7,140
11	42	1,054	16.3	5,460
12	12	372	5.6	1,360
13	16	592	8.8	2,960
14	4	172	2.6	860
Totals	1,116	9,847	146.9	33,170

The above plantation represents the 4th growth which is now 6 years old. The trees were originally planted 8x8. Several of the stumps died out, the reason for which might be attributed to the poor cutting of the original trees. From the appearance of the stumps they seem to be hacked to pieces which no doubt is the result of their not producing, still there is a fair stand of trees. Each time after the trees were cut off and sprouted again, the owner sent men through the grove to cut all but 1 to 3 of the best sprouts. The grove was cultivated several times when first planted.

The sprouts are very straight and should produce exceptionally good poles or tie timber. It is evident from the appearance of the trees in this grove, that by thinning out the volume of the stand will be greatly increased.

The flowers are about medium size, in clusters of 4 to 10, on a somewhat compressed stalk. The seed cases are cup-shaped or bell-shaped.

This species can be used as a forest cover, as a shade tree and as a wind-break where it is too moist and warm for other species; when planted in forest formation the tree grows exceptionally straight, clearing the lower limbs thus forming a long, clear bole, which makes it so valuable for piles, poles and construction timber. In its native home, it is considered one of the most valuable hardwoods of the colony, "New South Wales." It is a rich, red color, and in appearance resembling true mahogany. It is capable of taking a high polish, and is a fine furniture wood where its weight is not against it. However, when used in contact with the soil, it is one of the most durable timbers, being greatly resistant to damp and the attacks of white ants. For best development, the *E. resinifera* requires a deep, rich soil with plenty of moisture, and should attain its best development on the coast where it has the benefit of the heavy coast fog. This species is not a drought resistant tree, nor will it stand extremes of temperature, the range being from 26 F. to 105 F., and it must have moisture. In the hot climate of the interior valleys the tree when young is very often scalded by the winds in summer.

EUCALYPTUS DIVERSICOLOR—KARRI

The Karri is a large and stately tree, in the Southwest, growing much more rapidly than "*E. Amygdalina*," the only tree that in Australia exceeds it in height. The foliage is attractive in appearance, the leaves of the young seedlings being oval or roundish, and those of the adult tree narrower. This species thrives in moderately moist situations near the coast, but does not endure well the dry heat of the interior. It is quite resistant to frost. Its growth is rapid and in situations favorable for its culture, the Karri rivals the "Blue Gum," and the timber is superior to that of Blue Gum. The wood is straight-grained and makes good lumber, the tall, straight trunks make good masts.

EUCALYPTUS RUDIS

This species varies in habit, most being erect and stately, while occasionally others have drooping stems and branches. The grayish bark of the trunk is usually rough and persistent but sometimes flakes off, leaving the trunk smooth. As the tree grows older, the new leaves are longer and thinnish, finally being lance-shaped or curved. In the Southwest, the tree has proven to be remarkably hardy to heat and cold; enduring without injury, minimum temperature of 15' and 18' and of 110' to 118' F. The wood is used in Australia for fuel and posts.

EUCALYPTUS SIDEROXYLON—VICTORIA IRONBARK

This tree is of medium large size, and it usually grows erect, with an even trunk, having numerous side branches especially towards the top. It never grows to a great height. It endures minimum temperatures of 16' to 20' F., and maximum 110' to 112' F.

This tree is one of the very useful Eucalypts, its principal uses are for bridge construction, ties, girders and large beams in build-

HUNTER PLANTATION, BAIRDSTOWN, CAL.

Eucalyptus Globulus. Seedlings. 7 Years Old.

Diameter, Breast high	Number of trees	Volume, Cubic Feet	Cords	Volume, Board Feet
4	50	100	1.5	....
5	44	220	3.3	....
6	48	336	5.0	....
7	18	126	2.4	1,820
8	28	364	5.4	3,422
9	40	680	10.1	6,300
10	60	1,262	18.8	7,540
11	58	1,508	22.5	9,610
12	62	1,922	28.7	4,440
13	24	888	13.3	6,450
14	30	1,290	19.3	5,000
15	20	1,000	14.9	6,380
16	22	1,276	19.0	4,760
17	14	952	14.2	4,860
18	12	972	14.5	3,800
19	8	760	11.3	
Totals . . .	538	13,690	204.2	64,560

The above is a fair average of what can be expected under favorable conditions, i. e., good soil, ideal climate, healthy seedlings, carefully planted, and thorough cultivation for the first two years at least. The trees found growing in the above plantation are exceptionally tall and straight, planted 8x8, in very fine, deep, rich, alluvial soil, water table 10 to 12 feet. The seedlings were carefully selected and planted in the Fall of the year, when an abundance of moisture in the soil was present, thus enabling them to get their root system established before the warm weather arrived. The trees were set out in forest formation, between two low ranges of hills, thus protecting them from the prevailing winds.

The trees in the interior part of the grove seem to average the largest diameter. This may be attributed to the topography of the locality, as they had to reach up for the sunshine.

ings, joists, posts, hubs, spokes, shafts of vehicles and for a great variety of other purposes where strength and durability are required. The wood is a dark red and is very hard and heavy.

