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Issued July 12, 1912.

U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF PLANT INDUSTRY—BULLETIN NO. 251.

B. T. GALLOWAY, *Chief of Bureau.*

THE PECAN.

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BY

C. A. REED,

Special Agent in Nut-Culture Investigations, Office of Field Investigations in Pomology.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
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BUREAU OF PLANT INDUSTRY.

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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Plant Industry,
Office of the Chief,
Washington, D. C., March 20, 1912.

Sir: I have the honor to transmit herewith a paper entitled "The Pecan," by Mr. C. A. Reed, Special Agent in Nut-Culture Investigations, prepared under the direction of Mr. A. V. Stubenrauch, Expert in Charge of Field Investigations in Pomology.

I recommend that this paper be published as Bulletin No. 251 of the Bureau series.

Respectfully,

B. T. Galloway,
Chief of Bureau.

Hon. James Wilson,
Secretary of Agriculture.

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THE PECAN.

INTRODUCTION.

The pecan is one of the most important of the nut-bearing trees now grown in the United States, and within the area thought to be adapted to its culture no other agricultural or horticultural product which has appeared during recent years is attracting greater attention or being so widely exploited. It was not found by the early botanists nearer the Atlantic coast than western Alabama in the South and central Tennessee and Kentucky in the North, but with the progress of agriculture in the South the species has been carried eastward and widely distributed with apparent success over the eastern Gulf and South Atlantic States. It has also been sparingly introduced into many of the Northern States, including Ohio, Michigan, New York, Pennsylvania, Maryland, Delaware, New Jersey, and to a slight extent into the lower New England States. In the West it has received but little attention. A few planted trees may be found here and there from Washington to southern California, but pecan growing has not become an important industry west of the Rocky Mountains.

The evident age of not uncommon large trees near the Gulf coast indicates that the planting of pecans in the Southern States east and south of the area of the natural range of the species has been in progress for more than a century. The planting of orchards in those States began with seedling trees about 20 years after the Civil War. During the early nineties grafted and budded trees of named varieties appeared in sufficient numbers so that a few orchards of such trees were then planted, but comparatively few orchards of either seedling or grafted trees were planted previous to 1900. Since that time, especially during the past five years, the planting of pecan orchards in the Southern States has been taking place at a rapidly accelerating rate. In southern Mississippi, southern Alabama, central and southern Georgia, and northern Florida, large tracts of land, frequently several hundred acres in extent, are being planted to pecan trees and later sold to outside investors. For several years the demand for nursery-grown trees has been far beyond the supply, leading nursery-

men booking orders for their entire output from six to eight months before the planting season. Most unusual interest is being manifested in pecan culture, and investments, which are large for an industry that is still in its infancy, are being made in spite of the fact that very few pecan orchards are as yet of sufficient age to have been in bearing long enough to furnish reliable data upon which to make safe estimates as to the probable yields of a given variety at any stated age in particular localities. Observations, accurate in themselves, on the bearing records of single trees here and there are frequently taken as the basis for estimates as to the probable yield of an entire orchard of the same variety or varieties, but as it usually develops that the trees making these records have grown under conditions of exceptionally favorable environment, the fallacy of such calculations is at once apparent. To be at all trustworthy, estimates as to future yields must be based on the average records of a great number of trees under normal conditions rather than of single trees which are conspicuous because of their abnormal production.

An erroneous impression to the effect that the pecan has no serious enemies in the way of insect pests or fungous diseases and that it is not affected by drought, freezing temperatures, or high winds has become prevalent among a considerable portion of prospective commercial and amateur planters. No agricultural product is without its natural enemies and other obstacles that must be overcome. When any plant is brought under cultivation and large contiguous areas are planted, the opportunities for the development and spread of the insects and diseases attacking it are greatly increased. The pecan is no exception to this rule, and in due time many serious enemies to it must be expected to appear. Among the insects that have already appeared are those which attack the fruit buds in early spring; girdlers which cut off the twigs during the latter part of the growing season, frequently causing branches with clusters of nuts to fall to the ground; webworms which defoliate the trees; shuckworms which destroy the nut by burrowing out the soft hull while immature; weevils which work in the nut itself; and borers which penetrate the body and main branches of the tree; besides a number of others less well known. A large number of fungous diseases also attack the pecan. The most important of these diseases is the pecan scab, which attacks the foliage, stems, and hulls of the young nuts of mature trees and which is sometimes very serious on late, rapidly growing trees of certain varieties in the nursery.

Investigations of the control of insects and fungous diseases attacking the pecan are receiving the attention of other investigators; a detailed discussion of these problems is therefore beyond the scope of this bulletin, which is designed to give such general information

concerning the various phases of the pecan and its culture as is available at the present time.[1]

Long-continued rains at the blossoming time which interfere with pollination, late spring frosts which kill the buds or destroy the young nutlets, sudden drops of temperature in winter during which immature late growth may be severely frozen back, subtropical storms of such intensity as to blow the nuts off and sometimes to uproot grown trees, and droughts during the late summer months just as the nuts are maturing are inevitable obstacles which must be taken into consideration.

BOTANICAL CLASSIFICATION OF THE PECAN.

The pecan is an American species of nut-bearing tree belonging to the botanical family Juglandaceæ, which includes also the hickories, the walnuts, and the butternut. It has been variously known as *Juglans pecan*, *Carya olivaeformis*, and by other less common terms. The botanical name now commonly accepted is *Hicoria pecan*.

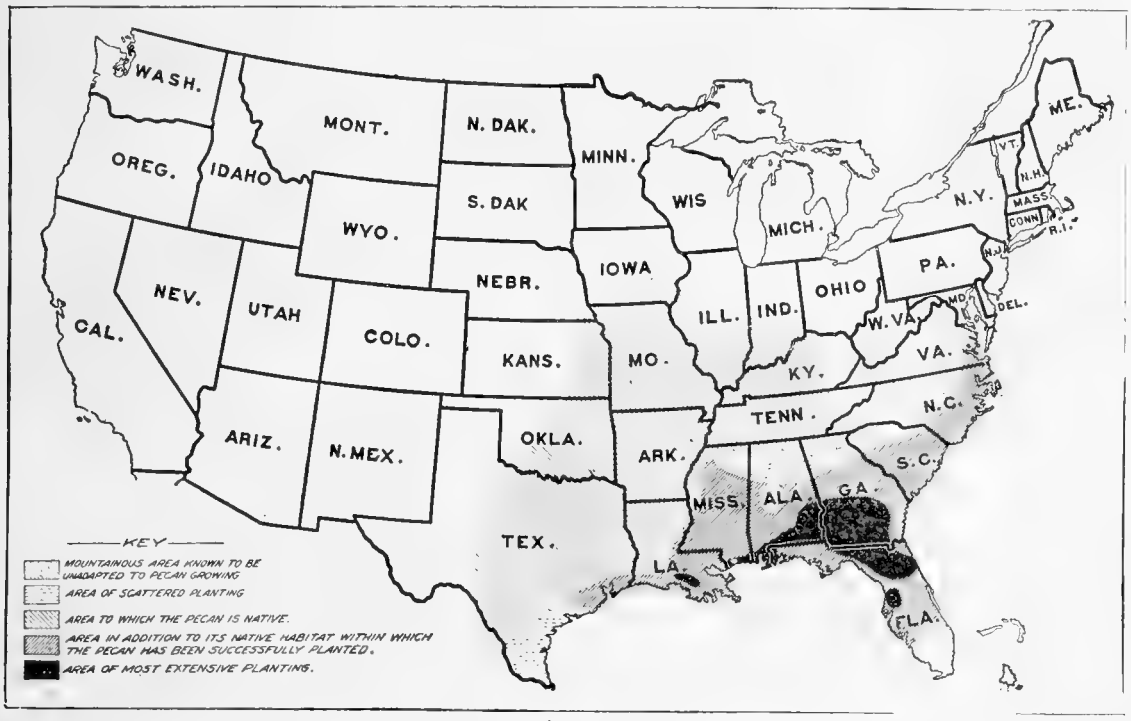

FIG. 1.—Outline map of the United States, showing the range of the pecan exclusive of occasional plantings in the Western States and scattered trees throughout the West and North.

NATURAL DISTRIBUTION.

The pecan is wholly an American species found only in certain parts of the United States and Mexico. Figure 1 is an outline map of the United States showing areas within which the pecan occurs at the present time. From this map it will be seen that with the

[1] All inquiries addressed to this Department relating to the matter of insect pests should be directed to the Chief of the Bureau of Entomology, and those regarding diseases to the Pathologist in Charge of Fruit-Disease Investigations, Bureau of Plant Industry.

exception of a small area [1] in central Alabama, west of Montgomery, the eastern boundary of the pecan habitat is marked by an irregular line drawn southward across central Kentucky to central Tennessee;

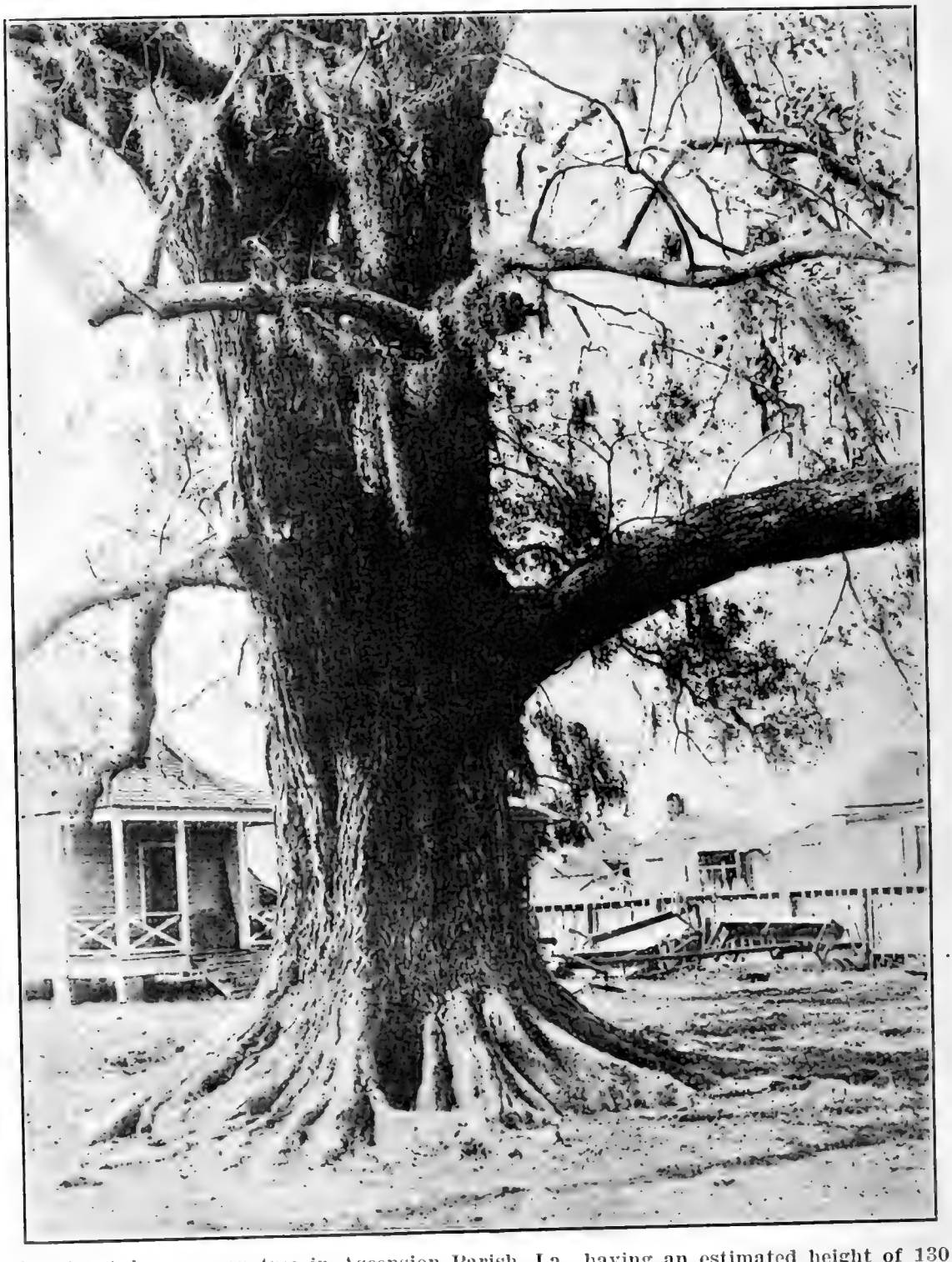

FIG. 2.—A large pecan tree in Ascension Parish, La., having an estimated height of 130 feet, a spread of 125 feet, and measuring 18 feet 3 inches in circumference at breast height.

thence south and west to near central northern Mississippi, and southwest to central southern Louisiana; from this point the line

[1] Mohr, M. C. Garden and Forest, vol. 6, p. 373.

parallels the border of the Gulf of Mexico to southern Texas without reaching the coast. In a line nearly parallel to that of the eastern border, the western boundary extends from southwestern Iowa across eastern Kansas, western Oklahoma, and western Texas to the Rio Grande.

HABIT OF GROWTH.

In habit of growth the pecan varies greatly, according to environment and locality. Under the most favorable conditions it develops a massive spreading top in the open, while in thickly crowded forests it attains great height. In the alluvial lands of the Mississippi River bottoms specimen trees ranging from 4 to 6 feet in diameter

FIG. 3.—A native forest cleared of timber other than pecan on the Kentucky side of the Ohio River, 10 miles from Evansville, Ind.

and from 150 to 170 feet in height are not uncommon. Figure 2 shows a pecan tree in Ascension Parish, La., photographed in 1909, having an estimated height of 130 feet, a spread of 125 feet, and measuring 18 feet 3 inches in circumference at breast height. A view of a native forest cleared of all timber other than pecan, situated on the Kentucky side of the Ohio River not far from Evansville, Ind., is shown in figure 3. Pecan trees having diameters of 2 to 4 feet and heights of 75 to 100 feet are not uncommon in this forest.

In the semiarid sections of Texas the growth is different from that of humid regions; the trees do not attain such great size, their

bodies are shorter, the limbs more irregular, and the terminal branches much more willowy. An illustration of the characteristic growth in that section is shown in figure 4, reproduced from a photograph taken in Landa Park, New Braunfels, Comal Co., Tex.[1]

FLOWERING HABIT.

