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BULLETIN No. 11.

U. S. DEPARTMENT OF AGRICULTURE.
DIVISION OF FORESTRY.

SOME FOREIGN TREES

FOR THE

SOUTHERN STATES.

PREPARED UNDER DIRECTION OF

B. E. FERNOW,

Chief of Division of Forestry.



WASHINGTON:
GOVERNMENT PRINTING OFFICE.

1895.

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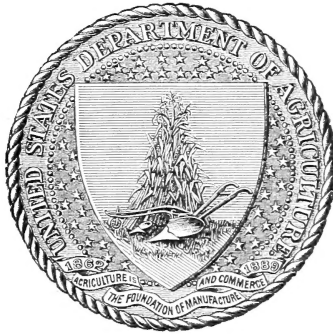
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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF FORESTRY,
Washington, D. C., August 15, 1895.

SIR: I have the honor to submit herewith for publication a bulletin containing accounts of the value and method of cultivation of some exotic trees of economic value, which may be cultivated with advantage in some parts of the Southern States, with a view to the enrichment of the forest flora and to give rise to new and valuable industries.

Respectfully,

B. E. FERNOW,
Chief of Division of Forestry.

Hon. J. STERLING MORTON,
Secretary of Agriculture.

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INTRODUCTION.

This bulletin has been prepared with a view to calling attention to a few economic trees of the highest importance which are believed to be worthy of extended trial in the Gulf region of the Southern States and in California.

The cork oak offers a new industry to the South, and one which, properly fostered, will prove of no small value to the people. Experiments so far made, as a result of a distribution of seeds and plants of this species, show that the cork oak can be successfully grown over a large range of territory as far north as the thirty-third degree of latitude in Georgia.

The rapidly decreasing supply of tan bark makes the cultivation of any tree rich in tannin a subject of practical importance. The Australian wattle trees are among the richest in tannin. Their culture in California, begun under such favorable auspices a number of years ago, received a severe check, however, by the attack of the cottony cushion scale, one of the worst insect pests which has ever visited this country. The wattles were the favorite host plants of the scale, which spread thence to the citrus fruit trees, threatening the destruction of one of California's most important industries. With the advent of the parasite of this scale it is no longer feared, and it is hoped the culture of the wattle will be resumed and greatly enlarged.

The great variety in form, habit, and value of wood which the genus *Eucalyptus* offers makes it one of the greatest interest, not only to economic botanists, but to planters as well. The wonderful rapidity with which these trees develop suggests their usefulness, not only for wood supplies, but for shelter-belt planting. In California these trees are well established and grown for economic purposes. Although probably not many localities in the South are adapted to their cultivation, experiments are still needed to show the adaptability of some of the species, the large number of these with different habitats in their native country suggesting the possibility of adaptation.

The bamboo, a grass rather than a tree, but of such dimensions and character as to serve for the purposes for which trees are grown, has so far also been grown only or mainly for ornamental purposes. The incredibly rapid growth and the usefulness of the material for many

purposes, together with the ease of propagation when once established, suggest an extension of its use also for shelter planting in more southern latitudes.

While it is true that the natural forest resources of the South are rich and varied and by no means near exhaustion, the addition of these species of foreign origin, in special localities and under special conditions, will not be found devoid of interest and usefulness.

B. E. FERNOW.

WASHINGTON, D. C., *September 15, 1895.*

SOME FOREIGN TREES OF ECONOMIC VALUE ADAPTED TO PLANTING IN SOUTHERN STATES.

CORK OAK.

By Dr. J. D. JONES,

Formerly Assistant Chief of Division of Forestry.

Among the minor products of the forest, cork is one of the most widely used, though the area of its production is extremely limited. With the rapid development of the wine industry of California, the home production of cork has become a matter of increased importance. Attention has been attracted to the possibilities of cork growing in America by the rapid development of a few trees from acorns imported by the Department of Agriculture and planted in California in 1860. The following notes are based principally on a French publication—*Le Chêne-Liège, sa culture et son exploitation par A. Lamey, Paris, 1893:*

HISTORY AND STATISTICS.

Among the more ancient writers, Theophrastus, 288 B. C., mentions cork, and the elder Pliny, 23-79 A. D., in his natural history (Liv. XVI, Chap. VIII), speaks of the tree, its growth, acorns, and the use made of its bark. The Greeks and Romans were familiar with many of the uses to which cork is put at the present time. They knew that the cork tree produced a new bark after the old had been detached, and they have recorded that in certain parts of northern Africa the natives used cork bark to cover their houses. Theophrastus mentions the cork oak of the Pyrenees, and all that Pliny says of it is true, except that the cork oak did not exist in Gaul.

The uses of cork were restricted, though knowledge of it had existed so long, until the seventeenth century, when the development of glass manufacture and the general use of bottles made it a necessity. At first only the native cork was used, and not until the eighteenth century do we find traces of the culture of the cork oak noted in Spain. Dr. Primitiro Artigas, professor of the School of Forestry at the Escorial, reports in 1760 a German—called by the people of the country Don Jose Rumez, director of the Royal Cannon Ball Foundry at San

Lorenzo de la Muga, a little village in the Pyrenees in the Province of the Girone—as having undertaken, with an associate, the farming of cork forests. After gathering the cork they burned the refuse and shipped the product to their own country. From this time cork forests commenced to be rented. In 1796 the proprietors were paid 6 reals (75 cents) per hundredweight. At the same time the culture of the cork oak was extended; workshops were established for the cutting of corks in this region; the product was sent to the principal cities in Europe, and the reputation of the quality, which was merited, is still retained.

Catalonia has a right to be considered as the cradle of the cork industry. In Portugal cork culture made the most rapid strides. Although of recent introduction, it became so extended that the production of Portuguese cork not only equaled but surpassed in quantity all the produce of other countries. The cultivation of the cork oak extended from Catalonia to other slopes of the Pyrenees and into the Province of Gascony, where its cultivation was seriously commenced in 1820. The first efforts in this direction for governmental forests date back to 1827.

There exists at the present time the following amount of cork-forest lands:

	Hectares.
Portugal.....	300,000
Spain.....	255,000
Italy.....	80,000
France.....	148,500
Algiers.....	459,000
Tunis.....	116,000
	1,358,500
	(3,488,250 acres.)

It appears that France, Algiers, and Tunis possess more than one-half of the total cork forests known. The Morocco forests are not mentioned, being still unexplored.

The cork oak industry, then, is of modern origin, but has increased in a most extraordinary manner. Already in a half century the production has more than doubled without a notable reduction in price, and with an extensively increasing market. The amount of prepared cork sold during 1892 equaled 587,000 hundredweight, which represents a value of \$7,630,000.

Portugal occupies the first place as a producer, while the United States, with an annual importation of \$400,000 to \$500,000 worth, and England and Germany are the principal consumers. Spain exports to all countries, the principal exportation being manufactured corks for bottles. In this industry, and in the quality of the product, she surpasses all other countries. Italy exports her product principally to Spain, France, and Germany. In France almost the entire production is consumed by the home manufacturers.

The quantity of corks that are manufactured and used each year by the world is enormous; 500,000 hundredweight of cork bark, allowing for loss, will give about 175,000 hundredweight of manufactured corks (there being about 1,000 corks to 3 kilograms of weight, which equals 5,833,333,000 cut corks). There are about 150 models, by which the various sizes and forms are regulated.

BOTANICAL.

The Swiss botanist J. Jay first presented the specific characteristics which distinguish the veritable cork oak (*Quercus suber* L.) from the cork of Gascony, which was named by Jay *Q. occidentalis*. The separation of these species made by him is of scientific interest rather than of practical benefit.

The two species of cork oak belong to the evergreen oaks; leaves oval-oblong, entire or more frequently toothed, and the teeth jagged; $1\frac{1}{4}$ to 2 inches long, width about 1 inch; branches rather scant, shade slight; the root system is strong and extensive, and roots are frequently seen on the surface; the growth varies as to locality, but is in general slow. The most suitable exposure is on southern slopes, as offering more free circulation of air and admission of light, rather than on plains. Care must be taken in the selection of soil. It is said that the tree in its wild state is found only on the older geological formations, such as granite, clay, and slate. The experience of cultivators is that the best cork and the most rapid growth is produced on granitic, siliceous, and slate (Silurian) soils. It succeeds but poorly, if at all, in calcareous soils. Moreover, it requires abundant moisture combined with good drainage.

The true cork oak appears spontaneously in the southern regions of Europe and on the northern shores of Africa. It grows alone or mixed with other trees, principally the maritime pine (*Pinus maritima*) and holm oak (*Quercus ilex*). The principal stations are Portugal (in the basin of the Tagus), Spain (Andalusia, Catalonia, Estramadura), France (Southern Pyrenees, Var, Maritime Alps, Corsica), Italy (Sardinia, Sicily, Tuscany), Istria, and Greece. It constitutes vast forests in Morocco, Algiers, and Tunis. It is not established in European Turkey, and is unknown in Syria and Asia Minor. With this range it is seen that the species is almost exclusively found in the basin of the Mediterranean. Its habitat is from about the thirty-fourth to the forty-fourth degree of north latitude, the region having an average temperature of about 59° F. It grows on the plains, but prefers slightly undulating ground, such as that of hills or mountains of slight elevation. In France it does not grow in a higher altitude than the grape vine, namely, an elevation of from 1,900 to 2,200 feet, but in Algeria it is found at an altitude of 4,000 feet.