The whole appearance of the tree, with its rough, dark bark, its silvery, narrow leaves and daintily colored flowers is quite distinctive, contrasting strongly with the smooth barked, broader leafed species of the genus.

EUCALYPTUS VIMINALIS—MANNA GUM

This species grows throughout the range of globulus and rostrata. It succeeds better than the globulus throughout the San Joaquin and Sacramento Valleys, and becomes one of the most suitable eucalypts for planting in this section. Viminalis is the only eucalypt which has reached equal dimensions with the globulus.

In frost-hardiness the viminalis is surpassed by rostrata and terebinthifolia but is ranked ahead of globulus, corynocalyx and citriodora. It has successfully endured the frosty winters of the Imperial Valley and grows without injury in the frosty parts of the San Joaquin and Sacramento Valleys. It is also little affected by high temperature.

Viminalis has been used to a limited extent in plantations, but its timber is of somewhat inferior strength, and its form development so variable that it cannot be ranked among the more valuable commercial species. Its timber has never been cut into lumber for comparison of its value with globulus wood. In the rapidity of its height and diameter growth to similar large proportions, the viminalis most nearly of all the commonly planted eucalypts approaches that of globulus. In plantations and when open grown the tree occasionally develops tall, massive shafts, straight and clear, and inferior to the best timber growth of the globulus. This form may not be depended upon, however, as the tree often in close plantation develops an irregular forking trunk dividing into heavy branches.

EUCALYPTUS CITRIODORA—LEMON GUM.

The lemon gum, *E. Citriodora*, is restricted in its planting range by its intolerance of moderate cold. When planted upon frosty valley lands in Southern California, it is repeatedly killed to the ground. It is best suited by abundant soil moisture, but will endure considerable drought. Planting of this species is necessarily restricted to the less frosty valley lands and to the less unfavorable portions of the planting range of corynocalyx.

High temperature combined with excessive atmospheric dryness affects the foliage of citriodora more or less seriously. It is one of the least drought-hardy of the eucalypts.

Citriodora produces a timber of value and makes comparatively rapid growth, superior to that of corynocalyx. Its straight, clear form recommends it, on situations suited to its exactions for moderate climate, as a species desirable for commercial planting.

EUCALYPTUS GUNNII—CEDAR EUCALYPT

This tree is usually not a tall one, but in some situations in Australia it is said to grow to a height of 250 feet; no tree growing in the Southwest, however, gives promise of attaining a great height, though some of them are already 60 feet high. This species grows well near the coast and sometimes inland. It is a very hardy species.

DE WITT PLANTATION, HARPER, CAL.

Eucalyptus Globulus. Seedlings. 5 Years Old.

Diameter, Breast-high	Number of Trees	Volume, Cubic Feet	Cords	Volume, Board Feet
2	56	28	.4	....
3	76	68	1.0	....
4	80	160	2.4	....
5	108	540	8.1	....
6	132	924	13.8	....
7	114	1,026	15.3	....
8	100	1,300	19.4	6,500
9	68	1,156	17.3	5,780
10	20	420	6.3	2,100
11	16	416	6.2	2,080
12	12	372	5.6	1,860
Totals	782	6,410	95.8	18,320

The above plantation was planted 6x6 on very poor soil. Water table from 15 to 25 feet away. The trees were irrigated for the first year and cultivated 6 times the first 2 years. From the appearance of the trees it is very evident that they were planted too close, being quite tall and spindling. A great number of the trees have died out, while others are suppressed, having a diameter, in some cases, of less than one inch. Another reason for their growth being so retarded might be attributed to the fact that the grove was irrigated for the first year only. The trees no doubt grew very rapidly for the first year while irrigation was practiced. By irrigating the trees for the first year it was not necessary for the roots of the trees to seek a lower water level, consequently, when irrigation was suspended, the roots were very close to the surface. It is evident that the trees had developed much more rapidly than the root system, the result being that the trees are stunted in their growth and will continue to grow very slowly until the roots reach permanent moisture.

and, since in Australia it grows to an elevation of 4,000 to 5,000 feet, it ought to succeed in elevated regions of the Southwest. It endures fairly well the summer heat of the interior valley, grows thriftily, even though the temperature falls to 20° F., each night. The tree does not furnish an especially useful timber. The sap of this tree is used by the aborigines of Australia for making a kind of cider.

EUCALYPTUS AMYGDALINA

In its native country, the individuals of this species are the tallest trees in the world. The record height of this species is over 400 feet, and diameters of 18 to 35 feet. One tree measured 220 feet long, 12 feet in diameter at the top and 30 feet at the base. The leaves when crushed have a distinct odor of peppermint. Flowers are in clusters of 8 to 15. It grows best in well watered mountain regions. The wood is comparatively light, unlike many other Eucalypts floating on water. It does not usually last well underground, nor does it furnish fuel of good quality.

EUCALYPTUS ROBUSTA—SWAMP MAHOGANY

The tree thrives at and near the coast, but does not endure well the dry heat of the interior. It has been much planted as an avenue tree in the State of California, but after a few years it usually makes an irregular, unsatisfactory growth, unless the roots are kept quite moist.