The pecan tree has alternate pinnate leaves, with from 11 to 17 leaflets each; the flowers are monœcious, i. e., the staminate and pistillate blossoms are borne separately upon the same tree. The staminate blossoms appear in clusters of catkins upon the last season's growth somewhat in advance of the pistillate blossoms, which

FIG. 4.—Characteristic pecan trees of Texas. Photographed in Landa Park, New Braunfels, Tex., 1910.

are found only at the terminals of the new branches. A cluster of pecan foliage illustrated in figure 5[2] shows the arrangement of floral organs. The catkins are to be seen as pendulous clusters suspended from the growth of the past season. The pistillate flowers are somewhat obscurely shown at the point of termination of the new growth. A section of a catkin is shown at *a* and of a pistillate flower at *b*, both greatly enlarged.

[1] These trees are draped with "Spanish moss" (*Dendropogon usneoides*), a pendulous, beardlike air plant of gray color which attaches itself to the branches of many species of trees in the South. This moss is not a true parasite, as it obtains no food from its host; but if neglected after it has established itself on pecan trees it is liable to become a serious pest, as it covers the branches to such an extent as effectively to smother the bearing area.

[2] The drawing was made very early in the growing season, before the normal number of leaflets had appeared. The staminate bloom is in somewhat greater profusion than the average for the variety shown, which is the Van Deman.

DECREASE IN NUMBER OF NATIVE TREES.

The normal clearing of forests in any community during its agricultural development, the increased use of pecan timber for hardwood manufacturing purposes, and the extravagant habits of cutting out the tops at harvest time and of chopping down the trees altogether in order more easily to obtain the nuts, practices which prevail in many sections, have combined seriously to reduce the number of pecan trees in the native forests. The first two causes can hardly

FIG. 5.—Pecan foliage and flowers. *a*, Section of a catkin (staminate flower cluster); *b*, pistillate flower.

be prevented, and it is doubtful whether the latter practices can be checked until the finest specimens have entirely disappeared.

CULTURAL DISTRIBUTION.

East of the Mississippi River and its northern tributaries the pecan has been introduced into a majority of those States to which it is not native, but it is only within certain localities that the species has thus far indicated its probable commercial adaptability. With the

exception of the native trees occurring in western Kentucky, southern Indiana, southern Illinois, southeastern Iowa, and eastern Missouri, pecan trees are not found in considerable numbers north of the latitude of lower Virginia. It does not adapt itself to mountainous sections or to lowlands in which standing water is found on or near the surface for protracted periods. Few plantings have been made below central Florida or in mountainous areas, but with these exceptions representatives of the species are not uncommon over any large area in the southeastern quarter of the United States. Certain localities are undoubtedly better adapted to pecan culture than others, but in the present infancy of the pecan industry it is too early to name the most favorable sections. Orchards already planted are mostly found within a few comparatively small areas, a fact which is without doubt largely due to the common tendency of a community to follow a leader, which in this instance has been in the matter of planting pecan trees, rather than to established proof of special adaptability of the particular locality. The areas of most extensive plantings are indicated by the gradations in shading shown on the outline map (fig. 1).

EXTENT OF PLANTING.

During the winter of 1908 an inquiry was made by the Bureau of Plant Industry regarding the pecan orchards then in existence. Replies were received covering about 600 orchards situated in various portions of the South. These reports show a total of nearly 300,000 trees then under cultivation. More than two-thirds of these trees, viz, 209,069, were of named varieties (including both nursery-grown and top-worked trees), 39,839 were seedlings of known parentage, and 45,086 were from seed of unknown origin.

Of the named varieties, 175,126, or nearly seven-eighths of the total number reported, were located in 10 States, as shown in Table I.

TABLE I.—*Distribution of plantings of named varieties of pecan trees in different States.*

State.	Number.	State.	Number.	State.	Number.
Florida	48,475	Alabama	20,694	North Carolina	966
Georgia	32,990	Texas	12,894	Oklahoma	908
Louisiana	27,507	South Carolina	2,957		
Mississippi	25,449	Virginia	2,286	Total	175,126

While these figures do not cover the whole area then devoted to pecan culture, they probably indicate the proportional planting in each State.

It has been recently estimated [1] that approximately 1,400,000 trees have been sold from the nurseries during the past five years, or

[1] Letters from leading nurserymen received during February and March, 1911.

from the season of 1906–7 up to and including that of 1910–11. These sales appear to have been distributed among the principal pecan-growing States in much the same proportion indicated by the figures in Table I.

ECONOMIC IMPORTANCE.

The figures of pecan production of the census for 1910 have not yet been published, but from estimates[1] made by a number of the leading wholesalers of pecans the annual crop in the State of Texas alone during the past five years has ranged from 135 to 660 carloads, or from 3,645,000 to 17,820,000 pounds.[2] The prices to the producer have ranged from 4 to 16 cents per pound. During the past five years the average midseason price has been from 7 to 9 cents a pound. Estimates derived from the same source indicate that, beginning with Louisiana, next to Texas in quantity of production, and ending with Indiana and Illinois, each producing about 10 cars, the remainder of the average crop is apportioned among the other pecan-producing States in about the following order: Louisiana, Oklahoma, Arkansas, Kansas, Missouri, Kentucky, Tennessee, Mississippi, Indiana, and Illinois.

Commercially speaking, orchard-grown pecans have not yet been produced in sufficient quantities to affect the general market to an appreciable degree. The demand for pecans of the named varieties created by nurserymen for use as samples, or by fancy confectioners, tourists, and occasionally by seedsmen has caused a very wide range in prices, which can not be expected to reach a normal basis until the cultivated pecans reach the general markets in sufficient quantity to compete fairly with wild nuts.

Among the nuts exported from this country the pecan is of relatively small importance and is not separately listed in the Government reports. According to the annual reports of the Department of Commerce and Labor, the importations of pecans from Mexico, first separately listed in 1908, are shown in Table II.

TABLE II.—*Importations of pecans from Mexico into the United States for the fiscal years 1908 to 1911, inclusive.*[3]

Fiscal years, ended June 30.	Quantity.	Value.
	Pounds.	
1908	1,118,071	$82,181
1909	1,480,289	106,298
1910	3,349,460	232,590
1911	2,333,087	158,312

[1] Letters received during the month of February, 1911.

[2] A carload of pecans weighs from 24,000 to 35,000 pounds.

[3] A duty of 1 cent a pound has been levied upon all pecans thus far imported.

CULTURE.

PRESERVATION OF NUT-BEARING FORESTS.

The value of pecan-producing forests is coming to be recognized to such an extent that at the present time certain enterprising owners are not only taking steps to prevent their further destruction but are increasing their productiveness by a careful and systematic elimination of all unprofitable trees, so as to give greater advantage to such as produce superior nuts.

FIG. 6.—A pecan forest near San Antonio, Tex., in process of transformation into a grove by the elimination of all trees other than the most desirable pecans. Note the distances between trees.

This work is well worthy of encouragement. As clearing too suddenly will expose the remaining trees to injury by high winds, the thinning-out process should be brought about gradually. The least desirable pecan trees should be marked during the harvest period and subsequently removed. In clearing such tracts the owner should keep in mind the best methods of converting the forest into an orchard. Trees which produce the best nuts in the greatest quantity should be the ones allowed to remain. As far as possible the low-headed trees should be given preference. Pruning, having in mind the cutting back of long, spindling branches and the removal of

broken tops, will have a decidedly beneficial effect. As the new tops begin to take definite form in later years, further improvement by elimination should continue. The owner must decide for himself regarding the advisability of top-working any or all trees.

When two trees of equal merit (so far as quality of nuts, regularity of bearing, health, and apparent condition of the trees are concerned) crowd each other, preference should be given the one which releases its nuts from the hulls with the greater readiness. If one is more subject to fungous diseases or to ravages of insect pests than the other, it should be removed. Vacant spaces in the wood lot should be filled in by planting nuts from the best trees or, better still, by transplanting. Any attention to cultivation, irrigation if necessary, or the application of compost should result in an increased production of nuts. A pecan forest near San Antonio, Tex., treated in the manner just described, illustrating what can be done, is shown in figure 6.

SOIL AND MOISTURE REQUIREMENTS.

In its early history the pecan was thought to be severely exacting in its requirements of soil and moisture conditions and in the essentials for successful propagation. Since becoming better known, however, it has been found that while certain conditions may be most conducive to good results, the pecan adapts itself to varying environment to such an extent that it has been planted with apparent success in a great variety of soils in the Southern States. Ideals are constantly changing as experience is gained, but in the light of present knowledge a deep, fertile soil, sufficiently porous to admit of free root growth, well drained yet by no means dry, is considered as being best adapted to pecan culture. Localities in which the water table below the surface is within reach of the taproot seem to be preferred by the pecan. This fact is of such common belief with the well drivers of the semiarid portion of Texas that they seek proximity to pecan trees when boring for water. It is essential that the trees should not be allowed to remain in standing water for any great length of time, although an occasional overflow to a depth of several feet apparently does no harm.

HISTORY OF PROPAGATION AND PLANTING.

Less attention has been paid to planting the pecan in orchard form in regions where it abounds as a forest tree than in many of the neighboring localities of nearly similar soil and climatic conditions. It seems to have been understood by certain pecan-growing pioneers previous to 1850 that the species did not come true from seed, but that information was not general until a half century later.

Practically all pecan orchards planted were of seedling trees. History [1] records that in 1846 or 1847 a slave gardener, Antoine by name, instructed by his owner, Telesphore J. Roman, succeeded in grafting 16 trees of the variety which later came to be known as Centennial. Subsequently 110 trees were similarly propagated by the same individual, bringing the total number known to have been grafted before the close of the Civil War (1865) to 126.

There is little evidence of further propagation by this method until 1877,[2] when Emil Bourgeois, of Union, La., successfully grafted 11 scions of the variety now well known as Van Deman, but then called the "Duminie" or "Duminie Mire," in honor of its owner. The Frotscher and Rome varieties were propagated by Richard Frotscher, of New Orleans, in 1882, as was the Stuart by the late A. G. Delmas, of Pascagoula (formerly Scranton), Miss., in 1886. Aside from these records there is little in pecan history to indicate that much was accomplished in the way of propagating the species other than by planting the seed until the early nineties, when grafting of named varieties came to be a matter of common practice with certain growers in southern Mississippi, Louisiana, and Texas. The limited number of superior parent trees from which to obtain grafting wood, the small degree of success then obtained with that method of propagation, the consequent high prices of nursery trees, together with the ignorance and doubt in the public mind regarding the certainty of grafted trees, resulted in the continued planting of nongrafted trees for the next decade. During the years 1900 to 1905 the fact of the very great dissatisfaction so certain to result from the planting of seedling trees came to be well known, and since then few trees of nongrafted stock have been planted.

PROPAGATION.

SELECTING SEED FOR PLANTING.

Until comparatively recent years very little attention has been paid to the selection of seed for nursery planting other than to obtain cheap nuts of high germinating quality. No thought has been given at the time of selecting the seed to the subsequent growth of the trees, and as a result there has been a conspicuous lack of uniformity in the rapidity of growth both in the nursery and in the orchard. While no one has compared the later behavior of trees which grew slowly in the nursery, when transferred from the nursery to the orchard, with the behavior of those which grew more rapidly as seedlings, it is logical to suppose that the degree of vigor is proportionately

[1] Yearbook, U. S. Dept. of Agriculture, for 1904, p. 407.
[2] Yearbook, U. S. Dept. of Agriculture, for 1904, p. 415.

the same. It is generally conceded by nurserymen in north Florida and in south Georgia, where by far the greater portion of all nursery pecan trees are grown, and by certain nurserymen in Louisiana who are known to have made the comparison, that pecan seed from Louisiana germinates more slowly and makes slower growth than does seed from the East. For this reason Florida and Georgia seed is commonly used by southern nurserymen.

Recent experience in north Florida and south Georgia in the South and in lower Virginia farther north has convinced the nurserymen in those localities that southern seedlings are undesirable as stocks for northern scions, and vice versa, in that, owing to the difference in time of starting in the spring and maturing in the fall, neither of the two makes a satisfactory growth when grafted or budded on the other.

Experience shows that for seed purposes plump nuts of medium size should be selected from vigorous-growing and productive trees as nearly free from disease as it is possible to obtain. As already indicated, it is also evident that seed from north Florida and south Georgia is preferable for use in the Gulf Coast States from Florida to Louisiana and that in the selection of seed for any locality the influence of latitude should be kept in mind.

STRATIFYING PECAN SEED.

Pecan nuts to be planted as seed should be retained in as nearly as possible their original condition at the time of harvest. If allowed to become dry they should be thoroughly soaked before planting. If the nuts are to be held for a period of several weeks or during the fall and winter for spring planting they should be stratified as soon as practicable after harvesting. "Stratification" is the technical term for the method of packing the nuts in moist sand and keeping in a cool, dark place to prevent evaporation or germination by combined warmth and moisture. To protect the nuts from rodents, the box or boxes in which the nuts are kept should be covered with wire screen. Proper drainage must be assured.

PLANTING PECAN SEED.

The planting of pecan seed may be performed soon after harvest or early in the spring. Fall planting does away with the need of stratifying, but encounters the risk of loss by winter injury and depredations of field mice and other rodents.

Germination is earlier and growth quicker in sandy soils than in heavy soils. Proper drainage is also more easily assured in sandy soils, and for these reasons light soils are ordinarily preferred for nursery purposes. Irrespective of its nature, the land should be

thoroughly prepared before the seed is planted. The soil should be fertile, well cultivated, and yet firm. Plant the nuts 2 to 3 inches deep and 8 to 12 inches apart in rows 4 to 6 feet apart; cover with loose, fertile soil, and pack firmly. A top-dressing of leaf mold or other light compost 1 or 2 inches deep will aid greatly in keeping the surface mellow and moist.

During the first season the growth will be largely confined to the development of a taproot, which will be from 3 to 5 times the length of the top. In ordinary seasons the growth above ground will be from 6 to 12 inches.

A method occasionally followed is to plant half a dozen nuts in the permanent location where the tree is to stand. Later the best one of the resulting trees is grafted with the desired variety, and the others are cut away. This method avoids the labor and expense of transplanting. In actual practice, however, this method has thus far rarely proved satisfactory. On the contrary, the claim is made by several of the more experienced growers that transplanting pecan trees results in more compact and fibrous root systems and is therefore a positive advantage. Unless protected by heavy stakes, the young trees under these conditions are subject to injury by careless workmen. Moreover, it frequently happens that none of the nuts planted produces a tree fit for grafting. It is therefore doubtful whether this method of establishing an orchard can be commended.