CULTIVATION AND YIELD.

The tree is usually raised from seed, the large sweet acorns producing trees of full and regular growth and yielding the finest cork, while the small bitter acorns produce trees of a coarse and inferior nature.

The most approved method of planting, which is otherwise carried on like other nut planting, appears to be in furrows or belts, 5 to 7 feet apart, between rows of grapevines, which afford shelter. Two or more acorns are placed 20 to 40 inches apart in the furrows. No further cultivation is necessary, excepting the usual thinning as circumstances require. The first harvest usually takes place at the age of 40 years, at which time the plantation should contain about 700 trees per acre. The yield of this first crop is about 7 pounds per tree, worth about 30 cents, so that the first crop may be estimated at about \$200 per acre. At 50 years the plantation should contain about 200 trees per acre, which is reduced to 100 trees at 75 years, and 40 trees at 120 years, when thinning ceases or replanting begins. The average yield per harvest for the period from the age of 40 to the age of 120 years may be considered a little more than 50 pounds per tree, and the gross income about \$225 per acre.

The yield of cork steadily increases with the age and size of the tree. At the age of 120 years over 100 pounds per tree is expected, and exceptional cases are on record where a single tree furnished 500 and even 1,000 pounds of cork bark at a single harvest.

Since manufactured cork costs in France 9 cents per pound, its value is almost doubled by the manufacture.

HARVEST.

The cork of commerce is by no means the natural product of the tree, but an abnormal development of the bark layers under certain treatment. The natural cork is entirely useless for the purposes of manufacture, being too coarse, deeply furrowed, full of siliceous deposits and very irregular, and sometimes so woody and dense that it does not float. This "wild" cork, which the French call *liege mâle* is developed as the tree grows until it attains a diameter of from 6 to 10 inches. It should then be removed, leaving the interior denser, darker, and softer cork layer, which is called the *liber*, or mother layer, from which the cork of commerce develops more or less evenly. (See Pls. I and II.)

There is no difficulty in removing the bark while in sap—an operation which can be also facilitated by beating with a mallet around the trunk: but in its removal it is necessary to be careful of the inner layer, or bast, for, if injured, no cork would be produced at that place. For the same reason it is also necessary to clear the *liber*, or bast, entirely of the "wild" bark, making a smooth, uninjured surface of the mother layer.

The first harvest is made when the trees are from 12 to 18 inches in circumference, and takes place usually from six to ten years after the first removal of the rough bark, which prepares the way for the development of the commercial article. The season for taking the bark is from the middle of June to the end of August. Operating earlier than the time of full sap should be avoided, also rainy days and violent and dry winds, in order that the tender bast may not suffer from the exposure. In gathering the bark a circular cut is made, taking care not to penetrate the layer subjacent to the mother layer; a similar circular cut should be made at the bottom of the tree, after which a vertical cut connects the two circular cuts, using the same precaution as before. (See Pl. III.) Commencing at the upper portion to open the incision with the edge of the hatchet, the layer of commercial cork is detached from the mother layer with the handle of the hatchet, the end of which is cut on a bevel for this purpose. (See Pl. I.) On arriving at the bottom of the tree the cork is detached by a sharp cut of the hatchet, the break being made at the level of the ground. When the trees are not more than 19 to 24 inches in circumference, the cork is taken off in one piece called a "cannon;" and when the trees are larger, in place of one longitudinal cut, two or three vertical incisions are made, so that the cork may be taken off in slabs; the portion of cork remaining on the bottom of the tree is called a sleeper, or heel; the presence on the stump of a certain number of these marks serves as a record of the number of gatherings of cork realized from the tree.

The mother layer develops new cork by annual layers, and its age is therefore discernible, just as in the barks of other trees. (See Pl. II.) It is allowed to grow until it has reached the thickness required in commerce, namely, about 1 inch, a thickness which in France takes at least six to ten years. The barking is a very simple operation in principle, but nevertheless requires great care and should never be intrusted to inexperienced workmen, for faults committed by them frequently cause the death of the tree. The barking can only take place when the tree is in sap, as at this time the separation of the layers is more easily effected, and when the vegetation is not in full vigor there is great danger of detaching the mother cork. It is very necessary not to commence the operation of barking too early, the best period being when the first mounting of the sap has somewhat slackened and when the new leaves have achieved their development. The end of May is considered the proper time in Algeria for the harvesting of the cork product, while in France, where vegetation is less forward, it is necessary to wait three or four weeks later. By the 23d of June the woods are full of activity, as when the work commences it is pushed forward in order to avoid the dry seasons and drying winds, which render the operation more difficult by retarding the flow of sap. This process of taking the commercial cork and removing part of the wild cork is repeated every six to ten years, until the heavy branches are reached.

If the branches are of good size they are treated in the same manner as the trunk. Care must be taken not to denude too much of the trunk at once, as that will endanger its life. Therefore each tree is managed so as not to expose in the same year more than one zone of mother layer, alternating the harvest among the trees. (See Pl. III.) The mother layer is liable to damage from exposure as well as from insect enemies, among which are the red ant (*Formica liquiperda*), the larva of *Coræbus undatas* (Corch), and also from various fungi.

Notwithstanding the care that is taken, there occurs from the unavoidable exposure of the mother cork a loss of trees amounting to 2 per cent after each decortication. Besides, there is a loss of 15 to 18 per cent of cork by the furrowing of the cork layer, due to dryness and also sand and dust blown against it and embedded, a considerable layer thus becoming useless. To avoid these losses it is proposed to cover the mother layer, using for the purpose the cylinders of "wild" cork attached by wire, closing their open sides with tar paper. This method is claimed by the originator (Capgrand-Mothe) to double the yield, but its practicability is doubted by others.

The question as to the age a cork oak must attain before the first barking is difficult to answer, as during the early years the cork oak is capricious as to its development; often a tree can be barked at 20 years, while another growing by its side would be 30 years of age before being sufficiently mature. Size is the only true guide. Many cork workers advise the first cutting to be made when the tree has attained a measurement of 12 inches in circumference 3 feet from the ground; others think it better to wait until the tree is 20 inches in circumference. These are extreme opinions.

The following progress may occur in a cork plantation regulated for a series of annual harvests (see Pl. III):

First period. Take a tree 14 to 16 inches in circumference that has been barked to a height of 30 inches. At the expiration of a period of from six to eight years the tree will measure from 18 to 21 inches in circumference, and will furnish the first harvest of cork to a height of 30 inches; at the time of gathering the cork the outer bark should be removed to a height of 18 inches above the last cut.

Second period. Six years after the first harvest the outer barking should again be extended 24 inches above the last cleared portion. At the expiration of the period for ripening, the tree will measure from 24 to 30 inches in circumference at the last barked portion. The cork may be gathered up to 48 inches from the ground.

Third period. Six years after the second harvest it is possible to detach the cork from the surface that was prepared during the second period, and at the same time another surface 24 inches higher should be barked. At the expiration of the period of development the new cork can be harvested from a surface 48 inches from the bottom of the tree upward; the measurement will be from 30 to 36 inches in circumference.

Fourth period. Six years after the expiration of the third period the harvest of cork may be taken from the surface measuring 48 inches on the upper portion. At the end of the period of development the harvest will be produced as before from the surface measuring 48 inches on the lower portion of the tree, which at this time will measure 34 to 39 inches in circumference. A surface of 24 inches in length situated above the last barked surface should now be prepared for a future harvest.

Fifth period. Six years after, the harvest will be taken from the surface having a dimension of 48 inches situated in the central part of the trunk. At the expiration of the period of development the cork can be taken from the 48 inches of surface on the lower part of the tree and the 24 inches situated on the upper part of the trunk. The measurements of various portions of the trunk will vary from 39 to 48 inches in circumference.

At the end of the fifth period the barking of the wild bark is not extended further unless the vigor of the tree well permits an increase of the barked area, and thereafter only the commercial cork is gathered twice during each period, alternating the harvest from the surface having a measurement of 48 inches situated in the center of the trunk with that of the surfaces having a measurement of 48 inches situated at the base and top of the trunk.

PREPARATION FOR MARKET.

The cork, having been stripped from the trees in the form of slabs or cylinders, is first placed in long rectangular vessels and boiled for the purpose of swelling the bark. The boiling closes the pores, increases its elasticity, and renders it more supple and compact. The efficacy of this treatment is incontestable; its specific weight is reduced, but the volume is increased about 20 per cent.

The vessels used are about 6 feet square and will hold from 3 to 5 hundredweight of bark, which is flattened and held in position by means of heavily weighted planks. The cork is boiled about one-half to three-quarters of an hour. After boiling, the cork slabs are allowed to cool. They are then scraped with an instrument, either by hand or machinery, by which means all the wood fiber is removed. The loss in weight is greater when treated by machinery than by hand. After the operation of scraping, the cork slabs go to the cutter, who trims them in proper shape, removes the defective parts, and sorts them into grades suitable for different purposes. The various qualities are placed in five classes, namely, thick, ordinary, bastard or fair, thin, and refuse, having measurements as follows:

1. Thick, measuring 31 millimeters or above.
2. Ordinary, measuring 26 to 30 millimeters.
3. Bastard or fair, 23 to 25 millimeters.
4. Thin, 22 millimeters.