The wood of this tree is not in special favor with artisans; but as it is durable underground, it is very useful for posts, ties and similar purposes. It is free from the attacks of destructive insects, which is ascribable to the presence of kino.

EUCALYPTUS FICIFOLIA

“Scarlet-flowering Gum.” The most ornamental species of the family, with large, leathery leaves and immense clusters of large magnificent, bright, crimson flowers.

RAISING EUCALYPTUS SEEDLINGS

Eucalyptus seedlings are not as easy to propagate as those of most other tree species, and some 40 to 50 nurserymen throughout the State are engaged in raising them. Seedlings grow to a height of 6 inches to 12 inches—that most suitable for field planting—in from 5 to 8 months. Seed planting should be timed, therefore, so that stock will reach proper size at the planting season selected.

By some propagators of Eucalyptus stock, seed is sown in the nursery in beds on the ground. Seedlings are successfully raised in this manner and probably at least expense, and the plan is favored by the best nurserymen. Most convenient boxes for transport in a wagon or handling in a nursery or in the field are 18x24 inches, and a depth of four inches will allow abundant space for root development. Deeper boxes are too heavy for ready handling, while shallower ones cramp and stunt the roots of the seedlings. The best results may be attained by the use of an artificially prepared soil, the composition and porosity of which may be suited exactly to the needs of the seedlings. A sandy loam with sand predominating should be prepared by mixture of fine sand with a heavier dark soil and a small quantity of partly decayed leaf mould. Seed should be evenly sown broadcast over the moist surface. The best results

PART OF THE FIELD REPORT ON MECHAM'S EUCALYPTUS PLANTATION, MECHAM, CAL., JULY, 1908.

Total area of groves, 200 acres, comprising 42 different plantations. The trees were planted to protect the house, barns, chickens and cattle from the hot sun and winds in the summer time. The first groves were planted 22 years ago, the seed being purchased in San Francisco at a cost of \$16.00 per oz. Mr. Mecham furnished the seed to the nurseryman at Petaluma. The first 1,000 trees furnished by the nurseryman at Petaluma were raised in pots and cost Mr. Mecham 25c each. At the age of 6 years, about 90 per cent of the trees planted, which were raised in pots, were blown over by a very heavy windstorm. Mr. Mecham said the roots apparently grew in a sort of ball shape. This was a result of growing the trees in pots and not trimming the roots before planting them in the field. Mr. Mecham's groves are set out on different portions of his 5,000 acre ranch and invariably located on top of the hills or ridges. Very few have been set out in the level valley land. Some of these ridges are 500 to 700 feet above the valley. When the seedlings were first planted, one single strand of wire was placed around the grove. This was to prevent the cattle from running through the groves and breaking down the young seedlings. When the trees reached the height of 3 feet, the wire was taken away as the cattle could do no harm by rambling through the groves. Cost of cutting trees into cord wood, \$1.50 to \$2.25 per cord. The wood was sold on the ground for \$5.50 per cord (California cord 96 feet). About 18 months after, the stumps had sprouted out again, Mr. Mecham sent his men through to cut away all shoots except 3 to 5 of the largest ones. This, he claimed, improved the trees greatly and from the appearance of his groves, which have been cut off at various times, it is apparent that the growth of the sprouts have been greatly aided.

Mr. Mecham made the statement that several offers had been made to him for his groves, especially those that would make poles and piling. One offer was two thousand dollars (\$2,000), and for what poles they could get and would leave the waste parts of the trees for him to cut into fire wood, but he refused all offers on the ground that the banks might bust up but the trees could not run away.

will be obtained from a density of not over 1000 seeds to 2 square feet. After sowing, the seed should be covered with a layer of fine sand a little deeper than the thickness of the seed, then covered with burlap. The soil should be kept thoroughly moist while germination is awaited. During warm weather germination may be expected in from four to ten days.

After the seedlings appear, care in satisfying but not over supplying their need for moisture will prevent nearly all difficulty experienced in raising them. The loss of stock by damping off, owing to an excess of soil or atmospheric moisture is the danger most to be feared, but the amount of soil moisture may easily be regulated. Should the seedlings at any time begin to wilt they should be examined at once to see if they are withered at the ground. Seedlings need abundant moisture for thrifty growth and it is the best policy to water them daily with sprinkling pots or fine spray hose. The seed beds should never be flooded. Watering should not be done too early in the morning, and should be regulated to suit the needs of the nursery stock rather than attended to at a definite time each day.

When the seedlings have reached the height of about two inches, they should be transplanted into seedboxes to afford them more growing space. Where through poor germination only a thin stand is obtained in a propagating bed, transplanting may be deferred. The seedlings should be placed in fresh soil in transplanting boxes, where they may remain undisturbed until field planting time. The plants will wilt slightly after transplanting, but if they are kept well shaded, and watered at once and freely for a few days, they will soon revive.