COMPARISON OF SEEDLING AND GRAFTED TREES.

As has been previously explained, no matter how carefully the seed may be selected, pecans grown from the nuts do not reproduce themselves true to the parent type. Of all the trees observed in past experience with the pecan not a single authentic instance is on record in which a tree grown from the nut has been identical with its parent or any of its sister seedlings. Whenever it is desired to perpetuate definite varietal characteristics of the pecan it must be done by asexual methods of propagation, i. e., by grafting or budding. In contradiction to this, certain tree dealers have recently advanced the claim that grafted and budded trees are proving unsatisfactory, asserting that they are shorter lived and more subject to disease than seedlings; that they are otherwise objectionable and are consequently being discarded. Evidence to support the claim that the operation of either grafting or budding, when successfully performed, has any effect whatever upon the longevity of the tree or its susceptibility to disease is entirely lacking. Healthy grafted and budded trees of all ages up to 30 years since the operation was performed are sufficiently common throughout the pecan area entirely to dispel all doubt as to the enduring qualities of trees

so propagated. Statements to the opposite effect are made evidently for the sole purpose of selling inferior seedling trees.

As ordinarily only such sorts as are especially productive or otherwise superior to the average are commonly perpetuated by asexual propagation, a belief has become more or less prevalent that in some way the operation in itself is responsible for the productiveness. This is a mistaken view, as the scions and buds only perpetuate such characteristics as they inherit from the parent tree. Wood of the previous season is preferable for grafting and should be taken only from the very best and most carefully selected parent trees.

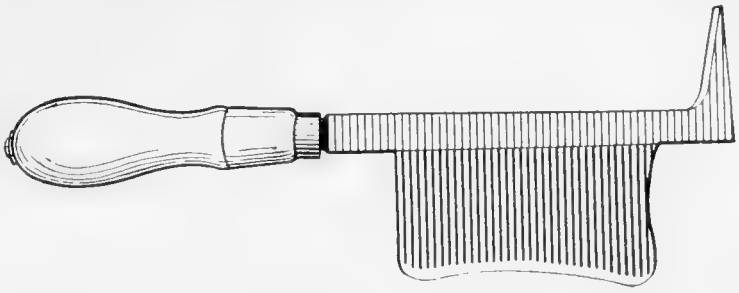

FIG. 7.—A tool especially designed for cleft grafting.

CLEFT GRAFTING.

In its modifications grafting has been longer employed than budding. It is performed during the late winter months just as the buds begin to swell, or very early in the growing period. At that time the upward flow of sap is most rapid and the union will be accomplished most quickly. Scions for any kind of grafting should be selected from the growth of the last season. Terminal twigs were formerly used almost exclusively and are still preferred by some propagators. But, as the bud at the end of the branch rarely produces a strong shoot, ordinarily drying up and falling off instead, terminal twigs are no longer used to a large extent.

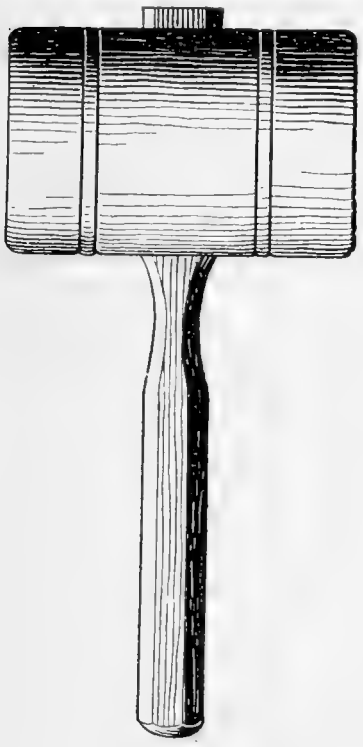

FIG. 8.—Mallet for use in cleft grafting.

A well-filed fine-tooth saw, a sharp grafting knife, a specially devised grafting tool (fig. 7), a short-handled wooden mallet (fig. 8), a quantity of raffia and grafting wax or grafting cloth, and a number of scions constitute the necessary equipment for grafting. In performing the operation of cleft grafting, the trunk or limb of the tree to be grafted (technically known as the stock) should be cut squarely across with the saw; the knife edge of the grafting tool should then be placed across the stock, either over the center or to

one side in order to avoid the pith, and by tapping the back of the tool with the mallet split or, better, cut the stock to a depth of 2 to 4

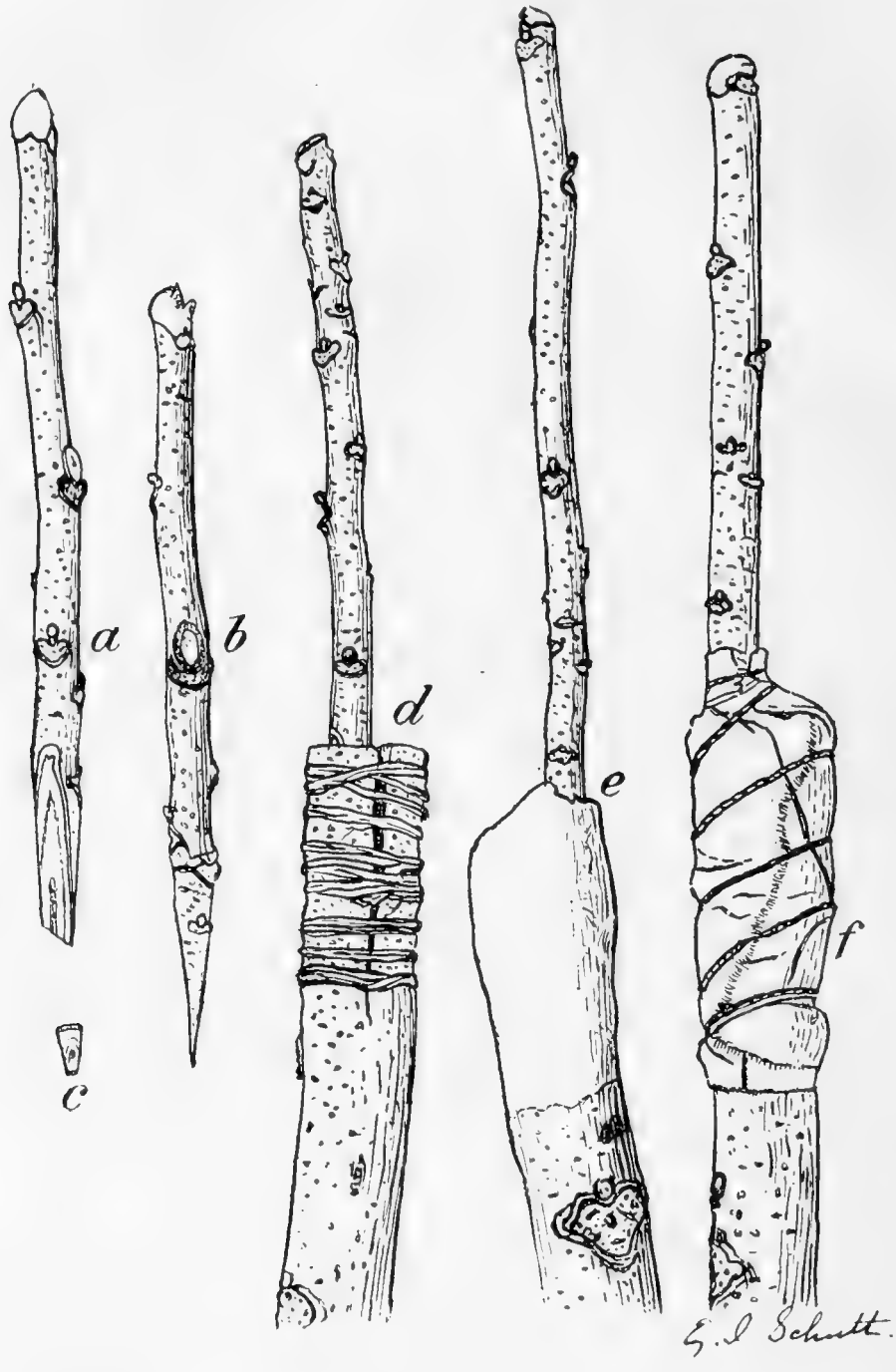

FIG. 9.—Cleft grafting. Successive steps in the operation: *a* and *b*, Views of the scion; *c*, cross section of the scion, thicker on one side; *d*, the scion in place and the stock securely tied to prevent splitting; *e*, the union covered with grafting wax; *f*, outer wrapping securely held with string.

inches. Remove the tool and pry the two parts of the stock apart with the thick, narrow wedge projecting from the back of the graft-

ing tool at the extreme end. Prepare the scion by sharpening its lower end with the grafting knife into the form of a wedge (fig. 9, *a* and *b*) made thicker on the side which will be outermost when in position (fig. 9, *c*). Insert the wedge end of the scion in the cleft of the stock so that the cambium layer (inner bark) of its thick side will be in close contact with the inner bark of the stock. The scion should be pushed into the cleft until the cut surface of the stock is on a level with the base of the first bud. It will do no harm if it goes slightly deeper. It is imperative that the two cambium layers be brought together as closely as possible. With stocks of sufficient size a second scion may be similarly placed in the opposite end of the cleft. Remove the iron wedge from the middle of the cleft and cover the cut surfaces, including the tip of the scions (unless terminal shoots have been used), with grafting wax especially prepared, being careful not to cover the buds. If the stock is weak and inclined to further splitting after the wedge has been removed it should be tightly wound with several wraps of a stout, rather coarse material before the wax is applied. Where a large amount of grafting is to be done, the best as well as the cheapest material for wrapping is a product of one of the eastern tropical palms, known as raffia, which is obtainable from dealers in nursery supplies. For propagation on a small scale, cotton warp, strips of old muslin, or similar material will answer fully as well.

FORMULAS FOR GRAFTING WAX.

(1) Mix together thoroughly 4 parts (by weight) rosin, 2 parts beeswax, and 1 part tallow.

(2) A harder wax for use in warm weather is made of the following: Rosin, 4 pounds; beeswax, 1 pound; raw linseed oil, one-half to 1 pint.

To prepare either formula melt the ingredients together, pour into water, and pull. Rub the hands with oil or grease before using to prevent sticking. In using the second formula the proportion of oil will depend upon the season, a greater quantity being necessary in cooler weather.

PREPARATION OF GRAFTING CLOTH.

Thin calico or cheap muslin saturated in melted wax, drained, and allowed to cool makes a material which answers both as a wax and as a binding substance. Before immersing in the liquid, tear the cloth into strips 12 to 18 inches wide or of whatever width may be most

convenient. When thoroughly saturated take it from the solution and while still warm remove the excess of hot wax. Various methods of accomplishing this removal are practiced. On a small scale the cloth may be wrung out with the hands, but when larger quantities of material are to be made a convenient method much in use is to draw the cloth between two flat pieces of wood. A simple method is certain to suggest itself to any ingenious operator.

When grafting cloth of the proper consistency is used raffia will be unnecessary, as the properly prepared material carefully wrapped holds itself in place without being tied.

CARE OF CLEFT GRAFTS.

Obviously, two scions placed in one cleft double the chance of success. With an ordinary wrapping of waxed cloth further attention to the graft itself will not be needed. If wound with stout material the bandages should be severed as soon as growth has begun, when the weaker of the two scions should be cut away. If both scions are allowed to remain, the formation of a fork between the two will be inevitable and splitting very apt to follow. A single scion affords a much better opportunity for the development of a symmetrical head and there is less danger of crowding than when two scions are left.

WHIP GRAFTING.

The operation of whip grafting is usually performed during the latter part of the dormant season, at any point in the trunk from immediately below the surface to several inches underground. For this method of propagation the stock and the scion should be of very nearly the same size, preferably not more than three-fourths of an inch in diameter nor smaller than a lead pencil. With the knife held so as to make an upward incision, cut the stock entirely across at a long angle, as shown at 1 in figure 10. At about one-third the distance from the upper end of the cut make an incision parallel with the grain, as shown at 2 (fig. 10). Cut the scion at as nearly the same angle as possible and make a similar incision in the cut surface one-third the distance from the upper end of the cut, as shown at 3 (fig. 10). Push the cut surfaces together in such a way that the tongue of the scion made by the incision will be crowded into the groove made by the incision in the stock, as shown at 4 (fig. 10). Bind the two parts together with raffia or other material, as shown in figure 11 at *a* (not as appears at *b*), and pack firmly with earth. The use of wax is not necessary.

CARE OF WHIP GRAFTS.

When grafted by the whip-graft method the young trees will require little subsequent attention other than pruning and ordinary cultivation. When the root is that of a very young tree there will be no danger of the supply of plant food being such as to induce a growth of top that is too rapid, as is frequently the case with cleft grafts, especially in the tops of old trees. While temporary staking as a support to the union is not necessary, in numerous cases stakes will be highly essential to insure erect growth. The moisture of the ground causes the wrapping material to decay in the course of a few weeks, and it is therefore not necessary to cut the bands, as with cleft grafts.