Each quality is subdivided again into various grades of superiority:

Thick into superfine, superior, ordinary, and inferior.

Ordinary into superfine, first, second, third, and fourth qualities.

Bastard or thin into good, ordinary, inferior, and refuse.

These grades are again divided into classes, "champagne cork" being the highest quality.

USES.

Cork was not generally used for stopping bottles until toward the end of the seventeenth century, though the Greeks and Romans used it for their wine vessels to a limited extent.

The importance of the cork crop has been appreciated in Spain only since 1850. The uses are numerous, each country having its own peculiar manner of utilizing this bark. The bottle cork is of course the article most largely manufactured and most universally used. In Spain are manufactured beehives, pails, pillows, window lights; in Portugal, roofing, linings for garden walls, fences, etc.; in Italy, images, paving for footpaths, sometimes used in buttresses of village churches; in Turkey, cabins and coffins; in Morocco, drinking vessels, plates, tubs, house conduits; in Algeria, shoes, wearing apparel, saddles, horse-shoes, armor, common boats, landmarks, fortifications, furniture, etc. The possibilities and usefulness of this bark are seemingly unlimited, and it is as great a necessity to the Algerian as the agave is to the Mexican or the palm to the Arab.

In France cork is used for insulating boilers, and being a bad conductor of heat and cold it is frequently used in situations where protection from either is necessary. Of the waste cork from the cutting of bottle stoppers, about 30 per cent is utilized for filling cushions, horse collars, hats, mattresses, also for the manufacture of cork-dust bricks, which are used where excessive dryness is required, and for wheels having small diameters. Pasteboard of a high grade is manufactured from French cork. The ground cork is thoroughly mixed with paper pulp by means of a machine, and the water is expressed by heavy Holland presses and the material dried. Cork waste is also used in the manufacture of linoleum, in lifeboats, buoys, etc., in insoles for shoes, artificial limbs, cork concrete, and many other articles where lightness and elasticity are required.

THE CORK OAK IN AMERICA.

The following notes were kindly furnished for this Bulletin by Prof. Charles H. Shinn, of the University of California:

There are twelve or fourteen cork oak trees growing on the farm of Mr. S. Richardson, Alhambra post-office, San Gabriel Valley, California, about 4 miles from Pasadena. The soil is a sandy loam, irrigated as required. The site is near a creek bank and is occupied mainly by an orange grove.

In 1860 the Commissioner of Agriculture sent a number of cork oak acorns to Don Benito Wilson (now dead). He gave two acorns to Mr. Carpenter, a neighbor who owned what is now the S. Richardson farm, and planted the remainder, perhaps 100, in his own nursery. They grew fast, but were all destroyed the next year by an ignorant workman, who took them for weeds; consequently the two Carpenter acorns, both of which grew, furnished the only stock in the valley. One made a tall, shapely tree, and grew well until 1892, when it died, probably owing to too much water and injury by visitors. The trunk of this tree was 21 inches in diameter in 1892; height to first branch about 15 feet; total height, 40 to 45 feet.

The second of the original oaks still remains. A windstorm broke the top, but it is recovering from the injury; it is smaller than the tree above mentioned, having been moved when 5 years old. It is now about 14 inches in diameter 3 feet from the ground, and 28 feet high, the trunk having a height of 12 feet to the lowest branch.

The finest cork oak on the Richardson farm is 13 years old. It is from the first crop of acorns produced by the original larger tree. It has made a remarkable growth, although, standing on a bank or bluff, it gets less water than the others. It is now 16 inches in diameter and 30 to 35 feet high, with a spread of branches of 25 feet. The trunk is 7 feet to the lowest branch.

The remaining trees range in size from 4 to 12 inches in diameter of trunk. Thousands of acorns have been distributed from these trees in fruiting years. The University of California has sent out several bushels at different times, and Mr. Richardson has given so many away that it is said there are now not less than 1,000 cork oak trees of small size in the San Gabriel Valley alone. Nurserymen in several places have also grown and sold them. The acorns germinate readily if planted in the fall and let alone. When potted and petted they usually fail.

Cylinders of the cork from the largest trees are on exhibition in San Francisco and Los Angeles.

It will be observed that Mr. Shinn's measurements indicate a much more rapid growth of the cork oak in California than is usual in France, which may be considered the best possible evidence of the adaptability of the species to the soil and climate of that part of California in which it has been tested.

The first distribution of acorns of cork oak was made by the Department of Agriculture in 1858. These seeds were distributed in the Southern States and California, and the trees resulting from them are occasionally met with.

Bark from one of these trees planted at Sandersville, Ga., is now on exhibition at the Cotton States and International Exposition in Atlanta. Sandersville is near the thirty-third degree of latitude, and while the tree has lost its foliage several times during severe winters it has always leafed out vigorously in the spring, seeming to entirely recover from the winter's injury.

In 1892 the Division of Forestry secured through Thomas Meehan & Sons, Germantown, Pa., two barrels of cork oak acorns, which were grown at the Maryland Experiment Station. Through lack of proper care comparatively few of the seed germinated, and many of the seedlings were badly damaged by grub worms. Sixteen packages of seedlings were distributed in the States suitable for their growth, in most cases to experiment stations.

The excellent showing reported by Professor Shinn and the few trees occasionally met with in the South indicate that the tree can be successfully grown on sandy clay soils throughout the southern part of the Gulf States and South Carolina.

Whether the cork industry will flourish in the United States can only be proved by time; the probabilities are that it will be successful and be of immense value. The official statistics show that the United States has imported cork during the year 1892 to the value of \$1,689,724, and during 1893 to the value of \$1,993,025. Cork is now at eleven times the price that was paid for it in 1790. This is certainly inducement enough for us to try to protect ourselves by entering into the production of cork.

WATTLE TREE.

By CHARLES A. KEFFER,
Assistant Chief of Division of Forestry.

Among the economic trees introduced in the Southern States by the Department of Agriculture the Australian wattles (*Acacia pycnantha* and *A. decurrens*) have a peculiar value as affording one of the richest tanning barks known. Many analyses of *A. pycnantha*, the broad-leaved, or golden, wattle, show a range of from 28.5 to 46.47 per cent tannic acid, and the range in *A. decurrens*, the black wattle, is from 15.08 to 36.3 per cent. These analyses were made in Australia, and the reports of the Australian Government on wattle culture contain quite complete records of them. Wattle bark grown in California has been analyzed by Professor Woodbridge with the following results for the species named: *A. pycnantha* 31.9 per cent tannic acid; *A. decurrens* 36.3 per cent tannic acid. These results are contrary to the average of the Australian analyses, which indicate a higher percentage of tannic acid in *A. pycnantha* than in *A. decurrens*. The average oak bark contains 12 per cent of tannic acid and the hemlock 13 per cent.

It will thus be seen that the wattle barks are very rich in tannin, and their successful cultivation in this country becomes a matter of increasing economic interest as our own supply of tanning bark decreases.

The acacias belong to the natural order Leguminosæ, represented in our country by the black locust, the honey locust, the Kentucky coffee tree, and the redbud. All of the species (312 are natives of Australia) contain more or less tannin, but only three are sufficiently rich to be worthy of cultivation, and of these *A. pycnantha* and *A. decurrens* much exceed *A. dealbata* in the percentage of tannic acid contained.

The acacias do best on a sandy soil with clay subsoil. On limestone formations the bark of trees is greatly inferior in tannin to those grown on any other formation, though wattles grow exceedingly well in limestone soil in South Australia and in California. The seed are hard and very small, there being 30,000 to 40,000 to the pound. If planted dry, they lie dormant several years, there being well-authenticated instances of seed germinating after being over thirty years in the soil. To hasten germination boiling water should be poured over them and left until the seed are soft. Thus prepared they will germinate in about three weeks. The soaked seed may be mixed with dry sand, to

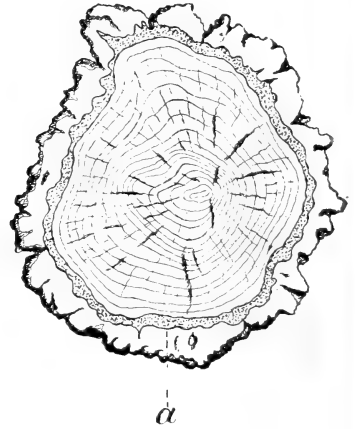
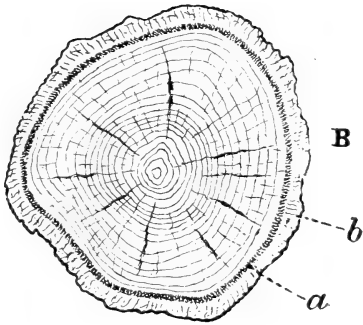
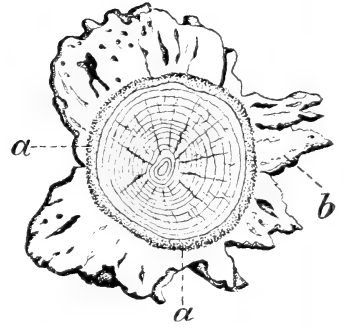
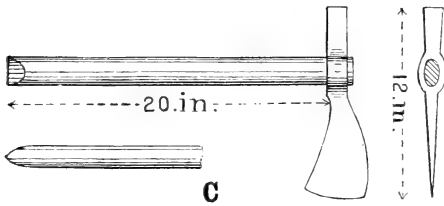
prevent their sticking together, and planted in drills, as is usual in nursery practice, the seedlings to be transplanted when one year old to their permanent places; or, where only a few are grown, the seed may be planted in short section of cane, open at both ends, and the seedlings set in their permanent places without removing the cane. In India and Australia both bamboo and *Arundo donax* are used for this purpose. The cane decays during the first season in the ground, and the young plant receives no check in transplanting. The principal advantage of this method is that it admits of planting out the young acacia plants at any convenient time, while if grown in nursery rows the seedlings can only be safely set while dormant.