Small seedlings are very tender, and care should always be exercised in handling and transplanting them to prevent pinching or injuring the stem or tip, else the plant may branch and become irregular, and retain this form in later growth. Ants should be prevented from invading the soil of seedboxes, as they often destroy the young seedlings. An established colony may be killed out by pouring carbon bisulphide into the passage holes which may then be plugged up with dirt. The gas kills the ants without harming the seedlings. As a further preventive the edges of the seedboxes may be painted with corrosive sublimate which ants will not cross.

Blue gum and most other species endure handling and transplanting very readily. Sugar gum develops taproot, and requires uniformly more careful handling than most other species. It is more difficult to transplant, as seedlings wilt and revive slowly after this operation. Best success is attained by nurserymen through transplanting seedlings of small size when but three to four leaves have unfolded.

FIELD PLANTING

The spacing and arrangement of seedlings in a plantation is important for thus is determined the number of trees per acre, the length of the period of cultivation and the character of the product. Close spacing is usually desirable since it affects the early shading of the soil thus conserving the solid moisture and preventing weed growth. shortens the period of cultivation and stimulates rapid

MECHAM PLANTATION, MECHAM, CAL.

Eucalyptus Globulus. 6 Years Old. Sprout Growth.

Diameter. Breast high	No. of Trees.	Volume, Cubic Feet	Number Cords	Volume, Board Feet.
3	42	38	.6	....
4	51	102	1.5	....
5	114	570	3.5	....
6	192	1,344	20.1	....
7	213	1,917	28.6	....
8	189	2,457	36.7	12,285
9	225	3,825	57.1	19,125
10	99	2,079	31.1	10,395
11	84	2,184	32.6	10,920
12	129	3,999	59.7	19,995
14	3	129	1.9	645
Total....	1,341	18,644	278.3	73,365

The above table represents the present stand of sprout growth 6 years old. The trees are straight and tall with long clear boles and very small tops, averaging 85 feet high. Some of the trees on the edge of the grove had much larger diameters. However, the sample acre measured was selected from the interior part of the grove, thus assuring average conditions. About 18 months after the trees were out, Mr. Meecham sent men through the grove to clear each stump of all the young sprouts excepting 3 to 5 of the largest ones. This, Mr. Mecham said, has greatly aided the present stand. This grove was cultivated several times the first two years planted but nothing has been done since, only the clearing of the stumps to aid the second growth. Soil is shallow and very poor. However, Mr. Mecham attributed the rapid growth to the prevailing fogs, which supplied sufficient moisture to insure rapid growth.

height growth with the formation of few lateral branches. However, planting should not be spaced closer than 6 by 6 feet, nor more openly than 10 by 10 feet for any purpose. For fuel, the wider spacing is recommended. For most commercial purposes a spacing distance of 8 by 8 will prove satisfactory.

Uniformity in spacing is desirable whenever practicable. Planting in straight lines and at uniform distance will secure a full stand per acre, facilitate cultivation, and insure the trees from injury from this operation.

On developing, the groves will become too dense forming tall, spindling poles. When this condition obtains, the suppressed trees should be removed in order to give those remaining room to develop more uniformly.

Eucalyptus tereticornis, Santa Fe Railroad. Plantation, San Diego County, California. 9 Months Old.

MECHAM PLANTATION, MECHAM, CAL.

Eucalyptus Globulus. Seedlings. 9 Years Old

Diameter, Breast-high	Number of Trees	Volume, Cubic Feet	Cords	Volume, Board Feet,
2	39	20	.3	....
3	30	27	.4	....
4	18	36	.5	....
5	66	330	4.9	....
6	3	21	.3	....
7	99	891	13.3	
8	78	1,014	15.1	5,070
9	93	1,581	23.6	7,905
10	69	1,449	21.6	7,245
11	69	1,794	26.8	8,970
12	99	3,069	45.8	15,345
13	123	4,551	67.9	22,755
14	111	4,773	71.2	23,865
15	51	2,550	38.1	12,750
16	22	696	10.4	3,480
Totals ...	960	22,802	340.2	107,385

The above grove is 9 years old. Part of this grove was cut off two years ago and produced an average of 388 cords of wood (California cord, 96 feet), per acre. The sprout growth is now averaging 32 feet high. The measurements shown in the table above were taken on the uncut area. The trees are tall and straight, with large diameters. The soil is a sandy loam, water table about 22 feet. On the portion of the grove that was cut off two years ago, the sprouts have made exceptionally rapid growth. Mr. Mecham trimmed all but 3 to 5 sprouts from each stump, which accounts for the rapid height growth.

In taking the measurements in this grove, extreme care was exercised to secure the average acre and each tree carefully measured. The trees were tall, straight, with long, clear boles, tapering very slowly. This accounts for the large amount of board feet, as is shown in table above.