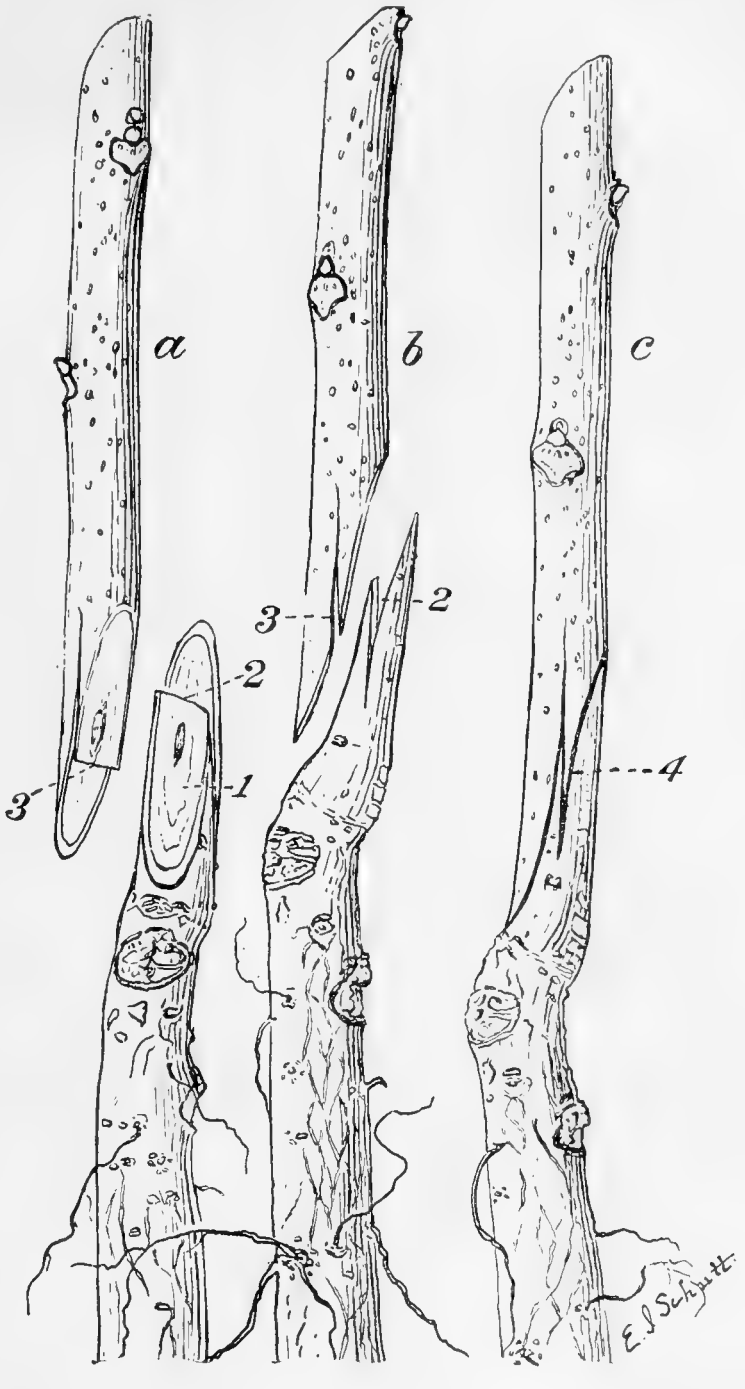

FIG. 10. —Whip grafting. Early steps in the operation: *a* and *b*, Front and side views of both stock and scion properly cut; *c*, stock and scion in position and ready for wrapping.

BUDDING BY THE ANNULAR METHOD.

It is probable that more pecan trees have been propagated by annular budding, with its modifications, than by all other asexual methods combined. The process is also known as "ring" and "flute" budding. It is performed during the midsummer months at such time as the bark is found to slip (release) most readily. In some seasons this period may be very brief, lasting only a few

days, while in other years the time during which annular budding may be successfully performed extends over a period of several months. In the latitude of southern Georgia it is not uncommon for this method to be successful from as early as May 10 until late in July or even in August.

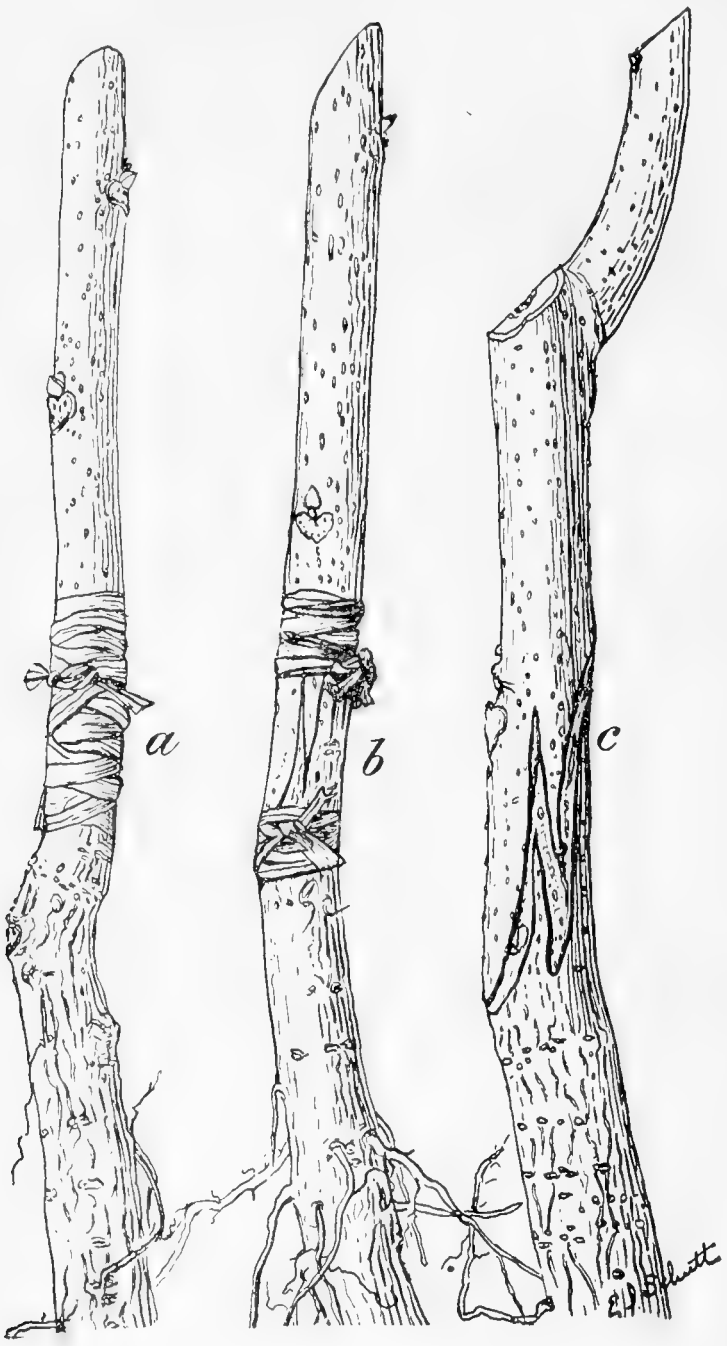

FIG. 11.—Whip grafting. Later steps in the operation: *a*, Proper method of tying; *b*, improper method of tying; *c*, one year's growth following a successful union.

Annular budding consists merely in transferring a ring of bark to which is attached a bud of the desired variety from a bud stick[1] to the trunk or branch of another tree in place of a similar ring of bark previously removed. Specially designed tools, such as are shown in figures 12, 13, and 14, have been devised for the purpose of cutting the rings. Two ordinary propagating knives having single blades may be fastened together and made to answer the purpose, although they are less liable to make uniform incisions. Cut a ring of bark from the stock with one of the tools, slit it with a single-bladed knife, and lift from its bed or "matrix," as it is technically called. Discard this bark and from the bud stick remove a similar ring, in the center of which is a dormant bud. The bark of the bud stick should be slit on the side opposite the bud. Immediately place this ring in the

[1] The bud stick is a branch, usually about 2 feet in length, cut from a tree of the variety to be propagated.

space left by removing the bark from the stock and wrap at once with waxed cloth, taking care not to cover the bud (fig. 15).

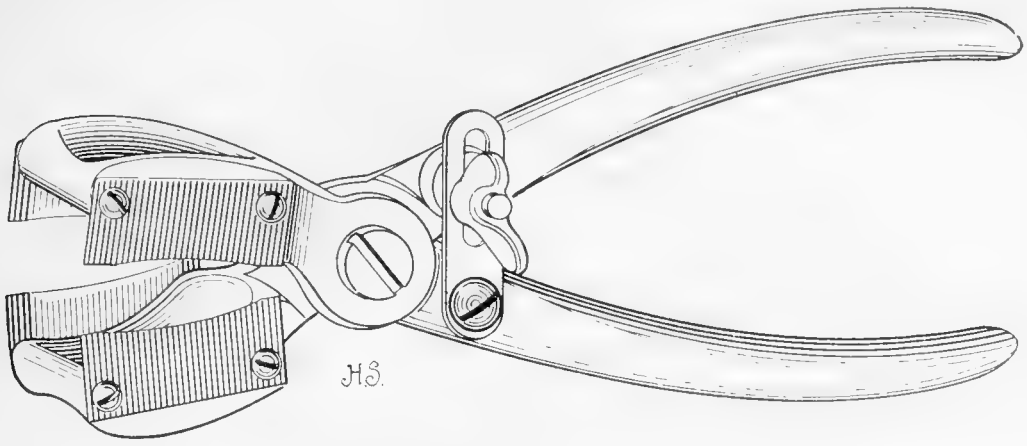

FIG. 12.—A metal tool specially designed for use in annular budding.

BUDDING BY THE PATCH METHOD.

When the annular method is used it is obvious that the stock and scion must be of nearly the same size. If the bud stick is slightly

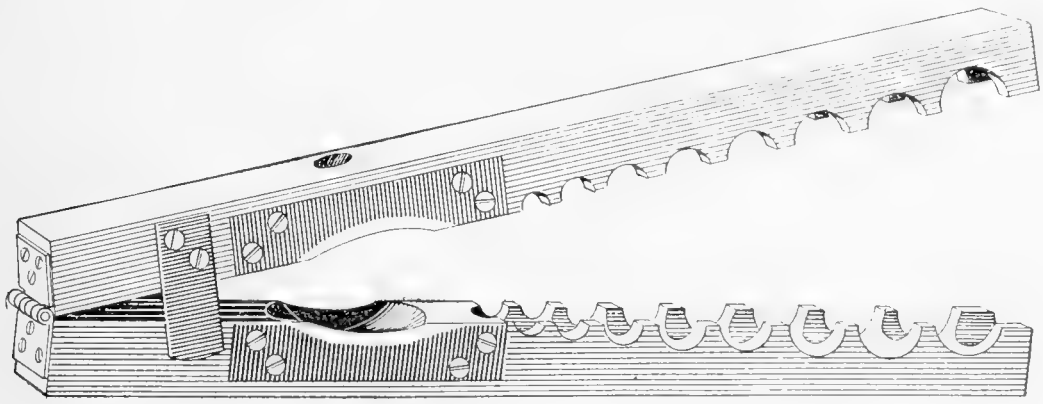

FIG. 13.—A tool with wooden handles and steel blades specially designed for use in annular budding.

larger than the stock a portion of the bark to which the bud is attached may be cut away so that the two ends of the ring just meet around the stock. If the bud stick should be smaller than the stock a strip of bark on the latter may be left in position to complete the ring. In actual practice, rings which extend only partly around the stock are most commonly used. Such process, however, is not true annular budding, because any bark which extends only partly around

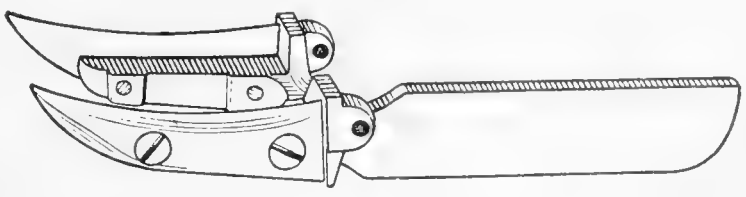

FIG. 14.—Another type of metal tool specially designed for use in annular budding.

the stock is merely a patch. It is to this deviation from the annular method of budding that the term "patch budding" has been applied. A tool specially designed for patch budding is illustrated in figure 16. It consists of four thin steel blades fastened together in the form of a rectangle, five-eighths of an inch wide by 1 inch long, and is used as a punch.

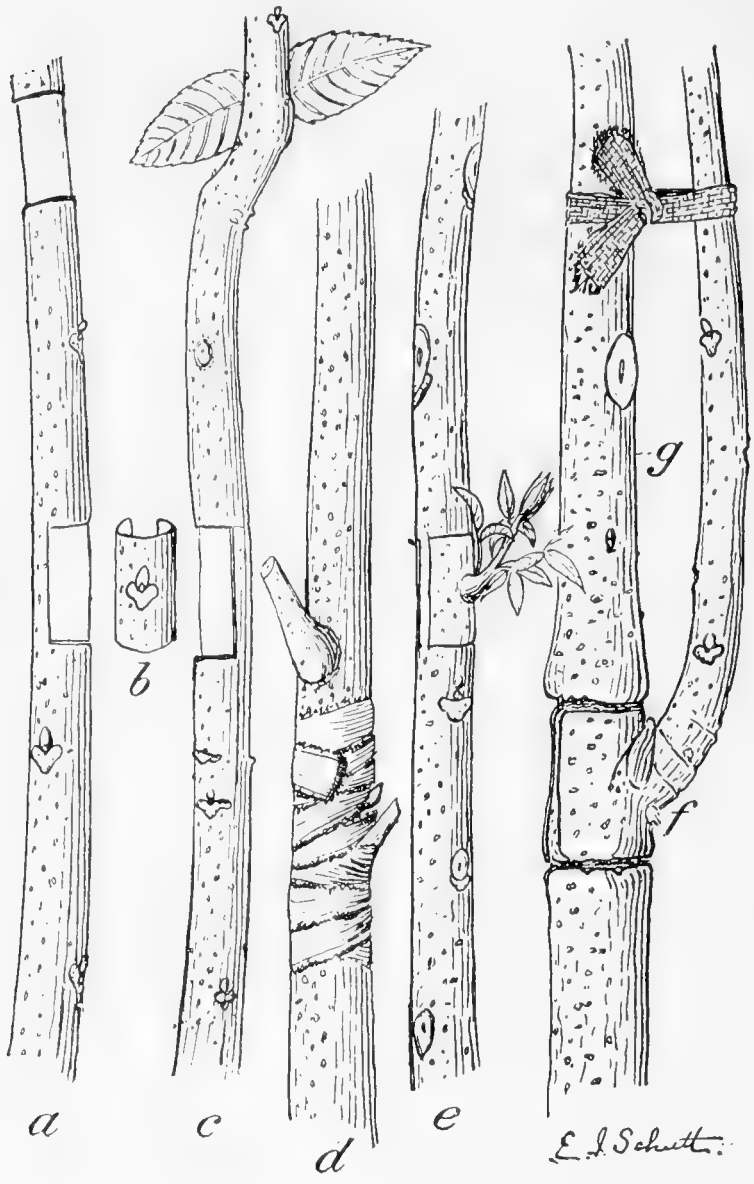

FIG. 15.—Annular budding. *a*, Bud stick from which the the bud has been removed; *b*, the bud ready for insertion in the matrix of the stock; *c*, the stock ready to receive the bud; *d*, the bud after being placed in position and carefully wrapped; *e*, growth taking place, the wrapping having been removed; *f*, growth from the bud supported by being tied to the stock (*g*) above the union. Note the scars above the union, where the buds were removed in order to direct the flow of sap to the new bud.