In Australia the trees succeed well under an annual rainfall of from 16 to 20 inches, and it is thought that an unlimited supply of water makes the bark deficient in tannic acid. They grow rapidly, increasing in diameter at the rate of an inch per year. The practice is to have the trees stand about 4 by 6 feet when the first bark is removed. When the seed is sown broadcast the proper distance is secured by two or three thinnings; and when planted in place the greater amount of cultivation required probably offsets the cost of thinning, making the expense of the two methods approximately the same. Doubtless the method recommended for general planting of forest trees in the prairies would be most satisfactory; that is, plant the seedlings 3 by 3 feet, with a view to shading the ground quickly, and thin as required.

The first harvest is gathered in from five to seven years from planting, when the trees are from 4 to 5 inches in diameter. The bark of the trunk is somewhat richer in tannin than that of the branches, but in stripping all of the larger limbs should be bared. The amount of tannin contained in the bark varies considerably during the time when the bark will peel, and Australian experiments indicate that the best season is when the bark will first peel readily, as when the buds are swelling.

When the trees are stripped they should be removed, and seedlings set in their place, or the sprouts permitted to grow. By this means a succession is obtained. The trees are at their best in Australia about the tenth year. Thereafter they are much more subject to injury from fungi and insects. The harvest is usually arranged on a system of thinnings, and covers a period sufficiently long to permit the stripping of the first trees of the second planting when the initial planting is exhausted, making a rotation of about ten years.

Of the two species the seeds of which were disseminated by the Department of Agriculture several years ago, *Acacia decurrens*, the black wattle, is the more rapid grower in Australia, but *A. pyrenantha* is considered hardier, will endure on drier soils, and is richer in tannin. From the standpoint of the producer, however, in regions where the temperature will permit the cultivation of both species, the black wattle will probably be the more profitable, as it attains larger size and



A.—CROSS SECTION OF WILD TREE.

a, mother bark layer.

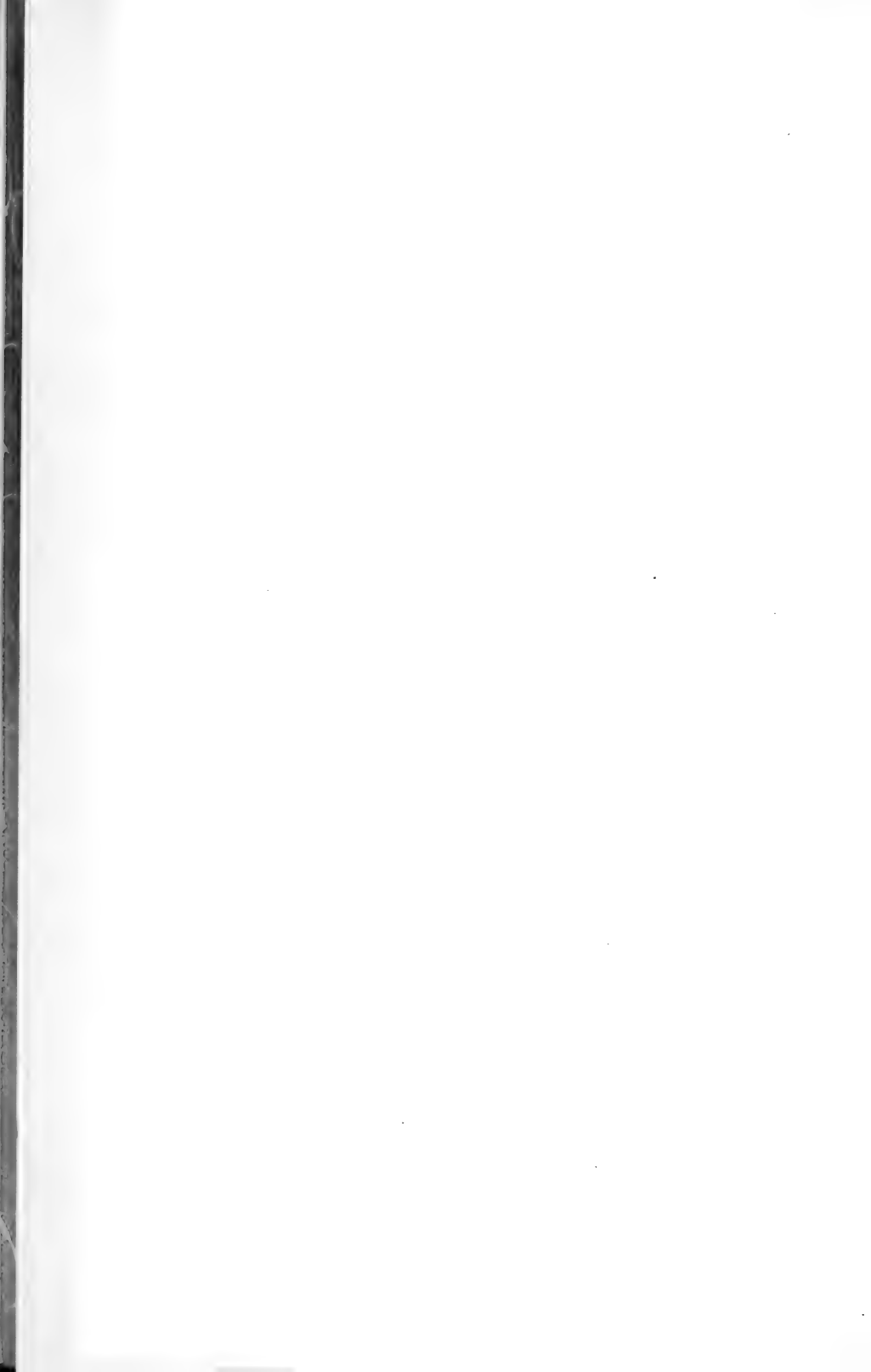
b, wild cork.

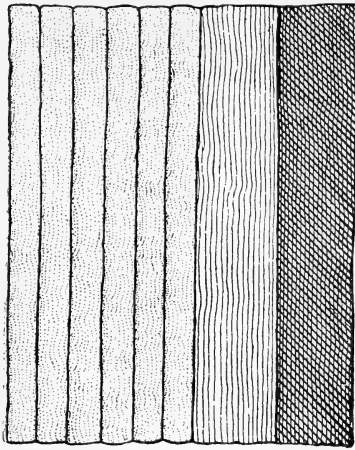
B.—CROSS SECTION OF DECORTICATED TREE.

a, mother bark layer.

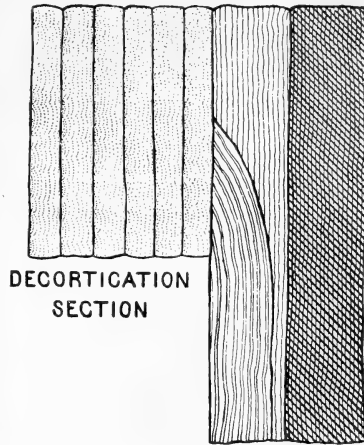
b, commercial cork.

C.—HATCHET USED IN DECORTICATING.