EFFECT OF ALKALI IN SOIL

In unirrigated land, black alkali can only be detected by chemical tests. In well-watered land, however, it can be detected if it exists in harmful amounts. It is indicated by the tendency of the soil to puddle readily, to set and to be difficult of cultivation. It is also known by a brown crust which accumulates upon the surface of the soil and is caused by the alkali bringing the organic matter to the surface in solution and the two drying and leaving a black covering. The presence of black alkali is also detected by the color of seepage water in pools or puddles on the surface. Such water is usually dark brown or black. Black alkali causes the soil to set or pack, while the white alkali forms a mulch on the surface. The presence of grease wood or salt grass indicates alkali. A heavy growth of sage brush indicates a rich soil, free from injurious amounts of alkali; tule grass indicates a swamp soil free from alkali. When the greasewood is interspersed with rabbit brush the quantity of alkali is low.

THE PRESENCE OF ALKALI HARMFUL TO VEGETATION

Soils containing alkali are divided into 5 classes:

1. The class containing less than .20 per cent. Known as alkali free soil. On this soil all crops do well.
2. Soil containing from .20 per cent. to .40 per cent. On this soil most crops do well, but alfalfa, tree fruits, grapes and grains suffer when the 40 per cent. is reached, while beets, onions, sorghum and some grasses still grow well.
3. Soil containing from .40 per cent. to .60 per cent. On this soil few crops grow well except salt grasses, alkali weeds and occasional pear trees.
4. Soil containing from .60 per cent. to 1 per cent is practically worthless and good for little except pasturage.
5. Soil containing from 1 per cent. to 3 per cent. supports only salt grasses and is absolutely worthless for cultivation.
6. Few species of eucalyptus will grow and thrive in soil which contains more than .80 per cent. of alkali.

MEANS OF CLEARING LAND OF ALKALI

There are temporary methods of removing alkali from land, but the only way to permanently reclaim or prevent the accumulation of alkali upon land is by a system of underdrainage. The black alkali is harder to remove than the white since sodium carbonate puddles

MECHAM PLANTATION, MECHAM, CAL.

Eucalyptus Globulus. 18 Years Old. Seedling Grove.

Diameter, Breast-high	Number of Trees	Volume, Cubic Feet	Number of Cords	Volume, Board Feet
6	8	56	.8	....
7	4	36	.5	....
8	12	156	2.3	780
9	10	170	2.5	850
10	40	840	12.5	4,200
11	10	260	3.9	1,300
12	30	930	13.9	4,650
13	10	370	5.5	1,850
14	34	1,462	21.8	7,310
15	38	1,900	28.4	9,500
16	26	1,508	22.5	7,540
17	36	2,448	36.5	12,240
18	44	3,564	53.2	17,820
19	22	2,090	31.2	10,450
20	14	1,540	23.0	10,267
21	8	1,008	15.0	6,720
22	6	852	12.7	5,680
23	28	4,480	66.9	29,867
24	8	1,416	21.1	9,440
Totals ...	388	25,086	374.2	140,464

The above grove is 18 years old. Planted 10x10 to 12x14. The trees are tall and very straight, with long clear boles. This grove is three-quarters of an acre wide and forty acres long. Four interior rows were measured, thus securing average condition. This grove has never been irrigated. Cultivated three times the first year the trees were planted. This grove extends from the railroad, up over the main ridge of the ranch. Mr. Mecham planted these trees as an experiment, the soil being very shallow and 20 to 60 feet to water. The successful growth might be attributed to the prevailing fogs which envelop the hills in Sonoma County all through the Summer months.

Some of the trees in the outside rows will measure three feet in diameter but are very crooked, and large branches are growing out from the trunk of the tree within six feet from the ground. This was caused by being exposed to the light.

the soil and carbonates cling tenaciously to the soil grains. One temporary method is the applying of gypsum which changes the alkali from black to white, a less harmful form. For the amount of gypsum necessary to neutralize given amounts of alkali, see Soil Survey of the Hanford Area, page 473. The best method of removing alkali is underdrainage which removes both black and white. Surface flooding washes the salts into the subsoil but this method is unsatisfactory, unless the soil is porous and the water moves freely, which is unlikely in alkaline soil.

This method is bad on low lands where the water stands for some time as the valuable mineral material is likely to be leached out. The growing of alkaline-resistant plants adds under-drainage, but it is not a satisfactory method by itself. The breaking up of the surface soil by cultivation destroys capillary spaces and prevents the accumulation of alkali on the surface of the soil.

Alkalies come from mountainous disintegration and are brought down as soluble salts by the rivers. Investigations have shown that the alkali salts which come from the Coast Range of California are those that result from the reaction between calcium sulphate and sodium chloride and the salts which come from the rocks of the Sierra Nevada Mountains are those which result from the reaction between calcium carbonate and sodium chloride. They accumulate at or near the surface of the land by the evaporation of subsoil water which is brought to the surface by capillarity. Alkalies are confined to the heavier soil types.

Eucalyptus Used As Shade Trees.

MECHAM PLANTATION, MECHAM, CAL.

Eucalyptus Globulus. Seedlings. 20 Years Old.