A very fair degree of success in patch budding by using an ordinary single-bladed budding knife is reported from Texas. A cut is made in the bark of the bud stick about half an inch in width by three times as long, in the center of which is the bud. The piece of bark so outlined is removed from the bud stick and laid over that of the stock. Using this as a pattern, incisions are then made around it in the bark of the stock. The pattern is then removed, the section of bark outlined in the stock is lifted, and the bark from the bud stick is put in its place. Some varieties of the pecan are more difficult to bud successfully than others; with such varieties the annular method, or a near approach to it, is generally most successful.

With the average sorts, however, the tendency among the more experienced nurserymen is much inclined to favor the patch method, which may be performed with any of the tools illustrated in figures 12, 13, 14, and 16.

The buds best suited to annular or patch budding are those in the axils of the leaves at the base of the current season's growth. It is well worth the time required to clip the leaves away, close to the buds, 10 days or 2 weeks before the bud is wanted, for by so doing the wound will heal over before the bud is needed; otherwise a serious lessening of the vigor of the bud through evaporation may take place.

CARE OF ANNULAR AND PATCH BUDS.

In annular budding the added ring of bark sometimes unites with the stock promptly, permitting the upward flow of sap to proceed without much interference. When this is the case the top should be carefully pruned back to such a degree as is necessary to direct sufficient sap into the new bud to cause it to swell. This pruning should not be done with too great severity, as an oversupply of sap is liable to accumulate under the bark of the new bud and cause it to decay or, as it is termed, "to drown" the bud. If the tree is young and the growth has been rapid, precaution should be exercised in cutting back the top in order not to expose the tender bark to the heat of the sun. A sufficient amount of foliage should be left as a protection from the hot sun. If the supply of sap be limited, it will be well to cut out all buds in the top of the stock as shown in figure 15. All dormant buds, both above and below the new bud, should be rubbed off as soon as they begin to swell. The wrapping about the new bud must be cut as soon as growth begins. As the union of a bud with a stock made by any method of budding is at first merely the uniting together of bark and not of wood, it is necessarily weak during the first few months. To avoid danger of breaking out at the bud the new tops should be provided with extra support. For this purpose side stakes driven into the ground are sometimes used, but these are expensive and unnecessary. By leaving a stub of the original top 8 or 10 inches long, entirely denuded of foliage (*g*, fig. 15), the new top may be quickly tied to it, and when no longer needed the dead stub may be cut away close to the union.

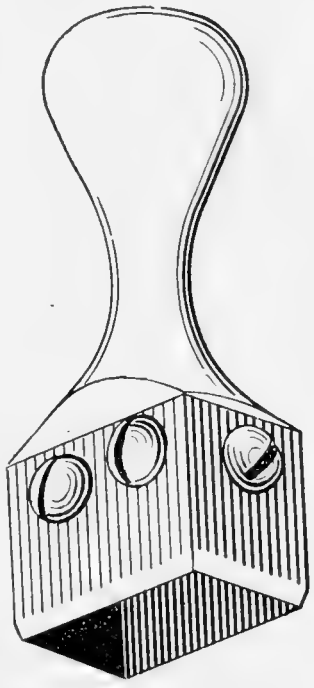

FIG. 16.—A metal tool specially designed for use in patch budding.

BUDDING BY THE CHIP METHOD.

Propagation by chip budding is performed in the early spring or late in the dormant period. Because of being done at this season it is also known as "dormant" budding. With a sharp knife a downward cut is made below the bud on the bud stick to a depth of perhaps one-eighth of an inch. Raising the knife to a point above the bud a long downward cut is made which meets the lower end of the first cut and the bud is removed with a chip attached, as shown in figure 17. A similar chip is removed from the stock and the desired bud is put in its place. This should be carefully wrapped with such material as will hold the cambium layers of the stock and the bud firmly together on at least one side.

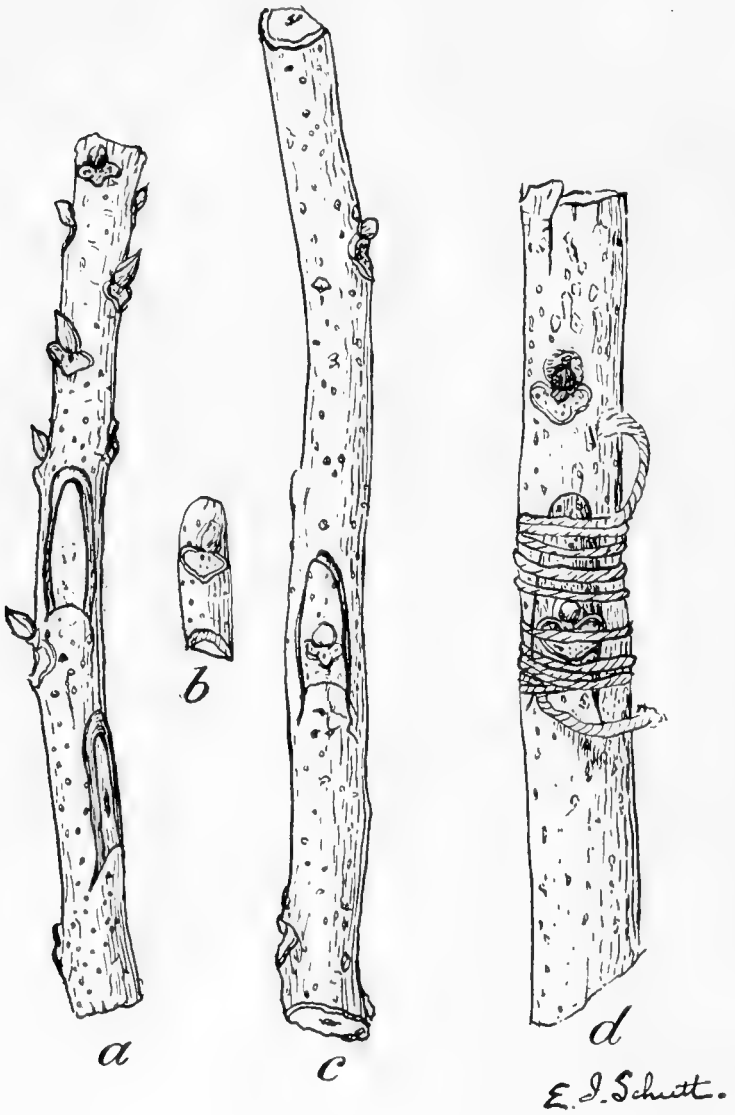

FIG. 17.—Chip or "dormant" budding. *a*, The bud stick; *b*, the bud ready for insertion; *c*, the bud inserted in the matrix of the stock; *d*, the bud securely tied in place.

Subsequent treatment similar to that already described for annular and patch budding should be given young trees propagated in this manner.

Trees of the pecan species are difficult to propagate asexually; that is, neither buds nor scions "take" with the readiness of ordinary fruit trees. The inexperienced operator, therefore, must expect a very low percentage of living buds as the result of his first attempts. Skilled propagators, however, are now so successful that under favorable conditions the percentage of failures is no longer a matter of consequence.

No attempt to bud pecans should be made on rainy days or in early mornings following heavy dews. Some nurserymen even go so far

as to select their men for budding the pecan, assigning those who perspire most freely to other duties. Extremely hot days should be avoided, especially if accompanied by drying winds. Moderately cool, cloudy days without wind or rain are the best for pecan budding.

STOCKS FOR GRAFTING AND BUDDING.

LENGTH OF TIME TREES SHOULD REMAIN IN THE NURSERY.

In the Gulf Coast States seed nuts are ordinarily planted during the months of January and February. With conditions favorable for rapid growth, a majority of the young seedlings should be large enough to graft in 12 months and should be ready for transplanting by the end of the second season. If they are to be budded they should reach sufficient size for that operation by the middle of the second season or when at the age of 18 months. Another period of equal length will be required for the trees to attain the desired size for transplanting. It will thus be seen that under exceptionally favorable conditions grafted trees will be ready for planting in the orchard two years from the time of planting the seed as compared with three years for budded trees under ordinary circumstances. In actual practice, however, comparatively few trees attain sufficient size for grafting until the end of the second season; the greater amount of grafting is, therefore, performed on 2-year-old roots. In either case the age of the root is the same, whether grafted or budded, and when established in the orchard the method by which a tree was propagated becomes immaterial.

TOP-WORKING.

The importance of changing the tops of pecans and other nut or fruit trees by the top-working method can hardly be overestimated. By this method seedlings and trees of unsatisfactory varieties may be quickly transformed into bearing trees of more valuable kinds, new varieties may be hastened into bearing, untried sorts may be quickly tested in a new locality, several sorts may be tested on the same tree, and varieties grafted to uncongenial stocks may be given a new trial by being transferred to other trees. Seedling orchards scattered over the entire pecan area are already being transformed in this manner. Wild trees, both in the forest and in the open, are being similarly improved.

STOCKS FOR TOP-WORKING.

For the purpose of top-working, trees of both the pecan and the hickory species are used. Although belonging to the same botanical family as the walnut and the butternut, the pecan is of a different

genus. The relationship is too distant to make the grafting of it upon stocks of either worthy of the attempt. The matter of top-grafting the hickory is discussed under another heading (p. 33).

In general, it is possible to transform the tops of pecan trees of practically any size or age by top-working; but the advisability of attempting so to transform giant trees or such as have begun to deteriorate with age is very doubtful. The operation is of chief value to healthy trees under 30 years of age.

HOW TO TOP-WORK.

The operation of top-working is begun during the dormant season. At that time little danger of killing the trees by severe pruning is incurred. With the exception of a few branches which should be left to utilize the excess of sap while the development of the new top is in progress, the top should be cut back to the point at which the new head is to begin. Commonly the lower three or four limbs are left for this purpose. In working over a large number of trees an elevated platform built at convenient height and attached to a wagon for use during the several stages of the operation will be a great convenience. If the limbs to be cut are large, wind a heavy chain about the branch immediately below the place of cutting, in order to obviate the danger of splitting. A shallow cut on the lower side will further tend to reduce this danger. Trunks more than 6 inches in diameter heal more slowly than those of smaller size; whenever practicable the larger trunks should not be cut. Figure 18 illustrates a tree properly cut back and figure 19 shows one which was cut back too severely. If desirable, the top may be cleft-grafted as soon as cut back, or new growth may be allowed to start, to be budded in midseason by whatever method may be preferred. In small trees three healthy scions or buds centrally located will be enough to insure a symmetrically formed top. As soon as the new growth reaches sufficient size to utilize the entire flow of sap the remaining branches of the original top should be removed. Figure 20 shows a 7-year-old tree which was cut back[1] in February, 1908, budded August 10 of the same season, and the lower branches of which were removed September 1, 1909. The four spurs below the branches indicate the points at which the branches were cut away. These spurs were later pruned closely during the dormant season.

Figure 21 shows a large tree near Morgan City, La., top-worked when about 25 years old and photographed six or seven years later. The points at which the operation was performed are indicated by the right-angular union more or less distinct in each branch. It is a very well-shaped tree. An objection to this method of top-working

[1] Top-worked by Mr. B. W. Stone, Thomasville, Ga.

lies in the fact that the new head of the tree must be formed considerably higher than the old and there is danger that it will be too high. This is especially true with varieties such as the Stuart, Jewett, and others which are inclined to upright growth. If the original top is already high, it is generally best to cut back and graft the lower branches a year before cutting away the central part of the top. Enough of the top may be cut back at the same time to force a liberal supply of sap into the graft. The sap can not be directed to the lower limbs in this manner if the higher limbs are grafted first, for in that case pruning will be fairly certain permanently to disturb the symmetry of the new top.

FIG. 18.—Seedling tree cut back during the dormant season to induce new growth for top budding.

TOP-WORKING HICKORY WITH PECAN.

Because of their close relationship the scions and buds of the pecan readily unite with stocks of the hickories. The advantages sought in such operations are the quick introduction of the pecan to localities to which it is not common but where hickories abound, the utilization of trees of inferior species, and the possibility of discovering a stock for the pecan which will have certain advantages over those ordinarily used. A number of species are known to have been tried; in southern Louisiana several trees of the water hickory (*Hicoria aquatica*) in standing water produced a healthy, strong pecan top, but later died outright, while others of the same species

not top-worked remained alive under the same conditions; another of these trees taken up and transplanted to drier land made good growth and according to latest reports was bearing satisfactorily.