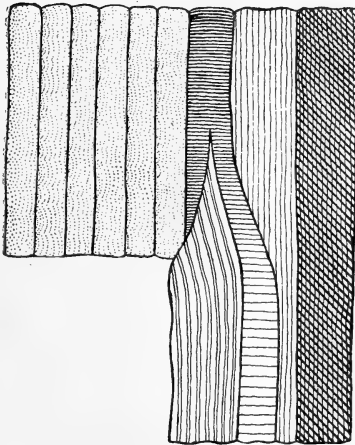


BEFORE DECORTICATION

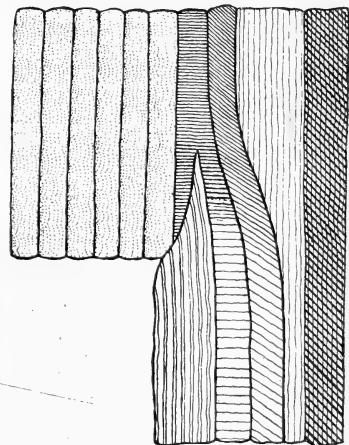


DECORTICATION SECTION









AFTER DECORTICATION



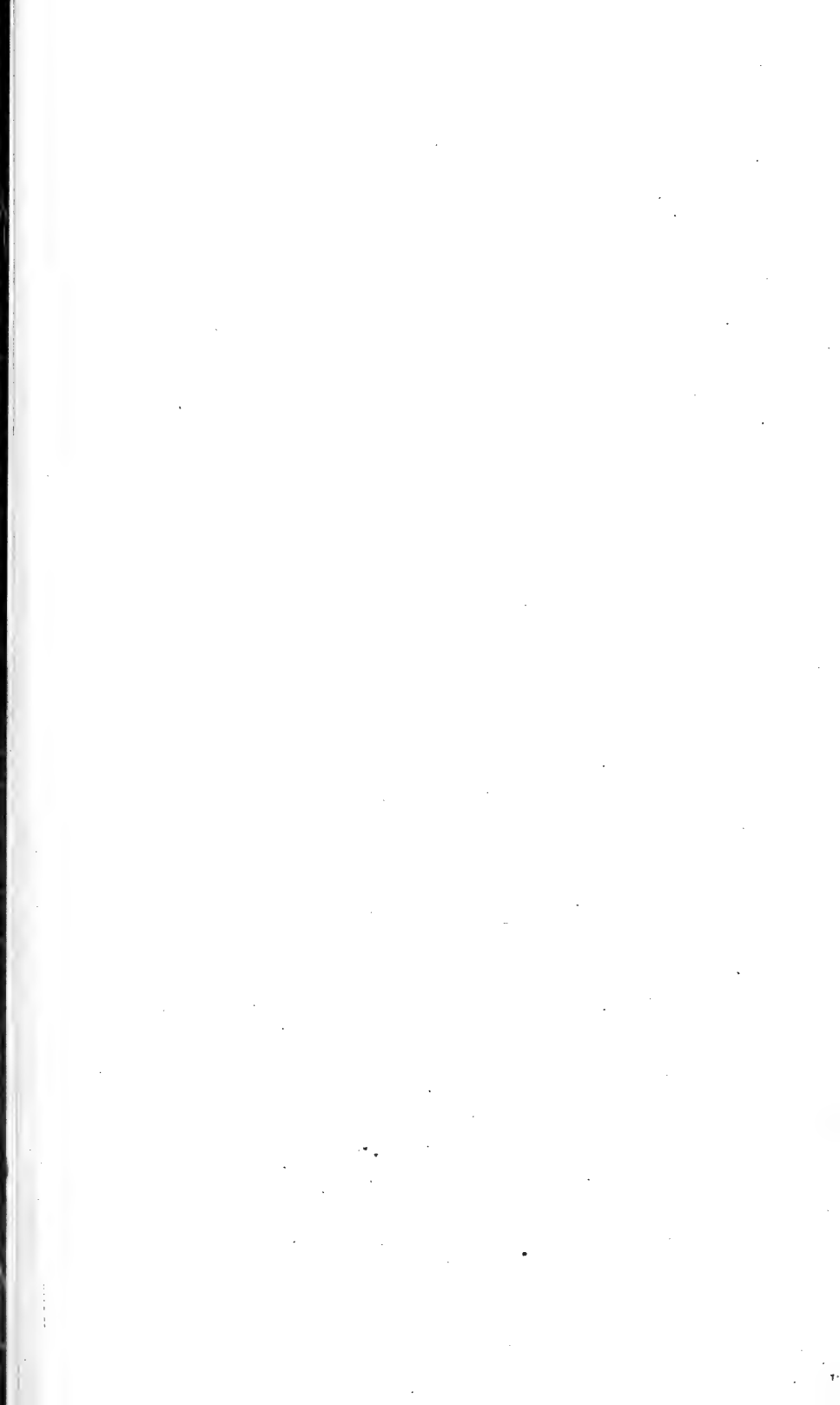
ONE YEAR AFTER DECORTICATION
FIRST LAYER OF COMMERCIAL CORK FORMED.

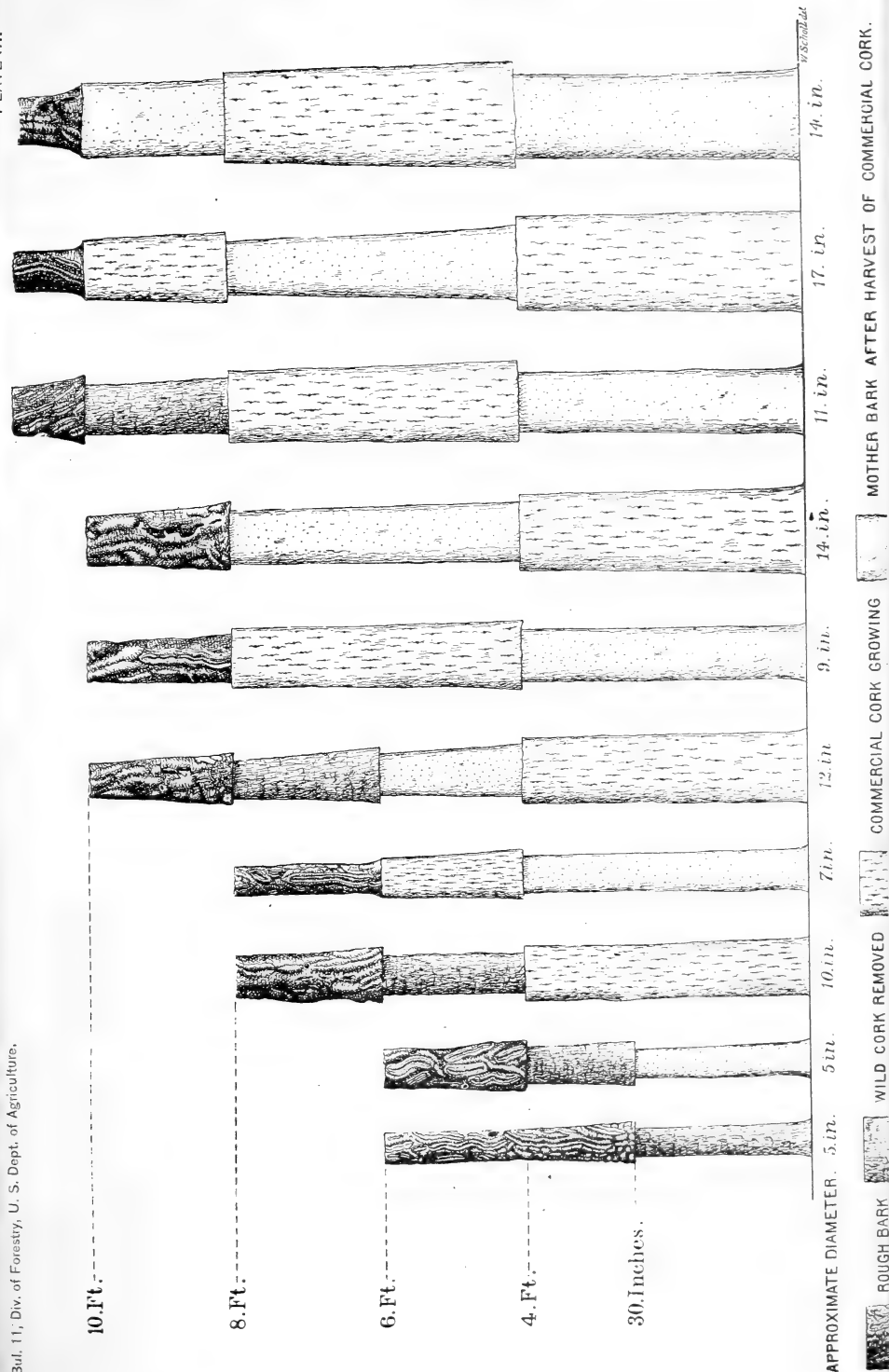


TWO YEARS AFTER DECORTICATION
SECOND LAYER OF COMMERCIAL CORK FORMED.

- | | |
|--|---|
|  WOOD OF TREE. |  FIRST LAYER OF COMMERCIAL CORK. |
|  MOTHER BARK. |  LAYER OF WILD CORK FORMED AT SAME TIME. |
|  HARDENED MOTHER BARK. |  SECOND LAYER OF COMMERCIAL CORK. |
|  WILD CORK OF SIX ANNUAL LAYERS. |  LAYER OF WILD CORK FORMED AT SAME TIME. |

W. SCHOLL DEL.





10 Ft.

8 Ft.

6 Ft.

4 Ft.

30 Inches.

APPROXIMATE DIAMETER. 5 in.

5 in.

10 in.

7 in.

12 in.

9 in.

14 in.

11 in.

17 in.