Diameter, Breast-high	No. of Trees	Volume, Cubic Feet	Cords	Volume, Board Feet
3	14	13	.2	....
4	11	22	.3	....
5	25	125	1.9	....
6	30	210	3.1	....
7	31	279	4.2	....
8	49	637	9.5	3,185
9	30	510	7.6	2,550
10	43	903	13.5	4,515
11	26	676	10.1	3,380
12	63	1,953	29.1	9,675
13	24	888	13.3	4,440
14	35	1,505	22.5	7,525
15	45	2,250	33.6	11,250
16	33	1,914	28.6	9,570
17	33	2,244	33.5	11,220
18	21	1,701	25.4	8,505
19	12	1,140	17.0	5,700
20	22	2,420	36.1	16,133
21	1	126	1.9	840
22	5	710	10.6	4,733
23	3	480	7.2	3,200
24	7	1,239	18.5	8,260
25	1	194	2.9	1,293
Total	564	22,139	330.6	116,064

The above grove is seedling trees 20 years old, average height 140 feet, planted 8x8. On one acre measured, 114 trees were missing. The two rows of trees on the edge of the grove range in height from 125 to 190 feet, with diameters of one foot to three feet six inches. Several of these outside trees were cut last year and produced 3 to 6 cords of wood from each tree. Part of the grove was cut a year ago and each tree cut averaged one cord of wood. (California cord, 96 feet.) The trees are tall and straight with small crowns. An average acre was carefully selected from the interior portion of the grove which contains about 20 acres. None of the figures shown in the above table were secured from outside trees.

EUCALYPTUS SPECIES IN CALIFORNIA.

The following is a list of the different species of *Eucalyptus* now growing in California. Many of these species can be found growing on a ranch near Santa Barbara, owned by Hon. Elwood Cooper, also at the University of California Forestry Station grounds at Santa Monica. Some of the species mentioned in the following list have made exceptionally rapid growth at the Santa Monica Station, while the same species found growing at Santa Barbara have not done as well, and vice versa:

<i>E. acmenioides</i>	<i>E. haemastoma</i>	<i>E. piperita</i>
<i>E. amygdalina</i>	<i>E. incrassata</i>	<i>E. platyphus</i>
<i>E. andreaana</i>	<i>E. jugalis</i>	<i>E. polyanthem</i>
<i>E. angustifolia</i>	<i>E. largiflorens</i>	<i>E. populifolia</i>
<i>E. botryoides</i>	<i>E. lehmannii</i>	<i>E. pulverulenta</i>
<i>E. citrioidora</i>	<i>E. leptophleba</i>	<i>E. punctata</i>
<i>E. calophylla</i>	<i>E. leucoxydon</i>	<i>E. regnans</i>
<i>E. cordata</i>	<i>E. longifolia</i>	<i>E. resinifera</i>
<i>E. coriacea</i>	<i>E. megacarpa</i>	<i>E. raverentiana</i>
<i>E. corunna</i>	<i>E. macrocarpa</i>	<i>E. rostrata</i>
<i>E. corymbosa</i>	<i>E. marginata</i>	<i>E. robusta</i>
<i>E. corynocalyx</i>	<i>E. macrorhyncha</i>	<i>E. redunca</i>
<i>E. cosmophylla</i>	<i>E. marginata</i>	<i>E. rubida</i>
<i>E. dicipiens</i>	<i>E. McArthurii</i>	<i>E. rudis</i>
<i>E. diersicolor</i>	<i>E. microcarpa</i>	<i>E. salmonophloia</i>
<i>E. eugeniioides</i>	<i>E. Mulleriana</i>	<i>E. siderophloia</i>
<i>E. eximia</i>	<i>E. moclata</i>	<i>E. sideroxydon</i>
<i>E. ficifolia</i>	<i>E. obcordata</i>	<i>E. Sieberiana</i>
<i>E. globulus</i>	<i>E. obtusifolia</i>	<i>E. stellulata</i>
<i>E. gomphocephala</i>	<i>E. occidentalis</i>	<i>E. stuartiana</i>
<i>E. gonioealyx</i>	<i>E. paniculata</i>	<i>E. tereticornis</i>
<i>E. gunnii</i>	<i>E. pilularis</i>	<i>E. viminalis</i>

SPACING

The following table represents the number of trees on an acre, planted at various distances. 8x8 is the most advisable way to set out trees for a commercial plantation. This gives them sufficient room to spread out the first few years and later aids them to attain the rapid height growth in the first 6 or 7 years. If they are planted much farther apart than 8x8 they are liable to become too branchy, thus retaining the larger branches for 6 or 8 years instead of pruning their lower limbs the first 3 or 4 years. If planted for fuel, 6x6 would be advisable.

Feet	Plants	Feet	Plant
6x6.....	1210	11x11.....	360
6x7.....	1038	12x12.....	302
7x7.....	889	15x15.....	194
8x8.....	681	16x16.....	171
9x9.....	538	18x18.....	135
10x10.....	436	20x20.....	109

SIZE AND QUALITY OF SEEDLINGS.