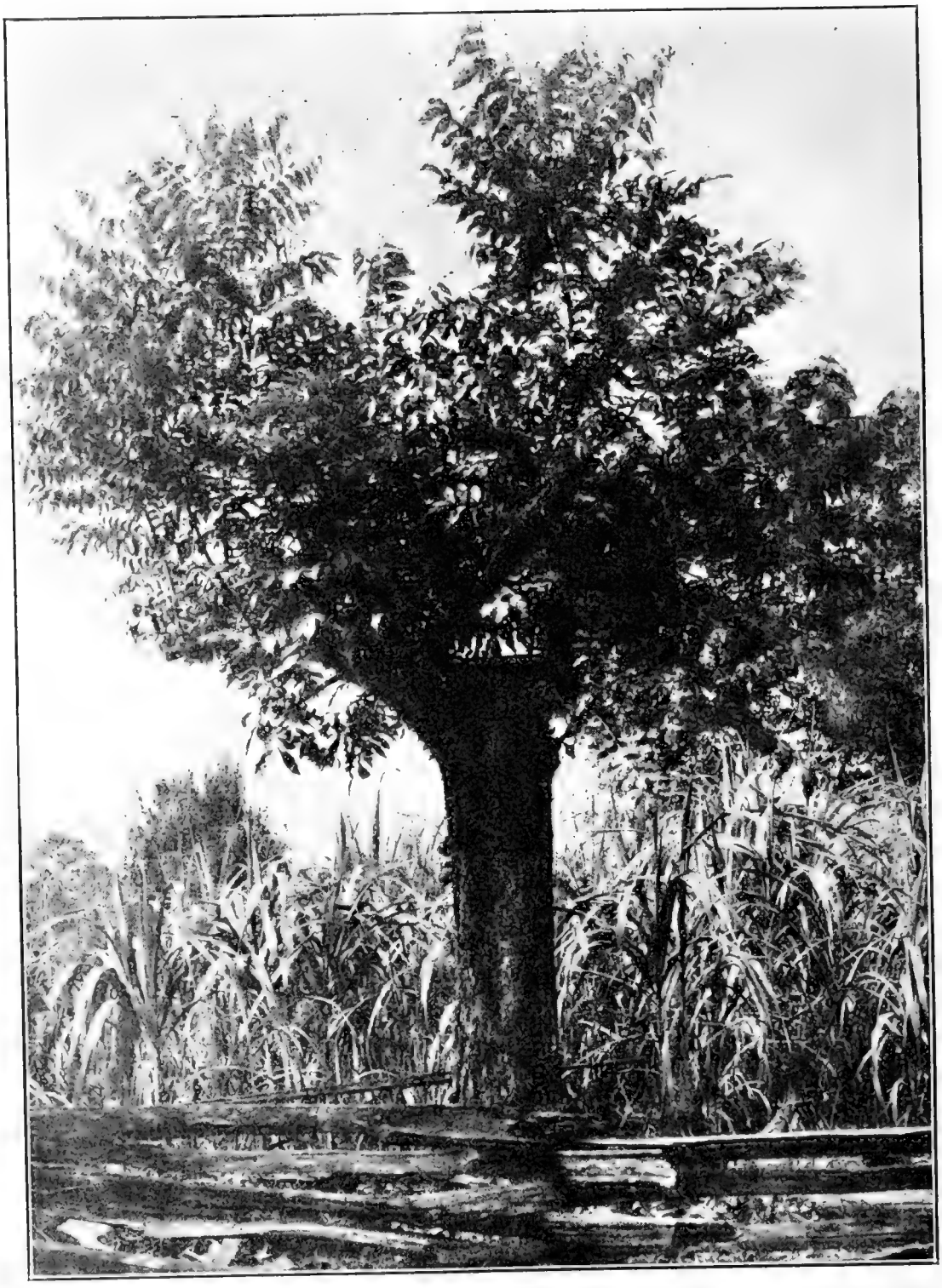

FIG. 19.—Seedling tree cut back to a stump 15 inches in diameter, for top-working. With large trees the sprouts on one side only should be budded. As large a portion of the stump as possible should be hewn away in order to allow the wound to heal.

In Florida, where the mockernut (*Hicoria alba*) is common, the pecan has been found to unite readily with it and to make a rapid growth until the diameter of the pecan becomes equal to that of the

hickory, after which it grows much more slowly. Other hickories have been tried; while the early growth is generally reported to be

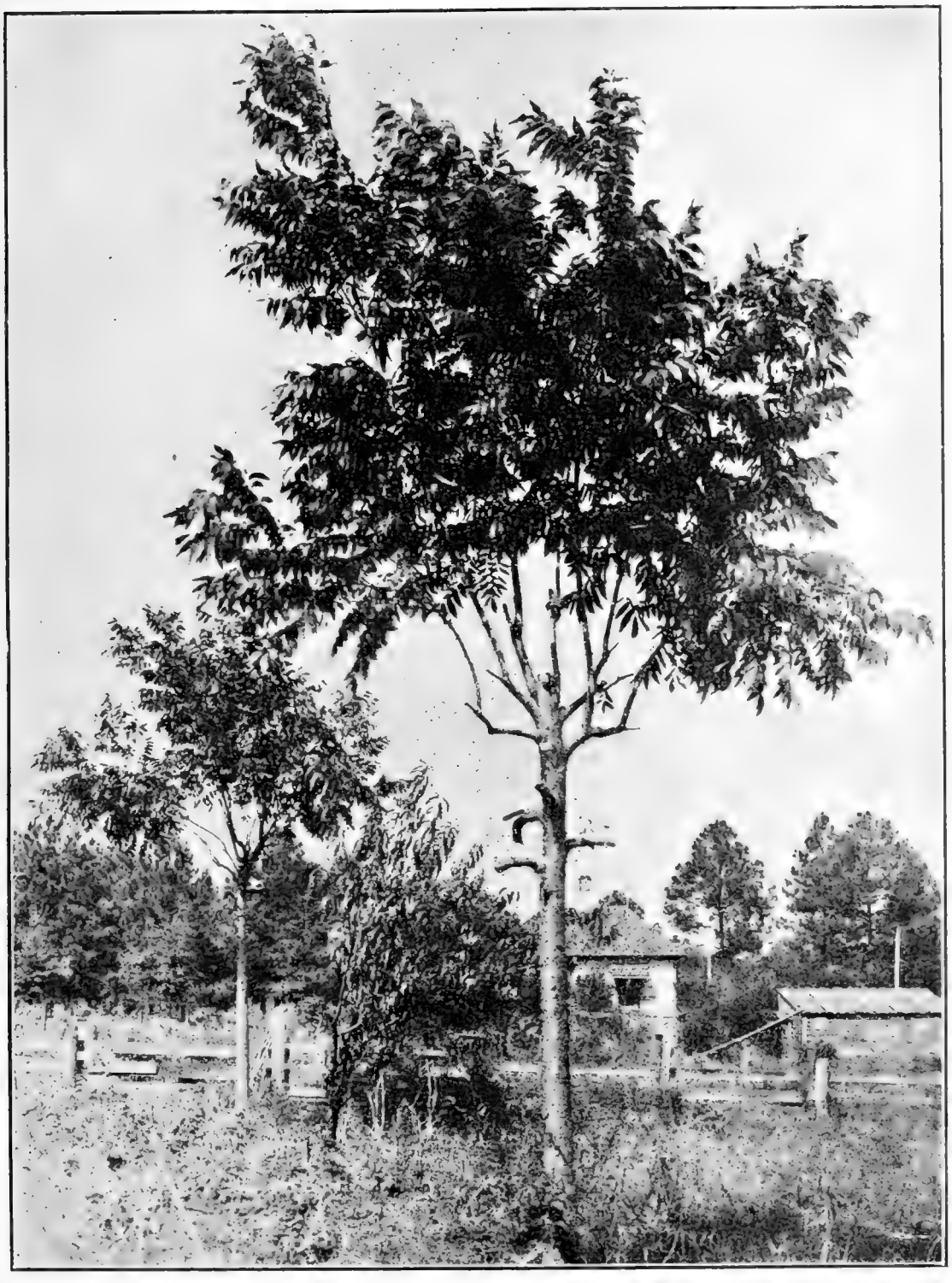

FIG. 20.—A 7-year-old pecan tree top-worked with Stuart scions. The seedling top was cut back in February, the buds were inserted August 10, and the lower branches removed September 1 of the next year. Note how the head of the tree has been elevated.

strong and rapid, very few have thus far proved satisfactorily fruitful.

As hickory trees top-worked with pecan usually stand in out-of-the-way places, not uncommonly in wood lots, it is doubtful whether

FIG. 21.—Pecan tree in Morgan City, La., top-worked when about 25 years old and photographed 6 or 7 years later. A very well-shaped tree, although headed rather high.

the reason for unfruitfulness is due to the influence of the hickory species or to the lack of cultivation.

Department investigators have generally observed a conspicuous difference in the rapidity of growth between the hickory stock and the pecan scion. As a usual thing the pecan is the more rapid grower, as is illustrated by figure 22, which undoubtedly affords the earliest

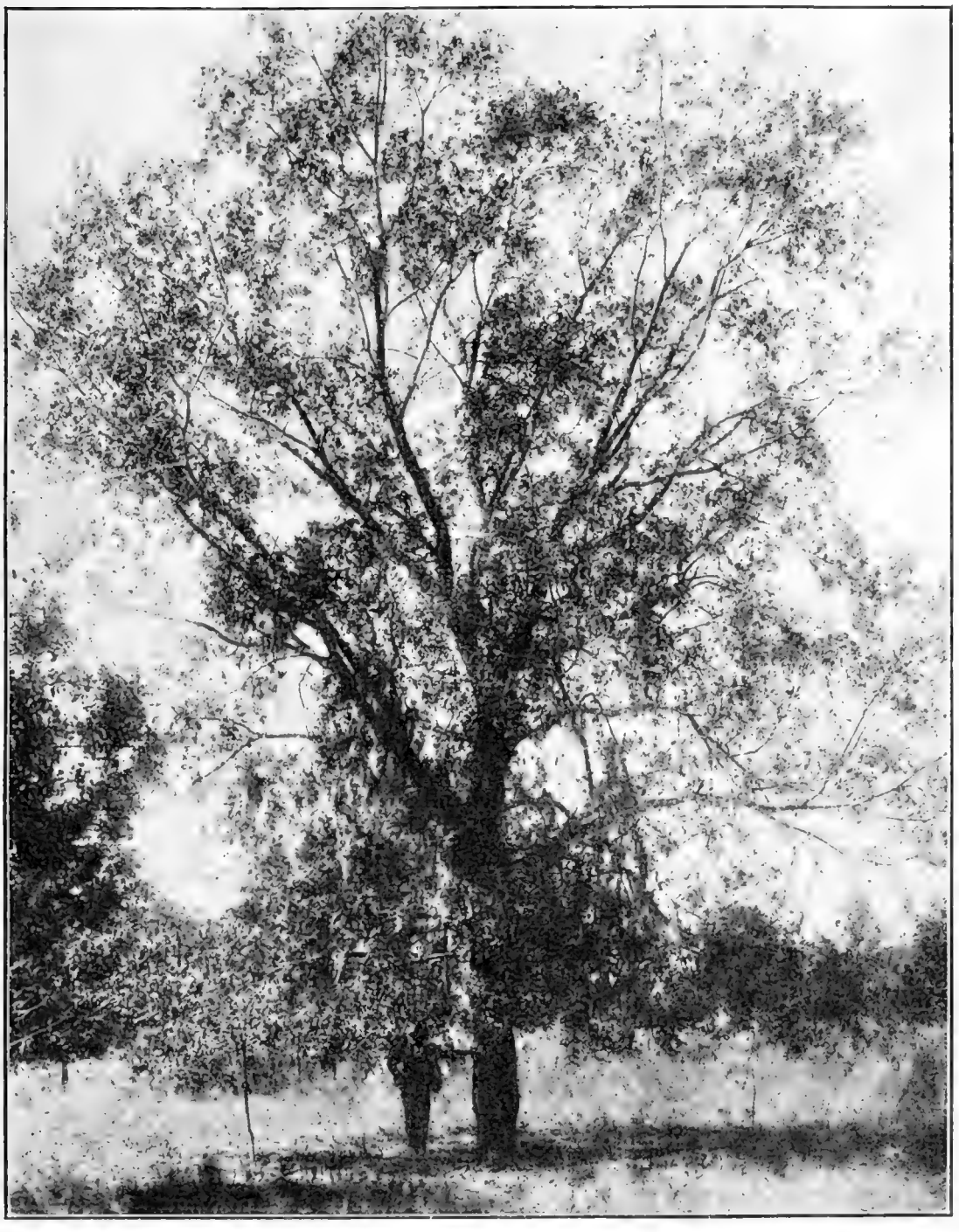

FIG. 22.—Pecan tree grown from a graft on a hickory stock inserted about 1880. Note the enlargement of the trunk 2 feet above the ground, the point at which the union was made.

instance on record of a pecan tree[1] grafted to a hickory stock. The operation was performed 1 foot from the ground about the year 1880. The tree is now 40 or 50 feet tall and has a spread of about the same

[1] Near Gainesville, Fla. Photographed in October, 1910.

distance. The trunk measured 5 feet 9½ inches in circumference below the graft, 6 feet 11 inches at the point of union, and 6 feet at breast height. It was, therefore, 1 foot 1½ inches greater in circumference at the point of union and 2½ inches greater 4 feet from the ground than the hickory trunk at the place of its greatest circumference.

Nothing is known of the source of the pecan scion, but it is not improbable that it was cut from an ordinary seedling. The bearing record of this tree is unknown, but as it stands in rather poor soil and bore no nuts during the year observed (1910), it has probably never fruited to any considerable extent.

PLANTING.

Orchard trees are ordinarily transplanted from the nursery to their permanent location during January or February. The soil should first be put in good condition by thorough cultivation and, if necessary, steps should be taken to insure proper drainage.

The usual distance for planting differs in localities. In the deep alluvial lands of Louisiana and the Mississippi Valley, where it is expected that the trees will attain greater size than when grown in the lighter soils of the more eastern States, pecans are now being set at distances varying from 50 to 75 feet. Some planters, having in mind the idea that 100 feet will be the most suitable distance when the trees reach maturity, are planting at 50 feet, with the intention of removing the alternate trees as soon as crowding begins, leaving them eventually 100 feet each way.

In Georgia, a distance of 46 feet and 8 inches each way (20 trees to the acre) was adopted for some years, but as the orchards so set approach maturity it is becoming evident that considerably greater space would have been better. These planters now agree that 60 feet apart (12 trees to the acre) is not too great a distance.

TREES FOR PLANTING.

As has been explained, nursery-grown trees are mostly planted at the age of 3 years. While sometimes sold as though graded according to age, they are actually graded according to size. If sold under the age grade the largest trees are naturally the "oldest." For this reason it is much more satisfactory to buy according to size, although in that case there is danger of slow-growing stock being worked into the lot. Within certain limits a nursery-grown pecan tree which has reached a given size in a given length of time is much to be preferred to one which has been twice as long in attaining the same size. It is natural to expect that the rapidity or slowness of growth displayed in the nursery will be relatively the same throughout the life of the

tree. For this reason the healthy, quick-growing trees in the nursery are much preferable to those which grow slowly. Figure 23 shows five trees, selected to show one of each of the grades adopted by nurserymen. Beginning at the right the grades of 1 to 2 feet, 2 to 3 feet, 3 to 4 feet, 4 to 5 feet, and 5 to 7 feet are represented. These measurements are of the top only; the length of the taproot is not taken into consideration.

FIG. 23.—Nursery-grown pecan trees, showing the standard grades. Right to left: 1 to 2 feet, 2 to 3 feet, 3 to 4 feet, 4 to 5 feet, 5 to 7 feet. The seed from which these trees were grown was planted in January, the seedlings were whipgrafted during the month of February of the second year following, and the trees were dug in the succeeding November. The board upon which the trees are standing indicates the point at which the taproots were cut.