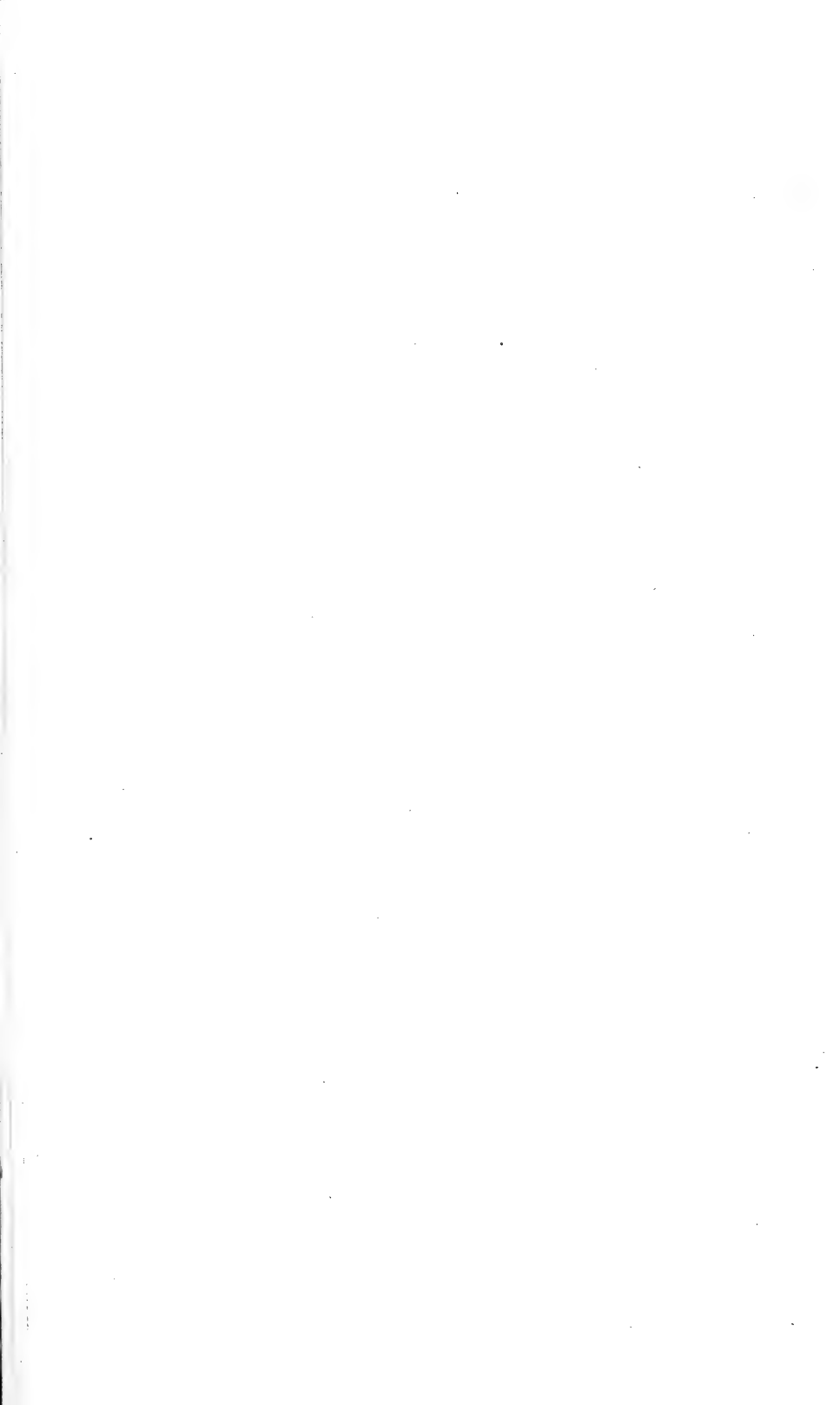
14 in.

ROUGH BARK

WILD CORK REMOVED

COMMERCIAL CORK GROWING

MOTHER BARK AFTER HARVEST OF COMMERCIAL CORK.



yields more bark than the broad-leaved. Professor Maiden claims that the two species will "supplement one another, the black wattle flourishing in situations too damp and cold for the broad-leaved." Baron von Mueller recommends the planting of the black wattle on worn-out lands in Victoria.

The Australian reports give remarkable estimates of the profits to be made in wattle cultivation in New South Wales and Victoria. Prof. J. H. Maiden, in his *Wattles and Wattle Barks*, quotes one estimate in which 100 acres of wattles would yield a net profit of \$12,763 in eight years from planting, after making full allowances for rent, interest, and all possible expenses. This would be at the rate of almost \$16 per acre per year. By another estimate, in which the purchase price of the land at \$14.50 per acre is included in the expense account, 100 acres of wattles is made to yield in seven years a net profit of \$5,362.72, or \$7.66 per acre per year. In the expense account is also included fencing, fire breaks, and interest, and the yield is put at 10 pounds of bark per tree, an admittedly low estimate.

Wattles have been cultivated in California for a number of years with varying success. Specimens of the hardiest species known in California (*A. melanoxyton*) were killed by a temperature of 14° F. at Chico, one tree being 18 inches in diameter at the stump. The tanning wattles will not stand more than 6° or 8° of frost, and if, as claimed by the Australians, a limited rainfall insures their best development, the only part of the Southern States adapted to their growth is southern Texas.

In California the cottony cushion scale threatened the complete destruction of all the acacias a few years ago, but with the introduction of its parasite its ravages have been so reduced that it is now considered practically harmless, and the renewed cultivation of the wattle trees is beginning.

An important purpose is served by the acacias in the vicinity of San Francisco, where they have been found especially adapted to planting on the sand dunes. They thrive in the desolate sands and cold sea breezes of that vicinity, and will prove an effective means of fixing the shifting sands. Their bright yellow flowers, which appear in great profusion, and their fine foliage make them highly ornamental, and thus far they have been more used for lawn planting in California than for any other purpose. The wood of the acacias makes a superior fuel, and in southern Texas this use alone would warrant their cultivation.

Both the black and golden, or broad-leaved, wattle are grown throughout the coast region of California, from San Francisco south, and in the more southern valleys, and there is little doubt that in that region at least the wattles rich in tannin can be grown with profit. It is to be hoped that they will be extensively tested throughout the warmer regions of the Southern States, especially in southern Texas, where there is need of forest planting.

Wattle seeds have been distributed by the Division of Forestry at various times, the first being sent out in 1886. While California has received the major part of these seeds, they have also been sent to Florida, Texas, New Mexico, and Arizona. Owing to a lack of knowledge of methods of germinating the seeds, and transplanting the seedlings, few favorable reports have been received from these Government distributions outside of California, but it is believed that both the golden and black wattles can be grown successfully in the extreme southern part of Texas and in Florida.

EUCALYPTUS.

By ABBOT KINNEY, *Lamanda Park, Cal.*

Among the foreign trees that may be grown in the warmest parts of the United States none are of higher economic value than several species of eucalyptus. The eucalyptus was introduced in California a number of years ago, and the most common form, *Eucalyptus globulus*, is now extensively grown in the southern part of that State. Comparatively few of the 150 species have been tested in the Gulf States, and it is yet an open question if any will be a complete success in the Gulf region, while in southern Florida several have become well acclimated.

GENERAL CHARACTERISTICS.

The eucalyptus is a genus of woody plants varying in height from a few feet to over 400 feet, and affording great variety in foliage and flower. The genus is one of the largest among tree forms, and all the species are natives of the Australian continent and adjacent islands. None have been found in New Zealand, on the one side, nor in Asia on the other. The foliage of all the species is persistent; i. e., is evergreen, and of many shades, running through grays, blues, and greens. The foliage as a whole may be fairly described as generally gray or dull green, of similar color on both sides of the leaf, hanging edgewise to the sky, and sickle-shaped. The blue color is almost entirely due to a bloom which when rubbed off leaves the leaf or fruit a dull green.

One striking characteristic of the eucalypts is the extraordinary difference of the foliage in both shape and color of young and old trees. The leaves of the young blue gum, for instance, are opposite, sessile or stemless, roundish to oval in shape upon a sharply quadrangular stem, and a bright gendarme blue in color. The leaves on mature trees are scattered, long-stalked, sickle-shaped, on a round stem, and a saturated green in color.

The color of the new growth of the mature trees varies greatly in the different species. In the blue gum, *E. globulus*, the new growth is green with a yellow shading, often changing to a red brown; in *E. rostrata*, red gum, it is a bright willow green; in *E. stewartiana* it is blue, while the main foliage is green; in *polyanthema*, it is blue; in *E. viminalis*, manna gum, and in *E. corynocalyx*, sugar gum, it is red.

The peculiarly strong eucalyptus smell of the leaves is absolutely the only apparent point in common between the yearling and the mature tree of *E. globulus*. Nearly all the species have a yearling condition quite dissimilar from the grown form.

There are a few of the eucalypts that retain their early form throughout life. One of these is *E. risdoni*, which is a bluish gray in color of its foliage and has nearly all its leaves opposite and sessile. Another is *E. gamophylla*, which has a similar coloring, with the leaves all opposite and united, whence the name *gamophylla*, or married leaves. The flower consists of a cup-like persistent calyx, on which the numerous stamens are inserted surrounding the pistil. There is no corolla. In some forms the flowers are brilliantly colored and of large size, while in others they are greenish hued and comparatively inconspicuous.

The eucalypts are valuable for the rapidity of their growth, the excellence of their timber, and the oils contained in their leaves. Add to these the great beauty of many of the species, and we have qualities which make these trees worthy of extensive trial wherever the climate will admit of their growth.

All the eucalypts must be transplanted when very young. The extraordinary rapidity of their growth makes this essential. This quality of the ability of the young to get an immediate possession of a prepared soil is doubtless one, if not the main, cause of their extensive popularity in all climates in which they can thrive. The economy of setting small trees, the short time that care is required, and the small cost of the trees on account of the short nursery handling are due to this feature of their rapid growth.

The genus has several groups of species that when mature are difficult to differentiate, largely on account of a tendency to vary according to the climate and soil in which the tree is found. The bark, the color of the leaves, as well as the general appearance of the tree, are consequently often deceptive. From this or some other cause great trouble has been experienced in obtaining seed and trees true to name.