Ample and compact supply of roots is essential for the successful growth of Eucalyptus, the ends of the roots being most important, as a straggling root system would require too large a hole. A well proportioned, medium plant is desired, straight and symmetrical, and it is best to know where and how the plant has been developed, and if it will adapt itself to the conditions where it will be set. Choose to plant into better conditions, from drier and cooler, not from a moist, rich soil to a poor dry soil, or from a very shady situation or lath house to an open field. Large plants are too expensive, the increase in geometric ratio makes cost greater in production and handling and more bulky to transport, therefore use as small sizes as are consistent with plant, soil and condition into which they are to be set; sizes 6-8 inches, at the most 15 inches, though in places they may have to be put in larger. However, smaller plant is surer, as it will take up root system better or will replace it because younger, though as the young are more liable to frost they should, if possible, have a good root system.

Choose stout material to grow away from the competition if planting is to be done on the redwood cutover lands. It is advisable to plant one or two years stock, when planting in mixture with the second growth redwood. Use nursery stock methods of compacting root system, that is by pruning the roots; this does not injure the plants. Nursery pulled stock may be used, but if roots are naked they suffer, and it is just as good if transplanted with a ball and may in the end save time and expense. However, in balling the roots, especial care should be exercised in selecting the proper kind of soil. If the soil is heavy, the roots might not break through it, and instead grow in a circle, thus retarding the growth of the tree for the first few years.

Young Globulus Plantation.

DETERMINING THE ACCRETION OF A FOREST

There are several methods employed in determining the mass accretion of a stand of trees for a short period (from ten to twenty years), during which it may be safely assumed that the number of trees of the stand will not diminish owing to natural thinning (death). Of these the following may be recommended:

When the growing stock of a forest has been ascertained by means of an average sample tree, then the accretion of that tree for a given number of years should be multiplied by the number of trees the forest contains, in order to determine the rate of growth of the forest for that length of time. In case the growing stock of the forest was established by arranging its trees in diameter classes, the accretion of each diameter class is determined separately by multiplying the accretion of the sample tree by the number of trees involved in the class. Adding together the accretion of all the diameter classes we obtain a sum which represents the rate of growth of the forest for the period of time in question.

When the growing stock of a forest is determined by means of a proportional number of sample trees representing each diameter, the accretion of the sample trees, calculated for each of them separately, are added together and the sum is multiplied by the quotient obtained by dividing the basal area of the forest by that of all the sample trees. The product gives the rate of growth of the forest during the period for which the accretion of the sample trees was determined.

A METHOD OF INVESTIGATING TIMBER GROWTH

When a forest is to be bought, sold or assessed, or when its timber is to be cut, the questions which are to be solved, relate either to its growing stock alone—if the forest is to be disposed of immediately—or to the progress of its growth during the period for which its standing timber is intended to be kept.

With additional knowledge relating to local prices on cleared land, market condition of lumber and timber, cost of labor, transportation, etc., the present value of the forest, or that which it may have at the expiration of a short period, is easily ascertained. The determination of the growing stock in such cases, terminates the inquiries. But when a forest is determined for rational management, with the expectation of making it yield continual returns, the knowledge of its growing stock serves only as a guiding point from which the way toward obtaining other information of equal importance becomes clearer. The success of conducting the other inquiries relating to the forest, with a view to working out an adequate plan for its management, depends upon knowledge of the sylvicultural possibilities of the species comprising it. The question, for instance, of how far the actual annual growth possible for the locality, under the given conditions and species or the age at which the cutting should be made in order to insure that possible annual growth, can be properly answered when the requirements of the species composing the forest and the rate at which those species grow at various ages and under various situations is known. In Europe the sylvicultural requirements of forest trees have been ascertained in an experimental or rather historical, way. The forest districts into which the State

forests were divided at the beginning of the epoch of forest regulation kept records registering the results attained by their forest trees under the various situations and treatment. These records, together with the casual and experimental observations organized later on by the European foresters, have accumulated a good deal of valuable and sound data, the systematic teaching of which has attained the rank of a science known under the name of silviculture. It would take the United States, with ten times as many species of economic value as are found in Europe, considerably more time to work out its silviculture, should it ignore the progress made in forestry science, and in spite of it follow the slow historical method of investigating timber growth.

The analysis of a few individual trees is sufficient to enable the forester with the general knowledge he possesses, of the rate of growth of the particular species, to determine the factor of the locality, i. e., to determine in what way the locality affects the general law of growth of the species. But when the silvicultural requirements of a species are totally known, an analysis of a few individual trees is scarcely sufficient even to indicate the rate of growth of the species. To be sure by analyzing a large number of trees taken on various sites and under various situations (which has been done in securing the measurements herein shown), the rate of growth of the species have been determined, but if each of the number of individual trees had been analyzed separately, as is done by European foresters, the work would have been too cumbersome. It was thought necessary, therefore, in this work of ascertaining the rate of growth of our species, to modify the European analytical method so as to make it more applicable for the thorough investigation of the growth of *Eucalyptus*

CONCLUSION

It has already been shown that the woods of the various eucalypts form satisfactory substitutes for the Eastern hardwoods, in the manufacture of agricultural implements, vehicle stock, boat ribs, paving house blocks, street curbing, naves and felloes of wheels, piles, posts, poles, railway ties, and for other similar purposes where strength and durability are desired. Owing to the great value of the *Eucalyptus* for so many uses, no mistake will be made in planting it wherever it will thrive.