The taproot, which it was once thought necessary to protect in transplanting, is now cut off about 2 feet below the surface. In a nursery[1] visited during the fall of 1910, a tool specially designed for the purpose was being used in cutting off the taproot.

Purchasers of nursery stock should insist that the trees be allowed to remain in the nursery in the fall until all growth has ceased and the foliage has fallen normally. The early demand for trees has recently impelled nurserymen to dig a great portion of their trees while still in full leaf. At that season neither the top nor the root system is in a condition to be disturbed. The cutting away of foliage, branches, and roots while the sap is still in circulation results in a heavy shock which is inju-

[1] The Monticello Nurseries, Monticello, Fla.

rious and wholly unnecessary. It is therefore highly important that every buyer of southern varieties of pecan trees grown in the South should insist that the trees be not dug until the leaves have dropped naturally, which is usually about the middle of November. With northern varieties the situation may be different, as the wood of these varieties matures very much earlier. However, with southern varieties grown in the South, it would be better for the trees not to be dug from the nursery rows before the last of November in any season.

SETTING THE TREES.

Extreme precaution should be taken to prevent the roots from becoming dry. They should be kept carefully covered from the time they are dug until finally set. A large hole, fully twice or three times the size actually required to receive the roots, should be dug. A quantity of well-rotted compost or nitrogenous fertilizer placed in the bottom of the hole, entirely covered with earth before setting the tree, will furnish plant food during subsequent seasons and tend to induce a deep root system. Immediate contact of the roots with compost or fertilizer of any kind must be avoided. All broken parts of the roots and all lateral branches of nursery-grown trees should be pruned away. Soaking the roots in a bucket of water for an hour or two or even over night gives the trees a very great advantage. The trees should be placed in the hole at about the same depth as they grew in the nursery. Spread out the roots carefully with the hands and pack firmly with moist surface soil thoroughly pulverized. If the soil is dry, it should be drenched with water before the hole is entirely filled.

CULTIVATION.

Satisfactory tree growth and bearing qualities can be expected only in return for careful attention to cultivation and orchard management. In addition to being unsatisfactory in bearing, neglected trees are very apt to become far more subject to attacks of fungous diseases and insect pests.

A common practice in the Southern States is that of renting the land between the rows to tenants, reserving a narrow strip on either side of the row to be cultivated and fertilized by the owner. As the trees approach the bearing age this strip is widened until all the land is included, after which cover crops only are grown between the rows. A good many soils in which pecan trees are now being planted are of such low fertility that they should be replenished with plant food rather than be further impoverished with intercrops. Of the crops

being grown between the rows, cotton and corn are the most common, although truck crops are not infrequent. Legumes, such as cowpeas, velvet beans,[1] lespedeza, and bur clover, are most commonly used for soiling purposes.

BEARING AGE.

Owing to the infancy of the industry, very little data as to the ages at which pecan orchards come into bearing are yet obtainable. This lack of information is partly due to the fact already made clear that with few exceptions practically all orchards planted prior to 1903 were of seedling trees and therefore of very uncertain bearing habits and partly for the reason that a great majority of the grafted and budded trees were of varieties which later proved to be shy bearers. Of the trees which have been planted since 1903 a great many are bearing to some extent. It is not unusual for trees of some varieties when grown under favorable conditions to mature a few nuts by the end of the second or third season after transplanting from the nursery to the permanent orchard location. A few nuts, however, can not be considered a crop. It is not improbable that such early bearing is detrimental to the vitality of the trees. In the belief that trees should not be allowed to bear until they have attained size, root hold, and constitutional vigor proportionate to that of maturity, some of the leading orchardists are now managing their orchards so as to prevent commercial production of nuts until the trees are 8 to 10 years of age.

NUT HANDLING.

HARVESTING.

In the latitude of north Florida the period of ripening and harvesting begins with certain varieties in some years as early as September 5 and with others extends until late into December.

The hulls open partly or entirely and the nuts fall to the ground, or they are whipped from the trees with poles of bamboo or other light material, after which they are gathered up and taken to shelter. No machinery has yet been devised for separating the nuts from the hulls; consequently this work is done by hand. In sections where the pecan is native, professional thrashers beat the nuts from the trees for a stipulated fee or for a portion of the crop, according to agreement.

In order to dry the nuts thoroughly as soon as separated from the hulls they are spread to a depth of not more than 3 inches upon

[1] The velvet bean is a remarkably vigorous grower and special precaution should be taken to prevent it from running over the young pecan trees, causing them to break down with the weight of the vines.

racks with perforated bottoms, so placed that the air will have free circulation above and below. With frequent stirrings the process of drying may be hastened so that in favorable weather the nuts may be ready for market in from 10 days to 2 weeks. A very appreciable loss in weight by evaporation will continue for some weeks following the ordinary period of drying.

MARKETING.

Comparatively few nuts of the improved varieties reach the general markets. They are largely sold to nurserymen for use as samples, occasionally to seedsmen, and to tourists, fancy confectioners, private consumers, and recently to a rapidly increasing class of in-

FIG. 24.—Wagons loaded with native pecans in Texas awaiting the arrival of buyers.

dividuals engaged in promoting land sales of orchard property. The nuts are put up in any shape or style of package that may suggest itself, and shipments are sent by mail or express directly from the producer to the consumer. The pound is the unit of measure by which such sales are made. No standard package has been adopted by the trade and so far as known no grower has his own trade-mark, as is the case with leading growers of citrus and other fruits.

When thoroughly dried the wild nuts are placed in burlap sacks holding 100 to 150 pounds and hauled to the local markets, where they are inspected and bid upon from the wagons drawn up in the streets much the same as grain dealers buy wheat in the Northern States. Figure 24 shows three wagon loads of pecans in the central

part of a Texas town[1] awaiting the arrival of buyers. From the local buyers they are sent in car lots to the larger markets, principally in San Antonio, New Orleans, Kansas City, St. Louis, Chicago, Cincinnati, Buffalo, and New York, whence they are distributed to smaller cities.

CLEANING, POLISHING, AND TINTING.

As the harvesting season extends over a period of two to three months, a large proportion of the nuts become considerably discolored and their surfaces more or less covered with particles of soil. To remedy this condition the nuts are rotated in cylinders of several hundred pounds capacity; the rubbing together in the cylinders removes the dirt and cleans and polishes the surfaces of the nuts, and they are then known as "polished" pecans. During the polishing

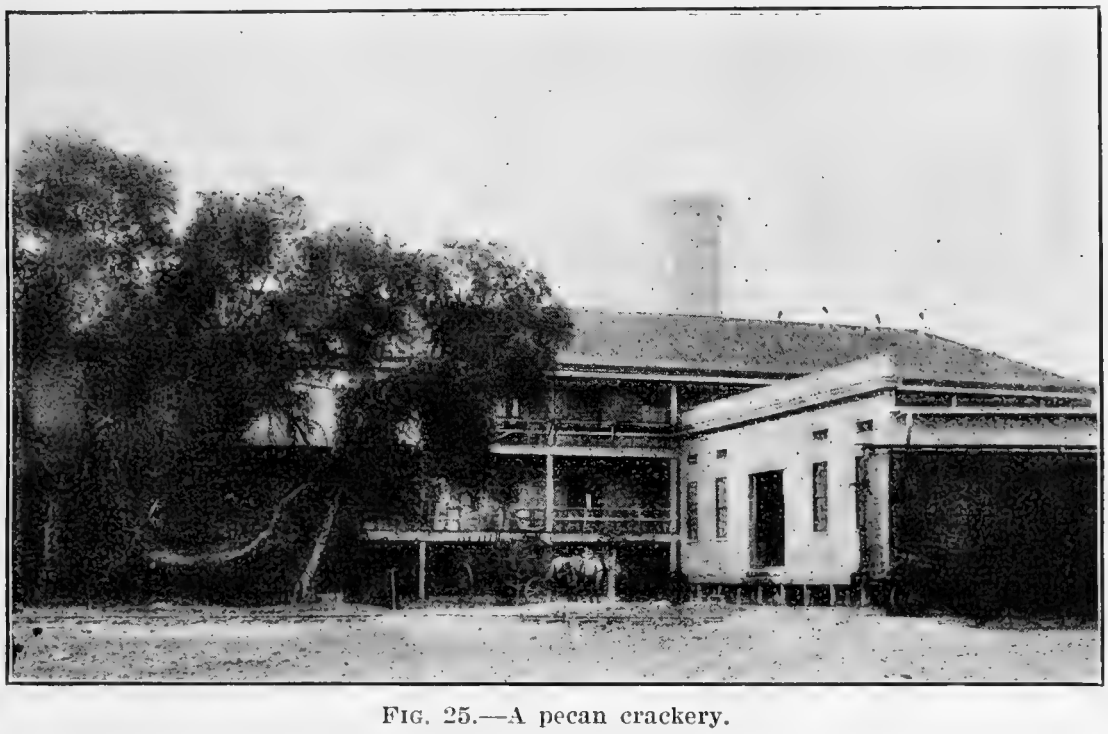

FIG. 25.—A pecan crackery.

process the natural rich appearance of the nuts is lost. Another common process by which wild pecans are prepared for market consists in the immersion of the nuts in a reddish dyeing solution, after which they are dried and polished by the method just described. The latter operation is known as "tinting" or "staining." Nuts thus treated may be readily detected by their bright, unnatural color, which is easily removable with a moistened finger.

CRACKING.

The invention of machinery for the cracking of pecans without breaking the kernels is undoubtedly more largely responsible for the marked increase in the demand for pecan products during recent

[1] San Saba, Tex. Photographed Nov. 12, 1910.

years than any other single factor. Some crackeries in the cities of San Antonio, St. Louis, Chicago, and New York are supplied with machines having a daily capacity of 500 to 800 pounds each. Figure 25 shows a crackery[1] in San Antonio in which 30 to 40 of these machines are installed, having a total maximum capacity of 20,000 pounds daily. After the nuts are cracked the kernels are separated from the shells by hand, generally within the same crackery. Of the wild product, approximately 60 per cent of the total weight of the nut is shell, or about 40 per cent kernel. Of those cracked, depending largely upon the character of the nut itself, the perfection of the machine, and the skill of the operators, from 75 to 80 per cent by weight is separated from the shell in unbroken half kernels. These kernels are placed in boxes, barrels, or other packages and sent to the retail markets, where the present prevailing price ranges from 60 to 85 cents a pound.

SIZING.

Public fancy is most readily attracted by mere bigness, and, as most of the cracking machines do not adapt themselves to varying sizes without special adjustment, the need of uniformity in size becomes apparent. To meet this exigency various sizing devices have been perfected. The type of device used by at least one of the large cracking companies consists of a hollow cylinder 24 feet long and 2 feet 3 inches in diameter, one end being slightly elevated. This cylinder is made up of three sections of equal length composed of iron rods placed equal distances apart, the distance varying in each section. The pecans are fed into the upper end of the cylinder, which has the smallest spaces between the rods. The cylinder is rotated slowly, the smallest nuts falling between the rods, while those of the larger sizes are carried forward. In experiments made by this Department with pecans of named varieties it has been found that a diameter difference of one-sixteenth of an inch is sufficient to constitute a difference between sizes.

VARIETIES.

ORIGIN OF VARIETIES.

Single trees possessing such superior merit over those of the general average in the matter of size, quality of nut, thinness of shell, productiveness, and other characteristics as to justify their propagation by grafting or budding have been given individual names and established as varieties. Varietal names apply to the original

[1] Photographed Nov. 7, 1910.

tree and to all trees grafted or budded from it, but not to those grown from its seed. Ordinarily these original trees are chance seedlings; exceedingly few varieties have thus far resulted from systematic breeding. Since attention has been called to the value of such individual trees, several hundred have been discovered, and more than 100 have been propagated as new varieties. Of these new varieties, however, comparatively few have proved to be of sufficient value to warrant their general sale to the public. The development of varieties superior in one or more respects to those already established and of varieties especially adapted to given localities is greatly to be commended, but unless a nut is plainly of special merit the attempt to add it to the present list of varieties should be discouraged, as mediocre sorts are already very numerous. It takes time to prove the value of a good variety in any locality; many good sorts are already available from which to select, making it not worth while to pay fancy prices for propagating wood or nursery-grown trees of any new sort, no matter how much may be said in its favor. In this bulletin the discussion of individual varieties is limited to such sorts as are best known or have been thought by some to be more or less promising.

SELECTION OF VARIETIES.

No factor in pecan culture is of greater importance than the selection of varieties for planting. Upon it alone may depend the success of the orchard. The following general suggestions are intended to be of service to the prospective planter.

(1) Ordinarily, varieties do not readily adapt themselves to soil and climatic conditions differing widely from those common to their place of origin.[1] Unless varieties have already demonstrated their adaptability to the soil and climatic conditions in a given locality they should be tested experimentally before being planted commercially.

(2) As far as practicable, varieties which have proved to be at least fairly resistant to fungous diseases and insect pests should be selected.[2]

[1] Evidence of this statement lies in the fact that when taken to the more humid climate of the Eastern States a number of the leading varieties (including San Saba, Sovereign, Kincaid, and Halbert) which originated in the semiarid portions of Texas have developed a marked degree of susceptibility to the fungous disease known as pecan scab. Furthermore, experience thus far has not been such as to encourage the planting of eastern varieties in the semiarid portions of the Southwestern States or southern varieties in the North other than to an experimental extent. Northern varieties have not yet been tried in the South to any great extent.

[2] It is highly improbable that any variety will ever be discovered which will be altogether immune under all conditions to fungous diseases or insect pests; but some varities are known to be less subject to certain diseases than others and considerable evidence at hand indicates that some are less affected by certain insect pests than others.

(3) The market for which the nuts are intended should be borne in mind at the time of selecting varieties for planting.[1]

PAPERSHELL PECANS.

With reference to the pecan the term "papershell" has been extended in its application until it is now practically without significance. Originally applied to those types of pecans having such thin shells that one nut could easily be cracked when two were placed in the hand and crushed together with both hands, the term during recent years has been made to include all cultivated varieties, many of which have fully as hard shells as the average wild nuts. Properly speaking, the term "papershell" never referred to a particular variety; its correct application has been only with reference to the group of varieties having very thin shells.

DESCRIPTION OF VARIETIES.

No attempt is made in this publication to discuss the merits of all varieties known to the trade; only such as are well known or at some time have been thought to give promise as future varieties are included.