E. viminalis, for instance, was introduced into California as the very valuable timber tree *E. rostrata*. It was extensively planted, and though a valuable timber tree in its own line, did not equal the real red gum in any way. This costly and disappointing work was done through a seedman's error. Both seeds and trees can now be obtained in California true to name. Doubtless many nurseries can furnish reliable stock.

USES.

The use of eucalyptus wood is being constantly extended. It is now, for instance, the exclusive source of rollers for moving buildings, an extensive business in southern California on account of the rapid growth of the towns, making land too valuable in the business centers for the early built buildings. George W. Bell has just written a pamphlet on the advantages of eucalyptus wood for paving.

An important by-product of the genus is eucalyptus oil, which is extracted from the leaves. Many of the species contain oils of the same general character, called eucalyptol, cuminol, citronellon, geraniol, phellandrene, etc. Of these eucalyptol is best known, and possesses

antiseptic qualities of a high order. The eucalyptus oils from Australia are from the native mixed forests, and are generally of mixed origin. The oils made in California are all extracted from *E. globulus*, and are consequently standard and reliable in their contents of eucalyptol, containing about 60 per cent.

Eucalyptus trees are said to be great absorbents of air moisture, as they are of soil moisture, and for this reason, coupled with the antiseptic oils contained, have been extensively planted in malarial districts. While the evidence of good resulting from such planting varies greatly, although it is generally assumed that several of the species have a beneficial effect, the improvement of sanitary conditions claimed due to extensive planting of eucalyptus in the Campagna Romana was, however, by a commission of investigation instituted by the Italian Government, declared to be largely due to other causes,

ABILITY TO WITHSTAND COLD.

Most of the species are very tender, enduring but a few degrees of frost. The most hardy can not resist a lower temperature than 25°, and prolonged cold periods, even though less extreme, are fatal. It will be seen from this that the extreme southern parts of Georgia and the Gulf States and California are the only localities in the United States where the temperature is adapted to the genus, and occasionally, as last winter during the exceptional freeze even in Florida, the trees are killed. They are peculiarly free from insect pests, being protected, doubtless, by the essential oils contained in their foliage.

The species that stand frost the best, and which are also fast growers and good trees, are the following:

Eucalyptus viminalis, the manna gum. This is a tall, graceful tree, reaching in damp gorges a height exceeding 300 feet. The timber is not very good, nor is there a large amount of essential oil in the foliage. It is a rapid grower. The common name is derived from a manna-like exudation from the leaves due to the action of certain Australian cicadæ. I have never seen the manna here, nor been able to make it appear by wounding the foliage. This tree, in the high Mojave plateau of southern California, has resisted temperature down to 10° F. It stands the English climate.

E. coccifera, a handsome tree closely allied to the *E. amygdalina*, reported as hardy in England. We have only opened trials with it in California.

E. urnigera, a handsome tree with dark-green leaves, hardy in England, and commencing its trial here.

E. gunnii. Very rapid grower; in fact, the fastest grower for the first two years we have ever tried. The first year's growth of an *E. gunnii* has exceeded 2 feet a month, or 26 feet for the year. The tree does not continue its rapid growth as long as the blue gum does. The blue gum grows in its phenomenal rapidity for about ten years, more or less,

according to soil and climate. It has frequently measured over 300 feet in height. *E. gunnii* is of a greener foliage than the gums in general, has a wavy or fluted leaf, and is a free bloomer, with small white flowers. Hardy in England. It has at times a tendency to irregular and fantastic forms of growth.

E. amygdalina. This giant has been noted in the damp Victorian gorges to reach a height of 480 feet, but it does not attain the cubic contents of timber of the Sequoia. Its extreme height is due to long, delicate branches very different from those of our big tree. In California we have been disappointed in this tree because probably we expected too much. It has not grown as fast as several other species nor finally made so large a tree. *E. globulus*, for instance, exceeds it here in every way. There are several varieties of *E. amygdalina* or of closely allied species. These are *E. amygdalina*, *E. coccifera*, *E. risdoni*, *E. regnans*, and *E. linnea*.

Besides *E. coccifera*, the *E. risdoni* stands low temperature. In California the narrow-leaved variety, or perhaps a sport, has withstood uninjured a temperature of 9° and perhaps even a short exposure of a lower temperature. The leaf has a pungent odor resembling a mixture of eucalyptus and peppermint, and the tree is commonly called peppermint gum.

E. hemiphloia, with a large percentage of oil containing eucalyptol, is reported as growing well in sandy places. It might, therefore, succeed better in such soils than the blue gum, which likes a rich soil.

SPECIES IN SOUTHERN CALIFORNIA.

The species of eucalyptus most popular in southern California at the present time are in about the order named as follows:

E. globulus, the blue gum, is first on account of its continued rapid growth, sanitary and medicinal effects, good fuel, fine piling, and general hardiness and vigor in all our valleys opening to or not far from the ocean. It makes new crops of fuel rapidly when pollarded, being in this respect like a willow. The blue gum plantations far exceed in importance those of all other forest trees whatever. In California when the eucalyptus is spoken of—as “a row of eucalyptus,” “a grove of eucalyptus,” “eucalyptus leaves,” etc.—*E. globulus* is meant and taken for granted. This is the species which has been almost exclusively used for its attributed ameliorating or inhibitory effects upon malarial disease. This antimalarial influence of certain eucalypts may interest sections in our Southern States. The blue gum when young will not stand frosts below 25° F. The mature trees have, however, withstood temporary temperatures down to 18°, with some frost burn.

E. corynocalyx, sugar gum, largely planted as a roadside tree in the warm and dry interior, makes a good head with dark-green, shining leaves. The timber in Australia is highly valued. Does not resist severe frost.

E. robusta, a very handsome tree, with large, dark-green, shining leaves. It is particularly attractive when in bud. The buds are a delicate cream pink and quite large. The timber of this tree is very durable and especially resistant in earth or water. It contains the largest percentage of kino yet measured. For ornamental road or street planting it is now the most sought of any of the eucalypts.

E. rostrata, red gum. This tree contains a considerable proportion of oil in the foliage and of fine kino in the timber. It is a highly valued timber in Australia. It is a good grower and is particularly adapted to very hot, dry climates. It also does well in our mild valley climates. I have just successfully introduced the tree in Arizona, where a number of other eucalypts have failed. It is with us nearly all the time covered with new growth. This is a vivid willow-green in color. The particularly agreeable odor of the leaves is an additional attraction.

E. leucoxyton, var. *rosea*. This tree has two distinct forms—one with green foliage and pink flowers and the other with silver-gray foliage and pink flowers. Both have a deep-red persistent bark. The silver-gray is far the more striking. The timber of this tree is exceedingly durable and is stronger than English oak (Laslett).

We have two other forms of *E. leucoxyton* here. One has rough red bark, green foliage, and white flowers. This is a very shy bloomer, while the others are all free flowering. The other form has a white, smooth bark, from decortication; green foliage; and, besides, grows differently. The first three are strong, single-stem trees, while the last, or white bark one, grows larger, but tends to branch low and make several stems. I feel sure that some of these varieties should have specific rank. The silver-leaved *E. leucoxyton* with pink flowers is extensively planted for ornament.

E. polyanthema is also planted for ornament. It has round leaves of silvery blue color.

E. fissifolia is extensively sought for its dark-green leaves and magnificent crimson flowers. It is to be noted that our seedling *E. fissifolias*, vary sometimes in flower color, the range being pink, orange, crimson, and magenta.

E. maculata, var. *citriodora*, is planted for the delicate fragrance of its foliage. The timber of this tree is valuable.

The most successful of these trees in California are *E. corymbosa*, bloodwood; *E. resinifera*, red mahogany; *E. diversicolor*, karri; *E. calophylla*, South Australian red gum; *E. botryoides*, bastard mahogany; the scarlet-flowered *E. fissifolia*, for ornament only; *E. corynocalyx*, sugar gum, for dry soils; and *E. robusta*, swamp mahogany, for heavy, damp soils and as an ornamental shade tree for streets.

Reports from the Exotic Nurseries of Seven Oaks, Florida, speak of *E. robusta* and *E. resinifera* as growing the fastest there. It is reasonable to presume that this type of foliage would be more favorable to the climate of Florida than that of the equally green group, doubtless

evolved to resist prolonged periods of drought characteristic of so much of Australia.

E. marginata has leaves somewhat paler beneath. Under the name of jarrah its timber has become renowned as a desirable, strong wood, capable of resisting the teredo, and consequently particularly adapted to piling. It is a tree well worth trying in southern Florida. It lives, but does not succeed for commercial promise, in the climate of California.

Another valuable timber tree of this unequally green leaf is *E. gomphocephala*, tooart gum. This tree grows well in California and makes a thick, symmetrical head, but is not a phenomenal grower. None of this type resist temperatures much below freezing; nor, with the exception of the *E. corynocalyx*, do they withstand dry air with long continued high temperatures such as those occurring in central Australia, southern Algiers, Arizona, etc.

SPECIES IN SOUTHERN FLORIDA.

Mr. Alex. Bauer, of Wauchula, Fla., reports to the Division of Forestry, under date of April 18, that the past severe winter had killed or badly injured all his eucalypts. Among the growths reported by Mr. Bauer are the following:

Eucalyptus (species unknown), planted October 7, 1890, height 52½ feet, circumference at base 3 feet 10 inches.