It is evident that the increased demand for hardwood and the prospect of a complete shortage of the supply in the not very distant future, must result in an increase in the cost price which will soon put it beyond the reach of manufacturers for ordinary utilitarian purposes.

In view of this existing condition, it is important to consider some forest trees that will take the place of eastern hardwood. When the supply in the central and eastern states is gone, there will be no other source to which to turn. The manufacture of furniture and vehicles calls for more hardwood than any other industry and employs hardwood almost exclusively as raw material. It is estimated that the furniture industry alone requires upwards of 20 per cent. of the entire hardwood production. As in furniture, the hardwood

is the chief material used in the manufacture of musical instruments, especially of pianos and organs.

Eucalyptus has gained the reputation of possessing a phenomenal rate of growth. Under favorable conditions, trees in seedling plantations have reached a maximum development of six inches in diameter and sixty-seven feet in height in four years. This represents an average growth of seventeen feet in height per year, though a growth of ten to fifteen feet in height yearly is the general average under favorable conditions. It may be planted with profit as a forest cover in ravines, on hillsides, on plains, and in quite dry, desert situations of the interior valleys. Such plantations will within a decade, begin to be sources of posts, fuel, railway ties, telegraph poles and bridge timbers and will produce timber suitable for other important uses. If such plantation were made along railway tracks, ties for keeping them in repair would be available within a decade, and later the product would be sufficient for extensions of the road into new sections. Timbers for repairing railway bridges and building new ones, as well as for telegraph poles, could also be thus supplied within easy reach of the points where they would be needed.

The cutover redwood lands of the coast region will some day become the most valuable hardwood producing area of the United States. The growth of Eucalyptus on the redwood cutover lands has been demonstrated by several lumber companies. The redwood belt is a natural forest plantation; the second growth redwood will be stimulated by the planting of Eucalyptus.

Eucalyptus has been planted a good deal and has been used almost exclusively as fuel, but it was not until 1904 that any commercial plantations were set out, in spite of the fact that there are thousands of acres of what is apparently waste land on which Eucalyptus grows well. The small country towns of California are constantly buying wood from the foothill farmers who have been cutting all the California Oak trees on their ranches, thus clearing the land for agricultural purposes. On the ranches around Denvertown, east of Suisun, there never was a supply of oak and consequently Eucalyptus had been planted for a number of years, each ranch producing its own fuel but having none to sell. That the so-called "tide land" or waste land, of which there is so much in the Bay Counties, might be made to produce Eucalyptus groves, has been well demonstrated on a tract 5 miles south of Suisun. The area was one that was flooded every high tide. A canal four or five miles long was dug, or at least in making a dike to keep back the tide a canal was formed. Along this dike, the top of which averaged about one foot above the high water mark, Eucalyptus trees were planted 25 years ago. These trees have made a wonderful growth, and part of them have just been cut for the third time. The Eucalyptus globulus has grown better under these conditions than on the high ground back from the Bay, and this in spite of the fact that the roots are constantly in brackish water. However, the fact must not be overlooked, that for the successful and rapid growth of Eucalyptus, good land is necessary. Much of this tide land will one day be reclaimed and used for agricultural purposes, but in the mean time it might be made to produce hardwood at a greater profit. If a small dike could

be placed around the plantation to keep the tide water off the property for the first two or three years, by which time the trees would have reached sufficient height that the water could not harm them, the growth of Eucalyptus would be exceptionally fast, in fact, an occasional submersion would aid their growth.

In the upper part of the Napa Valley conditions are much the same as in the Sacramento Valley, there being thousands of acres of land that will produce Eucalyptus. South of the town of Napa, Eucalyptus has been planted with marked success.

In the vicinity of Santa Rosa, groves of Eucalyptus are a common sight, and as stated previously in this bulletin on page 66, on the ranch of Mr. Harrison Meeham, six miles north of Petaluma, it has been clearly proved that there is money to be made in the growing of Eucalyptus on a large scale. Mr. Meeham is a large land owner, his ranch containing five or six thousand acres. The entire ranch is made up of low rolling hills, and though grain was once grown all over the ranch the character of the ground makes it unsuited for grain growing because the harvesters cannot be used and cutting has to be done with self-binders. For a number of years Mr. Meeham has been engaged in raising sheep and cattle for breeding purposes. About 22 years ago the first Eucalyptus was planted, and since some planting has been done nearly every year until now there are about 200 acres of Eucalyptus on the ranch. Some of this was planted in the valleys, but as a rule the plantations were made on the summits of the round hills that are so common. In nearly every one of these groves there is a large sheep shelter, the trees furnishing a good protection from the wind which is at all times brisk.

Showing Characteristic, Long, Clear Boles.

Eucalyptus Table.

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DUE DATE

Nov 10/71	NOV 24 1971
OCT 21 1971	
OCT 18 REC'D	
	JUN 10 REC'D
	MAY 18 1971
	MAY 15 REC'D
JAN 24 REC'D	
MAR 8 1978	
MAR 8 - REC'D	
OCT 14 1976	
OCT 14 REC'D	
NOV - 0 REC'D	

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