Alley.

From Jackson County, Miss. Widely disseminated since being introduced in 1896; size medium; shell thin; kernel plump; flavor good; a medium to heavy bearer and symmetrical, vigorous grower, somewhat subject to scab under certain conditions. Should be planted conservatively.

Appomattox.

Recently introduced from Dinwiddie County, Va. Parent tree not in normal condition, owing to stable built under tree. Size medium; shell of average thickness; flavor said to be good; believed to be promising for northern planting.

Atlanta.

From southwestern Georgia. Very much subject to scab.

Aurora.

From Mobile County, Ala. Not yet propagated to a great extent; size large; shell somewhat thick; partitions rather corky; kernel fairly plump; flavor good to very good. Probably adapted to markets catering to large nuts.

Beman.

From Hancock County, Ga. Propagated to a limited extent only. Size below medium; shell rather hard; kernel plump, bright colored, rich, and of excellent flavor. Very productive. Promising for north Georgia and vicinity.

Beveridge.

From Orange County, Fla. Large, but too shy in bearing and too much subject to scab to be of value.

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[1] For the market in which pecans are sold without being cracked, nuts of large size have a distinct advantage at the present time; in all probability this preference for size will continue. The varieties of medium size have certain cultural advantages over the larger types in that they are less often shy or irregular in bearing and are generally better fillers.

Bolton.

From Jefferson County, Fla. Size above medium; shell moderately thin; kernel not always plump; flavor fairly good. Bearing record not proved. Needs further testing.

Bradley.

From Baker County, Fla. Size below medium; shell of average thickness, hard; kernel plump; flavor very good. Very productive. Especially promising for Florida and south Georgia.

Burkett.

From Callahan County, Tex. Size large; shell thin; kernel plump; flavor excellent. Said to be productive. Should be especially adapted to planting in west Texas.

Centennial.

From St. James Parish, La. The first variety known to be propagated. Widely disseminated but very tardy in bearing. No longer planted to any considerable extent.

Claremont.

From Concordia Parish, La. Not yet extensively propagated. Size medium; shell somewhat thick; kernel plump; quality rich; flavor excellent; very productive. Considered very promising, especially for planting in northern range of the area adapted to southern varieties.

Colorado.

From San Saba County, Tex. Little propagated as yet. Size large; shell somewhat thick; kernel plump; quality rich; flavor excellent. A seedling of San Saba. Probably especially adapted to planting in western Texas.

Curtis.

From Alachua County, Fla. Size below medium; shell thin; kernel plump; quality rich; flavor excellent. Very productive. Widely desseminated. Popular in Florida.

Daisy.

From Comal County, Tex. Widely desseminated though not extensively planted. Size medium; shell moderately thin; kernel plump; quality rich; flavor very good. Tree vigorous; said to be productive; probably best adapted to western Texas.

Delmas.

From Jackson County, Miss. Widely disseminated. Size large to very large; shell moderately thin; kernel plump; quality good to very good; flavor excellent. Tree vigorous; productive. Very much subject to scab under certain conditions.

Dewey.

From Jefferson County, Fla. Size medium; shell thin; kernel plump; quality rich; flavor excellent. Tree of rather awkward habit and thus far irregular in bearing.

Frotscher.

From Iberia Parish, La. Widely disseminated. Size large; shell very thin; kernel moderately plump, often dark colored; quality fair; flavor medium. Popular in southwestern Georgia and parts of Louisiana.

Georgia.

From Mitchell County, Ga. Size above medium; shell thick, rather hard; kernel plump; quality good; flavor pleasant. Very prolific but extremely subject to scab in most places where tried. Should be avoided for the present.

Greenriver.

From Henderson County, Ky. Propagation recently begun. Size somewhat below medium; shell of average thickness; kernel plump; quality rich; flavor excellent. A promising variety, especially for northern planting.

Hadley.

From McDuffie County, Ga. Propagated to some extent in Grady County. One of the very large varieties, not yet well known.

Halbert.

From Coleman County, Tex. Widely disseminated, mainly by scions used in top-working. Size small; shell very thin; kernel unusually plump; quality rich; flavor excellent. Very prolific. Especially adapted to planting in western Texas and places of similar climatic conditions.

Hall.

From Jackson County, Miss. Not widely disseminated. Size very large; shell thin; kernel usually plump, frequently defective; quality dry; flavor medium. Very prolific.

Havens.

From Jackson County, Miss. Not widely desseminated. Size medium to large; shell very thin; kernel plump; quality good; flavor sweet though sometimes slightly astringent. One of the most promising new varieties, especially for Gulf coast planting.

Hodge.

From Clark County, Ill. Not propagated to any great extent. Size medium; shell rather thick; kernel somewhat shriveled; quality fair; flavor pleasant.

Hollis.

From San Saba County, Tex. Not widely disseminated outside of central and western Texas. Trees of this variety were at one time sold to some extent under the name *Post's Select*. Size medium to large; shell thick, soft; kernel plump; quality good to very good; flavor sweet.

Indiana.

From Knox County, Ind. Not yet widely disseminated. Considered highly promising for planting in the northern range. Size medium; shell of average thickness; quality said to be good.

Jacocks.

From Orange County, Fla. Size large and shell thin; awkward grower; irregular bearer and much subject to pecan scab.

James.

From Madison Parish, La. Not widely disseminated. Size medium; shell thin; quality rich; flavor sweet. Very prolific. Thought to be highly promising for the northern portion of the range of southern varieties.

Jewett.

From Jackson County, Miss. One of the earliest varieties disseminated. Fairly prolific but a very poor filler. Tree trunks of this variety are often subject to a peculiar bark disease. No longer planted by those familiar with it.

Just.

From Tarrant County, Tex. Recently introduced. Size small; shell very thin; kernel slightly shrunken; quality rich; flavor sweet. Said to be very prolific. Evidently well worthy of trial in central and western Texas.

Kennedy.

From Alachua County, Fla. Not widely disseminated. Size medium to large; shell moderately thin; quality very good; flavor sweet. Very productive in some years. Inclined to be irregular. Thought to be especially adapted to central and northern Florida.

Kincaid.

From San Saba County, Tex. Well disseminated in central and western Texas. Size large; shell of medium thickness; kernel plump; quality very good; flavor sweet. Very prolific. Especially recommended for central and western Texas. Very much subject to scab in the Atlantic States.

Lewis.

From Jackson County, Miss. Recently introduced. Size large; shell of medium thickness; kernel plump; quality rich; flavor pleasing. Said to be productive. Believed by introducer to be very promising, especially for Gulf coast planting.

Magnum.

From Mitchell County, Ga. Very much subject to scab. Little planted at present time.

Major.

From Henderson County, Ky. Recently introduced. Not yet widely disseminated. Size slightly below medium; shell thin; kernel unusually plump; quality rich; flavor excellent. Considered especially promising for planting in northern range.

Mantura.

From Surry County, Va. Size medium to large; shell thin; kernel not always plump at tip, somewhat shrunken; quality good; flavor good. Said to be productive. Believed to be especially promising for planting in the northern range.

Melançon.

From St. James Parish, La. Size medium to large; shell somewhat thick; kernel fairly plump; quality medium. This variety has been considerably confused since its introduction. At one time trees of Melançon and Van Deman were sold under the common name of *Paragon*, and it is highly probable that the variety disseminated from Ocean Springs, Miss., as *Capital* is true Melançon. The nuts of *Capital* appear to be identical with those of Melançon, and the scions with which *Capital* was first propagated were obtained from a grafted tree of about the same age as other grafted trees which are known to have been propagated with scions obtained from the same parish.

Mobile.

From Mobile County, Ala. Well disseminated, especially in southwestern Georgia. Size medium to large; shell moderately thin; kernel usually plump, frequently very defective; quality fair; flavor fair. Very productive, but thus far generally objectionable after second or third crop because of great percentage of defective kernels.

Moneymaker.

From Madison Parish, La. Widely disseminated. Size medium; kernel fairly plump; quality fair; flavor sweet. Very prolific. Especially suited to planting in northern range of the area adapted to southern varieties.

Moore. SYNONYMS: *Long Moore, Moore No. 1, Moore No. 2.*

From Jefferson County, Fla. Size below medium; shell of average thickness; quality fair; flavor fair. Unusually productive and one of the earliest to mature. Well suited to northern Florida.

Nelson.

From Hancock County, Miss. Size very large; shell thick; kernel generally plump, though often very defective; quality medium; flavor good. Tree unusually vigorous; very productive.

Owens.

From Coahoma County, Miss. Just being introduced. Size large; shell thin; kernel fairly plump; quality medium; flavor good. Parent tree said to be very productive. Evidently promising for planting in the northern range of the area adapted to southern varieties.

Pabst.

From Jackson County, Miss. Widely disseminated. Size large; shell somewhat thick; kernel usually plump; quality good; flavor sweet. Generally, productive, though by some thought not to be an early bearer.

Post. SYNONYM: *Post's Select.*

From San Saba County, Tex. Not widely disseminated. Size medium; shell thick; kernel somewhat shrunken; quality good; flavor delicate. Much confused with Hollis.

President.

From Duval County, Fla. Well disseminated in northern Florida. Size medium; shell of medium thickness; kernel plump; quality good; flavor pleasant. Vigorous and productive. Considered as especially promising for central and northern Florida.

Randall.

From Alachua County, Fla. Not widely disseminated. Size large; shell rather thick; kernel plump; quality rich; flavor sweet. Prolific, though irregular in bearing. Evidently well suited to central and northern Florida.

Reuss.

From Ascension Parish, La. Not yet disseminated. Size slightly below medium; shell thin; kernel plump; quality good to very good. Evidently promising, especially for northern range of area adapted to southern varieties.

Robinson.

From Orange County, Fla. Not widely disseminated. Size large; shell rather thick; kernel fairly plump; quality good; flavor pleasant. Very productive. Evidently promising for planting in the southern limits of the area adapted to pecans.

Robson.

From Jackson County, Miss. More or less widely disseminated, though not well known. Size medium; shell thin; kernel somewhat shrunken; quality good; flavor pleasant. From same parentage as Russell, resembling that variety in many respects.

Rome. SYNONYMS: *Columbian, Twentieth Century, Pride of the Coast,* etc.

From St. James Parish, La. Widely disseminated and very well known. Size large to very large; shell thick; kernel usually somewhat shrunken, often very defective; quality medium; flavor fair. Very irregular in bearing habits. No longer recommended for planting.

Russell.

From Jackson County, Miss. Widely disseminated. Size medium; shell very thin; kernel somewhat shrunken; quality good; flavor sweet. Prolific; said to be sensitive to cold weather.

San Saba.

From San Saba County, Tex. Very well known. Size small; shell unusually thin; kernel very plump; quality very rich; flavor excellent. Highly productive. Especially adapted to central and western Texas. Not suited to eastern planting.

Schley.

From Jackson County, Miss. One of the best known and most widely disseminated varieties. Size medium to large, although often variable, even on same tree; shell very thin; kernel plump; quality very rich; flavor excellent. Moderately productive, but a regular, annual bearer. Although sometimes quite subject to scab, it is one of the most popular varieties at the present time.

Seminole.

From Jefferson County, Fla. Not well known. Size medium; shell thin; kernel plump; quality rich; flavor sweet.

Senator.

From Mitchell County, Ga. Not well known. Small; hard shelled; prolific. No longer thought to be promising.

Sovereign. SYNONYM: *Texas Prolific.*

From San Saba County, Tex. Very well known. Size large; shell of medium thickness; kernel plump; quality rich; flavor sweet. Unusually prolific. Especially well adapted to planting in central and western Texas. Not adapted to the Eastern States.

Stuart.

From Jackson County, Miss. More extensively planted than any other variety. Size medium to large; shell of average thickness; kernel plump, usually breaks into crumbs while being extracted; quality good; flavor sweet. Moderately productive. Has succeeded in nearly all parts of the range adapted to southern varieties east of central Texas.

Success.

From Jackson County, Miss. Of comparatively recent introduction. Size large to very large; shell moderately thin; kernel usually very plump; quality rich; flavor very good. Generally reported to be highly prolific. Very promising.

Superb.

From Jackson County, Miss. Not yet disseminated to any great extent. Size medium to large; kernel fairly plump, often defective; quality fair. Judging from specimens examined, this is not a promising variety.

Taylor.

From Harrison County, Miss. Known for some time, but not widely disseminated. Size medium to large; kernel plump; quality very good; flavor sweet. Evidently well adapted to Gulf-coast planting.

Teche.

Thought to be from Iberia Parish, La. Introduced by confusion with Frotscher. Size medium to small; shell of average thickness; kernel fairly plump; quality medium to poor; lacking in flavor. Unusually productive and generally hardy over the entire range of southern varieties from Louisiana eastward.

Van Deman.

From St. James Parish, La. One of the most widely disseminated of all varieties. Size large to very large; shell of medium thickness; kernel plump; quality rich; flavor sweet. Very popular until recently, when it developed a susceptibility to scab serious in some sections. In the young orchards of the Eastern States this variety has not yet proved to be prolific.

Warrick.

From Warrick County, Ind. Not yet generally disseminated. Size slightly below medium; shell moderately thin; kernel plump; quality rich; flavor excellent. Parent tree reported to be prolific. Evidently a very promising variety for planting in the northern range.

Waukeenah. SYNONYMS: *Round Moore, Moore No. 1, Moore No. 2.*

From Jefferson County, Fla. Quite generally disseminated in northern Florida. Size small; shell of average thickness; kernel generally shrunken; quality below medium; flavor poor. Very prolific. One of the earliest to mature. Especially adapted to central and northern Florida.

Wolford.

From Collin County, Tex. Not widely disseminated. Size medium or slightly below; shell very thin; kernel plump; quality rich; flavor very good. Evidently well worthy of planting in central and western Texas.

Young.

From St. Martin Parish, La. Widely disseminated, but not extensively planted. Size large; shell very thin; kernel somewhat shrunken; quality good; flavor sweet. Possibly parent to Russell, which it resembles closely.

Zink. SYNONYM: *Big Z.*

From Jackson County, Miss. Recently introduced. Much like Frotscher in nut characteristics. Size large; kernel often shrunken; quality good. Though of attractive appearance, because of its deficiency in plumpness of kernel it should be held as a test variety.

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[Synonyms are distinguished from the correct varietal names by the use of italic type.]

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