E. raniculata, planted same date, height 42 feet, circumference at base 29 inches.

E. lanceolata, planted same date, trunk branched at surface, height 27 feet, circumference at base 27 inches.

Mr. Bauer is not discouraged by the damage of last winter, but has already sent to Australia for a supply of seed for renewed experiments.

I should think that in middle and southern Florida the very handsome *E. calophylla* would do well. It has cream-white flowers, dark-green, shining foliage, and its timber is valuable. The fruit of this timber is large. A company here is polishing these fruits and making them into pipe bowls.

A large and important group of the eucalypts has leaves dark shining green above and pale beneath. This group has less or none of the sickle-shaped foliage, makes a better head and gives more shade, as the leaves are not generally, if at all, turned edgewise to the sun. The species in this group generally contain a large amount of kino.

This kino is a gum something similar to the resin of our pines and more or less permeates the timber of these trees. It is usually red or reddish brown in color, has a powerful preservative effect on the timber, antagonizing insect life, and has an antiseptic action. This latter property is availed of in medicine for the treatment of indolent ulcers, gangrenous tendencies, and is a deodorizer in external cancer. The foliage of this group is poor in the oil to which the therapeutic and hygienic reputation of the eucalypts is due.

BAMBOO.

By HENRY G. HUBBARD.

[NOTE.—The following article, kindly written for this Bulletin by Mr. Henry G. Hubbard, of Crescent City, Fla., is valuable, not only for the facts it contains, but because they are based upon the practical experience of the writer in the cultivation of the plant.

The tribe Bambusæ (bamboos), the giants of the great grass family of plants, numbers about 20 genera and 200 species, of which the one Mr. Hubbard describes is at once the most common and the most useful. In addition to the genus *Bambusa*, the genera *Arundinaria*, *Arundo*, *Dendrocalamus*, and *Guadua* are the most important. The canes which grow in swampy places throughout the Southern States from Missouri to Florida belong to this tribe, and are its most hardy representatives. Several species of *Arundinaria* and *Arundo* can be grown for ornament and for the binding of sand dunes as far north as New York, while the bamboo itself is worthy of extended trial throughout the Gulf region.—B. E. F.]

A species of arundo closely allied to or identical with *Arundo donax* is widely distributed in the Southern States, where a variety beautifully variegated with white has long been grown in gardens as an ornamental plant. It attains a height of 12 or 15 feet, but has little economic importance. A similarly variegated variety of the larger European plant was introduced into Florida in 1884. It thrives wonderfully in moist, rich land and sends up canes annually 25 or 30 feet long. The stalks of this reed, however, have little strength and no durability, and are greatly inferior in this and other respects to the native cane of the canebrakes.

One of the so-called flat-stemmed bamboos was introduced in the city of Savannah, Ga., several years ago. It was obtained from a sailor who brought it from either China or Japan. It may be seen in one of the city parks, where, however, it is grown under adverse circumstances and is kept down by the surrounding shade trees. It is one of those bamboos that require moist land. In the outskirts of the town, in the gardens where it was first introduced, it has taken full possession, growing as high as the telegraph poles, and making culms 2½ inches in diameter at the base. It is, however, a pestiferous plant, and has the bad habit of spreading underground and sending up suckers at a great distance from the parent plant. It is this uncontrollable nature that makes most of the introduced species of bamboo and the native canes very undesirable neighbors in a garden. For this reason care should be exercised in transplanting from hothouse collections and importations

of ornamental plants the various species of these giant grasses to the open ground in semitropical countries like Florida and southern California. Many of the smaller species—for example that known in nursery-men's catalogues as *Bambusa violacea*—may be grown in a climate as mild as that of Washington, and form very attractive clumps in summer. But the same plant transferred to moist ground in Florida runs riot and becomes a veritable pest. Its subterranean stems penetrate even into quicksand, and at a depth of 3 or 4 feet below the surface soil, and send up shoots many yards away from the parent, often breaking forth in the very midst of other shrubbery, which is soon overgrown and destroyed.

The unarmed bamboo of Bengal, *Bambusa vulgaris*, has none of the bad qualities of the intractable species which spread in leaps and bounds by underground stems. It forms symmetrical clusters, which increase regularly by the addition of new stems on the outside.

The experience of the past fifteen years proves that it is admirably adapted to the soil and climate of Florida, and that it grows there under suitable conditions to a greater height than is recorded for this bamboo in any other country. In Florida its culms rise to a height of 72 feet in a single season, growing at the average rate of more than a foot a day.

Seed has never been produced in Florida. In its native home, also, it is said to bloom and set seed only at intervals of many years. Propagation of the plant is readily made either by roots or by cuttings of the stem. Offsets from the roots may be taken in early summer, when one of the large buds, with its surrounding rootlets, may be separated from the mass. Such a young plant will weigh from 40 to 50 pounds. When transplanted it will send up the first year, not the giant culm of maximum size, but several smaller canes of the size of fishing poles. These will be followed by larger and larger canes. The crop of each successive season will exceed their predecessors about 1 inch in diameter and 10 feet in height for five years, provided no exceptionally severe frost retards their development.

Plants of more manageable size may be obtained from cuttings. The readiest method of securing a strong plant in this way is to cut in May or June from a one year-old stalk one of the nodes, or divisions of the stem, with its wand-like branch, and place this in water in a cool, shady place. During the summer roots will be produced at the node, and it may be planted in moist, shady ground in the fall. Later on, when it has made stronger roots, it may be transplanted to open ground. This species of bamboo will not thrive in saturated soil, although it requires a constant supply of moisture. If cared for when young, mulched with leaves and watered carefully, it may be grown anywhere in Florida, and even on sandy hills will attain a large size. Its powerful roots will after a few years reach water even at a depth of 30 or 40 feet, after which the plant will ask for nothing of the cultivator.

There is no grander landscape decoration than the gigantic fountain of verdure produced by a well-grown clump of bamboo. At ten years of age a plant should consist of fifty or sixty stalks, the yearlings rising erect above the mass to their full height of over 70 feet, their tops for 20 feet or more lightly branched and tracing against the sky a delicate network. Below, the older culms, fully feathered out and heavy with leaves, bend outward on all sides in graceful curves like great ostrich feathers. The outer rows almost sweep the ground with their tips, and swaying in the wind give glimpses of the ascending columns, standing in close ranks, polished and as green as emerald.

About the first week in July the new shoots of the year make their appearance. A dozen or more of the mighty buds, sheathed in hairy scales, push their way out of the ground. They resemble gigantic asparagus shoots, and, like them, grow only at the tip, having attained their full diameter of 4 or 5 inches before they leave the ground, and only diminish in girth very gradually as they ascend. Each joint of the young stalk is protected by a broad scale of creamy white, which is thrown off as the culm matures, and these litter the ground in late summer as shingles are scattered about in the building of a roof. At the start and until they have risen 15 or 20 feet from the ground, the shoots grow in length at the rate of 8 inches in twenty-four hours, but during the heat of August and as the tapering stalks decrease in girth they rush on toward completion at the rate of 12 to 18 inches each day.

By the middle of September, or in nine or ten weeks from the starting of their growth, the July brood of culms will have reached their full height of 70 feet and upward. Another crop of buds appears after the first are nearly full grown, but these in Florida never make culms; the cool nights of September chill them to death. During the first season the new stalks produce branches only at the top, and these are scantily supplied with tufts of leaves. The second summer the development of branches extends downward along the stem and the tops feather out and bend under the weight of foliage. A third season of active branch growth brings the culm to full maturity, after which it has passed its prime and enters upon a period of decadence which ends in the fifth or sixth year with the snapping off of the dead and brittle stalk in some high wind.

The culms of *Bambusa vulgaris* have moderately thin walls, the hollow joints somewhat over a foot long and the partitions which divide them rather strong and thick, but brittle enough when dry to be broken out by a sharp blow. By means of an iron rod it is easy to convert the stalks into tubes, which may be used as water pipes, or they may be split in half and converted into troughs. They are easily put to numerous uses in a Southern garden. Cut into convenient lengths and the partitions removed, they make excellent and durable subsoil drains. Split and converted into troughs they make the best of roofs, being laid like tile, the alternate pieces inverted and covering the edges of

the upturned gutters. Flower pots and utensils for holding liquids are very simply made by sawing apart the joints. For light trellises and open sheds bamboo posts, poles, and rafters have no equal.

The proper manipulation of bamboo in constructive work is of course unfamiliar to our people, but is easily learned and would soon be acquired if the material was fairly abundant. There is also much to be learned as to the proper methods of curing and seasoning the timber. If cut too young or in the growing season the tubular stems check or split, which destroys their value for holding liquids and somewhat impairs their strength. In Florida the proper season to cut bamboo is during the winter before growth begins. In the West Indies, where there is less winter rest, it is said bamboo will not check if cut "in the dark of the moon." Water seasoning is practiced by the Chinese and Japanese, but it will not avail with young or sappy stalks in Florida, at least.

Bambusa vulgaris will stand 8° or 10° of frost in Florida, if of short duration, and is certainly destined to become more hardy with time.

The stalks at Crescent City, which is situated in Putnam County, and about the middle of the peninsula, have been cut down by cold three times since 1882. However, even the most disastrous frosts, like those of the past winter, can not materially injure the roots of well-established plants.

